

PALEOINDIAN ECONOMIC ORGANIZATION IN THE LOWER GREAT LAKES REGION:  
EVALUATING THE ROLE OF CARIBOU AS A CRITICAL RESOURCE

By

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## ABSTRACT

### PALEOINDIAN ECONOMIC ORGANIZATION IN THE LOWER GREAT LAKES REGION: EVALUATING THE ROLE OF CARIBOU AS A CRITICAL RESOURCE

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There is a widespread perception that *Rangifer tarandus* (caribou) constitutes a critical resource for Late Pleistocene and Early Holocene hunter-gatherers inhabiting the lower Great Lakes region. However, this perception has not been formally tested using the regional archaeological record. To this end, this dissertation constitutes a formal test of the caribou hunting hypothesis utilizing archeological data from lower Great Lakes Paleoindian (ca. 11,500-10,000 BP) sites. To formally test the hypothesis that caribou were the organizational focus of lower Great Lakes Paleoindian subsistence economies a heuristic model for a residually mobile caribou hunting society is constructed from ethnographic and comparative archaeological data. Archaeological data from lower Great Lakes Paleoindians are compared against expected patterning derived from the residually mobile caribou hunting model to evaluate the extent to which patterned variability in the Paleoindian archaeological record reflects an intensive caribou hunting society.

This formal evaluation of the caribou hunting hypothesis indicates that certain aspects of the Paleoindian archaeological record support the idea that caribou were an important resource. In particular, there is some evidence to suggest that more standardized extractive implements and larger, multi-locus, Lake Algonquian coastal sites support an interpretation of intercept caribou hunting. Likewise assemblage level data and regional scale data support the interpretation that Paleoindian inhabitants of the lower Great Lakes region practiced a high rate of residential

mobility across large territories. Residential mobility, the large size of these territories, and the likelihood for low population density are all characteristics consistent with those modeled for intensive caribou hunting societies.

However, and in contradiction with expected patterns, there is less evidence to support the interpretation that Paleoindian bands practiced herd-following, where groups would spatially relocate themselves between the winter and summer ranges of caribou herds. Instead, standardization data and site level data suggest an interior/coastal focus, as opposed to a north/south focus, within the overall organization of the economic system. This realization raises the possibility that caribou herds may have been intercepted during autumn near the coastal zone with the exploitation of other interior resources at other times of the year. In this regard, lower Great Lakes Paleoindian archaeological data conform more closely with central European Upper Paleolithic Magdalenian economies. This pattern contrasts with the classic barren-ground herd following pattern exemplified by ethnographic and archaeological data from the Ethen-edeli Chipewyan.

In loving memory of my mother,  
Diane Marie Carr, 1953-2003

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## Chapter 1

### INTRODUCTION AND BACKGROUND

#### 1.1 INTRODUCTION

The research presented here evaluates the hypothesis that *Rangifer tarandus* (Caribou) served as the focal point of Paleoindian (ca. 11,500-10,000 BP) subsistence economies in the lower Great Lakes region. The notion that caribou constituted a critical resource for peoples in this region is a widely utilized model that has yet to be explicitly tested using the archaeological record. This research constitutes a formal test of the caribou hunting hypothesis utilizing archeological data from lower Great Lakes Paleoindian sites. In addition to addressing the question of caribou hunting among Late Glacial hunter-gatherers inhabiting the Great Lakes region, this research also has broader implications by contributing to ongoing discussions regarding human adaptation to Late Glacial (ca. 18,000-10,000 BP) environments.

This dissertation seeks to address four interrelated research questions for the purpose of evaluating the hypothesis that caribou was the focal point of Paleoindian economic organization in southern Michigan and southern Ontario.

- 1) What are the organizational requirements of a specialized caribou hunting society in terms of territory and group size, mobility strategies, risk minimization strategies, and technological organization?
- 2) Based on these organizational requirements, what is a probable archaeological signature for a specialized caribou hunting society inhabiting the lower Great Lakes region during the Late Glacial period?
- 3) Does the Paleoindian archaeological record from southern Michigan and southern Ontario support the interpretation that caribou hunting was an organizational focus of Paleoindian economies in this region?
- 4) Along which dimensions does the Paleoindian archaeological record differ from the expected archaeological signature of a specialized caribou hunting population?

In addition to providing insight into the organization of lower Great Lakes Paleoindian subsistence economies, another significant dimension to this research is that it has the potential to contribute to an ongoing debate regarding fundamental processes of cultural change and adaptation such as the applicability of cultural evolutionary models. The standard model of human cultural evolution argues for an initial phase of specialized large game hunting during the Late Glacial period (cf. Gamble 1999) after which, and in conjunction with the changing climate, human populations subsequently evolve more generalized subsistence strategies during the succeeding early Holocene. These generalized subsistence strategies were organized in such a way to take advantage of a wider breadth of plant and animal species and, according to the standard model, the culmination of these increasingly more “sophisticated” economic strategies is the domestication of plants and animals and the concomitant rise of social complexity. However, recent critiques have questioned the long-term or sustainable viability of this initial phase of specialized big game hunting and pointed out significant misuses of both ethnographic analogy and archaeological data (e.g. Byers and Ugan 2005; Eriksen 1991:157; Kornfeld 1996). Nevertheless, aside from Eriksen’s (1991) discussion of the Paleolithic-Mesolithic transition in southern Germany, these critiques themselves have largely failed to test alternative strategies using the Late Glacial archaeological record (see responses to Kornfeld 1996:642-644). This situation leaves open the question as to whether or not specialized large game hunting was a viable subsistence strategy practiced by Late Glacial foragers.

To contribute to this ongoing discussion, this dissertation research evaluates one hypothesized instance of specialized large game hunting among a Late Glacial foraging society; namely the role of caribou in the organization of Great Lakes Paleoindian subsistence economies. More specifically this research utilizes a predictive modeling approach for evaluating

the Paleoindian archaeological record of a portion of the lower Great Lakes region. The primary research problem is that previous interpretations emphasizing the economic importance of caribou have been derived chiefly from ethnographic analogy and not an explicit analysis of the archaeological record. Rather, the presumed importance of caribou relies mainly on a limited body of archaeological data, coupled with the commonly held view that caribou would have been the most economically viable species of large game animal available to Paleoindian hunters in the lower Great Lakes region (Fitting et al. 1966; Funk et al. 1970; Meltzer 1984, 1988). Moreover, the popularity of the caribou hunting hypothesis is partly related to the fact that such an interpretation does not challenge the standard model of human economic development outlined above.

Yet, data directly reflecting subsistence practices, such as floral and faunal remains, are exceedingly rare among Paleoindian sites in the study area. In fact, such data are rare throughout eastern North America. Nevertheless, most reconstructions of Paleoindian lifeways for the region evoke caribou hunting as the basis of Paleoindian economies (Curran and Grimes 1989; Fitting et al. 1966; Funk 1976; Funk et al. 1970; Gramly 1984, 1988; Meltzer 1984, 1988; Meltzer and Smith 1986; Roberts 1988; Simons 1997; Spiess 1984; Spiess and Wilson 1987; Stork 1984). For instance, Simons (1997) interprets aspects of the Gainey site in southern Michigan, including site location and the long distance transport of Upper Mercer chert, as reflecting specialized caribou hunting by lower Great Lakes Paleoindians. Simons (1997) and others frequently employ ethnographic analogy with historically known arctic and subarctic caribou hunters as evidence for this economic adaptation and, at least superficially, their explanations do seem well suited to explaining distinctive aspects of the Paleoindian archaeological record including large, multi-locus sites (Gramly 1982; Meltzer 1988; Spiess 1984) and the long distance transport of lithic



raw materials (Curran and Grimes 1989; Custer and Stewart 1990; Deller 1979; Meltzer 1984; Simons 1997; Stork 1984; Jackson 1997; Loebel 2006). Despite this widespread acceptance of the caribou hunting hypothesis, others have questioned the environmental (Dincauze 1988, Levine 1997) and ethnographic (Loring 1997) analogies that represent the two centerpieces of the hypothesis.

One limitation in our understanding of Paleoindian lifeways is that current interpretations of Paleoindian subsistence for the lower Great Lakes regions are based primarily on relational analogies with arctic and sub-arctic ethnography and have been derived inductively (see Krist 2001 and Seeman 2009 for notable exceptions). I am not arguing that the use of induction *per se* is a problem, only that subsequent deductive analysis using archaeological data should be employed whenever possible so as to establish the relative strength and validity of these inductive observations. Fortunately we are at the point in Paleoindian research where datasets are sufficiently robust enough to facilitate deductive analyses such as the one undertaken here. Complimenting this approach are other research projects such as the use of GIS to model specific habitats around Paleoindian sites to test hypothesis about patch choice (Krist 2001) and the use of blood residue analysis to provide a direct line of evidence for subsistence related activities (Seeman 2009). These types of research projects along with the research presented here have the potential to greatly bolster our meager faunal record and assist archaeologists in developing strong inferences about lower Great Lakes Paleoindian economic behavior.

## 1.2 LARGE GAME HUNTING IN THE NORTHERN HEMISPHERE

Models of hunter-gatherer subsistence economies throughout the northern hemisphere emphasize the focused predation of a limited number of high ranked prey species during the Late

Glacial period (Bird et al. 2009:4; Clark 1952; Mellars 2004). One region where models of focused large game hunting have been prominently featured is north-central Europe, a region discussed here because of the importance of caribou in Upper Paleolithic large game hunting models. The archaeological record of Late Glacial hunter-gatherers in north-central Europe contains an abundant sample of faunal remains particularly from rockshelter and cave sites. These data are suggestive of a population that is intensively exploiting a limited number of high ranked food species. In fact, during the Magdalenian period of France faunal assemblages are so overwhelmingly dominated by a single species of large game mammal, caribou, that the period became referred to as the “Age of the Reindeer” (Enloe and David 1997; Spiess 1979). Elsewhere in Europe during the Upper Paleolithic, human groups appear to be less reliant upon reindeer specifically, but nevertheless species of large game animals like horse, red deer, ibex, and mammoth dominate the faunal record particularly at sites in the Cantabrian region of Spain and eastern Europe (Boyle 1990; Pike-Tay 1991; Straus 1999).

Despite these indicators of economic specialization, data from other regions of Europe during the Upper Paleolithic are contradictory and instead suggest that small mammals and shellfish were being incorporated into a diversifying economy (Craighead 1999:17-18; Jones 2007). Complicating reconstructions of Upper Paleolithic subsistence further is Kornfeld’s (1996) assertion that data from the Cantabrian region of Spain can be interpreted as reflecting either large game hunting or economic generalization simply by changing ones theoretical standpoint. Although these data may be inconsistently interpreted across Europe as a whole, enough unambiguous faunal evidence remains from the European Upper Paleolithic to emphasize the hunting of large game animals and, in particular, the intensive hunting of caribou (Audouze and Enloe 1991; Enloe and David 1997; Mellars 2004; Straus 1999:23-25).

A similar picture emerges for the Late Pleistocene archaeological record of the North American Great Plains and Southwest United States where recovered faunal data have traditionally been used to support interpretations of specialized large game hunting. A recent review of Clovis age kill sites from the western United States indicates not only that Clovis populations pursued Proboscideans (mammoth and mastodons) as a food resource, but they did so at a notably high frequency, at least when compared to the rest of the Northern Hemisphere (Surovell and Waguespack 2008). Likewise, there is a clear association between Folsom weaponry and extinct species of bison (e.g. Frison 1991; Hofman and Graham 1998). However, questions have been raised about the representativeness of large game kill sites and have led to data being examined from alternative perspectives (Gero 1995; Hudecek-Cuff 1998). Amick (1996) adopts a more moderate perspective to Folsom land use strategies in the Southwest United States and argues that variability in land use patterning suggests both a specialized hunting and a generalized foraging strategy were used by Folsom hunters in response to spatial and/or temporal variation in the local resource base. Nevertheless, models detailing Plains Paleoindian economies continue to emphasize the specialized hunting of large mammals (Cannon and Meltzer 2004; Kelly and Todd 1988; Surovell 2000; Waguespack and Surovell 2003).

### 1.3 LARGE GAME HUNTING IN THE LOWER GREAT LAKES REGION

In contrast to other portions of the Northern Hemisphere, the archaeological record of the lower Great Lakes region exhibits a relative absence of subsistence data. The forest soils of the region create favorable conditions for the destruction of organic material through microbial action, which is certainly a major factor contributing to the low number of archaeological sites

containing subsistence data from unequivocally Paleoindian contexts. Yet, the same can be said for the forest soils of Europe where, as discussed above, abundant organic material has been recovered from cultural contexts. Likewise, there exist anaerobic settings in the lower Great Lakes region including, but not limited to, poorly drained bog and marshland environs that would facilitate the preservation of organic materials. In other words Paleoindian behavior must, at least to some extent, account for the general absence of subsistence data in eastern North America when compared to Europe and the North American Great Plains. It is highly improbable that Paleoindians were simply not eating and depositing floral and faunal remains into the archaeological record, which leave two more probable explanations: Paleoindian site selection favored locations where organic materials rarely preserve and/or Paleoindian subsistence economy emphasized resources that preserve poorly.

In regard to site selection by Great Lakes Paleoindians, Walthall (1998) observed that throughout eastern North America caves and rockshelters apparently were not incorporated as a regular feature of land use strategies until the early Holocene. Dry cave environments are widely recognized for preserving organic materials and in Europe their regular use is a notable part of Upper Paleolithic land use strategies (Kornfeld 1996). While there are abundant late Pleistocene fauna found at Sheriden Cave, Ohio (Redmond and Tankersley 2005), Meadowcroft Rockshelter, Pennsylvania (Adovasio et al. 1978), Hiscock, New York (Laub 2003), and Dutchess Quarry Caves, New York (Funk et al. 1970) their relationship to cultural deposits have not been adequately demonstrated and therefore must be considered provisional (Cannon and Meltzer 2004:1970-1971; Laub 2003; Steadman et al. 1997). Likewise, Paleoindian archaeological sites located in floodplain settings are exceedingly rare as such landforms had not stabilized in some areas or have subsequently been eroded in others (Shott 2004). Instead, Paleoindian sites are

most frequently located in well-drained, upland areas that expose faunal remains to poor preservation conditions exacerbated by the effects of modern agricultural activities (Shott 2004). To date, the best evidence for Paleoindian subsistence in the lower Great Lakes comes from the few sites where cultural materials are associated with late Pleistocene pond deposits (Overstreet and Kolb 2003) or contain cultural features conducive to organic preservation (Cleland 1965; Stork and Spiess 1994).

If the sparse faunal record is taken at face value, then available evidence for prey selection by Paleoindian populations is suggestive of groups subsisting on several species of large mammals including mammoth, mastodon, and caribou supplemented by small game like arctic fox and hare. Butchering of the Shaefer and Hebior mammoths in southeast Wisconsin is demonstrated through cut-marks and the presence of lithic artifacts in context with the bones (Joyce 2006; Overstreet and Kolb 2003). In addition to the Shaefer and Hebior mammoths there is strong circumstantial evidence to suggest the predation of a mastodon found near Boas, Wisconsin (Palmer and Stoltman 1976). At other localities, such as several mastodon finds in southern Michigan, Fisher (1984, 2009) makes an argument for human butchering based on patterns of disarticulation and claims the presence of cut marks. However, in respect to the southern Michigan mastodon data archaeologists have questioned the validity of Fisher's (1984) claims because the data are difficult to assess and because cultural materials are entirely absent (Cannon and Meltzer 2004:1961; Fisher et al. 1994). Likewise, the remains of several mastodons at the Hiscock site in New York have been ultimately shown to be unassociated with the Paleoindian artifacts recovered there (Laub 2003). Aside from mammoth and mastodon, a pit feature excavated at the Udora site in southern Ontario contained the remains of barren-ground caribou, arctic fox, and hare alongside diagnostic Early Paleoindian artifacts (Stork and Spiess

1994). The feature at Udora is similar to another pit feature excavated at the Paleoindian age Holcombe Beach site in southeast Michigan that also contained calcined bone identifiable as barren-ground caribou (Cleland 1965).

It is difficult to reconstruct Great Lakes Paleoindian subsistence strategies directly from the few sites that contain preserved faunal remains. For instance, large mammals, particularly extinct species of megafauna, have greater bone mass than smaller mammals, fish, and even birds. Thus there is the risk that large mammals are over represented in the Paleoindian archaeological record and may not accurately reflect subsistence strategies. An even greater amount of ambiguity is introduced by attempts to quantify the significance of the few unequivocal sites with human-proboscidian or human-caribou associations discussed above. FAUNMAP (Illinois State Museum 1996) lists 73 mammoth and mastodon finds from Late Glacial deposits in the Great Lakes region between Wisconsin and New York, of which only three (4.1 percent) can be confidently associated with human activity. The numbers for caribou are not much more conclusive with only 7.1 percent (1 of 13; caribou remains from the Udora site in southern Ontario are not included in the FAUNMAP database; also see Spiess et al. 1984 for summary of caribou recovered from adjacent areas of the northeastern United States) of the listed Late Glacial sites associated with human activity. In other words, given the current record of fauna from Great Lakes Paleoindian sites it is difficult to say with any certainty that proboscidians, caribou, or any other species for that matter were the focus of subsistence strategies.

#### 1.4 GREAT LAKES PALEOINDIANS AS SPECIALIZED CARIBOU HUNTERS

With little flora or faunal data from unambiguous Paleoindian contexts archaeologists working in the lower Great Lakes have instead relied on other lines of evidence, namely ethnographic analogy, to infer the organization of subsistence economies. As a result, the customary view of Paleoindian subsistence in the lower Great Lakes (and northeastern United States) is that highly mobile foragers focused their subsistence efforts toward the intensive predation of migratory caribou herds (Meltzer 1988; Meltzer and Smith 1986). This customary view, however, is not derived from archaeological data, as there is little direct evidence for the intensive predation of caribou. In fact, mammoth, mastodon, and arctic fox occur in similar frequencies, yet, caribou remains the dominant prey of choice within these subsistence models. This is because models of Paleoindian subsistence in the lower Great Lakes region, and adjacent portions of the northeast, have instead relied on ethnographic analogy with modern arctic and sub-arctic hunter-gatherers (Curran and Grimes 1989; Deller 1988; Fitting et al. 1966; Funk 1976; Funk et al. 1970; Gramly 1984, 1988; Roberts 1988; Simons 1997; Spiess 1984; Spiess and Wilson 1987; Stork 1984; although see Krist 2001; Krist and Brown 1994 for models based on GIS).

Arguments relying on ethnographic analogy are based, in part, on the idea that modern arctic and sub-arctic environments of North America are a suitable analog for the Late Glacial environment of the lower Great Lakes and it is widely assumed that hunter-gatherers inhabiting similar environments are likely to employ similar foraging strategies (Fitting et al. 1966; Funk et al. 1970; Meltzer 1988; Roberts 1988). In particular, Meltzer (1988) suggests that in the more northern portions of eastern North America, including the Great Lakes, Paleoindian subsistence strategies were greatly influenced by significantly colder, harsher conditions resulting from the

close proximity of the Laurentian ice sheet. Furthermore, these conditions would be most similar to high latitude portions of North America today. Because hunter-gatherers occupying these high latitude environments are known historically to have relied heavily on caribou, there is the belief that caribou, as a large, gregarious herd animal, would be the most economically viable species of animal available to Paleoindians (Fitting et al. 1966; Funk et al. 1970; Meltzer 1988:41; Roberts 1988).

This perspective is supported by late Pleistocene climatic reconstructions that suggest a “hypercontinental” climate with colder winters and warmer summers during the earliest period of human occupation in the Great Lakes region (Williams et al. 2001). Radiocarbon evidence indicates the presence of humans in the region as early as 12,500-12,300 BP (Joyce 2006; Overstreet and Kolb 2003:94) and unequivocally by 10,915 BP (Waters et al. 2009). Radiocarbon dates from contemporaneous Paleoindian occupations in the northeast United States and Canada cluster between 11,300-10,100 BP (Newby et al. 2005). During this span of time human inhabitants would have experienced significant environmental and landscape changes as the Laurentian ice sheet began its final series of retreats and re-advances (Johnson et al. 1997; see also Larson and Kincare 2009). Lake levels in the Great Lakes also fluctuated throughout this period (e.g. Kincare and Larson 2009) most notably the presence of Glacial Lake Algonquin in the Lake Huron basin where several fluted point sites in southern Ontario have been associated with the Lake Algonquin paleoshoreline (Ellis and Deller 2000; Stork 1997). Vegetation changes likely experienced by human populations include areas of tundra-like vegetation located near the fluctuating ice margin that would have been succeeded by a spruce-sedge parkland as spruce populations expanded northward (Curry and Yansa 2004; Grimm and Jacobson 2004; Hupy and Yansa 2009). Pollen core and lake level data from the Midwest also indicate that toward the end



of this period there was a relatively abrupt westward expansion of pine that occurred in response to drier conditions and increased seasonality associated with the Younger Dryas (Shane 1994:12-13; Shuman et al. 2002; Williams et al. 2004).

Archaeological evidence cited in support of the caribou hunting model includes occurrences of large, multi-locus Paleoindian sites. One of the defining characteristics of the Paleoindian tradition in the Great Lakes and northeast are large sites exhibiting multiple spatially discrete loci (Dincauze 1993). Early Paleoindian sites such as Debert (MacDonald 1968), Vail (Gramly 1982), Bull Brook (Grimes et al. 1984), Shoop (Witthoft 1952), Gainey (Simons 1997), and Nobles Pond (Seeman 1994) all contain multiple activity areas linked together by the presence of diagnostic parallel sided fluted points. Likewise, three slightly later dating Barnes sites in southern Ontario, Parkhill (Ellis and Deller 2000), Thedford II (Deller and Ellis 1992), and Fisher (Stork 1997) also exhibit the same pattern of multiple activity loci. The classic argument in favor of caribou hunting advanced by Meltzer (1988:35-38) identifies Shoop, Vail, and Debert as probable caribou kills based largely on the high assemblage evenness, which apparently reflects consistency in the number and types of stone tools recovered from individual loci and argues for repeated seasonal occupations of each site. Yet, there is compelling evidence to suggest that some of the individual loci at these sites are in fact contemporaneous and the product of population aggregation rather than being the product of multiple reoccupations by small, mobile groups (Areas B and D at Parkhill, Ellis and Deller 2000; Vail, Gramly 1982; Nobles Pond, Seeman 1994). Despite contradicting views of how these multiple loci came to be deposited in the archaeological record, arguments cite caribou hunting as the probable economic basis of either reoccupation (Gramly 1982) or aggregation (Spiess 198) and Shott (2004) provides a comprehensive review of these arguments.

Lithic raw material procurement strategies are a second distinguishing characteristic of Paleoindian assemblages in the lower Great Lakes region. Assemblages are typically dominated by a single lithic raw material type (ca. 80 percent or greater) to the exclusion of other available lithic sources (Ellis 1984, 1989). This apparent preference for a single lithic source occurs regardless of proximity to bedrock sources as most sites are located in excess of 200 km from the nearest known quarries. Furthermore, high percentages of the dominant raw material are observed regardless of tool class and include debitage, although, Deller's (1989) examination of early Paleoindian data from southern Ontario suggests that projectile points may represent the only class of tools that varies somewhat from this pattern. More importantly, the prevailing direction that preferred lithic raw materials are routinely transported are generally from north to south (Deller and Ellis 1992; Ellis and Deller 2000; Stork 1984; Witthoft 1952) or south to north (Loebel 2006; Simons 1997). Some researchers (Simons 1997; Stork 1984) correlate this direction of movement with known migratory patterns of caribou, which also follow a general north to south trend as herds migrate to calving grounds on the tundra during spring and then back south during the fall to winter in the tree line. Rapid and long distance residential movements by Paleoindian hunters intended to intercept a mobile resource like caribou have been suggested as a likely explanation for the consistent patterns of long distance transport of lithic raw materials (Loebel 2006).

## 1.5 RESEARCH PROBLEM

Despite the apparent strength of the caribou hunting hypothesis to explain two key aspects of the eastern Paleoindian archaeological record, others have questioned the environmental basis for the analogy (Dincauze 1988; Levine 1997). Dincauze (1988) argues that

expansive areas of tundra were not available as calving grounds for caribou during the terminal Pleistocene and because of this large seasonal aggregations of caribou herds, like those observed historically, are likely not to have occurred. On one hand plant macrofossils from Late Glacial deposits in the upper Midwest do reflect the presence of tundra-like vegetation following retreat of the Laurentian ice sheet (e.g. Curry and Yansa 2004). Yet, as Dincauze (1988) argues, there is still considerable question about how extensive this tundra zone was as the zone could be confined to a belt along the Laurentide ice sheet or unevenly distributed and restricted to discontinuous patches. Late Glacial environmental reconstructions for the upper Midwest suggest that tundra-like vegetation was succeeded by an open, spruce-sedge parkland that later transitioned into a cool mixed forest by the onset of the Holocene (Grimm and Jacobson 2004; Hupy and Yansa 2009; Kapp 1999; Shane 1994; Williams et al. 2004). Because these Late Glacial environments possess no modern analogs and with the extent and patchiness of tundra in question, it is difficult to assume that caribou would have been available to Paleoindian hunters in the large migratory herds observed today.

Loring (1997) also voices skepticism about the use of arctic and sub-arctic ethnography as the basis for the caribou hunting hypothesis. He cautions against the uncritical use of analogy in reconstructing past human behavior, noting that the use of ethnography among Paleoindian research has served more to support stereotypes of arctic hunter-gatherers than they have to help shed light on the archaeological record. In fact, in many instances the specialized hunting of caribou among arctic and sub-arctic hunter-gatherers appears to be a post-contact development rather than a subsistence adaptation to tundra and boreal forest environments (Burch 1972; Loring 1988, 1997:208-209). Because specialized caribou hunting among arctic and sub-arctic peoples may reflect more accurately their historical circumstance rather than a stable

environmental adaptation, the validity of analogical arguments characterizing Paleoindians as specialized caribou hunters are weakened precisely because those arguments are based primarily on presumed environmental similarities rather than similarities in historical circumstance.

The Paleoindian as specialized caribou hunter model in the lower Great Lakes region has persisted for nearly half a century (e.g. Fitting et al. 1966; Funk et al. 1970; Loebel 2006; Meltzer 1988; Simons 1997; Spiess 1984; Roberts 1988). Despite its longevity, researchers have questioned both the environmental (Dincauze 1988; Levine 1997) and ethnographic basis (Burch 1972; Loring 1997) of the model. These critiques uniformly focus on the same central flaw; the hypothesis is derived primarily from ethnographic analogy rather than archaeological evidence. In fact, to date there has been no explicit test of the caribou hunting hypothesis in the lower Great Lakes region using multiple lines of archaeological data. Such a test, grounded in the archaeological record, is needed given concerns raised specifically about the role of caribou in the Paleoindian diet (Dincauze 1988; Levine 1997; Loring 1997) and more generally about characterizations of Late Glacial foragers throughout the Northern Hemisphere as specialized large game hunters (Bird et al. 2009; Byers and Ugan 2005; Kornfeld 1996).

## 1.6 STRUCTURE OF RESEARCH

In order to address the research questions outlined above the research presented here employs a predictive modeling approach that follows closely a program outlined by Jochim (1976, 1998). This predictive modeling approach seeks to integrate ecological, ethnographic, and comparative archaeological observations to form testable hypothesis about the archaeological record (Figure 1.1). There are three broad stages to this approach: 1) modeling a hunter-gatherer adaptation involving caribou hunting, 2) predicting an archaeological signature from the model,

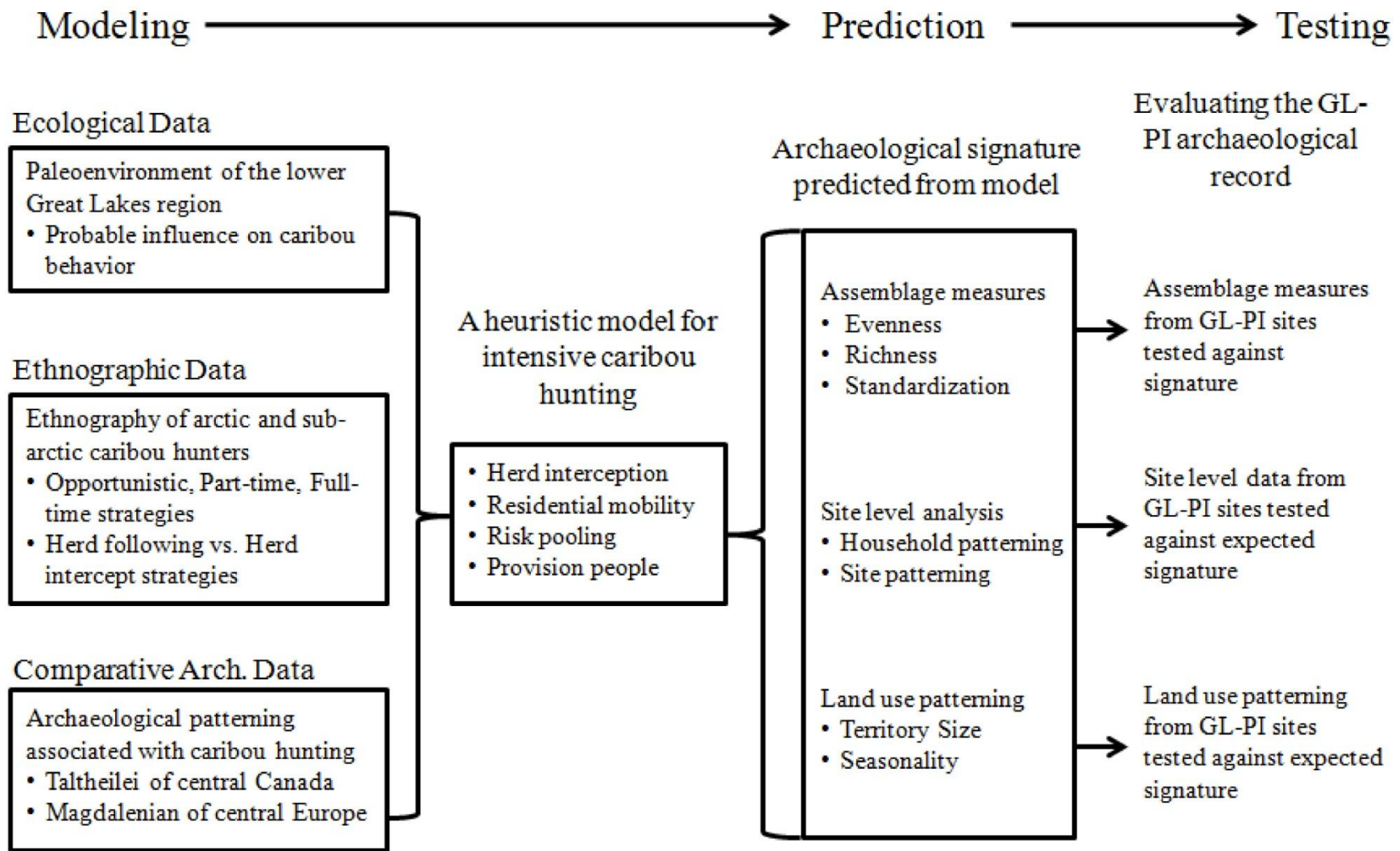


Figure 1.1. Organization of research

and 3) testing the lower Great Lakes Paleoindian archaeological record to determine how closely it corresponds to predictions.

More specifically, this research begins by modeling a generalized hunter-gatherer adaptation to intensive caribou hunting. Sources of information used in the model include ecological information about caribou behavior and the Late Glacial environments of the lower Great Lakes, ethnographic information about arctic and sub-arctic caribou hunting populations, and comparative archaeological information from the Taltheilei tradition of the Canadian barren-grounds and Upper Paleolithic Magdalenian tradition of central Europe. This model is loosely structured by an ecologically centered perspective on hunter-gatherer behavior that emphasizes time and risk management as key organizing principles (e.g. Jochim 1998:13-29; Kelly 1995). Based on this model the second phase of the research approximates an expected archaeological signature for a hunting and gathering population intensively exploiting caribou and identifies patterning in three complementary dimensions of prehistoric lithic technology; lithic assemblage variability, site organization and function, territory size, and lithic raw material provisioning strategies. These predictions are structured by a set of related methodological concepts known as Organization of Technology (OT; e.g. Nelson 1991). The final stage of the research evaluates quantitative and qualitative data from the lower Great Lakes Paleoindian archaeological record and statistically compares these data against the predicted archaeological signature of caribou hunters. This approach ultimately enables the current research to evaluate the relative degree to which the lower Great Lakes Paleoindian archaeological record corresponds to the approximated archaeological signature of a caribou hunting population.

The following chapters examine the suitability of the caribou hunting hypothesis as a model for Paleoindian subsistence in the lower Great Lakes region and employ a deductive

approach to evaluating the hypothesis that caribou were the focus of lower Great Lakes Paleoindian subsistence strategies. This deductive approach includes the development of a predictive model generalizing a probable hunter-gatherer adaptation to specialized caribou hunting, and will seek to combine ecological, ethnographic, and archaeological data. Relevant ecological information will include late Pleistocene environmental reconstructions for the lower Great Lakes, and information on modern caribou behavioral ecology. In addition to ecological information, ethnographic accounts from known caribou hunting populations in the North American arctic and sub-arctic, along with archaeological data regarding unequivocal instances of intensive caribou hunting during the late Prehistoric Taltheilei phase of the Canadian barren-grounds and Upper Paleolithic Magdalenian period in central Europe. The ecological, ethnographic, and comparative archaeological information are integrated to develop a strong inferential model of caribou hunting that draws upon multiple, independent lines of evidence.

The lower Great Lakes Paleoindian archaeological record from southern Michigan and southern Ontario is then evaluated against the expected, model derived, archaeological signature produced by caribou hunters. The goal of this evaluation is to determine the relative degree of fit between the Great Lakes Paleoindian archaeological record and a projected archaeological signature for specialized caribou hunters. Because lithic artifacts are the most common class of artifacts recovered from Paleoindian sites, analysis will be restricted to assessing elements of the stone tool technology in the absence of faunal remains from archaeological contexts.

#### 1.6.1 METHODOLOGICAL AND THEORETICAL CONSIDERATIONS

Methodologically this research addresses economic organization among human societies who inhabited southern Michigan and southern Ontario. Although the term lower Great Lakes

Paleoindian is used here, in the context of this research it specifically refers to those populations who inhabited southern Michigan and southern Ontario. Restricting analysis to this region is preferred because of the availability of a large, professionally excavated archaeological database from the region, consistency in the application of archeological systematics, and the environmental similarities between the two regions. Although the term lower Great Lakes Paleoindian actually encompasses a much broader region, as Ellis et al. (2011) point out combining data across the whole of the lower Great Lakes region may actually be detrimental as it introduces a lot of “noise” that may actually obscure meaningful variability in the archaeological record.

Two complimentary theoretical frameworks inform both the modeling of a generalized hunter-gatherer adaptation to intensive caribou hunting and the subsequent predictions about the expected archaeological signature that are to be derived from the model. First, this research employs an ecologically oriented framework that emphasizes time and risk as key organizing principles for hunter-gatherer societies and informs the development of the general model for a caribou hunting population (e.g. Jochim 1998; Kelly 1995). From this perspective coping with environmental variability is a paramount concern for hunter-gatherers, and is accommodated by strategies intended to mitigate risk and uncertainty (Halstead and O’Shea 1989; Jochim 1979:4-5; Smith 1988). Risk minimizing strategies commonly employed by hunter-gatherers include diversification (Minc and Smith 1989), mobility (Kelly 1983; Kent 1992), and storage (Ingold 1983; O’Shea 1981).

The second framework employed in this research is an approach to the analysis of stone tool technologies known as OT that similarly emphasizes time and risk management considerations as key variables influencing the design of lithic toolkits (e.g. Nelson 1991;



Torrence 1983). OT is a collection of middle-range conceptual models that view lithic technology as an open system articulated with other dimensions of human societies including, but not limited to, mobility, settlement, and subsistence concerns (Carr 1994; Ellis and Spence 1997; Nelson 1991). In the context of the research proposed here OT will serve to inform the specific predictions regarding the archaeological signature (restricted here to lithic technology) of a population subsisting primarily on caribou.

Likewise, it is recognized that patterning in the archaeological record reflecting hunter-gatherer settlement and subsistence strategies are present at both micro- and macro- scales (Bettinger and Baumhoff 1982). Site and assemblage level data best reflect micro-scale phenomena that operate at the individual and group level, while land use patterning such as site location, territory size, and lithic raw material transport strategies best represent macro-scale phenomena. Any effort to model hunter-gatherer lifeways should consider variability at both the micro- and macro-scales. To accommodate these complimentary scales of analysis the proposed research will predict an archaeological signature for a hunter-gatherer population engaged in intensive caribou hunting along the following dimensions: organization of lithic assemblages, site organization and function, territory size, and patterns of lithic raw material transport.

Evaluating the organization of lithic assemblages will focus on identifying patterned variability in the design and use of lithic tool-kits. Because lithic tool-kits are designed in anticipation of need, variability in lithic assemblages thus reflects the specific organizational needs of a population and not simply structural qualities internal to the technological system itself (e.g. Bamforth and Bleed 1997; Ellis and Spence 1997). It is understood that the specific organizational needs of hunter-gatherers intensively exploiting caribou (and by extension their technological signature) should differ in systematic and predictable ways from those of a

population favoring various alternative strategies. For example, targeting caribou herds during seasonal migration results in short periods of intense activity that favor tool-kits designed to be reliable as opposed to those that are designed to be maintainable (Kuhn 1989, 1994; Myers 1989).

In addition, site level data regarding size, artifact density, and the internal spatial organization and composition of artifacts and their relationships provide an explicit basis for archaeologists to make functional assessment of site type (e.g. Binford 1980). Assessing the functional role of individual archaeological sites has proven effective, particularly when combined with technological indices discussed above such as the emphasis on tool reliability over maintainability. Identifying variability in site function is an important component to research investigating adaptive strategies employed by mobile hunting and gathering societies. Technological indices, such as the ratios of finished tools to preforms or bifaces to unifaces, are useful for identifying differences in site function. Similar approaches have utilized comparable types of data to provide a generalized understanding of Paleoindian site types in eastern North America (Loebel 2006; Tankersley 1998), and in Europe for both Upper Paleolithic (Boyle 1996; Straus 2006; White 1985) and Mesolithic (Jochim 1998; Myers 1989) contexts. However, the current research expands on these analyses by using a model to specifically predict technological indices expected to result from caribou hunting.

Lastly, lithic raw material procurement and transport strategies serve as a macro-scale proxy for the size and nature of mobility strategies (Shott 1986; Soffer 1991) and interaction networks (Hayden 1982; Whallon 2006). The presence of exotic lithic raw materials in Paleoindian assemblages from the North America midcontinent is often cited as evidence for high mobility (Custer and Stewart 1990; Ellis 1989; Shott 1986), which some researchers have

linked to the movements of caribou herds of a similar scale and direction (Meltzer 1984; Simons 1997). Likewise, Whallon (2006) points out that long distance movement of lithic raw materials similarly reflect the scale of social interaction networks intended primarily for the movement of information. The importance of information exchange is noted by Loring (1997:188) who suggests there may be a link between the transport of exotic lithic raw materials and the need for caribou hunters to gain information about herd movements. It is clear that lithic raw material procurement and transport patterns reflect the movement of both peoples and information across a landscape.

#### 1.6.2 CHAPTERS 2, 3, & 4: MODEL BUILDING

The proposed research seeks to integrate multiple, independent lines of evidence in order to model a generalized description of a hunter-gatherer population engaged in intensive caribou hunting. Incorporating multiple, independent lines of evidence is generally acknowledged to result in the development of stronger inferences (Chamberlain 1965; Platt 1964; Wylie 2002). Inferential arguments, including those relying on analogy, become strengthened through the use of additional lines of evidence that are built upon independent bodies of theory; in this case biological, ethnographic, and archaeological theory.

Chapter two presents information about the Late Glacial environment of the lower Great Lakes and modern caribou behavior. Information provided in this chapter serves as the ecological basis of the model and specifically the goal is to provide a synthesis of the Late Glacial environment of the lower Great Lakes in order to infer the probable nature of late-Glacial caribou behavior within that region. It is generally understood that several subspecies of caribou exhibit different annual patterns of movement (Burch 1972; Heard 1997; Spiess 1979). For

instance, in North America the barren-ground and woodland subspecies exhibit widely different migratory tendencies with only the former exhibiting the classic pattern of long-distance migrations between summer calving grounds on the tundra and winter ranges in the tree-line. However, recent work in ecological modeling has shown that predictive modeling of herd movement is possible even for the Woodland subspecies, which appears to respond to factors such as avoidance of predators and maintaining spacing from other species of large ungulates (Franke et al. 2004; Johnson et al. 2002). Because of these known behavioral differences, being able to discern a general picture of the Late Pleistocene environment in the lower Great Lakes region is critical for accurately predicting caribou behavior for the same period and has specific implications for predicting the expected archaeological signature of an intensive caribou hunting population.

Building upon this environmental basis, chapter three provides information from the ethnographic record of arctic and sub-arctic caribou hunters. This ethnographic information constitutes a second line of evidence with the purpose of reviewing the ethnographic literature to enable cross-cultural generalizations about how caribou hunting societies successfully adapt to different environmental contexts. There has long been a close relationship between the ethnographic record of arctic and sub-arctic hunter-gatherers and interpretations of caribou hunting in the Late Pleistocene archaeological record of both North America (Curran and Grimes 1989; Funk 1976; Gramly 1988; Meltzer 1988; Meltzer and Smith 1986; Stork 1984) and Europe (Enloe 2001; Enloe and David 1997; Mellars 1989; Spiess 1979; Thacker 1997; White 1985). While much of the importance afforded to ethnographic analogy can be attributed to the fact that one such caribou hunting group, the Nunamiut, serve as the archetype for logistically organized hunter-gatherers (e.g. Binford 1980), there are several other well known hunting and gathering

societies in the high-latitudes of North America that, at least historically, are known to have organized their economies around the intensive predation of caribou (Bryan 2006; Burch 1972; Loring 1997). There is growing recognition that some specialized caribou hunting adaptations documented in the ethnographic record may instead reflect indigenous responses to European contact. Loring (1997) has rightfully critiqued studies seeking to use the ‘authenticity’ of ethnographically known caribou hunters as evidence for caribou hunting among archaeologically known foragers occupying similar environments. These studies incorrectly use ethnographic analogy to legitimize interpretations of the archaeological record. However, the current research seeks to use the ethnographic record as one of several lines of evidence to model a generalized hunter-gatherer adaptation involving specialized caribou hunting. The ethnographic record documenting caribou hunting among arctic and sub-arctic peoples provides clear information as to how hunting and gathering societies successfully make their living from intensive large game hunting. This information is of value to the proposed model regardless of the fact that this economic adaptation is an indigenously derived strategy or developed as a historical response to European contact.

Finally, chapter four provides comparative archaeological information that represents a third independent line of evidence to be incorporated in the modeling process. This chapter includes data and behavioral generalizations from the Late Pre-Contact Taltheilei Tradition of the Canadian barren-grounds and the Upper Paleolithic Magdalenian Tradition of central Europe. These comparative archaeological cases were selected because both are widely recognized as representing instances of hunter-gatherers intensively exploiting caribou as a primary subsistence resource (e.g. Bryan 2006; Enloe 2001). For instance, comparative archaeological data available from several European sites are important because these sites combine unambiguous faunal data

representative of intensive caribou hunting alongside sizeable lithic assemblages. This facilitates the development of generalized links between the organization of lithic technology and caribou hunting. Incorporation of this comparative archaeological data will rely on both published primary data about lithic assemblages (Audouze 1987; Bryan 2006; Leroi-Gourhan and Brezillon 1972) and more generalized synthesis of social and economic strategies involving caribou hunting (Enloe 2001; Thacker 1997). Published data about lithic assemblages enable a direct assessment of the OT associated with the predation of caribou and are able to readily be incorporated into the model developed as part of the current research. Likewise, macro-scale information regarding site type, location, and lithic raw material transport strategies has been synthesized (e.g. Enloe 2001; Thacker 1997) and are integrated into chapter four.

### 1.6.3 CHAPTER 5: MODELING AND PREDICTIONS

Chapter five encompasses the second stage of the research by defining a series of quantitative and qualitative parameters for hunter-gatherers engaged in intensive caribou hunting. These parameters comprise a generalized model describing a probable hunter-gatherer adaptation to intensive caribou hunting, which will subsequently be used to evaluate the lower Great Lakes Paleoindian archaeological record. As discussed above, there are two important points of consideration for the predictive stage of this research. First, it is recognized that hunter-gatherers interact with their environment at multiple scales, and secondly, analysis will be restricted to Great Lakes Paleoindian lithic technology. In regard to the first consideration, patterned behavior manifests itself differently in the archaeological record depending on scale (Bettinger and Baumhoff 1982). To allow for this key scalar relationship between hunter-gatherer behavior and the archaeological record, the generalized model is multi-scalar and

focuses on detailing observable patterning among lithic technological organization at three specific scales; assemblage level patterning, site level patterning, and regional scale patterning.

Predictions derived from the model are made within an OT framework that views lithic tool-kits as adaptive solutions to the needs of a population. These tool-kits are integrated with concerns that lie beyond the immediate technological system itself and include settlement and mobility requirements, subsistence goals, and social needs. Within this framework the design of toolkits ensures that sufficient numbers and diversity of tools are on hand to satisfy both the anticipated and situational needs of a population (Bamforth 1986, 1991; Bamforth and Bleed 1997; Binford 1979; Ellis 1984; Ellis and Spence 1997; Nelson 1991; Shott 1986; see also Carr 1994). Primacy among hunter-gatherers is most often placed among the competing concerns of time and risk management. For instance, tools that are intended to be used for a short, but intensive, period of time increases the risk accrued by a population in the event of tool failure (e.g. Bamforth and Bleed 1997; Kuhn 1994). The result is a greater emphasis on the design of tool-kits to ensure their reliability (Bleed 1986; Bousman 2005:195-196; Myers 1989).

Reliability can be achieved through a variety of means including selection of higher quality raw materials, design of tool forms to accommodate work load, or by incorporating redundancy in the technological system (Bleed 1986; Clarkson 2007). In contrast, the daily but less intensive use of tools places an increased interest on the management of time. The likely result is the investment in technologies that are easily maintainable, but perhaps not as reliable (Bleed 1986; Bousman 2005:196; Myers 1989; Torrence 1983).

Specifically, predictions at the assemblage level employ two measures of lithic assemblage variability; assemblage richness and assemblage evenness (Meltzer 1988; Shott 2005). Along with examining the composition of individual assemblages, this research also

examines standardization of extractive tools within the assemblages. Predictions about the expected pattern of assemblage variability and standardization are developed from the standpoint that considerations of risk and time management serve to structure the organization of lithic technological systems. A strong association between hunter-gatherer behavior and assemblage level patterning in the archaeological record has been repeatedly demonstrated (e.g. Bousman 2005; Melzter 1988; Riel-Salvatore et al. 2008; Villaverde et al. 1998). For instance, measures of assemblage evenness have been successful in quantifying variability in the number and types of tools discarded at archaeological sites and linking that variability to specific activities (Meltzer 1988). In the context of the present research, generalizing the technological signature at the assemblage level is thought to provide an important link between the models predictions and the available archaeological record.

Predictions about site level patterning are also modeled and identify broad relationships in the spatial organization of individual sites (Ellis and Deller 2000:217-252; Shott 2001; Stewart 1997). Because hunter-gatherers utilize mobility as a means to overcome spatial and temporal variability in the environment, different activities (and by extension a different archaeological signature) are generally thought to occur at separate nodes in a regional settlement system. Identifying seasonal aspects of prehistoric hunter-gatherer settlement is an approach that has a considerable time depth (e.g. Kowalewski 2008:232-233). This long tradition of emphasizing seasonal movements in the archaeology of hunter-gatherers has shown that modeling land use patterning can permit the recognition of distinct archaeological site signatures (e.g. Jochim 1976; Lovis et al. 2005). For instance, Jochim (1976, 1998) was able to successfully utilize northern Ojibwa ethnography in order to predicatively model the archaeological signature of Mesolithic hunter-gatherers inhabiting southwest Germany. Likewise, Tankersley (1998) compared relative



percentages of finished and unfinished bifaces, unifacial tools, local and non-local lithic raw materials to distinguish between three site types including lithic quarrying and processing, base camp, and kill/resource extraction. This research expands upon these studies by modeling the expected site level variability for specialized caribou hunters to evaluate the degree to which seasonal movements are influencing the archaeological record. Analysis in this direction also permits the analysis of important demographic information related to group size and by extension the ability to test predictions about the timing of group aggregation and dispersal.

Lastly, regional scale signatures of specialized caribou hunting peoples are modeled. Regional scale data focuses largely on evaluating lithic raw material provisioning strategies to determine the number lithic raw material sources being utilized and the overall distance such raw materials are transported. Occurrences of lithic raw materials have commonly been used to reconstruct the macro-scale patterns of mobility practiced by prehistoric hunter-gatherers (e.g. Brantingham 2003, 2006; Custer et al. 1983; Ingbar 1994). Although Meltzer (1989) cautions against directly relating lithic raw materials with annual population movements, Ellis (1984, 1989) has shown that even the apparently long distance transport of lithic raw materials was not only a regular occurrence among Paleoindian groups in the lower Great Lakes region, but that the overall scale of mobility did not exceed the size of known territories encompassed annually by modern hunter-gatherers. The present research is able to make specific predictions about the size of territories necessary to ensure that intensive caribou hunting is a sustainable economic practice and then compare those estimates against the regional scale data that serves as a proxy of group territory size.

#### 1.6.4 CHAPTER 6: TESTING THE PALEOINDIAN ARCHAEOLOGICAL RECORD

The final stage of this dissertation evaluates the lower Great Lakes Paleoindian archaeological record by compare it against an expected archaeological signature of specialized caribou hunters modeled in chapter five. The primary goal of this comparison is to evaluate the relative strength of arguments that suggest Early Paleoindians inhabiting the lower Great Lakes region organized their economies around the predation of large caribou herds. Evaluation of the Paleoindian archaeological record is multi-scalar and occurs across the three scales discussed above; assemblage level, site level, and regional level data.

Assemblage level data pertaining to lithic technological organization and site function are available from known Early Paleoindian sites in the lower Great Lakes region. Several Early Paleoindian sites in the region have undergone intensive and systematic investigation including Fisher (Stork 1997), Thedford II (Deller and Ellis 1992), and Parkhill (Ellis and Deller 2000) sites located in southern Ontario, the Leavitt site (Shott 1993) located in southern Michigan. These site reports are bolstered by additional data from professionally excavated sites in southern Ontario (Deller 1988; Jackson 1996, 1986; Stork and Spiess 2001; Timmins 1991) and southern Michigan (Shott 2005; Simons 1997; Simons et al. 1984). These excavations have provided a substantial database of lithic tools and consistency in archaeological systematic facilitates the comparison of richness, evenness, and standardization measures.

The available database of professionally excavated sites from the lower Great Lakes region also provides information regarding the number, size, density, and spatial organization of activity areas within the site. Patterning at the site-level is important because it permits analysis of group size and group composition. Similarly these data also permit the analysis of the scope of

social aggregation, which is an important dimension to risk minimizing strategies employed by many hunting and gathering groups.

Finally regional scale data involves the analysis of lithic raw material provisioning strategies by documenting the sources of tool-stone routinely utilized by lower Great Lakes Paleoindians. Distance and direction from site to source are calculated for each of the dominant raw materials present at the site. In addition, an approximate estimate of territory size is able to be drawn by examining the spatial area across which the three most commonly used regional materials, Fossil Hill, Bayport, and Onondaga cherts, are being transported. In this regard, the regional scale data analyzed here provides information to evaluate the relative size and density of territories and make inferences about the relative permeability of boundaries between territories.

#### 1.6.5 CHAPTER 7: ANALYSIS OF RESULTS

Results of the multi-scalar comparative analyses provide a means to reconstruct a general picture of lower Great Lakes Paleoindian subsistence economies that is grounded in the archaeological record. As discussed in chapter seven, the degree of correspondence between the actual and approximated archaeological signatures is variable. There are certainly elements of the archaeological record that correspond very well with the caribou hunting hypothesis and if viewed as a single line of evidence results do lend support to notion that Great Lakes Paleoindians were specialized caribou hunters.

However, when the multiple lines of evidence are considered as a whole, there are consistent statistical differences between the expected and actual archaeological signatures evaluated in this research. These results suggest that the caribou hunting hypothesis requires some modification. For instance, these data suggest that Paleoindian groups may not have

engaged in year round movements between wintering and calving grounds in a manner analogous to the hunting of barren-ground caribou documented in the ethnohistoric record. In fact, during a portion of the year caribou may not have been pursued at all where instead a constellation of interior species, including moose, may have been pursued (Krist 2001). Yet, several lines of evidence do suggest that social aggregation occurred at a place in the seasonal round consistent with the idea of intercepting migratory caribou. Because caribou forms the economic basis of social aggregation, they are similar in this regard to most ethnographically known specialized caribou hunting societies.

There are several implications that stem from the present analysis of the caribou hunting hypothesis. First, it requires alternative hypothesis for Paleoindian subsistence economies in the Great Lakes and northeastern United States to be generated and subsequently tested. In particular the use of interior resources has been previously suggested by both Jackson (1999) and Krist (2001) and data presented here do support their arguments. Secondly, a revision to the caribou hunting hypothesis similarly lends support to recent critiques that have questioned the viability of specialized large game hunting as a general framework for Late Glacial foragers throughout the northern hemisphere (e.g. Byers and Ugan 2005; Cannon and Meltzer 2004:1955-1956; Kornfeld 1996).

## **Chapter 2**

### **ENVIRONMENTAL BACKGROUND AND CARIBOU ECOLOGY**

#### **2.1 INTRODUCTION**

Human and non-human foragers are invariably linked with the environments within which they dwell. Because of this deep-rooted association, any effort to model forager behavior requires careful consideration of the environmental contexts those behaviors are performed within. In regard to the present study it becomes necessary to reconstruct the Late Glacial environment of southern Michigan and southern Ontario. Understanding the environmental setting is essential to situate the discussion of probable foraging behavior exhibited by caribou in the lower Great Lakes region. At the same time this environmental context also provides important contextual information about the regional environments experienced by human foragers. This environmental context serves as the backdrop against which subsequent chapters focus on developing a testable model of Paleoindian foraging behavior related to caribou hunting.

The stated goal of this chapter is to understand the environments experienced by Late Glacial human foragers in the lower Great Lakes region. For this reason much of the following discussion will focus primarily on the period between 12,500 - 10,000 BP. This period brackets both the earliest evidence for human occupation in the Great Lakes region (Joyce 2006; Overstreet and Kolb 2003) and the most recent accepted dates associated for the Paleoindian tradition in eastern North America (Newby et al. 2005). The Late Glacial period between 12,500-10,000 BP encompasses a major episode of global climatic change. In broad terms, the climate was transitioning from the cold, glacial conditions associated with Marine Isotope Stage 2 to the

current warm, inter-glacial conditions of Marine Isotope Stage 1 (Imbrie et al. 1993). Although the overall trajectory of climate change can be characterized by a shift from cold to warm, the specific pattern and rate of climate change during this period of time was neither gradual nor linear (Rasmussen et al. 2007). Recent isotopic evidence from ice cores in Greenland indicate multiple climatic oscillations during this period and these oscillations were often abrupt and severe (Lowe et al. 2008; Rasmussen et al. 2007). Understanding the magnitude and direction of climatic shifts has direct implications for reconstructing the Late Glacial environments experienced by human foragers.

During this period of global climatic change, the regional environment of the lower Great Lakes region is thought to have been substantially different from its modern counterpart. One significant source of influence on the regional environment was the proximity of the Laurentian Ice Sheet (LIS). Climatic modeling suggests that the LIS would have disrupted upper atmospheric circulation while at the same time producing stiff low-level katabatic winds moving southward from the ice mass (Kutzbach et al. 1998; Webb et al. 1998). The influence of the LIS may have been even more significant in terms of its affect on the physical landscape. Drainage systems in the lower Great Lakes were reconfigured by river channels periodically swollen by glacial meltwater, large pro-glacial lakes, and newly deposited landforms including moraines, kettle lakes, and broad outwash plains (Johnson et al. 1997; Kincare and Larson 2009; Larson and Kincare 2009). In addition to changes in the physical landscape, unique floral and faunal communities that possess no modern analogs developed within the region (Willaims et al. 2004).

Table 2.1. Major glacial phases and lake stages during the late Pleistocene  
(from Karrow et al. 2000 and Larson and Schaetzl 2001)

Age (BP)	Glacial Event	LIS margin	Lake Stage	Age (BP)
	Abitibi Phase	Retreat	Stanley/Chippewa Low (70 m)	ca. 10,000
10,025	Marquette Phase	Advance	Algonquian lowering	10,600
	Gribben Phase	Retreat	Main Algonquian (184 m)	11,000
11,850	Onaway Phase	Advance	Kirkfield High	11,600
	Two Creeks Phase	Retreat	Kirkfield Low	11,900
13,100	Port Huron Phase	Advance	Early Algonquian	12,000
	Mackinaw Phase	Retreat	Warren/Wayne	12,400
ca. 15,000	Port Bruce Phase	Advance		
	Erie Phase	Retreat		
ca. 23,000	Nissouri Phase	Advance		

## 2.2 GLACIAL GEOLOGY OF THE CENTRAL AND EASTERN GREAT LAKES

The southern margin of the LIS fluctuated across a vast area during the Late Glacial period leaving a complex history of glacial deposits. In the central and eastern Great Lakes these deposits reflect several major phases of both advancing and retreating ice (Table 2.1). Organic deposits buried under tills deposited by advancing ice have allowed for major ice advances to be radiocarbon dated (Gravenor and Stupavsky 1976; Kaiser 1994; Lowell et al. 1999). Likewise, the spatial distribution of diagnostic glacial tills and extensive systems of end moraines provide data regarding the final position of each major ice advance (Karrow et al. 2000; Larson and Kincare 2009). On the other hand, the locations where retreating ice halted is more difficult to trace and can only be inferred. The periodic opening of northern outlets for the Great Lakes suggests that retreat of the LIS was likely on the order of hundreds of kilometers (Kincare and Larson 2009; Larson and Schaetzl 2001). The specific rate at which the LIS was either advancing

or retreating is also poorly understood. But the fact that three major advances and two retreats occurred in the span of roughly 3000 radiocarbon years suggests that in terms of both geologic time and human experience shifts in the position of the LIS and the coupled affects on the Great Lakes landscape were rapid and profound.

In conjunction with the shifting margin of the LIS, lake levels in the Great Lakes basins also fluctuated significantly. Low water stages formed when the retreating LIS exposed lower outlets while advances of the LIS blocked those same outlets resulting in several notable high water stages (Kincare and Larson 2009). Distinctive shoreline features such as beaches, wave cut bluffs, off-shore bars, and spits preserve an accurate record of changing lake levels in each of the Great Lakes basins (Krist and Schaetzl 2001; Larson and Schaetzl 2001). These relic shore and near-shore landforms are prominent features of the modern Great Lakes landscape and can be found upwards of 100 kilometers inland from the present day shore. Bathometric data reveal similar shoreline features representing low water stages preserved at similar distances off shore (Krist and Schaetzl 2001).

Drainage of the Great Lakes also fluctuated widely during the Late Glacial period. At different points over the last 15,000 years the Great Lakes have been drained through the Mississippi, St. Lawrence, and Hudson River systems (Kincare and Larson 2009). The complex history of the Lake Huron basin exemplifies this changing landscape. In addition to its current southern outlet, at different points since the last glacial maximum water in the Lake Huron basin has also drained westward across the lower peninsula of Michigan; eastward through the Trent River valley into the Lake Ontario basin; and to the northeast near North Bay, Ontario where water eventually discharged into the St. Lawrence system via the Ottawa River (Eschman and Karrow 1985; Karrow 1986).



### 2.2.1 ADVANCE AND RETREAT OF LAURENTIDE ICE SHEET

Shortly before 13,000 BP, the southern margin of the LIS is thought to have retreated to a position somewhere north of the Straits of Mackinaw enabling water in the Lake Michigan basin to drain northward (Karrow et al. 2000). Following this retreat, several lobes of the LIS would once again surge southward. The Port Huron end moraine represents the southernmost extent of this particular advance of the LIS and the moraine can be traced extensively across the northwestern, northern, and eastern margins of Michigan's Lower Peninsula (Larson and Kincade 2009). Although much of adjacent southwestern Ontario remained south of the LIS margin, the Ontario lobe of the LIS did surge into southeastern Ontario as far south as the Lake Erie basin and upstate New York (Karrow et al. 2000). A radiocarbon date of 13,100 BP was obtained from a spruce log buried beneath glacial till near Port Huron, Michigan and is thought to date the southernmost extent of this advance (Gravenor and Stupanski 1979). The Port Huron phase represents the last time the LIS extended into the lower Great Lakes region as defined in this study.

During the subsequent 1250 radiocarbon years the southern margin of the LIS would once again retreat to a position north of the Straits of Mackinaw before re-advancing southward during the Onaway phase (Karrow et al. 2000). In Michigan, the advancing LIS extended only a short distance into the Lower Peninsula before stagnating. Multiple radiocarbon dates from the Two Creeks forest bed in eastern Wisconsin and the Cheboygan Bryophyte bed in northern Michigan indicate that the advancing LIS during the Onaway phase reached its maximum extent around 11,850 BP (Broecker and Farrand 1963; Larson et al. 1994). During the subsequent Gribben phase, which began after 11,850 BP, the LIS would once again retreat northward into the Lake Superior basin (Karrow et al. 2000). The Lower Peninsula of Michigan and all of

southern Ontario would remain south of the LIS after this point, although the LIS did surge southward one final time prior to the onset of the Holocene. The advancing margin of the LIS during the Marquette phase reached its maximum extent just beyond the southern margin of Lake Superior around 10,025 BP as evidenced by several radiocarbon dates from a buried spruce forest bed at the Lake Gribben locality near Palmer, Michigan (Lowell et al. 1999).

Although the timing of these advances has been well dated, correlating each phase of LIS advances and retreats with global climatic conditions is less clear. The notable lack of correspondence suggests that there is a lag between climatic change and the position of the LIS (Gonzales and Grimm 2009; Lowell et al. 1999). For instance, the Two Creeks phase does overlap with the onset of a period of climatic warming, but this phase begins some 700 radiocarbon years after the Port Huron advance reached its terminal position (Karrow et al. 2000). Meaning the Two Creeks retreat may have occurred during the GS-2a, cool period (Rasmussen et al. 2006). Likewise, it is unclear what may have spurred the subsequent advance of the LIS that characterizes the Onaway phase. Greenland ice cores indicate there was an abrupt cooling period (GI-1d) beginning around 12,150 BP, but isotopic data indicate conditions reverted back to a warm period (GI-1e) by 12,050 BP, well before the LIS advanced during the Onaway phase to bury the Two Creeks forest bed (Karrow et al. 2000; Rasmussen et al. 2006). Similarly, with the most recent dates from the Lake Gribben locality dating near the end of the Younger Dryas (GS-1), Lowell et al. (1999) suggest a possible correlation between the Younger Dryas and the advancing margin of the LIS during the Marquette phase.

### 2.2.2 LAKE LEVELS IN THE HURON AND ERIE BASINS

During the Port Huron advance the Huron-Erie lobe had expanded southward to occupy virtually the entire Lake Huron basin. However, unlike previous advances, the Saginaw lobe did not expand significantly into the Lower Peninsula of Michigan enabling Glacial Lake Saginaw to develop within the Saginaw valley. At the same time the Ontario lobe of the LIS had surged far enough south to block the Niagara outlet resulting in the formation of Glacial Lake Whittlesey in the Lake Erie basin that encompassed the Lake St. Clair basin and portions of SE Michigan, SW Ontario, and NW Ohio (Calkin and Feenstra 1985; Karrow and Eschman 1985; Kincare and Larson 2009). Lake Whittlesey drained into Glacial Lake Saginaw through a northern outlet along the southern margin of the LIS. The Whittlesey-Saginaw glacial lake complex ultimately drained westward across the Lower Peninsula of Michigan through the Glacial Grand River and into the Mississippi River system via the Chicago River outlet. As the LIS began retreating northward during the Two Creeks interstadial both Saginaw and Whittlesey expanded into glacier free areas to form a single pro-glacial lake known as Glacial Lake Warren (Kincare and Larson 2009). Relic shoreline features indicate there were several, progressively lower, stages to Glacial Lake Warren. There were several reasons for the lowering of lake levels at this time including down cutting of the outlet into the Glacial Grand. Likewise, the retreating Ontario lobe eventually exposed a lower outlet in upstate New York allowing the lakes to drain eastward into the Atlantic via the Mohawk River (Kincare and Larson 2009).

By 12,500 BP the outlet at Niagara had been established and Early Lake Erie formed in the eastern half of the lake. Isostatic depression of the Niagara outlet and the minimal influx of glacial meltwater would help keep lake levels of Early Lake Erie low and exposed much of what is now central and western Lake Erie. Lake levels would rise to flood the central basin during the

Early and Main Glacial Lake Algonquian phases (Calkin and Feenstra 1985; Holcombe et al. 2003). However, the western basin would remain above the lake level until the late Holocene.

Lake levels in the Lake Huron basin were also lowering around 12,500 BP, stabilizing briefly to form early Lake Algonquian before the retreating ice margin exposed the Trent River outlet (Eschman and Karrow 1985). Drainage through the Trent River would enable further lowering of water to the Kirkfield phase of Lake Algonquian, a low water phase in the Lake Huron basin. The advancing ice margin of the Onaway phase around 11,850 BP would once again block the Trent River outlet allowing a high water stage to form in the Huron basin and by 11,000 BP this lake had expanded to encompass the Lake Michigan basin and form the main stage of Glacial Lake Algonquian (Eschman and Karrow 1985). This main high water stage of Lake Algonquian (184m) persisted until around 10,600 BP when continued retreat of the LIS during the Gribben phase exposed successively lower outlets (Kincare and Larson 2009). Defined paleoshoreline features indicate that post-main Algonquian lake levels stabilized briefly at several lower elevations, including the well known Ardtrea, Upper Orillia, and Lower Orillia shorelines (Deane 1950), which were themselves succeeded by as many as additional 6 lower beaches formed as lake levels continued to fall (Eschman and Karrow 1985; Schaetzel et al. 2002). Finally, exposure of the North Bay outlet around 10,000 BP enabled Lake Stanley, an extremely low water stage to form in the Huron basin (Eschman and Karrow 1985; Kincare and Larson 2009; Larson and Schaetzl 2001).

The main stage of Glacial Lake Algonquian is perhaps the most widely studied of the pre-modern lake stages in the Great Lakes and extensive mapping of shorelines have been conducted by a number of researchers (Schaetzl et al. 2002). Throughout the Lake Huron basin, prominent beach ridges, off shore spits, and wave cut bluffs serve to mark the position of Glacial

Lake Algonquian. Krist and Schaetzl (2001) were able to correlate the orientation of off-shore spits and wave-cut bluffs to infer winds at this time were predominantly from the east or southeast. Their interpretation is consistent with climatic modeling that suggests cool air masses coming of the LIS would have a strong anti-cyclonic effect (Bartlein et al. 1998). In addition, several prominent Paleoindian sites in southern Ontario correspond to shoreline features of Lake Algonquian suggesting the lake played an important role influencing settlement and subsistence strategies between 11,000 and 10,600 BP (Ellis and Deller 2000; Stewart 1998; Stork 1997).

## 2.3 LATE GLACIAL CLIMATE

Evidence for reconstructing Late Glacial climates are derived from multiple proxy data sources that are both global and regional in scope. Because of the different scales at which paleoclimatic data may be applied, events visible in regional paleoclimatic records may not be synchronous at the global scale. The result is a hesitation to use terminology defined from regional climatic records and apply them globally (Lowe et al. 2008:7; Walker et al. 1999). The terms Bølling, Allerød, and Younger Dryas, for instance, have been widely employed throughout the northern Hemisphere in order to describe major climatic phases during the Late Glacial (Lowe et al. 2008). However, because these terms were originally defined as regional climatic markers for northwest Europe, the specific magnitude and direction of climate change associated with these periods almost certainly differed within other regions of the world (Lowe et al. 2008). Even in the event that global scale data corroborate climate change, as will be discussed shortly, the specific effect on the regional scale still needs to be demonstrated via regional data sources.

Ice cores constitute an important source of data that is global, or at least hemispheric, in scope and can be used to corroborate regional climatic records. Cores from the Greenland ice

sheet have produced stable oxygen isotope data (Figure 2.1) that suggests temperatures in the northern hemisphere began warming shortly after the last glacial maximum and reached a pre-Holocene peak around 12,400 BP when a rapid increase in  $^{18}\text{O}$  isotope values is observed (Lowe et al. 2008; North Greenland Ice Core Project members 2004; Rasmussen et al. 2006). This warm period is roughly synchronous with the Bølling-Allerød (Lowe et al. 2008).

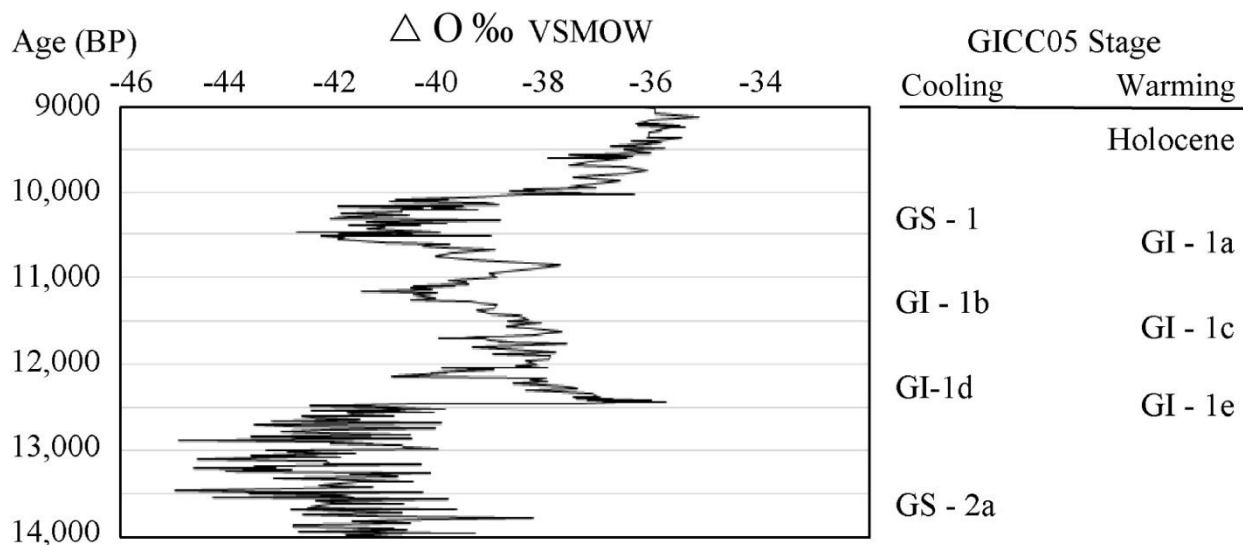


Figure 2.1. Oxygen-18 isotope data from the NGRIP core (adapted from Lowe et al. 2008, data from North Greenland Ice Core Project members 2004)

Data from the NGRIP core indicate global temperatures after 12,400 BP oscillated between brief warm and cold periods, although overall, the long term the trend was toward cooler temperatures. The oscillating Late Glacial sequence is punctuated by a marked return to very low  $^{18}\text{O}$  values indicative of global cooling. This cool stage (GS-1) persisted between 10,850 – 10,050 BP, roughly coeval with the Younger Dryas (Lowe et al. 2008; Shuman et al. 2001). Although the northwest Europe sequence is corroborated to some extent by ice core data, the magnitude and extent of these climatic oscillations still need to be defined within the lower Great Lakes paleoenvironmental record.

In addition to fluctuating annual temperatures, orbital insolation was very high during the Late Glacial period. Greater than modern orbital insolation is the result of perihelion in the earth's orbit occurred during July rather than January as it does now (Felzer et al. 1998; Kutzback et al. 1998; Viau et al. 2006). Increasing orbital insolation during the Late Glacial forced an increasingly more seasonal climate. Thus, when compared to today, the northern hemisphere received its greatest amount of solar radiation during the summer months (Felzer et al. 1998). Amplifying this effect was a slightly greater tilt, nearly a full degree, to the earth's axis at this time, thereby further increasing the amount of solar radiation received, particularly at higher latitudes (Felzer et al. 1998). The net effect overall was greater seasonality in the climate with both warmer summers and colder winters being experienced by Late Glacial foragers in the lower Great Lakes region.

Soil moisture also plays an important role and climatic models have estimated a positive moisture balance at 18,000 BP, which would have helped keep soil moisture in the region high (Kutzbach et al. 1998; Webb et al. 1998). Additionally, soil conditions within recently deglaciated areas likely would have remained highly saturated due to the melting LIS. By 9000 BP the environment began to dry substantially as net differences between precipitation and evaporation in the mid latitudes would have shifted in favor of greater evaporation (Kutzbach et al. 1998:495). Although not part of the climatic models, changes in the rates of lake sedimentation and the occurrences of depositional hiatuses strongly suggest that during the Younger Dryas lake levels throughout the Midwest dropped noticeably as the region experienced both dryer conditions and increased evaporation during the summer months (Shuman et al. 2002:1784-1785). One potentially important effect on human and non-human foragers was that

the distribution of wetlands across the landscape became increasingly restricted to smaller, more widely dispersed, patches.

Late Glacial temperature and moisture regimes in the lower Great Lakes region were also likely influenced by the presence of a strong anti-cyclone positioned above the LIS (Webb et al. 1998). Climate models predict cool air rising off the LIS helped develop a high pressure system that strongly influenced atmospheric circulation. Predictions from this model are supported by the orientation of several relic shoreline and near-shore features of Glacial Lake Algonquian that suggest the dominant wind direction was from the east to southeast (Krist and Schaetzl 2001)

Climatic information presented here pertain to the general temperature and moisture regimes present in the region and provide a suitable backdrop against which data pertaining to Late Glacial plant and animal communities can be evaluated. Climatic modeling and proxy data suggest that distinct episodes of rapid climatic warming and cooling define this period and no doubt played an important role in the continuously shifting margin of the LIS. In addition to general temperature regimes, high solar radiation likely produced greater seasonality including warmer than modern summers and cooler than modern winters (Kutzbach et al. 1998). Likewise, more wet conditions that may have helped keep ground moisture, already saturated with water from the melting LIS, very high. This wet moisture regime likely persisted until the onset of the GS-1, at which time the landscape began to dry out substantially (Shuman et al. 2002).

## 2.4 LATE GLACIAL FLORAL COMMUNITIES

Floral communities present in the region throughout the Late Glacial period were different than those observed today. Between 12,500 BP and 10,000 BP vegetation within the lower Great Lakes region underwent a significant reorganization as the climate transitioned from



cool, glacial conditions to the comparably warmer Holocene conditions. The oscillating climatic conditions and alternating periods of stability and instability described above greatly affected the composition of regional plant communities. Because vegetation responds to environmental change as individual taxa rather than biomes, the resulting picture reconstructed from proxy data is a unique combination of flora presently not associated together anywhere in the world today (Grimm and Jacobsen 2004). These “non-analog” environments contain species, such as spruce (*Picea*), found today in the northern boreal forest that were growing alongside taxa like black ash (*Fraxinus nigra*) that are more typically associated with mixed coniferous- hardwood forests of the southeast United States.

The timing of major vegetation changes is an equally important consideration, particularly when the ultimate goal is to discuss the relationship between the environment and foragers during a specific interval of time. Radiocarbon dates from pollen cores are commonly selected to specifically date transitions in a pollen sequence and to help organize data from the core temporally. Despite abundant radiocarbon dates, there are some concerns with conventional dates derived from bulk soil samples (Grimm and Maher 2002). Some (e.g. Shane 1994) have attempted to adjust the internal chronology of less well dated soil columns to better match diagnostic vegetation changes found within regional sequences. The need for such adjustments is corroborated through work by Grimm and Maher (2002) who found that when cores were re-dating using AMS conventional dates the age of diagnostic vegetation changes, such as the decline of spruce, may actually have been estimated as being too old when dated by conventional methods.

To aid in the reconstruction of the Late Glacial environments experienced by human foragers in the lower Great Lakes region proxy data for the region was downloaded from the

North American Pollen Database (NCDC 2011). A total of 18 pollen sites distributed across southern Michigan and southern Ontario are included in the present analysis (Table 2.2).

Percentages of individual taxa identified in the cores were organized according to locality, depth, and probable age of each sample. To facilitate comparison and make these data more robust, individual pollen samples are grouped into 100 year intervals with percentages of individual taxa then averaged across each interval. While the decision to aggregate pollen data from multiple sites into 100 year intervals removes some resolution regarding changes occurring at individual sites, the expectation is that the resulting composite is more applicable to this study because it presents a general illustration of changing vegetation at the regional scale.

Table 2.2. Pollen sites with data included in the analysis  
(data accessed from NCDC 2011)

	#	Site Name	State	Latitude (North)	Max Age (BP)	References
North	1	Chippewa Bog	Mich.	43.12	10024	Bailey and Aheam 1981
	2	Delmont Lake	Mich.	43.48	11500	NCDC 2011
	3	Vestaburg Bog	Mich.	43.42	20200	Gilliam et al. 1967
	4	Creditview	Ont.	43.60	13788	NCDC 2011
	5	Decoy Lake	Ont.	43.23	11729	Szeicz and MacDonald 1991
	6	Hams Lake	Ont.	43.24	11352	Bennett 1987
	7	Maplehurst Lake	Ont.	43.23	13042	McAndrews 1981
	8	Peatsah Section	Ont.	43.33	12452	Roberts 1985
	9	Rostock Mammoth	Ont.	43.50	15993	McAndrews and Jackson 1988
	10	Van Nostrand Lake	Ont.	44.00	14500	McAndrews 1973
	11	Wylde Bog	Ont.	43.90	12275	NCDC 2011
	12	Wylde Lake	Ont.	43.91	12453	NCDC 2011
	13	Edward Lake	Ont.	44.37	15098	McAndrews 1981
	14	Porqui Pond	Ont.	44.17	13500	NCDC 2011
	15	Rose Swamp	Ont.	44.18	10734	Dibb 1985
South	16	Wintergreen Lake	Mich.	42.40	12786	Manny et al. 1978
	17	Franis Lake	Mich.	42.33	17665	Kerfoot 1974
	18	Bondi Section	Ont.	42.09	13240	Morris et al. 1994

It should also be noted that Late Glacial vegetation change in the lower Great Lakes region is time-transgressive from south to north (Ellis et al. 2011). One consequence of this time-transgressive change is that aggregating pollen data from geographically distant sites can obscure real differences in vegetation between the northern and southern portions of the study area. To compensate for this observation, pollen sites in the present analysis are split between a northern and southern group to illustrate this geographical difference in vegetation. Sites included in the northern group are located between 43 and 45 degrees latitude; those included in the southern group are located south of 43 degrees latitude.

In addition to pollen data, plant macrofossil also provides information about Late Glacial floral communities. Unlike pollen core data though, plant macrofossils provide a more localized picture of the Late Glacial environment. In many cases plant macrofossils confirm the generalized picture of the Late Glacial vegetation drawn from the pollen data, but macrofossils also help refine our picture of Late Glacial vegetation by fill in the gaps where pollen data may under represent the occurrences of plant species. In particular, identification of tundra like environments through pollen is difficult due to low volume of pollen. Likewise, the recovery of *Salix* leaves and stems by Larson et al. (1997), Kerfoot (1974), Terasmae and Matthews (1980), Maher et al. (1998), and Kapp (1986) suggest that willow was consistently present at sites within the lower Great Lakes, even though pollen core data does not display any significant frequency of willow. This macrofossil data is particularly noteworthy as willow is preferred caribou forage (Johnstone et al. 2002; Person et al. 1980).

#### 2.4.1 TUNDRA PHASE

Tundra or tundra-like environments were likely present near the active margin of the LIS, although pollen core data are not well suited for the recognition of tundra vegetation. This is due largely to low pollen counts and the difficulty in sorting through background noise stemming from the introduction of extra-regional pollen from trees (Curry and Yansa 2004). However, macro-botanical records often provide the most credible evidence for the presence of tundra vegetation. The remains of dwarf willow (*Salix herbacea*) and arctic dryad (*Dryas integrifolia*), recovered from glacial deposits in northeastern Illinois, suggest the presence of tundra near the active ice margin between 17,600-15,700 BP (Curry and Yansa 2004). During the Mackinaw interstadial around 13,400 BP Terasmae and Matthews (1980) similarly recovered the macro-botanical evidence for arctic vegetation, including Arctic Dryad, from southern Ontario. Likewise, sites dating to the subsequent Two Creeks interstadial have also produced macro-botanical evidence of arctic vegetation including the Valders site in eastern Wisconsin (Maher et al. 1998) and the Cheboygan Bryophyte Beds in northern Michigan (Larson et al. 1994). In fact, at the Valders site ostracode and sedimentary evidence corroborate the macro-botanical findings and point toward the presence of a cold, open tundra-like landscape at about 12,200 BP (Maher et al. 1998). The presence of tundra is also supported by the prevalence of ice wedge casts within glacial deposits of the Upper Midwest, which is thought by some to reflect frozen ground conditions similar to tundra (Pavich and Chadwick 2004).

To date, there is little or no data from which to infer the presence of expansive sections of tundra in the Midwest that would be akin to the treeless barren grounds of northern Canada. Although not definitive, a conservative estimate based on the limited number and dating of sites would be to suggest the occurrence of tundra or cold, open tundra-like environments in the

region, but that these environments were restricted to either a band or small patches near the margin of the LIS (Curry and Yansa 2004; Dincauze 1988; Hupy and Yansa 2009:92). Macro-botanical remains may be the only way to accurately identify the presence of arctic vegetation such as Arctic Dryad recovered from sites in northern Illinois (Curry and Yansa 2004), eastern Wisconsin (Maher et al. 1998), southern Ontario (Terasmae and Matthews 1980), and northern Michigan (Larson et al. 1997). However, radiocarbon dating from these sites coincide with periods where the LIS was thought to be in relatively close proximity to them, such as during periods of advancing ice margin, and support the suggestion that tundra vegetation was restricted primarily to the margin of the LIS.

#### 2.4.2 SPRUCE AND SEDGE PHASE

By the onset of the GI-1e warm period (ca. 12,400 BP) pollen data indicate that spruce was the dominant source of arboreal pollen with maximum values peaking between 40-50 percent (Figure 2.2). The presence of sedge (*Cyperaceae*) pollen at most localities during this time is also significant and lends support to the inference that the environment was likely a spruce and sedge parkland rather than a spruce-dominated forest (Hupy and Yansa 2009; Yansa 2006). Such an interpretation is important because the spruce-sedge parkland would be a considerably more open landscape and thus may have been able to support a greater density of ungulates than would a closed, spruce-dominated forest. Macrofossils recovered from several mastodon finds in southern Michigan consistently indicate the presence of spruce macrofossils supporting the reconstructed importance of that species in the Late Glacial vegetation (Kapp 1999). The presence of an open parkland environment is particularly evident in the northern sample of pollen sites, while percentages of sedge pollen are comparably lower to the south. The

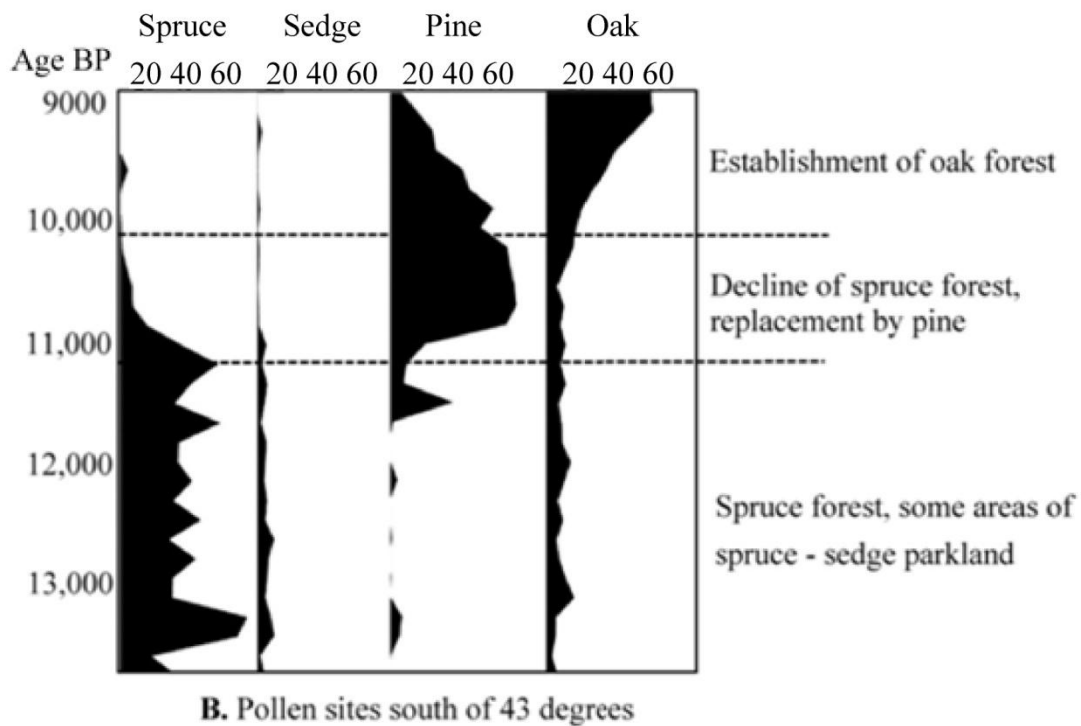
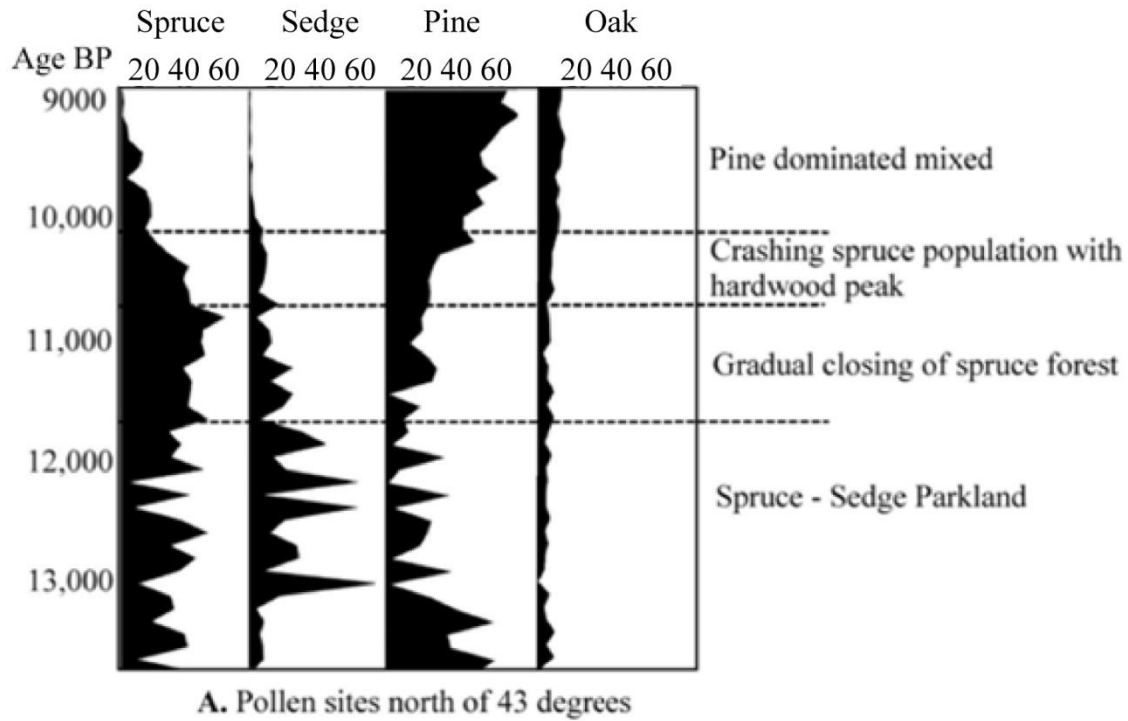


Figure 2.2 Pollen profiles for select species illustrating vegetation change discussed in text (data accessed from NCDC 2011, list of contributing sites listed in Table 2.2)

difference in the two groups reflects the time-transgressive nature of vegetation change for the region. To the north higher percentages of sedge pollen indicate the environment remained open, whereas the spruce forest appears to have closed much earlier in the southern sample.

Interpreting the pollen sequence as evidence for a spruce-sedge parkland also corroborates climatic data (Webb et al. 1998) discussed earlier that suggests annual temperatures were cooler during the Late Glacial period than they are today. In addition to cooler overall temperatures, there was also greater seasonality at this time with warmer summers but colder winters (Webb et al. 1998). The hydrology of the region was also likely different and perhaps substantially more wet than today. Large expanses of poorly drained outwash and lacustrine plains were likely to have been heavily saturated as a result of glacial meltout, shifting lake levels, and underdeveloped drainage systems (Larson and Kincaid 2009). Large blocks of debris covered glacial ice were probably still present in localized areas well after the retreat of the LIS from the Port Huron moraine. This comparatively high water table may also have been periodically swollen due to the continued discharge of glacial meltwater in the Great Lakes basins. In fact, the only consistently dry areas may have been the elevated systems of moraines, kames, and drumlins. High frequencies of sedge pollen (in excess of 70 percent at some localities) give the impression that substantial wetlands were present in the region, as does the seemingly anomalous presence of ash (*Fraxinus*) pollen. Some species of ash are found in the southern boreal forest, the likely source of the ash pollen in the samples examined here is black ash that typically grows in poorly drained habitats in more southern mixed coniferous-hardwood forests of the southeast United States. Even the dominance of spruce in the region may have been controlled to some degree by the poorly drained nature of the soil, rather than cooler annual temperatures.

The aggregated pollen data examined here suggests that the spruce-sedge parkland persisted in the northern sample until sometime around 11,800 BP, with a gradual expansion of spruce at the expense of sedges likely reflecting the drying out of the post-glacial landscape. It is about this time that pollen data suggests the beginning of a significant reorganization of vegetation communities. Shortly after 11,800 BP the percentage of non-arboreal pollen drops below 25 percent on average and continues to decline gradually from that point on. At the same time spruce populations may actually have expanding briefly, reaching a peak around 10,800 BP before also declining (Schuman et al. 2002; Shane 1994). This interpretation closely matches the pollen profile associated with the Smith Mastodon from Gratiot County, Michigan where peak spruce counts occur just prior to 10,700 BP (Oltz and Kapp 1963:344-345). These data suggest the interval between 11,800-10,800 BP represents the initial closing of the parkland environment by expanding spruce populations and corroborates Grimm and Maher's (2000) suggested revisions to the dating of pollen profiles from southern Wisconsin.

#### 2.4.3 REORGANIZATION PHASE (SPRUCE TO PINE)

Traditional radiocarbon dating places the onset of the GS-1 climatic event (Younger Dryas) at 11,025 BP, while ice core data from Greenland indicates that the oxygen isotope shift associated with the GS-1 event may not have begun until 10,850 BP (Lowe et al. 2008:10, Table 1). Regardless of the onset of the GS-1 event, cool dry conditions persisted until roughly 10,000 BP culminating with the pre-boreal oscillation (Lowe et al. 2008). It is about that time that the aggregated pollen data suggest spruce populations were expanding in the lower Great Lakes region. However, there is neither direct evidence to suggest, nor any reason to assume, that the GS-I event had a profound effect on the temperature in the lower Great Lakes region. While



spruce expands briefly at the onset of the GS-1, during the period as a whole spruce is declining. Furthermore, the modern distribution of spruce closely approximates that of the cool boreal forest, however, near its southern range limit spruce has a tendency to be restricted more by fall moisture availability than by temperature (Chinn et al. 2004). If cooling were the only climatic factor forcing vegetation change then a decline in spruce populations through the end of the GS-1 (ca. 10,000 BP) would not be expected. However, a decrease in moisture balance during the GS-1 may have enabled the rapid westward expansion of pine even if temperatures changed minimally. The noticeable and widespread drop in lake levels throughout the Midwest during this period of time are also suggestive that the landscape was drying during this period (e.g. Shuman et al. 2002). To be fair however, there are areas, such as Lapeer County, Michigan (Bailey and Ahern 1981; Kapp 1986:371), where evidence suggests the persistence of spruce populations into the onset of the Holocene, but this may be reflective of a circumscribed areas where moisture balance remained sufficiently high to prevent the successful replacement of spruce by pine.

The interval between 10,800 – 10,200 BP is best described as a period of instability and involves a substantial reorganization of vegetation as taxa were responding individually to climatic change (Figure 2.3). Beginning around 10,800 BP pollen data suggest a probable, region wide, crash in spruce populations that coincides with a brief spike in pollen from deciduous species such as birch (*Betula*) (Hupy and Yansa 2009:98). Although pine (*Pinus*) eventually replaces spruce as the dominant arboreal species in the northern part of the lower Great Lakes region, it appears to not have done so until a rapid expansion around 10,200 BP, when percentages of pine pollen increase from below 30 percent to over 50 percent on average. As discussed before this expansion of pine also coincides with observed decreases in lake levels

throughout the Midwest (Shuman et al. 2002). By the onset of the Holocene, pine populations had expanded to become the dominant source of pollen, almost completely replacing spruce in the region, while non-arboreal pollen continues to decrease below 5 percent of the total pollen.

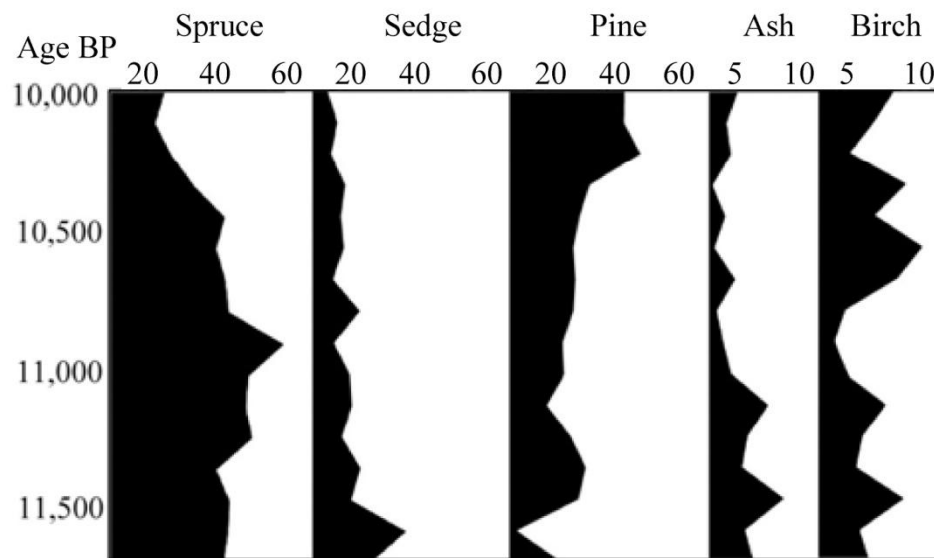


Figure 2.3. Vegetation change associated with the Younger Dryas, 11,025-10,000 BP (data accessed from NCDC 2011, list of contributing sites listed in Table 2.2)

#### 2.4.3.1 ESTABLISHMENT OF ECOTONE

The transition from spruce to pine was not uniform across the entire lower Great Lakes region. In fact, one significant result of vegetation changes during this period is the establishment of an ecotone corresponding with the central Lower Peninsula of Michigan (Hupy and Yansa 2009:98; Webb et al. 1983). The development of this ecotone is evident in northern and southern pollen profiles presented in Figure 2.2. To the south, a greater increase in oak (*Quercus*) pollen is observed. Pollen data from the southernmost sites included in the sample correspond more closely with cores from Ohio (e.g. Shane 1997) than with those localities situated north of 43

degrees latitude. South of this line oak and elm pollen exhibit a steady increase after 10,000 BP. In contrast, pollen data from north of this ecotone, as discussed above, are thought to represent the development of a pine-dominated mixed-forest (Hupy and Yansa 2009; Williams et al. 2001).

## 2.5 LATE GLACIAL FAUNAL COMMUNITIES

The purpose of this section is to present a general characterization of the Late Glacial fauna present within the lower Great Lakes region and to discuss one species, *Rangifer tarandus*, in detail. Like vegetation communities, the Late Glacial animal communities inhabiting the lower Great Lakes region possess no modern analog. The extinction of several species of Pleistocene megafauna and unique environmental conditions mean that the fauna encountered by human foragers during the Late Glacial were dramatically different than any faunal communities known today. While species of megafauna such as mammoth and mastodon define the fauna of this period, not to mention continue to capture the imagination of the general public and archaeologist alike, the more distinguishing characteristic of the Late Glacial fauna is the large diversity of large mammal species. Such richness in large mammal species finds stands in contrast to extant sub-arctic and arctic environments.

To facilitate a reconstruction of the Late Glacial mammal community, data from the FAUNMAP database were assembled to include all taxa from Michigan, Indiana, Ohio that are confidently attributed to deposits dating to the Late Wisconsin (ca. 10,000 – 35,000 BP; FAUNMAP working group, 1994). This is a much broader area than both the archaeological and pollen data that are restricted to southern Ontario and southern Michigan, but is deemed necessary to establish the geographic ranges of different large game species. Additional

specimens in the FAUNMAP database were attributed to the Wisconsin period in general (10,000-110,000 BP), but these were excluded because it is not certain that they pertain directly to the period of time that is the focus of this research. Likewise, several taxa attributed to Late Wisconsin deposits had minimum age estimates earlier than 15,000 BP and were also excluded from the present analysis. The sample considered here contains 229 individual entries from 87 different localities with a total of 52 different taxa grouped at the genus level. Twenty-four of these taxa can be reasonably classified as medium, large, and megafaunal sized mammals and thus were potentially important to human predation strategies (Table 2.3).

Reconstructing Late Glacial faunal communities from available fossil evidence presents a distinct set of challenges. Although lists of taxa, like the one employed here, can be assembled, these data only provide a very general picture of the range of species present during Late Glacial period. Using these data to estimate the relative importance, population size, and density for any one individual taxa should be done cautiously. For instance, taphonomic factors represent one potentially strong source of bias in the fossil record. It is perhaps no coincidence that the three most abundant taxa of large mammal identified in the sample, Harlan's musk-ox (*Bootherium bombifrons*), American mastodon (*Mammuthus americanum*), and Jefferson's mammoth (*Mammuthus jeffersonii*), also possess the largest, most dense, bones (Holman 2001). In other words the remains of these species are more likely to survive the multitude of taphonomic processes affecting bone and, due to their size, are more likely to be recognized when encountered in deposits (Holman 2001). An additional source of bias stems from habitat selection by individual species. It is recognized that fossil remains are often recovered from bogs, caves, and sinkhole deposits (Holman 2001). However, not all species are expected to occur uniformly in such contexts. Because of these challenges the available data need to be

Table 2.3: Economically important species present in the FAUNMAP sample evaluated here  
(data from FAUNMAP working group 1994)

Scientific Name	Common Name	Count
<i>Arctodus simus</i>	Short-faced bear	2
<i>Bootherium bombifrons</i>	Harlan's muskox	26
<i>Castor canadensis</i>	Beaver	3
<i>Castoroides ohioensis</i>	Giant Beaver	4
<i>Cervalces scotti</i>	Stag Moose	9
<i>Cervus elaphus</i>	Elk	1
<i>Dasypus bellus</i>	Beautiful armadillo	4
<i>Equus</i> sp.	Horse	1
<i>Mammut americanum</i>	American mastodon	36
<i>Mammuthus</i> sp.	Mammoth	12
<i>Marmota monax</i>	Woodchuck	4
<i>Martes</i> sp.	Fisher/Marten	5
<i>Megalonyx jeffersoni</i>	Jefferson's ground sloth	1
<i>Mephitis mephitis</i>	Striped skunk	1
<i>Odocoileus virginianus</i>	White-tail deer	7
<i>Ondatra zibehicus</i>	Muskrat	6
Pisces	Pisces	5
<i>Platygonus compressus</i>	Flat-headed peccary	2
Proboscidea	Proboscidea	3
<i>Procyon lotor</i>	Raccoon	4
<i>Rangifer tarandus</i>	Caribou	7
<i>Sylvilagus</i>	Hare	5
<i>Urocyon cinereoargenteus</i>	Gray fox	1
<i>Ursus americanus</i>	Black Bear	4

critically evaluated to gain a reasonable picture of the Late Glacial faunal communities present in the lower Great Lakes region. Despite these difficulties, reconstructing the Late Glacial fauna for the lower Great Lakes region is essential to any discussion of human subsistence strategies, as is providing some framework to understand the general behavior of species of likely importance to human foragers.

### 2.5.1 FAUNA AND COMMUNITY RICHNESS

Megafauna present in the region include American mastodon, Jefferson's mammoth, woolly mammoth (*Mammuthus primigenius*), giant beaver (*Castoroides ohioensis*) and Jefferson's ground sloth (*Meglaonyx jeffersoni*). Of these species, the probosidians in general (n = 48) and the American mastodon in particular (n = 36) dominate the FAUNMAP sample evaluated here (FAUNMAP working group 1994). Major differences between mastodon and mammoth include cusp morphology and it is most frequently assumed that the former, with sharp crowned molars, were browsers and thus abundant in the spruce parkland east of the Mississippi River while the mammoth possessed specialized grazing dentition and thus more commonly found in the Plains grasslands (Saunders 1996; Saunders et al. 2010). Along with the American mastodon, Jefferson's ground sloth and the giant beaver are also notable browsers. The identification of several different species of browsers no doubt reflects the presence of spruce dominated woodlands. Yet, occurrences of mammoth in the study area would imply that there were considerable open areas of grasslands suitable for a very large grazer.

Dietary analysis of the American mastodon includes stomach content and isotopic data, both of which imply the species was able to thrive on a variety of plants in the parkland environment of the Great Lakes (Saunders 1996:274; Saunders et al. 2010). Isotopic data suggest the preference for nitrogen-fixing vegetation such as alder (*Alnus*) that, as a common pioneer species, would have been available in recently deglaciated terrain (Koch 1991). Browsing by mastodon is also confirmed by the presence of leafy material from deciduous trees or shrubs identified in the stomach contents of the Burning Tree mastodon (Lepper et al. 1991). However, the Burning Tree mastodon in central Ohio also shows that the individual had consumed abundant herbaceous vegetation from wetlands; including sedges, pond weed, and water-lily.

The presence of wetland vegetation in the stomach of the Burning Tree mastodon supports Hallin's (1983) suggestion that mastodon hair reflects the use of semi-aquatic environments. This variety of data strongly suggests that the American mastodon appears to have been well suited to exploit the abundant wetlands and spruce stands that characterized the spruce-sedge parkland. Taphonomic factors aside, such apparent suitability to the lower Great Lakes environment would suggest that the frequency of mastodon in the FAUNMAP sample does reflect the presence of an abundant population of the species in the lower Great Lakes region.

The Late Wisconsin FAUNMAP sample also indicates the presence of numerous large ungulates including caribou, musk-ox, *Cervalces scotti* (stag moose), and *Cervus elaphus* (elk) (FAUNMAP working group 1994). In addition to FAUNMAP, Jackson (1990) provides a summary of Late Wisconsin fossil cervids recovered from southern Ontario. As noted above, the presence of such a diverse ungulate fauna is an important characteristic of the Late Glacial environment, although the question remains as to how prevalent individual species of ungulate were. The four species of large ungulate each have multiple localities where remains have been recovered and are distributed widely across the lower Great Lakes region (Figure 2.4). Both elk and stag moose are more prevalent within the southeastern portion of the sample area, while conversely the majority of caribou finds appear to be more prevalent the northern half of the sample. Similarly there is a general east to west distinction in the sample, with caribou and stag moose more prevalent in the east, while localities with musk-ox remains are more prevalent to the west. This distribution of ungulates in the lower Great Lakes region may reflect the mapping onto favorable ecological zones by individual species in effort to space themselves from competition. This interpretation is supported by Banks et al.'s (2008) study where ecological modeling suggests that Caribou and red deer (*Cervus elaphus*) in Europe were more conservative

regarding their selection of niches during the LGM. Despite the ability to grossly generalize the spatial distribution of large ungulates from the Late Wisconsin FAUNMAP sample, there still is considerable overlap in the distribution of individual species and additional data is needed to refine our understanding of the specific habitats selected for by Late Glacial fauna.

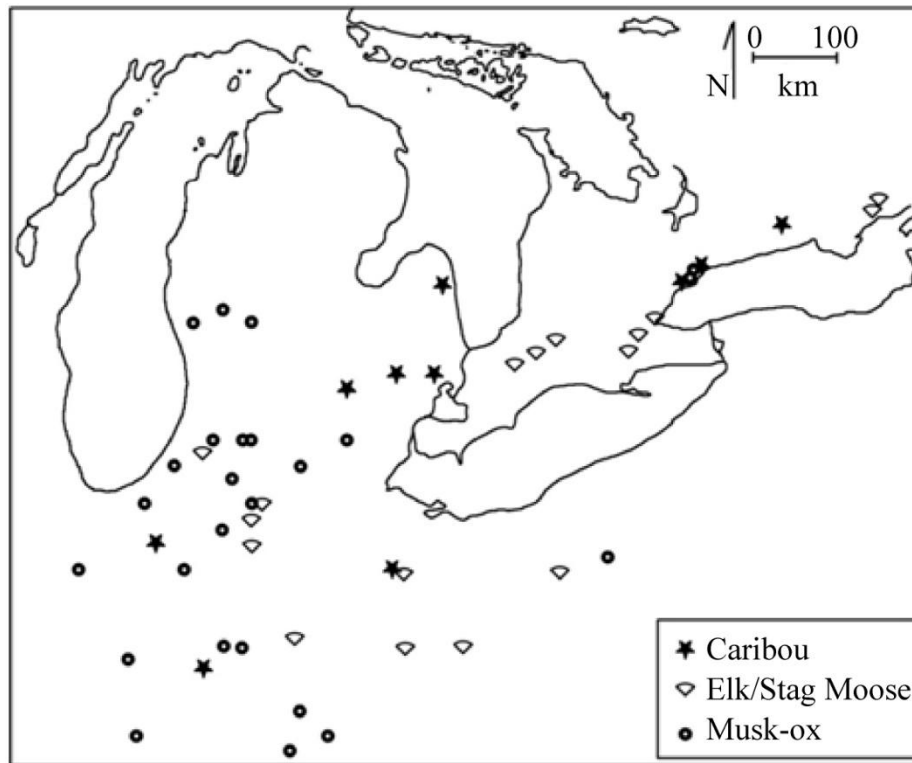


Figure 2.4. Distribution of large ungulate fossils recovered from Late Glacial contexts (data accessed from FAUNMAP working group 1994, Jackson 1990)

## 2.6 CARIBOU ECOLOGY

Caribou is the most northern dwelling member of the deer family and the modern distribution of the species is a widespread area encompassing the sub-arctic and arctic biomes of the Northern Hemisphere. The species is commonly known as caribou in North America and



reindeer in Europe and Asia and I elect to use the North American term, caribou, in the context of this study. Caribou are known to inhabit a diverse range of ecological settings that include tundra, boreal forest, mountain, and high arctic niches (Banfield 1961, 1970; Bergerud 2000). Currently seven sub-species are recognized and are loosely grouped according to their geographic and ecological distribution. The recognition of sub-species is bolstered by the observation that individual herds of caribou maintain spatially definite territories with high rates of fidelity, although gene flow between herds is well documented (Abraham and Thompson 1998; Shaefer et al. 1997; Thompson and Fisher 1979:272). Nevertheless, in spite of apparent morphological and behavioral variability between sub-species and a circumpolar distribution, *Rangifer tarandus* remains a single biological species (Banfield 1961). A pointed reminder of this biological fact are the current difficulties faced by domestic reindeer herders in Alaska who stand by helpless as their “domestic” herds continue to wander off and be absorbed into wild caribou herds that are expanding into their pasturelands (Schneider et al. 2005).

The common depiction of caribou is a gregarious herd animal that gathers seasonally into large herds of several hundred thousand individuals to undertake long distance seasonal migrations (Burch 1972). While this may be true to some extent, such a popular image is a misrepresentation of the species as a whole with a number of underlying assumptions that can be misleading. The term herd, as employed by wildlife biologists, refers to a collection of individual caribou that utilize a specific calving ground from year to year. While the herd may occasionally aggregate into extremely large numbers (100,000 or greater), the norm is for caribou to be encountered in bands not herds (Spiess 1979:138). Bands of caribou can number anywhere from a few individuals to several hundred and are comprised of individuals of differing ages and sex depending on the season (Miller 1975; Spiess 1979:39-40). During seasonal migrations large

bands of caribou often trail one another in close succession and along the same route thus giving the impression of a massive aggregation on the order of tens of thousands of animals, although the passing of such large numbers may take several days. It is clear from both the ecological and ethnographic literature that large migrations such as these are still internally comprised of individual bands of caribou (Banfield 1960; Gubser 1965; Miller 1974). Only occasionally does a herd aggregate into a mass of extremely large numbers and then this occurs infrequently and then lasting only for a brief time typically in late summer prior to the beginning of the rut (Burch 1972:359; Spiess 1979).

Just as aggregations are unpredictable, herd size (and by extension the size and frequency of individual caribou bands encountered) is known to fluctuate from year to year. Rapid growth and decline in the size of caribou herds are well documented, though, the specific reasons for dramatic crashes in the population of caribou herds remain unclear. While some have suggested that human predation may be a factor, others note that population increases have occurred during periods of intense hunting and that, similar to other mammal species, caribou are likely to experience cyclic periods of abundance followed by population crashes that occur independent of human involvement (Burch 1972:355-356). Overgrazing of productive areas, depth of snow cover, and the occurrence of a late winter rain that prevents caribou from reaching ground lichens due to an ice cover can all result in the reduced availability of forage and, particularly when these variables are combined, may result in the decrease of winter survival through either starvation or increased predation (Burch 1972). Skoog (1968:318) has documented historic increases in Alaskan caribou herds in the 1860s and 1920s along with episodes of population crashes in the 1890s and 1940s. These increases occur irrespective of periods of intensive hunting. At the same time Alaskan herds were experiencing population highs in the 1920s, herds

in Labrador were going through a dramatic crash in population at about the same time (Loring 1988; Strong 1986). These examples imply that dramatic fluctuations in herd size could be more the norm rather than exception. The near certainty that, at some point in their lifetime, human foragers will experience such fluctuations led Fitzhugh (1972; see also Mason and Gerlach 1995) to suggest a population sink model for Labrador culture change where areas dependent upon caribou are periodically occupied then subsequently abandoned once populations crash.

Along with long term fluctuations in herd size, short term shifts in territory and migratory patterns immediately impact those human societies reliant on the seasonal presence of caribou. Burch (1972:352-255) summarizes evidence for several large scale shifts in territory on the magnitude of several thousand animals over hundreds of kilometers, however, it should be noted that these are exceptional cases. It is his data regarding inter-annual fluctuation in the number of caribou bands passing through the catchment around the Kilvalina Inuit settlement in Alaska that is more pertinent to our understanding of forager behavior.

...the radical difference in numbers of caribou taken between 1964-65, on the one hand, and 1965-66, on the other. The former was a year of caribou scarcity at the local level, in spite of great abundance in northwestern Alaska generally. Only 228 animals were taken in Kivalina over a 12 month period. That figure was exceeded during a single day (October 11) in 1965, when the same hunters secured 375 animals, with a 2 week total of 550 (Burch 1972:353).

The example from Kilvalina demonstrates that caribou do not migrate along the same path from year to year making it difficult for hunters to position themselves without additional information regarding their movements. This is especially critical in the instance of Kilvalina where the settlement is permanent. The inter-annual changes in caribou migration virtually guarantee that from time to time episodes of shortage will occur at the local level, such as at Anaktuvuk Pass in the Brooks Range where

One season the animals may come through in great numbers, massed in a good sized band, a striking procession... Another season their passing may be almost unnoticed, as they dribble through in such small bands as to leave the impression that there are few caribou left in the country (Murie 1935:43).

The implication is that, for a population reliant upon caribou, mobility and information are essential to overcome these localized shortages.

The ease of hunting caribou is another often cited feature of the species and is commonly related to the general gregariousness of the species (Burch 1972:360-361). This is a bit of a misnomer as populations are unlikely to become specialized caribou hunters simply because the animal is easy to kill, and as Spiess (1979:138) points out:

Most artiodactyls are easily killed if one is intimately familiar with their behavior and techniques to exploit it. Caribou do seem to be “stupid” when compared with other deer species, however.

Stupid might come across as a harsh descriptor, but caribou do not appear to process information very well and frequently move toward an object in order to determine if it may be dangerous (Pruitt 1965; Spiess 1979:36). This curiosity is often exploited by indigenous hunters who attempt to draw caribou within easy killing range. In particular, one ethnographic account describes two hunters moving off in a direction away from a caribou band, which causes caribou to follow the walking hunters. One continues to move off in the direction while the other hunter conceals themselves behind a blind and waits for the following caribou to pass nearby. In addition, various decoys and rattles are employed to successfully draw the animals toward waiting hunters (Birket-Smith 1929:107; McKennan 1965:32). Curiosity notwithstanding, caribou do recognize certain patterns, such as a stalking wolf, which will cause them to flee (Pruitt 1965). Yet, there are plenty of accounts in the ethnographic literature of hunters using those qualities to their advantage, such as circling upwind of a caribou band to force them to

move toward waiting hunters, or the use of parka hoods to mimic the shape of a stalking wolf to cause caribou to flee into a drive line.

### 2.6.1 SUB-SPECIES VARIABILITY

The tundra adapted sub-species of caribou represent the classic image of the species and the specific behavioral adaptations of tundra dwelling caribou are often thought to be representative of caribou as a whole. Tundra adapted caribou are physically distinguished by large, expansive sets of antlers on both males and females; however, they are best characterized by their propensity to undertake the long distance migrations (Banfield 1961; Kelsall 1968; Miller 1975). During the spring individual bands begin to migrate northward onto tundra calving grounds in order to escape both predators and insects. One common misconception is that caribou subsist primarily on lichen, while in reality lichen comprises a relatively modest portion of their diet (Johnstone et al. 2002; Parson et al. 1980). In fact, during the summer months sedges, forbs, and deciduous shrubs such as dwarf willow comprise the bulk of their diet and are selected because of the high nitrogen availability and digestibility (Johnstone et al. 2002:86-88). During the fall bands of caribou once again migrate south where they winter near the tree line. Lichen increases in importance only during winter months as caribou feeding strategies typically include digging pits to reach ground lichens, supplemented by the occasional subsistence on arboreal lichen (Brown and Theberge 1990).

Forest dwelling or woodland caribou inhabit the taiga or boreal forest year round. Woodland caribou physically differ from the tundra sub-species by possessing smaller sets of antlers, with upwards of one-third of the females remaining antlerless (Banfield 1961) Woodland caribou are also distinguishable from tundra sub-species because of their larger body size

(Banfield 1961). Aside from physical differences, woodland caribou migrate at a much smaller scale than tundra caribou and instead move seasonally between different environmental patches (Cumming and Beange 1987; Rettie and Messier 2001). Data from radio-collar tracking indicate that modern woodland caribou prefer to winter in mature or old growth forests, with increased use of bogs, fens, and barrens during other seasons (Rettie and Messier 2001; Stuart-Smith et al. 1997). The diet of woodland caribou also includes sedges, forbs, and deciduous shrubs prior to snowfall and the increased use of arboreal and terrestrial lichens during the winter months. In particular, some have suggested the selection of older, mature or climax forests by caribou as winter habitat is due to both the increased time for lichen growth and the more closed forest canopy limiting snow depth to enable caribou to reach ground lichens (Antoniak and Cumming 1998; Brown and Theberge 1990). Elsewhere woodland caribou inhabit mountainous regions in Quebec, Alberta, and British Columbia. These populations of woodland caribou are known to undertake seasonal migrations across vertical, rather than spatial, distances in order to exploit alpine tundra or upland fens and barrens during the summer before returning to lower elevations to winter below the tree line (Gustine et al. 2006; Johnson et al. 2004).

Recognition of phenotypic differences among the sub-species does not mean they are universal. For instance, radio-collared females from the woodland caribou Red Wine Mountain herd in northern Quebec are known to have emigrated into the George River Herd comprised of primarily caribou that undertake long distance seasonal migrations onto tundra calving grounds (Schaefer et al. 1999). In addition there is the example mentioned above where domesticated reindeer introduced onto Alaska's Seward Peninsula have emigrated into the barren-ground caribou herds that are native to the region (Schneider et al. 2005). These documented instances indicate that gene flow does exist between caribou inhabiting broad ecological zones. In fact,

indigenous hunters who have contact with the Pen Island herd in northwest Ontario and northeast Manitoba note differences between the Pen Island herd and herds comprised of barren-ground caribou to the north and woodland caribou to south (Abraham and Thompson 1996). This would suggest that enough gene flow exists between herds that potentially have resulted in a recognizable phenotypic hybridization of the Pen Island herd. Likewise, genetic evidence suggests that “mountain” caribou inhabiting the cordillera of British Columbia and Alberta exhibit a mixture of barren-ground and woodland caribou genes. Like the barren-ground caribou these herds exhibit a strong seasonal migratory pattern, but migrate altitudinally to reach tundra.

Likewise phenotypic variability between North American and Eurasian barren-ground caribou is more the result of anthropogenic processes rather than reproductive isolation. In Europe and Asia there is a long history of reindeer herding among nomadic peoples whereas comparable instances of indigenous caribou husbandry is entirely absent in North America (Ingold 1980). Archaeological data suggest the intentional management of reindeer herds extend back nearly 2000 years, while in North America, aside from isolated ethnohistoric accounts of raising individual caribou, the systematic husbandry of caribou did not come about until the historic era and in those instances domestic caribou herds from Eurasia were imported into North America (e.g Schneider et al. 2005). The intentional husbandry of domestic caribou herds in Eurasia has resulted in the reduction of leg length, decreased occurrence of antlers on females, and an increase in the gregariousness of the animals.

Recent genetic studies have provided a more clear understanding of the influence that reproductive isolation has had on individual caribou populations. These genetic studies suggest that much of the present variability among caribou worldwide is the result of populations becoming isolated in distinct late Pleistocene refugia. The classic model, originally suggested by

Banfield (1961), argued that the three broad ecological zones inhabited by caribou today resulted from populations inhabiting different Pleistocene refugia. Banfield (1961) hypothesized that the modern tundra adapted herds had occupied the Beringian refugia, where there is evidence for the persistence of tundra throughout the late Pleistocene, while herds occupying High Arctic islands today persisted in an unidentified refugia north of the LIS. Likewise, herds adapted to woodland settings were thought to have occupied refugia south of the ice sheets. Genetic evidence confirms the presence of at least two distinct refugia, however these data also indicate that modern ecological and sub-species divisions are not an accurate reflection of the recent (e.g. late Pleistocene) evolutionary history of caribou. Instead, barren-ground caribou inhabiting the tundra zone in both North America and Europe along with *R.t. fenniculus*, the woodland sub-species present in Europe, and *R.t.perryi*, inhabiting High Arctic islands, share multiple haplogroups, which is suggestive that there was a significant degree of gene flow between these populations throughout the late Pleistocene (Flagstad and Roed 2003). In fact, the only sub-species that exhibited statistically distinct genetic markers, and therefore likely a separate late Pleistocene refugium, is *R.t. caribou*, the woodland sub-species present in North America (Flagstad and Roed 2003:667). These data are mirrored in an analysis of mtDNA from 18 herds distributed across North America that also indicate *R.t. caribou* is genetically distinct from the tundra adapted sub-species (Cronin et al. 2005). Flagstad and Roed (2003) suggest that woodland caribou (*R.t. caribou*) would have been reproductively isolated in a North American refugia south of the LIS while the remaining sub-species were able to maintain gene flow with each other throughout the late Pleistocene.



## 2.7 SUMMARY AND DISCUSSION

Available evidence pertaining to the Late Glacial environments in the lower Great Lakes region has been reviewed here. This review focused primarily on the period between 12,500 and 10,000 BP, which encompasses the known Paleoindian occupation of the region. During this span of time paleo-environmental data suggest that the environment not only differed from the modern climate in the region, but that dramatic changes to the physical landscape, climate, flora, and fauna also were occurring. Pollen core data presented here provide a robust body of evidence suggesting a series of abrupt and successive changes to the vegetation occurred between 10,800 – 10,200 BP, beginning with an expanding spruce forest, followed by crashes in both spruce and black ash populations. A brief rise in hardwoods is observed in the century immediately following the spruce crash. However, by the end of the GS-1 significant increases in pine pollen indicate that a sizeable pine population has become established in the region. Changing vegetation occurred alongside abrupt shifts in climate as evidenced in the NGRIP ice core data (Lowe et al. 2008) and coincided with a probable period of drought (Shuman et al. 2002). More importantly, rapid environmental changes occurred within a span of about 600 radiocarbon years and at that scale were probably recognizable to communities of human foragers inhabiting the lower Great Lakes region and are suggestive that organizational responses to environmental change were active, agent driven occurrences (Ellis et al. 2011).

## Chapter 3

### ETHNOGRAPHY OF NORTH AMERICAN CARIBOU HUNTING SOCIETIES

#### 3.1 INTRODUCTION

The goal of this chapter is to review the body of ethnographic literature pertinent to understanding hunter-gatherer adaptations involving caribou hunting. The literature reviewed here is important in the sense that it helps discern the range of behavioral variability exhibited by caribou hunting societies and is intended to provide contextual information to aid in the study of archaeologically known caribou hunters. Ultimately it is hoped that by undertaking this review a more informed predictive model regarding Late Glacial caribou hunters can be developed in subsequent chapters.

This predictive modeling approach employed in this dissertation seeks to use the ethnographic record as one line of evidence to help develop a model for caribou hunting during the Late Glacial period. Testable predictions concerning the archeological record are to be derived from this model. The key difference in using the ethnographic record in this manner, as opposed to ethnographic analogy, is that this study does not assume *a priori* that the organizational requirements were similar between ethnographic and archaeological hunter-gatherers, nor were caribou hunting strategies necessarily the same. In fact, a predictive approach does not assume that human societies inhabiting the lower Great Lakes region were even hunting caribou, let alone in a preferential manner. Rather the focus of this approach is to test those assumptions using appropriate archaeological data. Of course, insight gained by testing these assumptions can serve as the basis upon which strong, appropriate, analogical arguments may be developed in the future (cf. Randall and Hollenbach 2007; Wylie 2002).

The organization of this chapter includes two parts. First I review the available ethnographic literature pertaining to indigenous caribou hunting societies of North America. While this review is purposely restricted to indigenous societies of North America, it is acknowledged that indigenous caribou hunters/pastoralists were, and in some areas still are, prevalent throughout the circumpolar region including Asia and northern Europe. The primary reason for restricting analysis to the North American ethnographic record is because, to the best of our knowledge, caribou were never domesticated in North America and this restriction serves to mitigate the influence that pastoral economies no doubt have had on human-caribou relationships (e.g. Ingold 1980). This study makes the obvious assumption that Late Glacial caribou were never domesticated either.

The central question guiding this review is how do foragers, reliant to some degree on the hunting of caribou, go about the practice of making their living within a variety of environmental, cultural, and historical contexts? Environmental contexts include inland and coastal areas of the arctic along with transitional and boreal forested zones of North America. These environments also exhibit a considerable range of topographic relief ranging from the rugged Brooks Range of Alaska to the broad, flat barren-ground plains west of Hudson Bay. The ethnography of caribou hunters includes examples from Inuit, Athapaskan, and Algonquian speaking peoples. These diverse cultural contexts underscore the observation that the specific organizational responses to caribou hunting are influenced considerably by the social milieu inhabited by indigenous caribou hunters of North America. Lastly the influence of historical processes on caribou hunting strategies will also be discussed. The ethnographic present in this study generally spans the eighteenth through mid-twentieth centuries. This was a significant period of time in North American history when indigenous societies were undergoing profound

changes resulting from their increasing integration with Euro-American economic and political entities.

This interplay between ecological, cultural, and historical processes can exert a strong influence on the relative importance of caribou to any one group of foragers. Significant ecological variables include the relative density of caribou in contrast to other resources and the structure of caribou movements. Density and movement patterns of caribou can exert a great deal of influence on how traditional societies schedule their exploitation and scheduling concerns serve to structure the overall organization of traditional economies. For instance, some areas may experience extremely high densities of barren-ground caribou, but are only accessible for short periods of time while herds migrate through a region. Conversely, other areas experience lighter densities of woodland caribou. Since woodland caribou often migrate only short distances seasonally, some caribou may be available virtually year round. Similarly, certain other species of plant or animals may prove to be attractive for purely economical or cultural reasons and detract from the local importance of caribou. Examples of this are represented by the dominance of harp seal remains at Inuit sites in the Foxe Basin, despite the fact that large herds of caribou were likely present in the vicinity (Maxwell 1968). Certainly for the Inuit who colonized (a historical process) the area due to the availability of marine resources (a cultural preference), as long as returns from seal hunting remain sufficient (an ecological baseline) to provide for their needs they were unlikely to abandon their marine oriented economy merely because caribou also happen to be present. Likewise, within the Mackenzie Delta region the fall caribou hunt coincided with the bowhead whaling season. This created a crucial scheduling conflict that affected the attractiveness of hunting caribou. Aside from politically marginal individuals, the social ramifications of whale hunting led to a situation where most Mackenzie Inuit ignored the

fall caribou hunt despite, or precisely for, the greater economic risk involved in whale hunting (Morrison 1988).

The second part of this chapter utilizes the ethnographic literature to reconstruct a generalized picture of the behavioral and economic strategies employed by caribou hunters. Areas of particular interest are those dimensions of human behavior that can potentially translate to observable dimensions of the archaeological record. For instance, territory size, land use and mobility strategies, hunting techniques, and risk managing strategies each can be inferred to some extent from both ethnographic and archaeological data. These, along with general observations regarding the relative intensity of caribou hunting, comprise the important dimensions of the ethnographic record to be evaluated in the second part to this chapter.

### 3.2 ETHNOGRAPHY AND ETHNOHISTORY

The goal of this first section is to introduce the indigenous caribou hunting societies of North America and to situate each ethnographic present within their unique historical context. In fact, one striking and recurrent theme in the ethnographic literature is the magnitude of cultural change that occurred during the post-contact era. This serves as an important caveat against uncritically projecting a particular ethnographic present onto the past as a stable, long term adaptation to caribou hunting. In all probability episodes of change also occurred throughout the prehistoric period. In light of the known fluctuations in caribou herd size and migratory behavior discussed in the previous chapter, instability may ultimately prove to be a more characteristic feature of caribou hunting societies than long periods of stability (Fitzhugh 1972; Mason and Gerlach 1995).

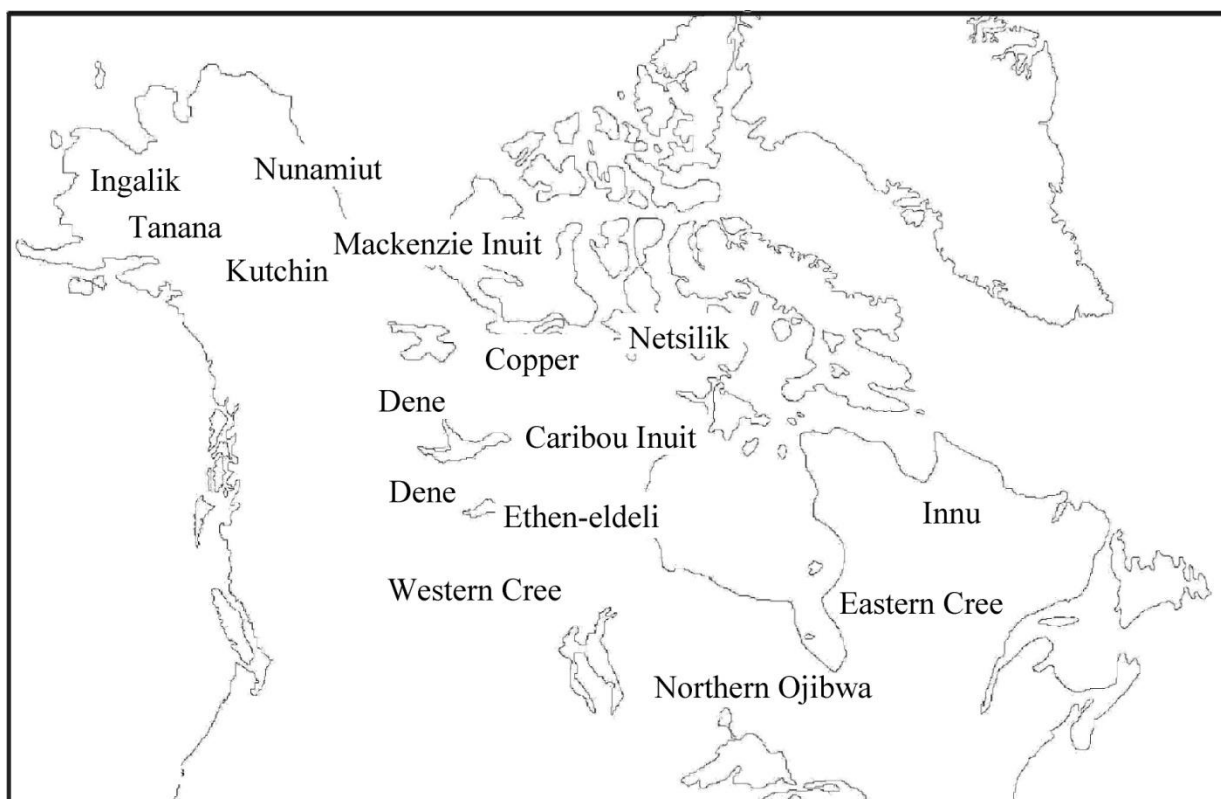


Figure 3.1: Location of indigenous peoples referred to in text (adapted from Helm 1984)

### 3.2.1 INUIT CARIBOU HUNTING SOCIETIES – TUNDRA ADAPTATIONS

#### 3.2.1.1 NUNAMIUT

The Nunamiut have been the subject of several ethnographic (Campbell 1968; Gubser 1965; Ingstad 1954; Spencer 1959) and ethnoarchaeological (Amsden 1977; Binford 1978, 1979) studies dating to the mid-twentieth century. Considering the wide influence of Binford's (1978, 1979, 1980) writings one could even argue that the Nunamiut are something of ethnoarchaeology celebrities. Observations concerning the economic and technological strategies employed by these archetypal collectors have had considerable influence on how several generations of archaeologists, myself included, interpret the archaeological record of hunter-gatherers.

Contemporary Nunamiut inhabit the interior of northern Alaska along the north slopes of the Brooks Range. Traditionally the Nunamiut have subsisted on migratory caribou to the near exclusion of other resources and serves as the organizational focus of the Nunamiut seasonal round. Despite such notoriety as specialized caribou hunters in the interior, the Nunamiut have their origins among the Inupiaq Inuit of the Kotzebue Sound region who practiced a mixed economy incorporating marine mammal hunting and fishing to a much greater extent (Burch 1976:63, 1984). Archaeological evidence suggests that there have been multiple periods of occupation and abandonment of the region and that the most recent iteration of ‘Nunamiut’ owe their origins to an eastward migration of people from the Noatak basin into the region centered on the upper Coleville River basin (Hall 1976). The specific causes for this migration, dating to around A.D. 1400, are not fully known, but within 200 years a comparatively dense late prehistoric archaeological record is present and includes concentrations of late pre-contact archaeological sites situated around interior lakes (Campbell 1968; Wilson and Rasic 2008). In light of the exalted place that the Nunamiut hold in archaeological method and theory, the specific processes leading to this transition from a mixed coastal/terrestrial economy to an interior adaptation involving specialized caribou hunting is a woefully understudied aspect of arctic prehistory. Archaeological evidence for the rapid increase in the density of late pre-contact archaeological sites would seemingly indicate that the Nunamiut adaptation to interior caribou hunting was initially very successful (Hall 1976). However, crashes in historic caribou populations led to abandonment of the region in the early 1900s and it wasn’t until the reestablishment of the Nunamiut village at Anaktuvuk Pass in the 1940s that the contemporary version of Nunamiut caribou hunting was studied by anthropologists (Gubser 1965).

The economic foundation of the Nunamiut is the predation of migratory barren-ground caribou from the Arctic herd that passes through the Brooks Range in large bands during both the spring and fall (Gubser 1965; Skoog 1968). Although some caribou may be found within Nunamiut territory year round, the vast majority of caribou consumed over the course of the year are taken during these two rather punctuated events. Cooperative hunting techniques are typically employed to drive caribou into either corrals or lakes where large numbers of animals could be dispatched with comparable ease (Hall 1985). One result of an economy focused on intercepting migratory caribou are the marked temporal and spatial discontinuities in available resources that Binford (1980, 2001) argues is the key organizing principle resulting in logistical mobility and a heavy reliance on practical storage. Nunamiut supplement stores of caribou meat accumulated from communal drives with the stalking and snaring of small bands of caribou present throughout the year, along with pursuit of other resources chief of which were Dall Sheep, fish, and ptarmigan. Hall (1985) estimates that as much as 90 percent of their diet came from caribou and the tremendous importance of caribou in the Nunamiut diet is similarly echoed in the works of both Gubser (1965) and Binford (1979).

The largest social aggregations among the Nunamiut occur in accordance with the fall caribou hunt. In addition to its social importance, aggregation was also necessary to provide labor to operate communal drives and process the high volume of caribou taken. The non-food proceeds of the fall caribou hunt were also critical as preparations for winter would have included the necessary manufacture and repair of clothing and shelter coverings (Gubser 1965). Throughout the remainder of the year groups would be in a constant state of flux between aggregation and dispersal with the greatest period of residential mobility occurring during the summer months. Practical storage is a key dimension to the Nunamiut economy and includes



both sub-surface meat caches, typically used as insurance caches during the summer, and above ground storage throughout the cold winter months when freezing temperatures would preserve the meat (Binford 1993).

### 3.2.1.2 CENTRAL CANADIAN ARCTIC

Inuit bands inhabiting the Canadian arctic have also been the subject of some of the most detailed ethnographic work of any circumpolar peoples. Research by Boas (1888), Balikci (1970), Damas (1972, 1984), Jenness (1922), and Rasmussen (1931) has shed considerable light on traditional lifeways within one of the most remote portions of the earth. While these ethnographies have largely focused their attention toward addressing issues pertaining to Inuit social organization and their maritime adaptation, there is still considerable discussion regarding the economic role of caribou. Beginning in late spring herds of barren-ground caribou would appear in the region inhabited by the Copper and Netsilik Inuit. Fat content and hide condition in the earliest spring were poor and, aside from periods of starvation, caribou generally would be avoided until summer when they have had time to replenish fat stores. Caribou would continue to be present throughout summer and fall before beginning their migration south. It was during the period from summer to late fall that caribou constituted the critical resource. Bands of caribou were taken in large numbers whenever available and both the Copper and Netsilik have been known to employ drives through boulder lines and shooting from blinds (Brink 2005; Jenness 1922). Caribou not only provided an immediate source of fresh meat, but also supplied much needed hides for clothing and gear, and enabled caribou meat to be cached for retrieval during the lean winter months. These insurance caches represented a critical risk minimizing strategy

and point toward the importance of caribou even beyond the few months that they were available.

Although caribou represented an important resource in an otherwise marginal environment, in the event that the caribou did not appear in anticipated numbers the availability of trout and arctic char provided an alternative source of food during the summer (Balikci 1984). The summer months were also the time of greatest population dispersal as small extended family bands were widely scattered throughout Copper and Netsilik territory. Residential mobility would all but cease after the fall caribou hunt as individual family bands waited for sufficient sea ice to develop. During freeze-up Inuit bands subsisted on surplus caribou meat and concentrated activity toward preparing hides for winter clothing and shelter. Once the sea ice developed, Inuit within the central Canadian arctic would then aggregate into large winter villages organized exclusively around breathing-hole sealing. Although cached caribou meat and the occasional polar bear provided some variety to the diet, sealing remained the most important component to the seasonal round among the Copper and Netsilik Inuit (Balikci 1984).

In the context of understanding caribou hunting adaptations, it is important to note that both the Copper and Netsilik pursued caribou during the dispersed phases of their annual settlement systems. This certainly runs contrary to the conventional view that the interception of large caribou herds and population aggregations went hand in hand. While few would argue with the suggestion that there is a need for hunter-gatherers to periodically aggregate and disperse, it is important to observe that, while caribou undoubtedly can provide an economic basis for aggregation, the predation of caribou per se does not necessitate social aggregation. Among Central Inuit groups there was a need to coordinate labor during the winter months to reduce

daily variation in breathing hole sealing returns, which constituted the primary concern influencing social aggregation (Riches 1982:21-30).

#### 3.2.1.3 QUEBEC/LABRADOR INUIT

Inuit populations east of Hudson Bay engaged in seasonal movements inland during the fall to hunt caribou (Saladin d'Anglure 1984). While these hunts provided some variance to a diet otherwise dependent upon marine mammals, interior caribou hunts were primarily undertaken for purpose of acquiring hides with the secondary benefit of provisioning insurance caches in the event that sea mammal hunting produced lower than expected returns. Although there is some evidence for a more intensive occupation of the Quebec interior by the Inuit in those areas where coastal resources were less abundant, others have argued that this took place after the introduction of firearms to the region (Saladin d'Anglure 1984:476). Residential relocation into the interior to hunt caribou was undertaken sporadically. Most families occupied the Quebec/Labrador coast for much of the year and only logistically exploited the interior (Taylor 1984). For the most part, occupation of the interior was rather limited and generally did not influence the basic organization of Inuit settlement strategies where residential camps were positioned principally for access to marine resources (Hawkes 1919; Saladin d'Anglure 1984; Taylor 1969, 1974).

#### 3.2.1.4 MACKENZIE DELTA INUIT

Among the Inuit communities inhabiting the Mackenzie Delta region, caribou also constituted a secondary resource that, in addition to food, was a critical source of hides for clothing and shelter. Unlike Inuit communities elsewhere in the Canadian Arctic, whale hunting

was a vastly important fall activity that presented a scheduling conflict with the fall caribou migration. Because successful whaling had greater social ramifications, caribou hunting among many Mackenzie Inuit was restricted only to the summer months. However, Morrison's (1988) examination of ethnographic and archaeological data makes it clear that while whaling provided a large volume of meat, blubber, and prestige, some Mackenzie Inuit chose to resist the hegemony of whaling and pursued caribou during the fall migration. While this placed groups such as the Nuvorugmiut at the bottom of the Mackenzie Inuit social hierarchy, caribou hunting did facilitate access to a stable resource and provided a surplus supply of hides that were subsequently traded with those groups that chose to participate in the whale hunt (Morrison 1988).

#### 3.2.1.5 CARIBOU INUIT

Today the Caribou Inuit occupy the barren-grounds west of Hudson Bay, inhabiting a broad territory centered on the lower Thelon and Kazan River valleys. As the name given to them by Europeans imply, the Caribou Inuit are best known as specialized caribou hunters whose principal economic adaptation was the interception of migrating caribou herds during the spring and fall. Much of our knowledge of the Caribou Inuit is due in large part to ethnographic work carried out by the Fifth Thule Expedition (Birket-Smith 1929; Rasmussen 1931). Contemporary ethnographic and ethnohistoric work has served to extend the already important role of the Caribou Inuit among sub-arctic and arctic ethnography (Arima 1984). Likewise, the Caribou Inuit have long served as a source of analogy for the archaeological community thanks to the work of Burch (1972) and to a lesser extent Spiess (1979). Contemporary ethnohistoric and archaeological work has centered on understanding specific changes that occurred among post-

contact Caribou Inuit economic practices (Friesen 2004; Gordon 1996) and documenting archaeologically visible features of the traditional Caribou Inuit landscape (Stewart et al. 2004). As a result the Caribou Inuit have served as the prototypical specialized hunters of barren-ground caribou, most recently having been used to interpret the positioning of sites in the Great Lakes region as reflecting the interception of caribou herds (Stewart 2001; O'Shea and Meadows 2009).

Contrary to both their name and stereotypical anthropological image, the Caribou Inuit adaptation to specialized caribou hunting developed late in the contact era. In fact, when compared to their Athapaskan speaking (Dene) neighbors the Caribou Inuit are relative newcomers to the region (Burch 1991; Friesen 2004; Gordon 1996). Archaeological data suggests that Inuit peoples reached the western shore of Hudson Bay around A.D. 1100 with the establishment of a colony centered on Marble Island and inhabited the area between Chesterfield Inlet and Eskimo Point (Smith and Burch 1979:77). This group, who became known historically as the Caribou Inuit, inhabited a relatively circumscribed territory along the coast. Available data suggests that they were adapted to a mixed terrestrial/marine economy and primarily exploited bands of caribou that available along the coast during the summer, but rarely pursued caribou inland (Smith and Burch 1979). In this regard the pre-nineteenth century settlement and subsistence strategies employed by the Caribou Inuit only involved seasonal caribou hunting and closely mirrored the subsistence practices of other Inuit communities discussed above.

During the first several centuries of inhabiting the western Hudson Bay region exploitation of the interior was either not considered, given their marine focused worldview, or avoided outright because that territory was claimed by the Ethen-eldeli, a sub-division of Dene peoples commonly referred to as the caribou-eater Chipewyan in the ethnohistoric literature

(Friesen 2004). The ethnohistoric record shows that interaction between the Caribou Inuit and Ethen-eldeli was complex, not always peaceful, and was often defined by episodes of violence (Glover 1958; Smith and Burch 1979). Documented episodes of hostility may have accounted for the apparent avoidance of interior areas by the Inuit prior to the nineteenth century. Nevertheless, Ethen-eldeli and Caribou Inuit interactions were not all negative and considerable trade, and presumably other forms of social interaction, occurred between the two ethnic groups (Smith and Burch 1979).

Slowly over the course of the nineteenth century the Ethen-eldeli shifted their territory southward, which opened up significant portions of the interior for occupation by the Caribou Inuit (Friesen 2004). Immediately prior to this period the Hudson Bay Company (HBC) invested heavily in an effort to achieve peace between various Dene and Cree groups as part of an attempt to fully incorporate the former into the fur trade (Smith and Burch 1979). The success of this effort by the HBC ultimately led to the full integration of the Ethen-eldeli into the fur trade through the HBC post at Churchill. The success of their efforts also resulted in a southward shift in Ethen-eldeli territory as groups abandoned the barren grounds in favor of the more fur rich transitional and boreal forests (Friesen 2004). In response to the Ethen-eldeli abandonment of the barren grounds, the Caribou Inuit sites begin appearing in the interior during the mid-nineteenth century (Gordon 1996). By the time the Fifth Thule Expedition reached the region in 1918, the Caribou Inuit had abandoned their reliance on marine resources and developed an interior adaptation that focused on the specialized hunting of caribou supplemented by fishing (Birket-Smith 1929).

The Caribou Inuit adaptation to specialized caribou hunting includes a heavy investment in the interception of migrating caribou herds at key water crossings. The Inuit kayak, with great

maneuverability and stability, is well suited to enable even a small group of hunters to spear large numbers of swimming caribou (Birket-Smith 1929). The greater ability to hunt from the kayak allowed the Caribou Inuit to more efficiently exploit water crossings than the previous Ethen-eldeli occupants of the region (Friesen 2004). As a result of the concentrated focus on water crossings, the Caribou Inuit inhabitants of the region have produced a substantial archaeological record; impressive in light of the relatively recent time depth to their occupation of the interior (Friesen and Stewart 1994; Stewart et al. 2004).

Similar to the Nunamiut, the specialized caribou hunting adaptation practiced by the Caribou Inuit resulted in a marked temporal and spatial variability in the resource base. Investment in practical, long-term storage is also a central feature of the Caribou Inuit economic strategy designed to overcome long periods when caribou were present only in low numbers (Arima 1984; Birket-Smith 1929; Friesen 2004). This reliance on practical storage also means that, when available, large numbers of caribou needed to be taken during the spring and fall migrations to ensure the build-up of meat caches. Consequently, aggregation among the Caribou Inuit occurred in conjunction with the critical spring and fall caribou hunts, while populations were more dispersed during the remainder of the year (Arima 1984). Again it is significant that this pattern of aggregation and dispersal is similar to the Nunamiut, but remains in contrast to other Inuit communities where population aggregation more often coincided with the movement into winter sealing villages (Riches 1982).

### 3.2.2 ATHAPASKAN AND ALGONQUIAN CARIBOU HUNTERS:

#### TAIGA/TUNDRA ADAPTATIONS

The pursuit of migratory caribou herds by non-Inuit speaking peoples represents a second, distinctive adaptation to specialized caribou hunting. These groups include both Athapaskan speaking groups to the west of Hudson Bay and Algonquian speaking groups east of Hudson Bay who spent at least part of the year pursuing caribou in the more open transitional forest and tundra ecological zone of North America (Ingold 1980). Early ethnohistoric writing often makes a marked distinction between the Eskimo (Inuit) and Indian (Athapaskan and Algonquian) peoples whose territories and access to the northern trading posts such as Fort Churchill and Fort Chimo overlapped (Birket-Smith 1979; Glover 1958; Tanner 1944; Turner 1894). This section focuses on summarizing Ethen-eldeli and the Innu adaptations and represents the two best known groups occupying the transitional forest/tundra ecotone.

#### 3.2.2.1 ETHEN-ELDELI (CARIBOU-EATER CHIPEWYAN)

The Ethen-eldeli are a northern Athapaskan speaking (Dene) peoples who traditionally inhabited the transitional forest and barren-grounds immediately west of Hudson Bay. Although the Ethen-eldeli share a number of cultural traits with other Dene peoples such as the Slave, Dogrib, and Yellowknives, they have been consistently distinguished from their western neighbors in the historic and ethnographic record (Smith 1981:271). The availability of caribou and the highly mobile nature of the traditional Ethen-eldeli economy made them initially very resistive to efforts by European traders to incorporate them into the fur trade economy (Smith and Burch 1979). However, gradually throughout the eighteenth and nineteenth centuries the Ethen-eldeli became increasingly more reliant on European trade goods (Smith and Burch 1979). Along with this increased reliance on trade goods was increased pressure to abandon caribou hunting in favor of trapping full-time (Smith and Burch 1979). Such efforts by European traders



became increasingly more effective after 1717, once a tentative peace agreement with neighboring Cree groups became established and the Ethen-eldeli had regular access to the HBC post at Churchill (Gillespie 1976; Smith and Burch 1979:78). By the late-nineteenth century in order to better participate in the fur trade Ethen-eldeli territory had shifted southward into the boreal forest year round (Irimoto 1981; Smith 1981; Smith and Burch 1979). This not only provided greater access to areas with high densities of fur bearing animals, but also positioned the Ethen-eldeli to operate as middle men in the fur trade between the post at Churchill and other Dene groups to the west and northwest (Smith and Burch 1979). As discussed above, it was the abandonment of traditional land use practices that enabled the Caribou Inuit to develop their specialized caribou hunting adaptation (Friesen 2004; Smith and Burch 1979).

Prior to, and in the first centuries after, European contact the economic basis of the Ethen-eldeli was the nearly year-round predation of caribou from the Beverly and Kaminuriak herds (Birket-Smith 1929; Burch 1991; Gordon 1990; Smith and Burch 1979). These herds occupy large territories west of Hudson Bay and undertake long distance seasonal migrations between the boreal forest, where they winter, and their summer calving grounds several hundred kilometers north on the barren-grounds (Gordon 1996). Traditional land use strategies closely mirrored the movements of caribou and are distinguished by similar long distance residential movements between the barren-grounds and boreal forest (Burch 1991; Gordon 1990). Unfortunately, by the time anthropologists had reached this portion of the Canadian subarctic most Dene groups had already reorganized their economy to accommodate the fur trade.

The territory nowadays inhabited by the Chipewyan [Ethen-eldeli] lies on the border between the boreal forest belt and the barren-grounds...The Chipewyan have made regular hunting excursions to the Barren Grounds, especially in former times, but it is the forest that is their real home and it is the adaptation to the woodlands that stamps their life and culture...South of the boundary mentioned

[the Churchill River], which, however, for the most part coincides with the Chipewyan's own border, occurs the woodland caribou. It was the summer migration of the Barren-Ground caribou towards the north that at one time brought the Chipewyan onto the far side of the tree line (Birket-Smith 1930:16-18).

It is clear from Birket-Smith's description of Ethen-eldeli life in 1922 that their territory was largely restricted to south of the tree line. Yet, there is still reference made to the former use of the barren-grounds to pursue caribou in the not so distant past. Use of the barren-grounds by the Ethen-eldeli prior to 1900 is well documented in both the archaeological and ethnohistorical records (Burch 1991; Friesen 2004; Gordon 1996; Smith and Burch 1979).

During the early contact-traditional period there are multiple references that highlight the familiarity and use of the barren-grounds by the Ethen-eldeli. This familiarity is exhibited in Samuel Hearne's account of his travels between 1770 and 1772, where some Ethen-eldeli were extremely knowledgeable about places and travel routes across an expansive stretch of the barren-grounds between Churchill and the mouth of the Coppermine River (Glover 1958). More telling is the fact that Haerne's party routinely encountered other Dene camped out in the barren-grounds hunting caribou (Burch 1991). Additional information about traditional economic practices has been gleaned from HBC archives (summarized in Smith and Burch 1979) and missionary travels by Father Gaste (summarized in Burch 1991). During the summer of 1869 Gaste accompanied a band of Ethen-eldeli on their annual, long distance migration northward to hunt caribou in the vicinity of the Kazan River (Burch 1991:441-443). Although currently inhabited by the Caribou Inuit, this stretch of tundra comprised the traditional summer hunting territory of the Ethen-eldeli (Burch 1991; Smith and Burch 1979). Ethen-eldeli use of the tundra in the vicinity of the Kazan river is further substantiated by an account in 1722 when Captain John Scroggs noted that several Ethen-eldeli sailing with him north of Chesterfield Inlet in

Hudson Bay remarked that that they were only “two or three days walk from their own country (Smith and Burch 1979:80),” which would place them along the same stretch of the Kazan River documented in Gaste’s account nearly 150 years later (Burch 1991). Archaeological research in the region further corroborates the ethnohistorical picture, and has been able to document continuity in the use of tundra between the late pre-contact Taltheilei tradition and historic Ethen-eldeli during the contact-traditional era (Gordon 1996:27)

Like caribou, long distance seasonal mobility was the salient feature of the traditional Ethen-eldeli seasonal round. In the spring, caribou meat was accumulated and processed into pemmican or dried to facilitate transport (Burch 1991). These stores were intended to support mobile bands of Ethen-eldeli during their residential relocation northward. During Hearne’s second attempt to reach the Coppermine River the Ethen-eldeli band he was traveling with spent nearly all of April camped at the treeline waiting for conditions to improve before exiting the sheltered forest (Glover 1958). By mid-May Hearne’s party broke camp and set out northward onto the tundra. The purpose of migrating northward was to remain in contact with caribou while they summered near calving grounds on the tundra (Burch 1991; Gordon 1990, 1996). Out of necessity, peoples dependent upon barren-ground caribou would have to cover very large distances, upwards of 500 km one way, in a comparably short period of time as evidenced by Gaste’s account of his travels (Burch 1991:443).

The return southward was conducted at a similar pace and done in advance of the analogous migration by caribou. During their return southward individual bands would camp near the treeline and await the large migration of caribou returning to their winter ranges (Gordon 1996). Similar to many caribou hunting peoples, the fall caribou hunt was arguably the most critical time of year as sufficient numbers of animal were needed to provide a large supply

of meat to sustain people through freeze-up a period when virtually all mobility ceased (Burch 1972; Spiess 1979). The fall caribou hunt also supplied the necessary hides to replace worn clothing and tent coverings (Burch 1972; 1991). These hides were in their optimal condition during the fall. Ethnohistorical data indicates the Ethen-eldeli and other Dene groups would employ cooperative hunting tactics involving the chute and pound and interception of swimming caribou at water-crossings (Morrison 1981). The use of these tactics reflects the importance of maximizing returns during the fall caribou hunt.

#### 3.2.2.2 INNU

The Innu (Montagnais-Naskapi) are the traditional inhabitants of interior Labrador and Quebec who occupy a diverse geographic region containing both the boreal forest and tundra environments. The division of the Innu into the Montagnais and Naskapi reflects variability between local bands inhabiting the tundra-forest ecotone in the north (Naskapi) and the full time occupants of the boreal forest (Montagnais) in the south (Reid 1991). Yet, as the recent reassertion of a collective Innu identity demonstrates, those divisions reflect more the need for Western political and economic entities to make sense of their interactions with an otherwise mobile people possessing fluid band membership (Loring et al. 2003).

By the time amateur and professional anthropologists had reached Labrador during the late-nineteenth and early-twentieth centuries, the Innu had abandoned coastal regions and were engaged in an interior adaptation focused on the specialized hunting of caribou (Loring 1992). This situation is similar to that of the Caribou Inuit where, in spite of the fact that specialized caribou hunting appears to be a recent economic adaptation, the northern Innu (Naskapi) have become rigidly defined as specialized caribou hunters. This freezing of “traditional” Innu

behavior as interior adapted caribou hunters removes the particular historical circumstances surrounding their nineteenth century economic pursuits and has, more or less, uncritically projected the sense that specialized caribou hunting represents the quintessential northern adaptation in Labrador (Loring 1992).

Archaeological work by Loring (1992) has shown that the late pre-contact Daniel Rattle and Point Revenge complexes, ancestral to the Innu, incorporated marine resources to a much greater extent and occupied coastal areas at least part of the year. By A.D. 1500 the political landscape of the Labrador coast was changing dramatically. At the onset of the contact period European economic interests in the region centered on fishing and whaling industries, which into themselves had little direct impact on Innu cultural adaptations (Loring 1992). More disruptive was the eastward expansion by Thule Inuit that coincided with the western expansion of European whalers (Loring 1992). Contact between Europeans and Thule Inuit was characterized by outright aggression and ultimately resulted in the withdrawal from coastal areas by the Innu, which led to the development of a specialized caribou hunting adaptation during the contact-era (Loring 1992).

The writings of early eco-tourists such as William Brooks Cabot (1920) are an invaluable snapshot into this period of caribou hunting. During the late-nineteenth century the size of caribou herds within Labrador were apparently on the rise, enabling bands of Innu to successfully target these abundant herds during the spring and summer migrations. From the perspective of the few westerners that witnessed Innu hunting during this period, it seemed successful almost to the point of excess (Loring 1992). Cabot's (1920) encounter with an Innu family at Indian House Lake in 1906 documented the capture and butchering of nearly 1500 caribou. However, these accounts underemphasize the importance of sharing and that the success

of the specialized caribou hunting adaptation in interior Labrador was predicated on at least one family having an abundantly successful hunt (Henriksen 1973). As Loring (1992) discusses the broad, interconnected social networks ensured the ability of those experiencing unsuccessful hunts to seek aid from those more fortunate families. Open access to resources through sharing is a central tenant of the Innu social world (Lips 1937).

While the maintenance of broad social networks to facilitate sharing serves as a critical risk minimizing strategy, the writings of Lucien Turner (1894) underscore additional dimensions to the Innu's nineteenth century caribou hunting adaptation. Turner remarks on the remarkable scale of residential mobility exhibited by Innu families and their ability to exploit stable, second line resources such as fresh water fisheries. High residential mobility is an important dimension to the Innu caribou hunting adaptation in that it not only helps to move consumers to resources, but also ensures the continued flow of information between groups of hunters. There has been ample treatment in the literature regarding the use of different mobility strategies to overcome geographic and temporal variations in subsistence resources (e.g. Binford 1980; Kelly 1996), and certainly the organization of Innu subsistence around a highly mobile animal such as caribou necessitates a similar scale of mobility. Yet, a second and often overlooked dimension to mobility is the assurance of proper information flow (Whallon 2006). Information such as game movements and locations where bands are likely to be hunting should be adequately distributed throughout the social network (Lovis and Donahue 2010; Whallon 2006).

Turner's (1894) writings also underscore the understanding that second line resources remained important in spite of the successful caribou hunts during the nineteenth century. Families often relocated to interior lakes that were well known to contain stable fisheries. Likewise, ptarmigan served as a supplemental resource when supplies of caribou meat ran low

and caribou were unable to be located. In much the same way that fish and ptarmigan were viewed as secondary resources, so too were the various fur trade posts scattered along the coast. The ability of small, all-male task groups to make a “short” (300 km!) trip to the coast is discussed by both Turner (1894) and William Duncan Strong (Leacock and Rothschild 1994). While the Innu, for the most part, resisted being brought fully into the fur trade, begging and trading from the white-run trading posts likewise became a stable and highly predictable second line resource. Nineteenth

By the 1920s the sustainability of specialized caribou hunting is brought into vivid focus with the work of Strong (Leacock and Rothschild 1994) who spent the winter of 1927-1928 with a local band of Innu in the Davis Inlet region. When contrasted to the earlier writings of Turner and Cabot, Strong’s ethnographic work illuminates the negative impact of a region wide crash in caribou populations. In response to the increased uncertainty that came with caribou hunting, the Innu in the Davis Inlet area had shifted the focus of their settlement to better exploit second line resources. Instead of occupying interior near the George River as both Turner and Cabot document, during the winter Strong spent with the Davis Inlet Band the group resided primarily at an important freshwater fishery closer to the coast (Leacock and Rothschild 1994). Reorientation of this winter settlement near to the coast was likely influenced by both the presence of the fishery and the fact that it afforded easier access to the few White outposts that were thinly scattered along the coast. During this period caribou hunting was heavily supplemented by fishing and trading/begging and is reminiscent of the “Fish and Hare” period endured from 1845-1890 by Northern Ojibwa during a similar crash in local large game (moose and caribou) populations (Rogers and Black 1976).

### 3.2.3 ATHAPASKAN AND ALGONQUIAN CARIBOU HUNTERS: BOREAL FOREST ADAPTATIONS

The Kutchin are one of several Athapaskan speaking groups that inhabit the mountainous interior of northern Alaska and the Yukon. Throughout this region caribou were pursued wherever available, and several groups were known to have relied heavily on the communal hunting of caribou. More than any of the other northern Alaskan/Yukon Athapaskan peoples, the Kutchin were the most heavily reliant upon caribou (McKenna 1965). Ethnographic information from Osgood (1937) and McKenna (1965) make it clear that, while the Kutchin were able to pursue caribou essentially year round, the centerpiece of their traditional economic strategy were large, communal fall hunts. The importance of the fall caribou hunt is reflected by the labor invested in the construction of sturdy drive fences and corals used in the fall hunt (Osgood 1937; Spiess 1979). Snares manufactured from hide were often set in and around surrounds in order to capture caribou as they attempted to escape (Spiess 1979). During other times of the year corrals and snares continued to be utilized by the Kutchin, however, unlike the fall hunt, their construction and use was often improvisational consisting of piled brush (Spiess 1979). Other times of year individual bands of caribou would be pursued by stalking and were supplemented by other resources such as Dall sheep, ground squirrel, and fishing (McKenna 1965; Osgood 1937; Wilson 1978).

Caribou were seasonally present or migrated through other parts of the interior during brief periods each year. Similar to the Kutchin, groups occupying these localities also sought to maximize their exploitation of caribou by operating drive fences and corals. Unlike the Kutchin however, the availability of productive salmon fisheries were the economic focus of many of these groups such as the Ingalik and Tanana (Osgood 1937). Because salmon fishing was the



principal organizing factor in their subsistence economies, Spiess (1979:117) suggests that the hunting of caribou for hides was as much as, if not more, of an important dimension to caribou hunting as was the acquisition of fresh meat. Fresh caribou meat also would be a welcome change in a diet otherwise dominated by fish, particularly during the late winter and into the early spring prior to the migration of herds northward and before preparations for the first salmon runs needed to be undertaken (VanStone 1985:231).

There is a sparse ethnographic record detailing the hunting of woodland caribou by Ojibwa and Cree bands within the boreal forest in comparison to the greater role afforded to moose hunting. By 1730 some Ojibwa, grouped loosely under the term Northern Ojibwa, successfully expanded into the interior regions north of Lake Superior and as far west as Manitoba (Rogers and Taylor 1981). During this period of expansion the Northern Ojibwa modified an economy that combined summer aggregations at major fishing centers with a dispersed settlement phase during the winters that focused on the hunting of large game such as moose and woodland caribou (Jochim 1976; Rogers 1962). Given the propensity of modern caribou to space themselves from moose it is likely that some areas possessed abundant populations of woodland caribou while others favored moose populations.

Ethnohistoric reconstructions, principally through HBC company archives, suggest that the large game hunting economy (moose and caribou) practiced by the Northern Ojibwa only persisted for about a century. Beginning in the 1820s there was a widespread crash in large game populations throughout northern Ontario, which led to the disappearance of moose from the region and severe reductions in woodland caribou populations (Bishop 1974:12; Rogers and Black 1976). Although woodland caribou remained the only large game animal present in some parts of the region, they were such a rare occurrence that they were only hunted on an

opportunistic basis as the economy switched to a focus on fish and small game (Bishop 1974:185-186; Rogers and Black 1976).

### 3.3 CARIBOU HUNTING STRATEGIES AND TECHNOLOGY

#### 3.3.1 HERD FOLLOWING

One of the principal arguments advanced by Ernest Burch's (1972) in his review of caribou hunting peoples was that, in effect, herd following is an impossible strategy for human populations to successfully employ. The basis of the argument is that during their annual spring and fall migrations barren-ground caribou maintain a near steady rate of speed (5-10 km/hour) across tundra, exposed rock outcrops, and large, broad lakes and rivers. According to Burch's (1972) notion of herd following, human populations, without the aid of modern transportation aids such as snowmobiles and helicopters, would have a difficult time maintaining this steady rate of movement across difficult terrain for the multiple weeks that herds migrating.

Even if adult male hunters in superior physical condition could keep up with the migrating animals for a while, they would not have time to butcher the meat, and unprocessed carcasses would be scattered thinly over a wide area in a very short time. The energy expenditure would be so great, and the net production so low, as to be disastrous for people who tried it (Burch 1972:345).

There are two points regarding Burch's (1972) explanation that require clarification, which he later does (Burch 1991). Burch does not underestimate the capacity of foragers to undertake rapid, long distance movements. In fact, this attribute of forager mobility, particularly among indigenous peoples of the North American subarctic and arctic, is well documented (Amsden 1977:286-287; Ellis 2011:7-8; Glover 1958; Helm 1972; Henriksen 1973; Leacock and Rothschild 1994; Taylor 1969). Rather, he asserts that moving in such a manner as to maintain regular, if not daily, contact with a single concentration of migrating caribou would place severe

time limits on the ability to hunt and process the animals. More energy would be expended keeping up with the caribou than could be immediately consumed, nor time available to allow for the labor necessary to process a suitable volume of carcasses for transportation or storage and there is no reason to assume Late Glacial foragers would have attempted this in all but the most dire circumstances.

Maintaining daily contact in this manner is what Blehr (1991) describes as “herd accompaniment” and both he and Burch (1991) maintain that accompaniment should be distinguished from herd following as an economic strategy. Much of the confusion between the two terms comes from the unreasonable view prevalent among Upper Paleolithic research in the 1950s and 1960s that caribou herds were essentially “walking larders” (Clark 1967:64-65). Such a view likely stems from the fact that traditional hunting societies in northern Europe and Asia maintained domestic caribou herds, which are, in some sense of the term, “walking larders.” This close relationship between humans and domestic caribou herds was probably unfairly projected onto reconstructions involving Pleistocene peoples and wild caribou herds. The often cited gregarious nature of caribou, combined with popular views regarding the utopian affluence of hunter-gatherer economic strategies, likely contributed to the pervasiveness of this view during the 1950s and 1960s (Blehr 1991; Burch 1991). The purpose of Burch’s (1972) statements were to dispel this overly simplistic notion that Upper Paleolithic hunter-gatherers were able to accompany wild herds of caribou and prey upon them when needed.

While herd accompaniment, in the restrictive sense of maintaining daily contact with wild herds of caribou, might be impossible, there is regularity in the regions where caribou herds migrate to and from. Human foragers reliant upon caribou are no doubt keenly aware of this regularity and have both the capability, and incentive, to relocate to areas where caribou are. This

is a point in Burch's (1972) treatment of herd following that remains underdeveloped and is one that Brian Gordon (1990, 1996:11-15) and Burch (1991) himself took exception to. As discussed previously, traditional Ethen-eldeli settlement and subsistence strategies indicates that some foragers are both able and willing to make rapid long distance residential moves between the summer calving grounds and wintering areas. Although physically unable to accompany herds on their migration, an informed human population is still capable of using long distance residential mobility to position oneself in proximity to the known summer and winter ranges of migratory caribou herds. Hunter-gatherers need not accompany caribou on their migrations *per se*, but rather have enough food on hand to cover a similar distance and enough information on hand to locate caribou near the end of their respective migrations.

Ethnographic data pertaining to territory size for the Ethen-eldeli suggest that hunter-gatherers employing a herd following strategy have the capabilities to make regular residential moves of nearly 300-400 km one way (Binford 2001:274, Table 8.04; Burch 1991; Ellis 2011). The scale of mobility, of course, depends on the actual distance migrated by caribou themselves and is likely to vary considerably. Demographic estimates for traditional Ethen-eldeli groups suggest that this economic strategy also results in an extremely low population density, likely the result of high residential mobility (Binford 2001:8.01; Burch 1972). In this ethnographic instance the Ethen-eldeli were highly mobile in terms of distance and frequency of moves. Although the pre-fur trade Ethen-eldeli can be characterized as highly mobile peoples that maintain a dispersed population, Hearne's (Glover 1958) journal makes it clear that larger aggregations of people are common, particularly at locales where large concentrations of caribou are also able to be intercepted in the fall.

### 3.3.2 INTERCEPT HUNTING

While it is difficult to predict the exact location of caribou, the habitual responses of caribou when encountering man-made obstacles have enabled most caribou hunting groups to adopt water and terrestrial based interception strategies (Burch 1972; Spiess 1979). The ability of hunters to kill large numbers of caribou in a short period of time means that herd interception often represents a critical juncture in the overall organization of subsistence economies. In the case of societies practicing herd following, like the Ethen-eldeli, the ability to move southward ahead of caribou and intercept caribou bands during their fall migration is a crucial phase in their seasonal round (Gordon 1990, 1996). Likewise, other societies, like the Tanaina, whose economy is primarily organized around salmon fishing, would largely restrict their hunting of caribou to the annual interception of bands during their fall migration when hides were in their optimal condition (Osgood 1937). On the extreme end of this spectrum are the historically known Caribou Inuit and Nunamiut who, for the most part, intercept caribou during both the spring and fall migrations and rely heavily on stores of caribou meat during the remainder of the year.

The classic image of intercept hunting involves organized bands of hunters targeting swimming caribou (Burch 1972). The predation of caribou during their attempts to cross a major water body is a particularly important strategy as this represents one of the few instances where human hunters have a marked advantage over an otherwise highly mobile terrestrial animal with the ability to disperse quickly. Although caribou have the tendency to wander considerable distances to avoid physiographic barriers, bands of caribou at certain points in their migrations are forced to swim across large water bodies (Arima 1985; Burch 1972:345-346). When approaching such crossings caribou typically travel parallel the watercourse for some distance

before turning onto a sloping point of land that offers easy access to water where bands begin swimming in mass to the adjacent bank (Burch 1972; Stewart et al. 2004). While caribou are strong swimmers they tend to restrict their crossings to select narrows on water bodies (Burch 1972:345). This predictability in caribou behavior means that hunters need only have information regarding which crossing, or cluster of crossings, to anticipate caribou at, then wait. More so, the practice of constructing small drive lines of boulders or *inuksuit* can exert considerable influence on the movements of individual bands of caribou and permit selection of those crossings most favorable to human hunters (Brink 2005; Morrison 1981).

In the autumn the Eskimos take advantage of the migration of caribou, and these autumn hunts are the most important of the whole year, both on account of the vast numbers of the animals and the quality of the skins. For this purpose converging lines of small stone cairns, several kilometers long, are built up....on the top of the cairns are placed grass sods with the black soil upwards. Women and children make their way behind the herd and frighten it....The intention is to prevent herds of caribou coming from the north from going into the lake itself, where they can spread out and are difficult to hunt, whereas the row leads them down the crossing-place in Kazan River just by its outlet from the lake (Birket-Smith 1929:110-111).

Once the caribou are forced out into the narrows, lance wielding hunters in kayaks are able to out-maneuver the caribou. The number of kayaks (e.g. hunters) employed varies considerably. While intercepting caribou in this manner is the most effective with multiple hunters, intercept hunting has been successfully employed by the Caribou Inuit with even a single kayak (Arima 1975:150-153; Spiess 1979:110-111).

The predation of swimming caribou is a strategy employed throughout the arctic region and nearly every Inuit community reliant on seasonal caribou hunting has been known to have lanced swimming caribou from the kayak. For instance, communal drives undertaken by the Nunamiut at Chandlar Lake, Alaska were known to have forced caribou into the water to make

them easier to hunt (Wilson and Rasic 2008:132). Like the Caribou Inuit, both the Copper (Jenness 1922) and Netsilik (Balicki 1970) in the central Canadian arctic constructed drive lines to influence which water crossings caribou would utilize, presumably to ensure the successful hunting of swimming caribou (Brink 2005). Even in the far eastern arctic the Labrador Inuit made annual forays inland to hunt caribou at water crossings during the fall migration (Hawkes 1919; Taylor 1969). The primary goal of these hunts is to acquire hides for clothing and shelter and to provide supplemental stores of caribou meat for the winter.

### 3.3.2.1 TERRESTRIAL BASED INTERCEPT HUNTING

In the absence of predictable water crossings the construction of drive fences, pounds, and corrals facilitate the killing of large numbers of caribou in a relatively short period of time. Captain George Cartwright (Townsend 1911:19-22), who was stationed in Labrador and Newfoundland during the 1790s, made several observations regarding the use of these constructed features to aid in caribou hunting:

“if I may judge by the number of deer's heads which I saw by the river side, they must be very dexterous hunters. The very long, and strong fences which they had made, were convincing proofs, that they knew their business. I observed, that these fences were of two kinds. Those Indians who lived on the South side of the river, erected theirs on the top of the bank, and extended it for a mile or two in length. Where they found plenty of tall trees, they felled them so as to fall parallel to the river, and one upon another; the weak places they filled up with the tops of other trees. Where any open place intervened, they made use of a sort of sewell, made of narrow strips of birch rind, tied together in the form of the wing of a paper kite: each of these was suspended from the end of a stick, stuck into the ground in an oblique position, that it might play with every breeze of wind. These sewells were placed at no great distance from each other, and the effect produced by their motion, was considerably heightened by the noise of the strips, when they struck against each other. By these means, the deer were deterred by the sewells from attempting to enter the woods at the open places, and the fences were too high to be overleaped, and too strong to be forced. Of course, they were compelled to walk along the shore, until they could pass those obstructions and

proceed to the Southern parts of the island....At certain intervals the Indians make stands, from whence they shoot the deer with their arrows (Townsend 1911:19-21).”

The first strategy described by Cartwright involves a drive line that includes long sections of fence intended to keep herds moving parallel to a water body. As discussed previously the typical response of migrating caribou to a water barrier is to walk parallel to the river until a suitable place to cross is encountered. The constructed fence is intended to take advantage of this normal behavioral response by preventing access to suitable crossing places. This enables hunters, who are positioned behind blinds, to prey upon caribou following the fence line. Cartwright’s description of herds “proceeding to the Southern parts of the island”, would suggest that this strategy was intended to target herds migrating southward during late summer or fall.

The second strategy described by Cartwright was observed on the northern half of Newfoundland.

“The other kind of fence is always built on the North side of the river, and is so constructed, that a herd of deer having once entered, it is almost impossible for one of them to escape. From their house, which is always situated by the side of the river, they erect two high, and very strong fences, parallel to each other, forming a narrow lane of some length, and stretching into the country. From the farther end of each, they extend two very long wing-fences, the extremities of which are from one mile to two, or more, asunder. The deer travel in small companies, few of them exceeding a dozen head, and when they meet with these hawk, or wing-fences, they walk along them, until they are insensibly drawn into the pound, as partridge are into a tunnel net. The women prevent them from returning, and they are all killed with great ease by the men (Townsend 1911:21-22).”

Along the northern side of the island of Newfoundland hunters, unable to prey upon large migratory herds, employed a system of pounds and wing fences to concentrate smaller bands of caribou to enable hunters to take larger numbers of the animals. This description of deer traveling in small companies is suggestive of the smaller cow-calf bands that fission during late



spring to summer prior to aggregation for the fall migration and/or references small bands of non-migratory caribou that may spend the winter on the northern parts of the island.

That similar features have been employed by indigenous hunters across the North American continent is a strong testament to the utility of this strategy. Gubser (1965:173-174) describes the use of wooden pound features by Nunamiut hunters in northern Alaska. In addition to constructing pounds, the Nunamiut, and others, made use of bibache snares, a soft leather strap made from caribou skin, set at approximately neck height. Individual caribou driven into a pound would panic and become entangled in snares upon trying to escape (Gubser 1965). The only major variation that occurs in terrestrial based drive fences, pounds, and corrals are the materials utilized for their construction. Within the boreal forest there is regular use of wooden fences and pounds complimented in many instances by the use of leather snares described above (Herne 1958:120-121; Honigmann 1954:37; Morrison 1981; Osgood 1937:25, 1940:237; Turner 1894). Ribbons were often tied along gaps in the drive fences to create the illusion of movement, which would deter caribou from crossing. North of the treeline a shortage of wood led to the construction of lines using boulders and *inuksuit* to direct the movements of caribou toward concealed hunters (Arima 1984; Balikci 1970; Stewart et al. 2004). The ethnographic literature makes frequent reference to the placement of sod on top of *inuksuit*, which apparently lends an eerily human like in appearance from a distance. The use of ribbons to create movement is similarly documented among arctic drive systems. While pounds and corrals were unable to be constructed north of the treeline, Brink (2005) has documented the presence of a “V” shaped funnel on Victoria Island in Canadian arctic. Constructed of boulder piles this funnel would have operated in the same way that the wing fences, described by Cartwright, funneled caribou into the pounds. Instead of a pound however, two shooting blinds were positioned at the apex of the

funnel that would have afforded hunters an easy opportunity to dispatch caribou routed through the narrowing (Brink 2005).

### 3.3.3 INDIVIDUAL HUNTING TACTICS: SNARES, PITFALLS, AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The importance of intercept hunting is clearly evident given the capacity of this strategy to capture a relatively large number of animals. The trade off of for increased volume is that intercept hunting represents a temporally restricted event. During the remainder of the year small bands of caribou are encountered, but the structure of these resource encounters differ in several fundamental ways. First, resource encounters are not as predictable as they are during the interception of migrating caribou. This means the organization of hunting strategies have to integrate a great deal more flexibility and are likely to differ depending upon the season (e.g. late winter vs. summer). Secondly, although the use of snares, pitfalls, and decoys are widely noted in the ethnographic record, their successful implementation is predicated on a deep ecological knowledge concerning caribou behavior. This is not to say intercept hunting does not require an informed knowledge of caribou behavior, only that specialized technological systems (e.g. drive lines, chutes, wing fences) are generally not required during the pursuit of individual caribou bands. If employed they are frequently done so on an *ad hoc* basis and only if conditions permit once caribou have been spotted (Spiess 1979). Thus, a robust body of shared traditional ecological knowledge concerning caribou behavior underlies the execution of individual hunting tactics by arctic and sub-arctic peoples.

One characteristic of caribou behavior is their propensity to walk toward an object, seemingly out of curiosity, to determine if an object poses a danger. Captain William Parry's

(1824) experiences among the Central Eskimos best illustrate one tactic human hunters employed to take advantage of this distinctive caribou trait.

one of the most ingenious [hunting tactics] consists of two men walking directly from the deer they wish to kill, when the animal almost always follows them. As soon as they arrive at a large stone, one of the men hides behind it with his bow, while the other continuing to walk on soon leads the deer within range of his companion's arrows (Parry 1824:512).

Such an account reflects the general lack of wariness exhibited by caribou, particularly during the summer months when the species is the least cautious (Spiess 1979). Lack of wariness is generally attributed to the gregariousness of the species and its difficulty in processing information. In fact, caribou as a species has very few genetically pre-programmed flight releasers (Pruitt 1960, 1965).

This curiosity or gregariousness of caribou is exploited by nearly every caribou hunting peoples, although the variability in such tactics is remarkable. For instance, Jenness (1922:141-147) describes several different tactics employed by the Copper Inuit to hunt individual bands of caribou. Hunters will sometimes try to mimic the movements of feeding caribou, such as the bobbing the head and using the bow to replicate antlers, while mimicking these movements the hunter will be slowly moving closer to the feeding caribou. Such mimicry requires a deep, intimate, knowledge of caribou movements and the hunter can never approach the caribou directly in a straight line, but instead must gradually take a meandering path. The Copper Inuit are also known to have employed pitfalls to capture those few caribou that winter on the tundra. Pits excavated into the snow are lined with knives and a thin covering of snow on top. Hunters frequently urinate on the snow covering where the smell, or more likely the salt, attracts caribou who are then subsequently lured into the trap (Jenness 1922:151).

Elsewhere the uses of visual and auditory decoys are known to have been employed. Honigmann (1954:36) describes the practice among the Kaska to construct a decoy using a willow frame and caribou skin. Auditory calls have also been documented in several instances, again reflecting a deep, intimate knowledge regarding caribou behavior. The use of antler rattles or a bellowing grunt are often successful, particularly during the rut when males can be aggressive in their challenging of competitors and often move directly toward waiting hunters (Birket-Smith 1929:102, 1930:20-21; Ingold 1980:64; Irimoto 1981:104; Osgood 1932:41). In much the same way Kelsall (1968:215) describes the ability of indigenous hunters to lure does or fauns toward a hunter by replicating calls.

Hunters familiar with the movements and behavior of caribou often need not directly influence their behavior at all. By employing an informed knowledge of the local topography a hunter can identify the direction that feeding caribou are likely to move toward (Balikci 1970:39-41; Birket-Smith 1929:107; Jenness 1922:141-147). Such knowledge enables hunters to position themselves in a good place to intercept moving bands of caribou. The effectiveness of such tactics, often requiring the hunter to utilize a blind or remain very still, is accentuated by a personal account of Burch's (1972:361) who claims to have been able to position himself in the oncoming path of caribou and reach out from a hunting blind and touch passing caribou with his bare hand.

A similar application of traditional ecological knowledge in a familiar local setting comes from an account by Gubser (1965:200-204). He and his Nunamiut guide startled a band of caribou that they were hunting, causing the band to rapidly ascend a nearby mountainside outside the range of their rifles. Instead of wasting time fruitlessly stalking the caribou that would only have continually remained outside their rifle range, Gubser's guide suggested they return to their

field camp and wait until late afternoon when caribou typically descend in elevation to spend the evening on the valley floor. Gubser and his companion, having waited for the caribou to move back downslope, were able to dispatch most of the band later on that afternoon.

Equally as important is the ability of hunters to elicit a flight response among caribou when favorable conditions permit. Inuit elders discuss that while an individual hunter standing downwind might attract curious caribou by standing straight up with one's parka hood pulled down, the same individual can elicit a flight response in caribou by pulling the hood of the parka up and bending at the waist. This latter tactic is thought to develop a flight response by mimicking the recognized pattern of a stalking wolf (Pruitt 1965). The importance of eliciting a flight response comes from its benefit in channeling caribou movements in an advantageous manner, such as directing them towards waiting hunters or into a pound (Jenness 1922:149). Such a tactic can be employed successfully in conjunction with a wing fence and shooting blind (e.g. Brink 2005; Jenness 1922:141) or without the aid of any constructed feature such as by driving caribou toward waiting hunters hidden from view by the local topography.

### 3.4 ECONOMIC CONSIDERATIONS

#### 3.4.1 DIETARY CONSIDERATIONS

Caribou meat and fat, at least theoretically, are capable of providing the total nutritional requirements for a population (Burch 1972:362-363; Spiess 1979:139). Although in practice this situation has likely never occurred over the span of an entire year. Nevertheless it is common for many sub-arctic and arctic foragers to subsist almost entirely on caribou for long stretches of time and even resort to consuming articles of clothing and shelter manufactured from caribou hide during extreme periods of starvation (Helm 1993). More so, for many arctic foragers the

only source of plant material in the diet is taken from the semi-digested contents of the rumen of caribou, frequently consumed on the spot by the hunter (Jenness 1922). Depending on the specific cultural context caribou may constitute upwards of 80-90 percent of the annual dietary intake. The Nunamiut for instance not only consume a vast quantity of caribou meat during the annual spring and fall migrations, but also rely heavily on accumulated stores of caribou meat during the winter and summer months (Binford 1978:137, 1993; Burch 1984; Gubser 1965).

Among those groups who subsist primarily on caribou meat the key concern is the availability of fat in the diet rather than other considerations such as the accessibility of protein or calories. The strong desire for fat does not simply result from a taste preference, but the consumption of fat is necessary to enable the digestion of fat soluble vitamins such as Vitamin A and D and helps facilitate the breakdown of the much longer protein chains (Eastwood 2003). Additionally, at 9 kcal/g, fat provides a much greater caloric return compared to both protein and carbohydrates, each of which provide only 3 kcal/g in energy (Eastwood 2003). Human physiology aside, among foraging societies whose dietary choices are not based in a framework emphasizing caloric returns and nutritional content, fat is relished primarily for its taste (Egan 1993).

The percentage of fat on caribou meat is known to fluctuate widely depending on several factors including age, sex, and time of year. As a general rule caribou is a lean animal and such leanness is particularly evident by late winter and spring. Aside from visceral fats and marrow after the long winter most caribou, particularly males, are nearly free of body fat (Spiess 1979). In fact, the Copper and Netsilik Inuit typically avoid hunting caribou during the spring due to their leanness (Balikci 1984). Both male and female caribou begin to develop stores of fat during the summer months when the quality of forage is the greatest. Mature males in particular develop

a large strip of back fat by late summer, but lose their fat stores quickly once the rut starts (Spiess 1979). By the end of the rut bulls can be so lean that it often puts them in jeopardy of surviving an unusually harsh winter (Spiess 1979). Females also develop their fat stores during the summer months. In contrast to bulls females retain their fat well after the rut and throughout much of the winter months (Spiess 1979). Obviously the expenditure of energy during the rut is considerably lower for females, but adult females also retain their antlers during the winter months providing them with preferential access to feeding craters, and by extension the best forage, during the winter (Henshaw 1969; Spiess 1979:98-99).

Among foragers heavily reliant upon caribou for their subsistence the non-uniform availability of body fat has an important affect on hunting strategies. Human foragers, well aware of these differences in fat content, selectively pursue males or females during different seasons (Spiess 1979). For instance, bulls are preferentially hunted during the summer and fall for their well developed fat stores. Yet during the winter it is the cows that become preferentially pursued. As Spiess (1979) discusses in great detail, the selective predation of males and females at different times of the year should be visible in demographic profiles from archaeological assemblages. Such selection may provide some evidence of seasonality. Likewise butchering strategies place a premium on those cuts of meat that are the fattiest, while extremely lean portions of meat are either utilized as dog food or avoided all together (Binford 1978; Spiess 1979).

Bone marrow consumption is also an important component to the diet of caribou hunting peoples. Particularly during periods when caribou are the leanest the consumption of bone marrow often is the major, if not only, source of fat in the diet (Spiess 1979:24-26). Nunamiut hunters butchering kills made during the spring migration frequently test the quality of bone

marrow. Individual caribou exhibiting spongy, firm marrow are considered the best and quickly butchered, while those individuals with runny marrow are avoided unless time permits processing of the carcass (Binford 1978:187). Likewise consumption of marrow from the long bones forms the centerpiece of the *mokoshan* ritual feast among the Innu (Henriksen 1973; Leacock and Rothschild 1994).

Further accentuating the strong desire for fat is the production of bone grease, which is a processing strategy, documented among many caribou hunting peoples. Although Binford (1978:157-165) provides the most detailed discussion regarding the production of bone grease, some mention to the process is made in nearly every ethnographic account of caribou hunters. The widespread application of this process reflects the importance of fat in the diet. Specifically the manufacture of bone grease involves crushing the articulator ends of long bones, distal metapodials, tarsals, and carpals. These crushed bone elements are then boiled with the fat subsequently scooped off the top and allowed to cool (Binford 1978:157-158). Grease produced in this manner is incorporated in the diet in a number of ways. For instance, the Innu (Leacock and Rothschild 1994) and Ethen-eldeli (Burch 1991:442) are both known to have mixed bone grease directly with pulverized dry meat to form a dense, high energy, and readily transportable food. Such processing reflects the emphasis among both the Innu and Ethen-eldeli for maintaining high residential mobility. In contrast, among the logistically organized Nunamiut the grease is processed into small cakes just prior to relocating a base camp (Binford 1978:157). Presumably these cakes were stored and utilized during the ensuing occupation of the new base camp. Regardless of the context, the clear archaeological result of bone grease manufacture is the presence of large piles of crushed and burned bone fragments deposited in or near hearths.



A more expedient process related to bone grease manufacture is the production of “bone juice” that also reflects the strong desire for fat. Instead of further processing the grease, the entire kettle of fatty broth is simply consumed directly along with meat. Unlike bone grease manufacture, bone juice often is manufactured from the greasy mandibles and vertebrae from fresh kills. One reason for this difference is that these elements do not preserve well, although Binford’s (1978:163-164) observations suggests that bone juice consumption occurs in conjunction with periods of greater residential mobility or by males occupying special purpose logistical hunting camps.

### 3.4.2 NON-FOOD CONSIDERATIONS

The importance of caribou as a resource extends well beyond its obvious contribution to the diet of indigenous peoples. Equally as important, and in some contexts more important, is the non-food resources derived from caribou; namely hides, antler, and bone (Jochim 1976). For instance, antler and bone also play an important role in arctic and sub-arctic technologies. They serve as a ready source of raw material for the production of specialized tool types, including lances, harpoons, ladles, fleshers, fishhooks, awls, needles, and an innumerable variety of ornamental items (Osgood 1940). The use of antler as a tool for chipped stone tool technologies is well recognized, but the Nunamiut also use antler to help mark caches that would otherwise become buried by snow (Binford 1978). Caribou antlers have even been utilized in the construction of shelters, although this practice does not appear to be widespread (Gordon 1994).

The broad utility of bone and antler aside, hides probably represent the major non-food resource derived from caribou hunting. The skin of caribou is distinctive for the presence of two separate layers of hair, including an outer layer of longer “guard hairs” and a thick layer of

shorter fur (Skoog 1968:65-68; Spiess 1979:29-30). Combined, these two layers of hair produce clothing that is durable, extremely warm, and nearly waterproof (Spiess 1979:29-30). All three qualities are essential for life in the harsh arctic and sub-arctic environments. These qualities are also the reason why caribou hides are highly regarded when compared to other species, including other cervids. The only context where caribou hide is not favored is specifically for the manufacture of spring boots. During the spring, when the tundra is extremely saturated, seal skins favored over caribou hide (Birket-Smith 1929). Otherwise there is a considerable demand for caribou hides within arctic exchange systems (e.g. Morrison 1994:319-320).

Like most mammals that inhabit seasonal environments caribou molt annually in the spring and grow their thickest, most dense coats of hair during the winter months (Skoog 1968). Caribou hair can get extremely thick during the winter and several references are made that winter hides are only suitable for sleeping platform coverings (Spiess 1979:29). Hides available during the spring are also considered ill-suited for most purposes because both layers of hair are molting at this time (Spiess 1979:29). While new growth of hair occurs during the summer hides are generally avoided because warble fly larva have hatched and chewed their way through the skin leaving hides scarred during this time. This means hides are at their most optimal state between late August thru October, once the warble fly scars have healed and prior to the development of an overly thick coat of hair, which can make hides too heavy and bulk to be of much use for clothing and shelter (Skoog 1968; Spiess 1979:29-30). Fortunately for those foragers reliant upon barren-ground caribou the optimal state for hides coincides with the annual fall migration making a sufficient supply of hides readily available.

Hides are utilized for the manufacture of all types of clothing including boots, socks, mittens, pants, and parkas. While Hoffman (1976:70-71, quoted in Spiess 1979:30) notes that

different parts of mature bulls are preferred for boots, while calf skins are preferred for the manufacture of socks, the major differences in hides used for individual articles of clothing relate to preparation (de-haired or hair) and processing (hair facing in or out) preferences. In addition to clothing, hides are utilized for shelter coverings, kayak coverings, and is processed into bibache, a thick rope preferred for dog sled harnesses, snares, and snowshoe lashings.

### 3.4.3 CONSUMER SUPPLY AND DEMAND

Consumer demand includes both dietary and non-food considerations. Along with meeting basic caloric needs, as discussed above, the primarily dietary consideration is fat rather than protein. Because of this desire for fat a considerable volume of lean meat often goes to waste, even among those who can almost certainly expect to endure periods of famine (Ingold 1980:69-71). While the supply of fat is conditioned by large seasonal fluctuations in caribou body fat percentages, such fluctuations are mitigated by the production of bone grease and bone juice, which serves as an alternative source of dietary fat. Similarly there is a consistent annual demand for hides because these hides supply nearly all of the requirements for clothing, shelter, and transportation, each of which typically need to be replaced on a yearly basis.

All things considered Burch (1972:362) quotes one estimate that suggests 250 caribou are needed annually to supply the needs of a family of four. Included in the estimate are subsistence, dog feed, and non-food needs that suggest some 50 caribou per person are needed annually. Adopting Binford's (1978:18) estimate of 43.5 kg of meat and fat per caribou, Burch's (1972) estimate works out to be about 5.95 kg of meat and fat/person/day. It should be noted that this estimate is considerably less than Binford's (1978:135-139) estimate of 2.6 lbs (1.18 kg) of caribou meat and fat consumed daily per person. Binford's (1978) estimate works out to be only

about 10 caribou/person/year needed to satisfy food requirements. Even accounting for considerable waste, this would mean that either an additional 30-40 caribou worth of hides are needed per person if Burch's estimate is correct, or the truth lies somewhere in-between. Spiess' (1979:26-29) estimates an upward limit of 3.25 kg of lean meat needed per day and considerably less if fat is available.

In reality Helm's (1993) calculations from Peter Fidler's account of Dene subsistence does confirm that high latitude foragers will consume large quantities of lean meat per day. Of course consumption of meat is based first and foremost on availability, and certainly periods of famine are all but guaranteed among high latitude foragers. Dietary habits lacking any appreciable carbohydrate, like those outlined here, does suggest that individuals would be living in a state of ketosis where the body, out of necessity, will break down ketones to compensate for the lack of glycogen being introduced in the energy system. Notable symptoms of ketosis are a pungent odor from the body and a strong desire for consuming water, both of which are noted quite extensively in the historic record (e.g. Jenness 1922; Parry 1824). These accounts, along with Helm's (1993) calculations confirm the above estimates that, when available, a large volume (3-5 kg/person/day) of meat is likely to be consumed by specialized caribou hunters.

Hoffman (1976 70-71, quoted in Spiess 1979:30) provides a detailed description of the number of hides required by Caribou Inuit for clothing, shelter, and other uses which comes to be about 15-25 hides per person. Similar estimates by Gubser (1965) and Smith (1975) suggest hide requirements are on the order of 20-25 per person. This is still considerably less than Burch's (1972) estimate. The large range reflects variance in the quality hides, size of the animals, and the fact that some clothing requirements favored the hides of juveniles or cows while others favored bulls. What is clear is that the annual requirements of caribou per person for hides is

equal to or exceeds the requirements for subsistence, although one can certainly use a single caribou for both. There is also a notable scheduling conflict in that the optimal time for hides is August through October, which is also the worst time of year to preserve meat for storage either through freezing or drying. This scheduling conflict means that some of the meat associated with the harvest of caribou for hides is almost certainly wasted, thereby increasing the total number of caribou required per year. Obviously the specific consumer requirements depend on a host of other factors such as ratio of adults to juveniles, degree of reliance on storage, use of secondary resources. However, given the food and non-food requirements just outlined, the minimum consumer demand per year is not likely to be much lower than 25 caribou per person and could be considerably more.

#### 3.4.4 SUSTAINABILITY

Just how sustainable then is an economy based on specialized caribou hunting? Issues surrounding sustainability include the ability of human foragers to hunt, process, and perhaps store enough caribou to satisfy the annual dietary and non-food requirements without significantly reducing the overall health of the caribou herd(s) they prey upon. The pertinent literature provides conflicting views in this regard. Ingold's (1980:23, 47-48) review of ecological data regarding the effect of wolf and human predation on caribou herds suggest that such predation results in a state of equilibrium. Predation in this instance operates as an effective check on populations growing too quickly and exceeding the local carrying capacity (see Schaffer 1951 for an account of the catastrophic result of unmitigated caribou growth in the absence of predation). Thus when occurring at optimum levels predation provides for a situation where herd size remains uniformly high and suffers less severe oscillations. Of course this

viewpoint precludes the ability of wolves and humans to overhunt, or even underhunt, herds to the extent that predation fails to operate as a substantial check on population growth. As discussed in chapter two, modern population studies and historic accounts indicate that, at least in North America, severe and catastrophic oscillations did occur during the post-contact era (Burch 1972; Skoog 1968; Spiess 1979:65-66) and oral histories and archaeological data suggest that such oscillations may have a considerable time depth (e.g. Fitzhugh 1972:185; Minc 1986). It remains unclear specifically what underlying causes affect each oscillation and increases or decreases in population have been linked to overgrazing (Mahoney and Schafer 2002), overhunting (Thompson and Fischer 1979), and immigration/emigration (Calef and Hawkins 1977; Schafer et al. 1999).

To explore issues surrounding consumer demand in more detail data from the Kaminuriak herd are explored here. The Kaminuriak herd represents the classic barren-ground caribou that migrate annually through traditional Ethen-eldeli and Caribou Inuit territory west of Hudson Bay and represents one of the most exhaustively studied caribou populations in the world. Population studies conducted in the 1960s and 1970s suggest an average population of 63,000 animals in 1972 (Parker 1972) with lows of around 40,000 animals being recorded in 1968 (Kelsall 1968), 1976-1978 (Thompson and Fisher 1979). These numbers represent a significant decrease from both the previous (149,000 in 1955, Loughy 1955) and subsequent decades (320,000 in 1985, Graf and Heard 1990). It is unclear if any or all of these surveys represent an accurate reflection of herd size. For instance, the count of 320,000 in 1985 certainly has benefited from increasingly refined survey methodology. However, the question remains as to how influential modern wildlife management practices have been on herd size. Likewise, population numbers in the 1960s and 1970s fluctuated dramatically from year to year, suggesting

that population surveys exhibited a large standard error of measurement. Nevertheless, herd size during this period was certainly at historic lows and the high 1985 population estimate no doubt has benefited to some extent from modern herd management policies.

To examine these data a model presented by Graf and Heard (1990) is utilized to calculate natural mortality and recruitment rates of a caribou herd relative to population size. The only significant modification to their model that I made was to recalculate how mortality losses were attributed to males and females. The authors attempted to maintain a stable male (45 percent) to female (55 percent) ratio, but their calculations actually led to an unchecked growth of females in the herd at the expense of males (e.g. the sex ratio became nearly 95 percent female). Over a 25 year interval this miscalculation led to a rather unrealistic exponential growth in herd size and unrealistic male:female sex ratio. To correct for this error mortality and hunting losses were assigned equally to males and females, which in practice better served the intended purpose of maintaining the original herd sex ratio. From these estimates the number of caribou available for hunting while maintaining a stable population can be calculated. This in turn can be utilized to identify a general parameter for population size and density, based on the estimated number of caribou needed per person for food and non-food requirements.

Table 3.1 presents these data calculated for low (63,000, Kelsall 1968), medium (149,000, Loughrey 1955), and high (320,000, Graf and Heard 1990) population estimates. In addition, herd recruitment, indicated by spring calf:cow ratios, for the model were set at both 30:100 and 40:100. These numbers represent the higher ratios identified among the model run by Graf and Heard (1990) and while these ratios may be higher than some identified elsewhere (e.g. Mahoney and Virgl 2003, Stuart-Smith et al. 1997) the numbers used here fit comfortably into ranges for stable or growing populations reported elsewhere (e.g. Messier et al. 1988).

According to the model, in order for hunting to be sustainable at current recruitment levels of 30:100 or 40:100, returns from hunting are limited to between 6-10 percent. These data suggest that even when herd populations were high the ability of a specialized caribou hunting economy to support an overall dense population is limited. Nonetheless, a limit on population density should not be viewed as precluding the ability of a caribou hunting economy to periodically support large population aggregations. In fact, given the need for labor to process hides and meat accumulated via intercept hunting, periodic aggregation may be a requirement of a specialized caribou hunting economy. What these data do support is the notion that over the course of the entire annual round, populations engaged in specialized caribou hunting are likely to exhibit a low population density relative to the large size of territory being exploited (Burch 1972:350, see also Table 3.1 below). As these data also show, population size of foragers dependent upon a given caribou herd is strongly controlled by the recruitment rate of the herd. In fact, population nearly doubles with only a 10 percent increase in herd recruitment. Of even greater concern for foragers is that a 10 percent reduction in herd recruitment is equally as catastrophic in terms of population supported by sustainable hunting.

Table 3.1. Estimated rates for the sustainable harvest of the Kaminuriak caribou herd  
(model adapted from Graf and Heard 1990)

Herd Size	Calf: Cow	Male: Female	Nat. mortality	Sustainable hunting (%)	Pop estimate. (25/person)	Pop. Estimate (50/person)
63,000	30:100	45:55	8.44%	3717 (5.9%)	149	74
149,000	30:100	45:55	8.44%	8791 (5.9%)	352	176
320,000	30:100	45:55	8.44%	18800 (5.9%)	752	376
63,000	40:100	45:55	8.5%	6111 (9.7%)	244	122
149,000	40:100	45:55	8.5%	14453 (9.7%)	578	289
320,000	40:100	45:55	8.5%	31040 (9.7%)	1242	621



### 3.5 SITUATING CARIBOU HUNTING ECONOMIES OF NORTH AMERICA IN AN ETHNOGRAPHIC PRESENT

By the 13<sup>th</sup> century A.D. the Thule Inuit had completed a rapid migration across the North American arctic establishing viable colonies as far east as the southern Labrador coast (Fitzhugh 1972; Taylor 1974). Such a remarkable population expansion across the entirety of the North American arctic has been linked to the Thule developing an economy invested in the pursuit of several species of whale. It is clear from both the ethnographic and archaeological records that the pursuit of marine mammals formed the backbone of Thule society, not just economically, but socially, politically, and ideologically as well (Friesen 2004; Maxwell 1983; Morrison 1994; Whitridge 2002, 2004:237-238). One immediate cultural impact of the Thule expansion is that earlier Dorset cultures, who occupied much of the arctic coast prior to the Thule, essentially disappeared from the archaeological record (Maxwell 1985). A longer lasting ramification was that the Thule expansion established a dichotomy between the coastal dwelling Inuit and interior dwelling Athapaskan and Algonquian speaking peoples who, for the most part, straddled the boreal forest/tundra boundary (Ingold 1980). The predation of migratory caribou herds represents one significant zone of overlap between the coastal Inuit and their interior neighbors and it is evident from the ethnographic literature that interaction between these broadly defined cultural groups (Inuit/Athapaskan and Inuit/Algonquian) was complex and often characterized by outright fear, mistrust, and violence interspersed by seemingly contradictory accounts of trade and peaceful cultural exchange (Clark and Clark 1976; Loring 1992:161-165; Smith and Burch 1979; Taylor 1979).

Exploitation of caribou by the Inuit primarily involved the seasonal exploitation of caribou while herds were present near the coast. In these instances caribou were typically

available to Inuit communities from summer to early fall and provided an important supply of both surplus meat and hides. Some Inuit communities inhabiting areas with less abundant marine resources would subsist principally on caribou meat throughout mid-summer and fall (Morrison 1994). This seasonal strategy is best exemplified among the Copper and Netsilik Inuit. In the months immediately following the fall caribou hunt dispersed bands of Copper and Netsilik would rely almost entirely on stores of caribou meat while waiting for sufficient sea ice to develop enabling aggregating into traditional winter sealing villages (Balikci 1970; Jenness 1922). Other Inuit communities, such as the Labrador, Mackenzie, and Inuqpat Inuit, had access to a more diverse and regular supply of marine mammals than those groups inhabiting the central Canadian arctic (Morrison 1994). As a result these communities would utilize the fall caribou hunt principally for hides and cached the surplus meat as insurance against poor returns from hunting seals near the edge of ice flows (Stenton 1991; Taylor 1969). Among these latter Inuit communities it is likely that the value of caribou as a non-food resource exceeded its value as a food.

Other Inuit adaptations to caribou hunting include the Nunamiut and Caribou Inuit. These groups represent two formerly coastal dwelling Inuit bands that historically relocated into the interior, adapting their economy to subsist on caribou virtually year round (Burch 1976; Friesen 2004; Hall 1976; Smith and Burch 1979). It is the hunting of caribou among these two groups that have formed a substantial portion of the ethnographic record employed in the interpretation of archaeologically known caribou hunters (Binford 1978; Burch 1972; Enloe 1997; Spiess 1979). There are a number of key parallels between Nunamiut and Caribou Inuit economies. Both are logistically mobile economies that hinge on successful kayak based communal hunts during both the spring and fall migrations of caribou and are supplemented to a lesser extent by

fishing (Arima 1984; Gubser 1965). Population aggregations occur in conjunction to the spring and fall caribou hunts, although aggregations associated with the fall hunt are typically larger (Arima 1984; Stewart et al. 2004). There is also an investment in practical storage as the primary risk minimizing strategy used to endure periods when caribou were not available (Arima 1984; Binford 1978; Enloe 2004:215).

Contrasting the Inuit predation of caribou, Athapaskan and Algonquian speaking peoples pursued caribou hunting in different ways than those observed for the Inuit. The result is a considerable degree more variability. Some groups hunted caribou throughout the year (Loring 1992; Smith 1981), while others only pursued caribou seasonally (Honigmann 1954; Osgood 1932, 1937), and some only occasionally (Rogers and Black 1976). The specific economic adaptation to specialized, year round caribou hunting varied depending on the local environment and behavioral ecology of individual caribou herds. Those herds occupying the expansive barren-grounds west of Hudson Bay migrate distances upwards of 500 km annually and likewise Ethen-eldeli bands that preyed upon those herds undertook similar long-distance residential movements onto the tundra in order to hunt caribou throughout the year (Burch 1991). Correspondingly the nineteenth century Innu also pursued caribou throughout the year, but could also do so with much more limited distance mobility because the Labrador herds themselves only migrate 150-200 km (Loring 1992). Despite differences in the distance between residential movements, both the Ethen-eldeli and Innu made use of communal hunting tactics centered on the fall migration of caribou (Burch 1991; Gordon 1996; Loring 1992; Smith 1981). These communal hunting tactics involved the use of drive lines, the chute and pound, and even canoe based interception of swimming caribou (Morrison 1981; Smith 1981; Turner 1894). Instead of a heavy reliance on practical storage however, the Innu and Ethen-eldeli principally relied on

residential mobility and social storage to mitigate the risk of shortages in caribou (Enloe 2004:215; Jarvenpa and Brumbach 1983:181-182; Loring 1992).

### 3.6 GENERALIZING THE ORGANIZATION OF CARIBOU HUNTING ECONOMIES

The ethnographic record of arctic and sub-arctic foragers surveyed here portrays a broad mosaic of economic adaptations involving the use of caribou as a resource. Although each specific ethnographic case has resulted from a unique combination of environmental, cultural, and historic processes, I believe it is reasonable to group these case studies into three general adaptive strategies; opportunistic, seasonal (part-time), and specialized (full-time) caribou hunters. Grouping the ethnography of caribou hunters into these categories is based on several factors including the relative contribution of caribou to the diet, the amount of the annual round spent hunting caribou, the degree to which caribou influenced land use strategies, the degree to which caribou factored into risk minimizing strategies, and whether or not caribou served as the economic basis for social aggregation (Table 3.2).

#### 3.6.1 OPPORTUNISTIC CARIBOU HUNTERS

While opportunistic hunters will take advantage of caribou when encountered, these groups seldom position themselves on the landscape with the expressed intent of hunting caribou. In other words, the volume of time spent hunting caribou and the influence of caribou on land use strategies remains low. Consequently the overall contribution of caribou to the diet is also minor and in effect the perceived importance of caribou is also low, since pursuit of the species does not factor into risk minimizing strategies aside from diversification of the diet. Caribou hunting among these societies does not support social aggregation.

Table 3.2. Summary of different economic strategies employed by those caribou hunting societies identified in chapter three

	Opportunistic	Part-Time	Full-Time
Contribution of caribou to diet	Low	Low to High	High
Time investment in caribou hunting	Minimal	Seasonally high, minimal otherwise	Caribou exploited virtually year round
Influence of caribou on land use	None	Influences mobility on a seasonal basis	Caribou movements structure nearly the entire seasonal round
Caribou as a basis of social aggregation	No	No social aggregation; Communal hunting in some instances	Economic basis for social aggregation; communal hunting
Caribou and risk management	Second line or emergency resource	Provision of insurance caches	Mobility; Heavy investment in practical and/or social storage
Ethnographic cases	Northern Ojibwa; Cree; Kotzube Inuit	Kutchin; Tanana; Mackenzie Delta, Central, and Quebec/Labrador Inuit	Ethen-eldeli; Innu; Caribou Inuit; Nunamiut

The clearest examples of opportunistic caribou hunting are from those peoples who traditionally occupied areas on the periphery of main centers of caribou distribution, such as within the boreal forest where smaller herds of woodland caribou are present. Within these areas moose is typically the dominant large ungulate and woodland caribou are known to intentionally space themselves from moose as part of a predator avoidance strategy (Seip 1992). As a consequence, caribou are heterogeneously distributed across the environment in small, dispersed

patches. Among Cree and Ojibwa peoples that inhabit this portion of the boreal forest, ethnographic data make it clear that moose remained the single most important ungulate in the diet. Even during the period between 1820-1930 when moose were absent from the region small game provided the bulk of winter subsistence and caribou were only hunted opportunistically, although this was probably due to a similar decline in caribou numbers as well (Rogers and Black 1976). Even more telling is the fact that social aggregation occurs during the summer months and is organized around access to important fisheries (Rogers and Rogers 1959).

### 3.6.2 PART-TIME (SEASONAL) CARIBOU HUNTERS

Part-time specialists will, on a seasonal basis, relocate themselves either residentially or logistically for the express purpose of hunting caribou for food or non-food needs. Caribou in this context often comprise the major portion of the seasonal diet and may also represent a significant portion of the overall annual diet. Even among those peoples that prey upon caribou principally for non-food resources like the Labrador Inuit, the caching of caribou meat does serve as a critical insurance strategy (Saladin d'Anglure 1984). Communal hunting of caribou is often an important strategy employed by part-time caribou hunters, particularly where there is a strong emphasis on maximizing returns. Yet, in spite of the seasonal importance of caribou, the primary instance of social aggregation among these societies is the extraction of marine and/or aquatic resources such as salmon fishing, seal and whale hunting. In this sense caribou does not serve as the basis of social aggregation, the implication being that the perceived importance of caribou among part-time specialists remains secondary to those resources that for the economic basis for maximal social aggregation.

The Copper Inuit illustrate several key elements of part-time or seasonal caribou hunters as defined here. During the summer and fall months caribou hunting represents the major contributor to the Copper Inuit diet (Damas 1972, 1984). Although supplemented by fishing, particularly during the short period when arctic char are running, caribou constitute the primary resource exploited during the summer and fall and are often hunted by communal tactics such as drives and intercept hunting at water crossings (Damas 1972). By late fall, after the caribou migration is over, the Copper Inuit subsist on stores of caribou meat while processing the necessary volume of caribou hides in anticipation for the upcoming winter (Damas 1972). After a sufficient volume of sea ice has developed the Copper Inuit aggregate into traditional winter sealing villages, which are located out on the sea ice near known fields of seal breathing holes (Damas 1972). The sole economic activity during the winter months is to engage in breathing hole sealing. In terms of sheer volume of meat, not to mention hides, caribou represent the major contributor to the annual diet of the Copper Inuit (Damas 1972). However, the major period of social aggregation occurs principally in conjunction with winter sealing, which is necessary to ensure a constant supply of food during the winter months (Riches 1982:29-31). Because the organization of Copper Inuit settlement strategies places such an economic and social emphasis on winter seal hunting, caribou are secondary in cultural importance in spite of the species actually contributing more meat to the diet. The Copper Inuit may be an extreme example, but is useful to illustrate the important link between the subsistence base, social aggregation, and relative cultural importance of a particular species.

Other part-time specialists include inland adapted groups that are able to position themselves around important fisheries, which was unquestionably the economic focus of those societies. This form of part-time caribou hunting is exemplified by the Tanana who would

disperse during late winter and early spring to hunt caribou (Osgood 1937). The timing of the spring caribou hunt was in response to dwindling stores of dried salmon and would cease once preparations for the first salmon runs needed to begin (VanStone 1985:231). Limited hunting of caribou during the fall also occurred, but this was done primarily for hides. Similar to the coastal Inuit of the central and eastern arctic, caribou provided the Tanana with an important source of meat and hides. Yet, the economic and social basis of the Tanana remains the ever important salmon fisheries (McKenna 1959; Osgood 1937).

### 3.6.3 FULL-TIME (SPECIALIZED) CARIBOU HUNTERS

Specialized caribou hunters employ residential and logistical strategies to position themselves in order to subsist on caribou virtually year round. This may involve residential mobility at a scale similar to the caribou herds preyed upon, or alternatively may be accomplished through logistical strategies accompanied by a heavy reliance on caches of caribou meat. Labeling a group as full time specialists is not to say that they only subsisted on caribou, rather the distinguishing characteristic is that the economic organization of these societies is driven primarily by the desire to ensure year-round access to caribou or, minimally, year round access to caribou meat, fat, and non-food products. Secondary resources are utilized, but their use is restricted to two contexts. Secondary resources are either exploited opportunistically to introduce variety into the diet, or on a situational basis as a second-line resource should the caribou hunt fail. Caribou among full time specialists also represent the resource base upon which social aggregation is facilitated and is a key characteristic that helps to distinguish specialized caribou hunters from opportunistic and part-time caribou hunters.



The ethnographic record from North America provides four separate accounts of an interior adapted specialized caribou hunting economy. The Nunamiut, Caribou Inuit, Ethen-eldeli, and Innu each can be characterized as full-time caribou hunters according to the definition employed here. Among these groups caribou not only provided the major portion of food consumed annually, but caribou hunting also served as the economic basis for social aggregation. Even though there are a number of important parallels among the specialized caribou hunting economies, these four ethnographic cases also represent widely different linguistic groups including Inuit, Athapaskan, and Algonquian speaking peoples. This linguistic diversity underscores the varied and distinctive cultural responses to a particular economic adaptation, namely the specialized hunting of caribou.

Prior to their incorporation into the eighteenth century fur trade the Ethen-eldeli maintained a specialized caribou hunting economy predicated on a herd following strategy (Burch 1991; Gordon 1996). Herd following in this manner resulted in the Ethen-eldeli traditionally undertaking long distance seasonal movements to summer on the barren-grounds and winter in the transitional forest. These long distance movements closely mirrored the winter and summer ranges of migratory barren-ground caribou from the Kaminuriak and Beverly herds. Remarkably this specific adaptation to caribou hunting appears to have been relatively stable for several thousand years based on the regional archaeological record (Gordon 1996). To minimize risk the Ethen-eldeli employed a high degree of residential mobility to overcome seasonal shortages of caribou. In fact, the magnitude of Ethen-eldeli mobility strategies is among the largest ever known for hunter-gatherers, and was undertaken in order to position themselves near caribou year round (Burch 1991). Furthermore, Herne's (1958) diary makes it clear that most Dene relied little on practical storage and would feast on meat when available, or otherwise

process it into a readily transportable form (Burch 1991; Glover 1958; Helm 1986). Likewise, the killing of large numbers of caribou during the fall communal hunts did not appear to be driven by a strong interest in accumulating stores of caribou meat. Instead one might suppose that the acquisition of hides was the major motivating factor, while the surplus caribou meat was more apt to be shared than stored. Throughout much of the year caribou hunting Dene remained dispersed across a wide geographic front, which represents a form of risk pooling (e.g. Wiessner 1982, 1983) by ensuring that at least some bands would intercept the main body of migrating caribou (Burch 1991; Smith 1975, 1978). It was this assurance of a successful fall hunt that facilitated the largest social aggregations among the Dene (Friesen 2004:302; Smith 1975, 1978).

In response to Inuit and European expansion into coastal Atlantic Canada, during the eighteenth and nineteenth centuries the Innu of Labrador retreated to the interior and developed a specialized caribou hunting economy (Loring 1992, 1997). The Innu adaptation to caribou hunting was in many ways similar to the traditional Ethen-eldeli strategy. Like the Ethen-eldeli, the Innu adaptation was also distinguished by a high degree of residential mobility (Loring 1992:167-169; Speck 1935). Although the magnitude of residential movements was far less in Labrador, the Innu exhibit a similar frequency of residential movements (Binford 2001:Table 8.04). The decrease in magnitude is almost certainly related to the fact that Labrador caribou herds also migrate across smaller distances relative to their barren-ground cousins. Innu movements are also more circumscribed due to the presence of Inuit colonies ringing the Quebec-Labrador coast. In conjunction with a high frequency of residential mobility, the ethnographic record indicates there was also little emphasis on the practical storage of caribou meat (Loring 1992, 1997; Speck 1934; Turner 1894). Instead feasting related to the *mokoshon* often accompanied the arrival of caribou meat in a camp (Leacock and Rotschild 1994). Given

the importance of feasting in this context, it is argued that the primary risk minimizing strategy was, again, the pooling of risk and sharing of resources. In fact, the late pre-contact Innu of the Point Revenge and Daniel Rattle complexes are distinguished archaeologically by evidence for a very high degree of social integration at the regional scale (Loring 1992). Such integration also appears to have carried over into the period when the historic Innu developed their interior caribou hunting economy.

The Caribou Inuit also established their adaptation to specialized caribou hunting during the nineteenth century, although this was in response to a different suite of historic and economic factors. With the Ethen-eldeli abandoning the barren-grounds to pursue the fur trade further south, the Caribou Inuit were able to expand into the interior barren-grounds (Friesen 2004; Smith and Burch 1979). By the time Birket-Smith (1929) and the Fifth Thule expedition reached the Caribou Inuit in 1920s they were occupying a territory centered on the summer ranges of the Beverly and Kaminuriak caribou herds year round. However, and unlike the Ethen-eldeli economy, the Caribou Inuit did not develop a herd following strategy partly because of the continued presence of the Ethen-eldeli in the transitional forest to the south and west prevented the Caribou Inuit from expanding any further (Friesen 2004; Smith and Burch 1979). As a result there is a need among the Caribou Inuit to rely upon the practical storage of caribou meat in order to overcome seasonal shortages (Arima 1984; Birket-Smith 1929; Friesen 2004). Their economy developed an emphasis on taking large surpluses of caribou during the spring and fall migrations (Arima 1984; Stewart et al. 2004:186-188). To ensure large surpluses were taken the Caribou Inuit concentrated their settlement on major water crossings that allowed for large communal hunts utilizing kayak based hunters to readily dispatch large numbers of caribou (Friesen 2004; Friesen and Stewart 1994; Stewart et al. 2004). In particular, the interception of

caribou at water crossings during the fall became the center piece of the seasonal round, not to mention the period of greatest social aggregation. Stores of caribou meat accumulated during intercept hunting were supplemented by fishing and musk-ox hunting, which also represented critical second line resources in the event of a sparse caribou migration (Arima 1984; Friesen and Stewart 2004; Stewart 1993).

The Nunamiut also developed a specialized caribou hunting economy that relied heavily on accumulating stores of caribou meat. In this regard the Nunamiut strategy is more similar to the Caribou Inuit economy than either the Ethen-eldeli or Innu economies described previously. Historically the Nunamiut have resided in a single residential village located at Anaktuvuk Pass, although prior to the twentieth century several different residential villages were likely utilized (Gubser 1965; Hall 1976). Also like the Caribou Inuit, large residential base camps are situated in proximity to major caribou water crossings. This proximity to key intercept localities enabled the Nunamiut hunters to maximize returns within their logistically organized economy (Binford 1980). Caribou herds migrating through the area during both the spring and fall would have been taken in large numbers with surplus meat cached (Binford 1978; Gubser 1965). This intercept hunting strategy also represented the periods of greatest social aggregation based on the communal caribou hunt. The remainder of the year was spent in dispersed campsites or engaged in long distance logistical forays where individual bands of caribou would be hunted when encountered, with most of the meat being cached near the location of the kill for later retrieval (Binford 1978, 1991). Caches were often individually marked and returned to when needed, with each household keeping a careful inventory of the number of caches and quantity of meat in each cache (Binford 1978, 1991, 1993). Caching in particular was critical to overcome seasonal shortages in the availability of caribou and served as the principal risk minimizing strategy

(Binford 1980, 1991; Enloe 2004:215). Although there are similarities to the Caribou Inuit caribou hunting economy, it is clear that the Nunamiut adaptation involved an even greater emphasis on practical storage and logistical mobility (e.g. Binford 1980).

### 3.7 FULL TIME CARIBOU HUNTING ECONOMIES: INUIT VS. NON-INUIT ADAPTATIONS

Reviewing the four documented specialized caribou hunting economies from the North American ethnographic record reveal a considerable amount of variability. Each ethnographic case reflects a unique cultural adaptation to subsisting primarily on caribou year round, and each developed from different environmental and historical circumstances. The importance of these factors is perhaps best exemplified by the Caribou Inuit and Ethen-eldeli, who preyed upon the same herds of caribou in the same general region, yet developed two strikingly different economies (Friesen 2004; Smith and Burch 1979). Nevertheless, in order to develop a general model for a specialized caribou hunting economy that is applicable to the lower Great Lakes Paleoindian it is necessary to seek meaningful generalizations rather than only describing variability. To accomplish this goal I will attempt to place variability aside for the moment and focus on generalizing important characteristics of the four specialized caribou hunting economies identified here. This is not done to depreciate the recognized variability in cultural systems, only to identify elements that have use for modeling the archaeological record of caribou hunters in the lower Great Lakes region.

As noted above, there are similarities between the Ethen-eldeli and Innu case studies on one hand and the Nunamiut and Caribou Inuit case studies on the other. In part, such similarities can be seen to have resulted from the reorganization of arctic and sub-arctic peoples during the

10<sup>th</sup>-13<sup>th</sup> centuries A.D. coinciding with the Thule expansion across the region (Maxwell 1983).

The result is a notable dichotomy between coastal Inuit peoples of the tundra and the Athapaskan/Algonquian Indian peoples of transitional tundra-forest ecotone (Ingold 1980). Similarities among these two broad cultural contexts will be explored in more detail here.

### 3.7.1 INTERCEPT HUNTING AND THE KAYAK

Two salient features of the Inuit economic adaptation involving specialized caribou hunting stand in notable contrast to the Athapaskan/Algonquian Indian adaptations. The first feature is the ability to successfully employ kayak based hunts for caribou at major water crossings (Arima 1975; Stewart et al. 2004). The efficiency at which caribou can be killed by using these tactics is unmatched by the use of less mobile canoes along with any terrestrial adaptation such as the chute and pound (Spiess 1979:111). The greater maneuverability of the kayak enables large numbers of caribou to be reliably killed by even small numbers of hunters (Arima 1975:150-153; Birket-Smith 1929:110-111; Spiess 1979:111). Particularly in the nineteenth and early-twentieth centuries when the Caribou Inuit were developing their specialized economy the kayak was more of a technological advantage for caribou hunting than were firearms that often broke or else suffered from an inconsistent supply of ammunition (Smith and Burch 1979).

Among the Caribou Inuit it is clear that their ability to utilize kayaks contributed greatly to their ability to take large numbers of swimming caribou (Friesen 2004:310). This almost singular focus on water-crossings similarly reflects the maritime legacy of the Caribou Inuit as descendants from the Thule Inuit. While the stalking of individual caribou and construction of pitfalls were also utilized, the Caribou Inuit apparently did not employ more intensive methods

such as the corral and snaring (Birket-Smith 1929). Likewise, the Nunamiut are known historically to have driven caribou into large interior lakes where they were dispatched by kayak based hunters. At Chandalar Lake this communal hunting strategy was executed by the Nunamiut as recently as the 1940s where oral histories explicitly detail the construction of kayaks to aid in the hunt (Wilson and Rasic 2008:132).

The Ethen-eldeli and Innu are also known to have utilized watercraft in order to intercept swimming herds of caribou. However, none of these groups are known to have employed the kayak, which is an Inuit invention. The continued use of canoes by non-Inuit hunters is well documented in the ethnographic record (Herne 1958; Smith and Burch 1979; Turner 1984). For instance, although the Ethen-eldeli are known historically to have adopted the Inuit double paddle specifically for hunting caribou (Smith and Burch 1979), they avoided the kayak and continued to utilize their small, one person canoes to hunt swimming caribou. In fact, there is no record that I am aware of for any non-Inuit peoples adopting the kayak to hunt swimming caribou during the nineteenth and early-twentieth centuries. Instead most continued to utilize the less maneuverable canoe (Friesen 2004:303; Gordon 1977:76; Loring 1992:181), lanced caribou once they moved ashore (Gordon 1977; Tanner 1944:618), or employed the chute and pound to hunt caribou on land (Loring 1992:178, Plate 5.3; Morrison 1981; Townsend 1911).

There are a number of potential reasons why the kayak was never adopted by non-Inuit hunters, but an anecdotal account from the HBC archives summarizes one important consideration for those with limited experience trying to operate the two different forms of watercraft:

Two Persons appeared on the Southern Shore [of Wager Bay], and on the *Eskemaux's* Return to the Boats, one of them came in one of the *Eskemaux* Canoes [Kayaks], but seemed to know little how to manage her; and there being a Swell, was very much frightened; returning ashore conducted between two other Canoes [Kayaks]. These People were in Complexion

and Manner very different from the Eskimaux, although in the same Habits (Swaine 1748, II:266; cited in Smith and Burch 1979:81).

Smith and Burch (1979:81) suggest that the reference to people of “different complexion and manner” but “same habits” refers to individual Dene present among the Inuit. It is clear from the passage that they had a very difficult time maintaining the stability of the kayak in open water. Doubtless stability would be an even greater concern when trying to maintain ones balance while at the same time attempting to lance a panicked caribou in heavy current!

Thus, and in contrast to the Inuit use of kayaks, the use of canoes by the Ethen-eldeli and Innu probably were not viewed as such an overwhelming advantage. In fact, Ethen-eldeli hunters were just as apt to abandon their canoes and employ the terrestrial equivalent, the chute and pound, despite the proximity of suitable water crossings (Friesen 2004; Gordon 1977; Morrison 1981). During the historic era, while the Caribou Inuit often rejected firearms and continued to intercept caribou at water crossings using their kayaks, the historic Ethen-eldeli preferred to utilize firearms to intercept caribou from a distance (Gordon 1996:12). Likewise, Tanner (1944:618) describes an Innu aggregation and communal hunt at Mishikamau Lake in central Labrador. Of note is that instead of driving the caribou into the water to hunt, the Innu choose to construct a drive fence and corral on land. Further to the north, Turner (1894) observed Innu attached to Fort Chimo to have intercepted swimming caribou at water crossings, but, like the Ethen-eldeli, hunting was conducted by the less stable canoe rather than kayak.

### 3.7.2 RISK MANAGEMENT – PRACTICAL STORAGE VS. SOCIAL STORAGE

The second feature of the Inuit adaptation is that, ideologically, the Inuit are predisposed to relying heavily on stored resources stemming from their own cultural history as hunters of large marine mammals (Friesen 2004:311). The Thule expansion principally involved a coastal



adaptation organized chiefly around the hunting of large sea mammals and reliance on stores of meat. Thus the use of practical storage represents a critical risk management strategy employed by the Inuit. On one hand such a reliance on storage is certainly related to the pragmatic difficulties in processing very large packages of meat provided through whale hunting. However, storage also satisfies the obvious need to overcome periodic shortages of resources in the coastal arctic ecosystem (Maxwell 1983; McGhee 1978). This is an important distinction because, as Friesen (2004:311-312) notes, demographic packing during the historic era prevented both the Nunamiut and Caribou Inuit from residentially occupying the entire territory utilized by a single caribou herd. As a result periodic shortages in caribou were inevitable. Yet, the historic Innu were subjected to similar demographic pressures and while they did prepare dried meat to consume into the winter months, they also shared surpluses widely (Loring 1992:180-193). This would suggest to me that an ideology of storage played as much a role as did demographic pressures in the development of these different economies. In this regard the use of storage may reflect the Nunamiut and Caribou Inuit ancestry from coastal dwelling marine mammal hunters, rather than a specific local adaptation to caribou hunting developed wholly in response to demographic pressures. In other words, already established strategies involving practical storage facilitated the transition by Inuit peoples to specialized caribou hunters, rather than their having developed a strategy of practical storage as a result of becoming specialized caribou hunters.

This is not to say that the Inuit did not engage in other risk minimizing strategies such as sharing and mobility. However, sharing among Inuit communities is governed by cultural preferences that control or restrict the distribution of meat to kin and formal, institutionalized non-kin relationships like trading partners (Riches 1982:64-68). To be fair, rules governing sharing among the Nunamiut and Caribou Inuit are probably more relaxed than among other

Inuit groups, nevertheless they are still part of the broader cultural context of Thule Inuit that both caribou hunting societies developed from (Enloe 2004:215; Friesen 2004). In other words, there are distinct notions of ownership over food stores and limits to sharing:

All the people were happy to have their relatives from the Killik River join the camp on Tulugak Lake. On the other hand...the migrants transported no food stores...the Tulugak people had not anticipated the arrival of the Killikmiut and had therefore only stored enough food to meet their own summer needs. During the initial days...food was freely shared in large “happy” meals and at dances. However, it became evident that the stores of the Tulugakmiut would be insufficient if such sharing continued and distant kinsman began to fail to offer food to the Killik River families (Binford 1978:323,226).

Apparently the Tulugakmiut chose to rely on their food stores and did not hunt during their stay at Tulugak lakes, while at the same time essentially forcing their Killikmiut relatives to hunt in unfamiliar terrain by withholding food from them. This failure to offer assistance to those recognized as kin is contrasted below by Innu and Ethen-eldeli ethnographic accounts where assistance is freely given to kin and stranger alike with apparently little consideration for their own access to meat in the future.

In regard to mobility, both the Caribou Inuit and Nunamiut practice what is commonly described as logistical mobility (cf. Binford 1980). The ability of either group to employ residential mobility for overcoming seasonal shortages in caribou is severely restricted due to the fact that other peoples (Dene) already inhabited the areas encompassing the winter ranges of caribou (Friesen 2004). Such a restriction becomes even more recognizable when considering the long history of hostile relationships between Inuit and non-Inuit neighbors (Smith and Burch 1979; Turner 1894). Still, it should be stressed that even if high residential mobility were an option there is no reason to assume *a priori* that Inuit caribou hunters would abandon cultural

practices involving caching and logistical mobility in favor of residential mobility as Friesen (2004:311-312) implies.

Perhaps the most explicit way to emphasize the influence that an ideology of storage has on the organization of specialized caribou hunting economies is to contrast the Nunamiut and Caribou Inuit systems with the Ethen-eldeli and Innu systems. Ethnographic accounts from Athapaskan and Algonquian foragers reflect what Bird-David (1992:28-31) has described as an ideology of sharing that serves to structure human-environmental interactions.

The primary metaphor of “sharing” is thus a concept.... By which *they* make sense of their environment, one that guides their actions within it. Through their close interaction with the environment they have come to perceive it, and act within it, as with a friend, a relative, a parent who shares resources with them (Bird-David 1992:31).

There is a strong belief, repeated throughout Athapaskan and Algonquian ethnographies, that hunting success is not governed by individual skill but rather through maintaining social relationships with supernatural entities (Bird-David 1992; Brody 1982; Helm 1993; Lips 1947; Smith 1998; Speck 1935; Tanner 1979). One strategy used to maintain these critical relationships are reflected in the specific rules for the treatment of animal remains. In the framework outlined by Bird-David (1992) such treatment of animal remains reflects the emic perspective that once a hunter kills an animal he or she is participating in a system of generalized reciprocity. By accepting the gift (i.e. killing an animal) he or she has acknowledged that they have certain social obligations to the supernatural entity that permitted or shared the kill with them.

Such views are certainly not restricted to Athapaskan and Algonquian foragers and are similarly present to some extent among all hunter-gatherers including Inuit and others who rely on practical storage. Still, it takes a particular ideology to abandon the trust that existing

reciprocal relationships (human-human and human-nature) will continue to provide for the needs of the group. In other words, among foragers lacking an ideology of storage it is simply inconceivable to regulate ownership of meat by caching it. Two case studies, the feast and famine existence of the Dene depicted in June Helm's (1993) classic essay and William Duncan Strong's (Leacock and Rothschild 1994) characterization of the Innu *mokoshon* ceremony illustrate this point.

Peter Fidler, a HBC employee who spent the winter of 1791-1792 living with a band of Dene in the vicinity of Great Slave Lake, made an extraordinarily detailed account of the daily consumption of food among the Dene band he was traveling with (Fidler 1934, cited in Helm 1993). In fact, concern regarding the availability of food seemed to preoccupy Fidler's thoughts throughout the winter and on many occasions the band he was traveling with quietly endured periods of starvation. Contrasting these episodes of famine, and there were many, was the indulgent feasting that accompanied the arrival of fresh meat into the camp. Fidler's Dene companions seemed to lack any concern for storing and rationing enough food for the future and on several occasions Fidler expressed his great dismay at the generosity of his hosts sharing their limited resources with anyone who was in need. At one point Fidler's hosts felt obligated to give away nearly all of their remaining supplies to one such group that joined their camp on the verge of starvation (Fidler 1934, cited in Helm 1993:58). This account stands in stark contrast to the account quoted above where sharing between Inuit bands actually ceased once the Tulugakmiut stores were deemed insufficient to support both groups (Binford 1978:323,326). This seemingly open context for sharing among the Dene echoes similar statements by Hearne (Glover 1958) from his own experiences. The point is that among the Dene withholding food was unimaginable and would be horrific to suggest otherwise. Instead the ethnographic record of the Dene is

littered with accounts of feasting and sharing with any and all who were present until supplies of meat have dwindled. If fresh resources could not be immediately obtained, then a period of famine was quietly endured. To paraphrase both Helm (1993) and Fidler (1934), life was always a feast or famine.

In much the same way, William Duncan Strong spent the winter of 1922 living with the Davis Inlet band of Innu in central Labrador (Leacock and Rothschild 1994). During the early-twentieth century the specialized caribou hunting economy practiced by the Innu was severely stressed after historic crashes in the Labrador caribou herds. To compensate, the group Strong wintered with had positioned themselves near a good fishing lake that was also in proximity to Euro-American settlements on the coast should they have recourse to trade furs or even beg for food. Indeed, Strong's first encounter with the Innu was the previous winter at the expedition headquarters near Davis Inlet where one such group of Innu appeared to beg for handouts. Famine more so than feasting characterized the Innu experience during much of the twentieth century. Yet on the rare occasion when surplus caribou meat was accumulated, the tent with the successful hunter(s) was obligated to host a *mokoshan* (Leacock and Rothschild 1994). The *mokoshan* is a feast involving the ritual preparation of bone grease from caribou long bones, and would coincide with visiting to the tent of the successful hunter as the group feasted largely until the meat was gone and the group returned to a general condition of famine if fresh game could not be located (Leacock and Rothschild 1994; Loring 1992:201). There was little consideration of storing large caches of surplus meat instead the Innu favored the short term storage of dried meat and bone grease to ensure the ability to transport, rather than cache, surpluses (Loring 1992:180-193). This reliance on short-term, transportable stores and the cultural practice of *mokoshon* serving to distribute surpluses among the social group suggest that rationing meat

across long periods of time was not a large component of Innu economic organization. Julius Lips (1947:9) after undertaking ethnographic research among the Innu apparently struggled with reconciling this very point within his own western capitalist worldview when he remarked “Psychologically, the individual Indian, as long as his exchanged supplies are still abundant, is not very much inclined to worry about possible shortages of the future, since planning for the future is more or less foreign to his mind.”

Bird-David (1992) places this feast or famine behavior of the Dene and Innu into a humanistic context by arguing that foragers view hunting as a social event instead of a rational economic act. Thus hunting is not perceived as an extractive enterprise, but rather is viewed in the context of interacting, or socializing, with supernatural agencies. A successful hunt becomes an important social event and meat is freely shared with any and all who are present until supplies run out. In contrast, the Nunamiut and Caribou Inuit economies are distinguished more by an ideology of storage. When resources are abundant, such as during the spring and fall migrations, instead of engaging in indulgent feasting much of the meat is cached for future use. Sharing was not freely distributed, but instead largely structured through formal kin and non-kin relationships. Similar contrasts among hunter-gatherer economies have been proposed elsewhere under the rubric of immediate-return and delayed-return economies (e.g. Woodburn 1982).

In terms of the generalizing framework of behavioral ecology, Inuit caribou hunters mitigate temporal and spatial discontinuities via practical storage and by engaging in logistical mobility, while Athapaskan and Algonquian foragers relied heavily on residential mobility and social storage to overcome these very same shortages. Some researchers have even argued that the practice of social storage sharing among the Ethen-eldeli reflects the practical difficulties in predicting the location where fall migrations of caribou could be intercepted prior to their

reaching the treeline (Burch 1991; Gordon 1996). The Ethen-eldeli would spread out in a broad front and capture caribou well in excess of the needs of the local group. However, instead of storing this surplus to last through the winter, it was shared with others who did not have such a successful hunt. Once the supply of caribou meat ran out the aggregation would disperse and scattered bands of foragers pursued similarly dispersed caribou bands within the boreal forest throughout the winter (Burch 1991; Smith 1978).

## **Chapter 4**

### **COMPARATIVE ARCHAEOLOGICAL CASE STUDIES**

#### **4.1 INTRODUCTION**

Archaeological instances of caribou hunting provide a second important body of comparative data by affording a direct line of evidence to archaeological signatures of intensive caribou hunting. Although the two archaeologically known instances of caribou hunting reviewed here differ in many respects, they offer the means to address two key questions. First, are there generalizeable characteristics of the archaeological record produced by intensive caribou hunting? And, secondly, are there identifiable sources of variability related to ecological or cultural factors that can serve to better inform the model developed in this study?

Because the principal goal of this chapter is to provide comparative information regarding the archaeological manifestation of caribou hunting, particular attention will be paid to the relationship between a caribou hunting economies at different scales of analysis. At the regional scale the organization of settlement, mobility, and lithic raw material provisioning strategies will be discussed. Complementing regional scale information will be site and assemblage level information concerning site layout, assemblage diversity and richness, and the organization of the lithic technological system.

The late pre-contact Taltheilei tradition of the Canadian barren-grounds practiced a caribou hunting economy that is the precursor for the historic Ethen-eldeli herd following adaptation discussed in chapter three. Given the ecological context of the Canadian barren-grounds and the clear continuities with historic Dene peoples, the near exclusive predation of barren-ground caribou can be inferred for the late pre-contact Taltheilei. The second body of



comparable archaeological data comes from the Magdalenian tradition of north-central Europe. Available faunal evidence suggests that Magdalenian peoples occupying the Paris Basin of France and Rhine basin of southwest Germany preferentially exploited caribou throughout much of the year while relying on horse predation in a secondary manner. Perhaps equally as important is that, like Great Lakes Paleoindians, Magdalenian foragers of north-central Europe were responding to late Pleistocene environmental changes.

#### 4.2 TALTHEILEI TRADITION: BARREN-GROUND HERD FOLLOWERS

The ethnohistoric record of peoples occupying the barren-grounds of central Canada was presented in the previous chapter and showed that prior to the mid-eighteenth century the Ethen-eldeli were widely distributed throughout the region. The historic Ethen-eldeli routinely engaged in a long distance, residential movements between the tundra and transitional forests as part of an economy centered on the predation of the Beverly and Kaminuriak caribou herds. The main focus of this economy was to employ residential mobility as a strategy of maintaining year round contact with the caribou herds (Burch 1991; Gordon 1996). In this context, residential mobility and food sharing served as the primary risk mitigating strategies while practical storage was practiced rarely and only on a short-term basis (Friesen 2004).

Supplementing information from the ethnohistoric record is a growing body of historic archaeological data that corroborates the eighteenth century abandonment of the barren-grounds by ethnic Dene followed by the inland expansion by ethnically Inuit peoples (Friesen 2004; Gordon 1996). This archaeological record also shows convincing evidence for continuity between early historic Ethen-eldeli sites and late pre-contact sites of the Taltheilei tradition (Gordon 1996:56). Such continuity is strongly suggestive that the archaeologically known

Taltheilei tradition represents a pre-contact example of specialized caribou hunting that employed an economic strategy similar to the historically known Ethen-eldeli herd following strategy.

MacNeish (1951) initially defined the Taltheilei complex during his reconnaissance survey of the Great Slave Lake region. Although he initially proposed an early date for the complex, Noble's (1971) subsequent survey of the region served to further define the Taltheilei complex as a distinctive region wide cultural tradition and clarified the late prehistoric chronological placement of the tradition. The Taltheilei complex is now recognized as spanning roughly the last 2000 years of barren-ground prehistory (Noble 1971). Building upon Noble's (1971) cultural-historical work, Gordon's (1996) summary of several decades of work within the region has helped articulate differences between sites located on the tundra and those located in the transitional forest. Archaeological data pertaining to the Middle (A.D. 200-700) and Late (A.D. 700-1700) Taltheilei phases are considered here.

#### 4.2.1 ORGANIZATION OF SETTLEMENT AND MOBILITY

To date, only limited testing has been possible in this remote portion of central Canada and as a result only coarse scale information pertaining to the organization of settlement strategies is available. Like the historic Ethen-eldeli occupation of the region, Taltheilei sites are distributed widely across both the tundra and transitional forest zones between Great Slave Lake and Hudson Bay. These sites typically cluster along the major rivers and lakes within the region (Gordon 1996). Although survey work has been similarly restricted to major water bodies, Gordon (1996:24) provides some convincing anecdotal evidence to suggest that this distribution does, in fact, reflect a cultural preference rather than sample bias. While more recent survey

work discussed by Friesen (2004) shows that smaller bodies of water away from major river course were also occupied, his findings do not differ appreciably from those of Gordon (1996). In general Taltheilei caribou hunters show a strong preference for inhabiting localities near water that afforded good opportunities to intercept bands of caribou that, because of the local topography, were forced to pass nearby (Friesen 2004:307; Gordon 1996).

The overall distribution of Taltheilei phase sites extend across a considerable portion of the Canadian Interior. Based on Gordon's (1996) summary of Taltheilei components, the territory occupied extends across nearly 800 linear kilometers in a general northeast-southwest manner. Spatially this would include a remarkable 100,000 km<sup>2</sup> of territory (adapted from Gordon 1996:87, Figure 5.1). Certainly the whole of this territory was not traversed annually, but given our knowledge of the erratic movements of caribou (Burch 1972; Spiess 1979) it should come as little surprise that such a large territory was inhabited. In fact, a territory of this size is certainly not much larger than those occupied by caribou hunters known from the historical record (Burch 1972:350,1991). It is also likely that such an exceedingly large territory evidenced by the archaeological data reflects inter-annual variation in range and that only a fraction of this space was exploited during any one year (Ellis 2011).

The limited site level data includes survey work at Lake Athapaska (Wright 1975), Lake Aberdeen (Wright 1974), Skinny Lake (Friesen 2004), and the Migod site (Gordon 1976). Because many of these sites contain both structures and unifacial tools, it is reasonable to argue that movements across this large territory included the entire domestic unit. Based on the available, albeit limited, data Taltheilei mobility does appears to be primarily residential in organization. These data include rather uniform measures of assemblage richness and evenness among Taltheilei sites (Table 4.1) that would suggest that absence of many special purpose sites

that would be characteristic of hunter-gatherers emphasizing logistical mobility. However, it is fair to note that until systematic surveys include higher resolution data regarding internal site patterning it is difficult to ascertain how important logistical mobility was within the Taltheilei economic system (Friesen 2004:305). Nevertheless, the emphasis on residential mobility seen in the archaeological record corroborates the suggestion that the historic Ethen-eldeli mobility system described in chapter two was in place during the Taltheilei period (Burch 1991; Burch and Smith 1979). Likewise, both Gordon (1996:12) and Friesen (2004:306) note the general dearth of meat caches associated with Taltheilei sites, which contrasts with the prevalence of meat caches on historic Caribou Inuit sites. The absence of meat caches certainly suggests that Taltheilei bands mitigated risk via risk pooling or food sharing rather than through practical storage.

When these aspects of the Taltheilei archaeological record are viewed as a whole there is little archaeological data to dispute the notion that the historic Ethen-eldeli settlement system was in place by the onset of the Taltheilei tradition, an observation echoed by Gordon (1996). Certainly during the Middle and Late Taltheilei phases examined here it is apparent that long distance residential movements onto the tundra did occur (Friesen 2004; Gordon 1996; Wright 1974). The clear clustering of large sites near the tree line is also reminiscent of the strategy to intercept caribou during their fall migration prior to their reaching the treeline (Gordon 1996). The size and repeated occupation of the Migod site, at a major water crossing near the treeline, attests to the prevailing importance of both the locality and the fall caribou hunt (Gordon 1976). Similarly, the Skinny Lake tent rings discussed by (Friesen 2004) is also positioned at a locality suitable for intercepting migrating bands of caribou and the distribution of surface features there suggests the aggregation of multiple local bands for this purpose. Subsequent to the fall caribou

hunt, the regional band would disperse throughout the forest zone in order to hunt caribou and other available game (Gordon 1996). The small size, but wide distribution, of Taltheilei sites tested by Wright (1975) on the east end of Lake Athabasca corroborates the interpretation that through winter and early spring dispersed groups practiced a high degree of residential mobility within the transitional forest (Burch 1991; Friesen 2004; Gordon 1996; Wright 1975).

#### 4.2.2 SITE LAYOUT AND STRUCTURE

Large scale horizontal excavations are generally absent due to the logistical difficulties in conducting archaeological field work in the region. This unfortunately precludes the ability to infer much about the spatial organization of Taltheilei sites. However, the noted size and density of materials at the Migod site have led Gordon to suggest short term regional band aggregation near the treeline (Gordon 1976, 1996:12) and the Skinny Lake tent rings are similarly suggestive of aggregation by a regional band (Friesen 2004:307). In contrast, only two house basins were excavated at Aberdeen Lake, which is located well out on the tundra away from the treeline. It is unclear if the two houses were ever occupied contemporaneously (Wright 1994). Similar to small tundra sites, Taltheilei sites located south of the treeline also have largely failed to produce evidence of aggregation or long-term occupation (Gordon 1996; Wright 1975).

#### 4.2.3 USE OF LITHIC RAW MATERIALS

Taltheilei lithic assemblages are characterized by the use of locally available silicified shale and quartzite. Because these materials are easily accessible as cobble sources widely distributed in glacial tills, it is difficult to relate population movements with raw material distribution. One exception is a distinctive variant of red quartzite from Eyeberry Lake in the

upper Thelon River that appears in Taltheilei phase components at Lake Athabasca (Gordon 1996:11; Wright 1975) and the Migod site (Gordon 1976). The presence of this barren-ground lithic raw material at Migod and south of the treeline at Lake Athabasca is suggestive of the long distance seasonal movements between the two ecological zones.

Table 4.1. Summary of point breakage and length data from Taltheilei sites  
(data from Gordon 1996:275-332)

		Forest	Tundra
Late Phase	Complete	125	45
	Broken	103	86
	mean length	44.42	47.79
	s.d. length	12.68	13.1
	CV	28.5	27.4
Middle Phase	Complete	44	93
	Broken	69	222
	mean length	58.22	66.28
	s.d. length	17.43	15.1
	CV	29.9	22.8
Aggregate	Complete	169	138
	Broken	172	308

#### 4.2.4 ORGANIZATION OF LITHIC TECHNOLOGY

Table 4.1 summarizes site level data from excavated Taltheilei phase sites and data assembled by Gordon (1996:275-332) pertaining to general differences between forest and tundra sites. Projectile points, bifacial knives, scrapers, and adzes comprise the majority of formal, curated tools recovered from Taltheilei phase sites, while more expedient, informal tool types, such as wedges, flake scrapers, and utilized/retouched flakes, are also common in the

assemblages (Gordon 1976, 1996; Wright 1974, 1975). Core forms vary widely but typically include platform and cobble/bipolar cores. Bifacial cores, while noted, are an apparently minor component on sites (Gordon 1996). Blade cores are also absent from Taltheilei assemblages (Gordon 1996).

Table 4.2. Results of chi-squared tests comparing frequencies of broken and complete points between tundra and forested zones

Phase	$\chi^2$	df	p
Late Phase	13.988	1	0.000
Middle Phase	3.387	1	0.066
Aggregate	28.156	1	0.000

Breakage patterns on the hafted bifaces recovered from tundra sites indicate they are much more likely to be discarded in a broken state than points recovered south of the tree line. Chi-square tests confirm that this pattern is statistically significant (Table 4.2). Likewise, of the complete points, those discarded in the forest zone were probably resharpened to a much greater extent than their tundra counterparts. This is evidenced by the generally shorter length on discard. In contrast, the longer length of complete points discarded at tundra sites would suggest that these bifaces had considerable utility left on them when discarded from Taltheilei toolkits. Finally, continuity in the structure of these data from the Middle to Late Taltheilei phases suggests that such patterning is a cultural, rather than a sampling, phenomena.

There are several explanations that can account for these data. The most obvious is that use of points on the tundra is more likely to result in accidental breakage when compared to the transitional forest. Certainly there is more exposed rock out on the tundra that would make points

prone to breakage. However, there is still a considerably high degree of chance involved with this explanation. Likewise it also does not account for the active decisions not to re-tip broken point bases while out on the tundra, when it is apparent that utility remained on longer bases and that such reworking did, in fact, occur on points in the forest zone.

An alternative explanation is that seasonal differences in Taltheilei economies were dissimilarly influencing decisions about how to manage lithic tool-kits. As noted above, a distinct seasonal organization to Taltheilei settlement and subsistence has been proposed and is based on the direct historical method that suggests groups employed a herd following economy involving long distance movements out onto the tundra during the summer, interception of caribou herds near the treeline during the fall, and subsequent wintering inside the transitional forest (Burch 1991; Gordon 1996). There are several dimensions to the Taltheilei economy that should influence the design and management of lithic toolkits and by extension the Taltheilei archaeological record. For instance, during late spring through early fall bands of Taltheilei would be moving out onto the tundra. As Burch's (1991) analysis would suggest movement during this period included a high frequency and magnitude of mobility. From an organization of technology perspective it has been argued elsewhere that during episodes of high residential mobility there is a greater importance placed on time management (Ellis 1989; Fisher 2000; Torrence 1989). In this instance then it is suggested that time would become the primary consideration that influences not only the design of lithic toolkits, but also influences decisions regarding the management of lithic toolkits. Time management influences lithic economies in several predictable ways. First, the design of curated tools would reflect an emphasis on maintainability (Bleed 1989). Secondly, we can expect the consistent supplementation of expediently produced tools and by extension a more embedded procurement of lithic raw



materials (Ellis and Spence 1994). More so in the absence of any additional cultural constraints high mobility across a landscape that affords a relatively equal access to raw materials may also result in a less selective preference for lithic raw materials, although this is certainly not always the case (Ellis 1989).

Placing additional strain on the organization of toolkits among a herd following economy within the barren-grounds of central Canada is the fact that the fall caribou hunt represents the most critical point in the overall seasonal round. Interception of migratory caribou is not only critical for supplying fat and protein, but it is at this point in the year that caribou hides are also at their most optimal state. Because of the punctuated nature of the fall caribou hunt, there should be a high importance attached to the reliability of lithic toolkits utilized during this short, but intensive, episode (Bleed 1989). Ethnographic data points toward a strategy where caribou herds migrating southward during the fall were intercepted on the barren-grounds near the historic treeline (Smith 1978). The archaeological record provides evidence for a similar land use strategy during the Taltheilei tradition. The larger known Taltheilei localities that exhibit evidence for repeated occupation, such as Migod (Gordon 1976), Pikes Portage (Noble 1971), Skinny Lake (Friesen 2004) and Taltheilei Narrows (MacNeish 1949; Noble 1971), are all positioned near the treeline. While this patterning may be an artifact of the restricted survey methodology employed within the region, it is telling that when Taltheilei components have been identified away from the tree line, in either direction, those sites appear to be more indicative of small, highly mobile groups (Friesen 2004:306-307; Gordon 1996; Wright 1971, 1975).

Between the fall caribou hunt and prior to the spring migration northward ethnographic data also indicates a high degree of residential mobility. Again this suggests that toolkit maintenance becomes a greater concern in regard to the management of lithic tool-kits.

Additionally, winter should also be the period where access to fresh tool stone will be the most limited with snow cover making it difficult, though not impossible, to access raw material sources. Similarly, some ethnographic data suggest a greater reliance on bone and wood tools during the winter (Ellis 1997).

The higher frequency of point breakage suggests that, while out on the tundra, Taltheilei hunters were seemingly indifferent to reworking broken points. The availability of fresh tool stone may have meant that broken tools were able to be replaced with new ones rather than reworking broken ones. Although availability of tool stone does not necessarily mean replacement will occur in favor of reworking (Ellis and Spence 1994). More so, it is very likely that any tool-kit management decisions made while out on the tundra took into consideration the upcoming and eminently critical fall caribou hunt. The need for a well provisioned and reliable tool-kit during the fall hunt could provide the necessary incentive to replace a broken tool rather than rework it. In much the same way the discard of longer points retaining some utility would also reflect a desire to keep toolkits in a maximum state of repair prior to the fall caribou hunt. As Table 4.1 demonstrates both of these characteristics are, in fact, observed among the Taltheilei archaeological record.

During the subsequent winter months there would be less of an emphasis on tool replacement that, in conjunction with a greater difficulty in accessing fresh tool stone due to snow cover, would result in management decisions favoring the reworking of broken tools. This is evident in both the shorter length of complete tools and less frequent discard of broken tools suggesting that considerable reworking and recycling did occur. As a result those tools that do enter the archaeological record in the forested zone clearly reflect the greater length of time those tools spent in the toolkit prior to discard.

#### 4.3 MAGDALENIAN TRADITION: PALEOLITHIC INTERCEPT HUNTING

The Magdalenian tradition of western and central Europe spans nearly the entire Late Glacial period with associated radiocarbon dates ranging from 18,000-11,000 BP. Magdalenian foragers were adjusting to major climatic changes while re-colonizing much of central and northern Europe that had been abandoned by human populations during the last Glacial Maximum. Although it is tempting to correlate internal changes in Magdalenian cultural systematics with major climatic fluctuations, recent fine-grained examination have shown that important benchmarks in Magdalenian culture history, such as the re-colonization of southern Germany, occurred prior to instances of rapid climatic change (Housley et al. 1997; Jochim et al. 1999). Nevertheless, other analyses have clearly demonstrated a link between the organization of Magdalenian stone tool technology and the structure of the regional environments inhabited by Magdalenian foragers (Fisher 2000, 2006).

Of particular relevance to this study is the strong link that has been made between the importance of caribou predation and Upper Magdalenian peoples occupying the Paris Basin of northern France between 13,000-11,000 BP (Audouze 2007; Audouze and Enloe 1998; Enloe 1997; Taborin 1994; Valentin and Pigeot 1997). Comparable evidence for caribou predation is also present from Magdalenian assemblages within southwestern and central France (Boyle 1990; Gordon 1988; Grayson et al. 2001; Spiess 1979), the Rhine Basin of southwest Germany (Fisher 2000; Floss 2000; Jochim et al. 1999; Weinger 1989), the contemporaneous Hamburgian tradition of northern Germany and southeastern Scandinavia (Bratlund 1996), and, to a lesser extent, from the Creswellian tradition of southern England (Jacobi 2004; Stevens et al. 2010). Although evidence from these other regions will be discussed in a supporting manner, the primary focus here is on sites from the Paris Basin that, almost uniquely so, contain abundant

evidence for a specialized caribou hunting economy from multiple, well-preserved archaeological contexts.

#### 4.3.1 MAGDALENIAN SUBSISTENCE ECONOMY: AN OVERVIEW

Magdalenian economies throughout western and central Europe are commonly interpreted as having a strong focus on the hunting of large game mammals (Audouze and Enloe 1991; Bignon 2006; Grayson et al. 2001). When viewed in its entirety Magdalenian hunting strategies appear to be remarkably diversified with faunal assemblages including the remains caribou, red deer, horse, bison, ibex, moose, mammoth, woolly rhinoceros, musk-ox, and chamois (Boyle 1990; Grayson et al. 2001; Pike-Tay 1991; Straus 1999). Of these species caribou, red deer, and horse were clearly the most economically important species in central Europe (Audouze and Enloe 1991; Bignon 2006; Fisher 2000; Jochim et al. 1999; Pike-Tay 1991), while ibex and red deer were the basis of large game hunting economies in Cantabria Spain (Straus 1999). What is apparent is that Magdalenian faunal assemblages are often dominated by certain species of large game mammals and that these reflect local (and/or seasonal) abundances in those species (Bignon 2006; Grayson et al. 2001; Pike-Tay 1991).

Despite the popular image of caribou hunting and abundant large mammal fauna from Magdalenian sites, interpretations of Magdalenian economic organization have undergone serious revision in recent decades. Some have even argued against interpreting these faunal assemblages as reflecting intensive large game hunting in the first place (Kornfeld 1996). Kornfeld (1996) presents a model that stresses the greater exploitation of plant and shellfish resources in Cantabrian Spain. Likewise, there has been some debate regarding the importance of aquatic resources, namely salmon, as a staple resource among Magdalenian subsistence

economies (Hayden et al. 1987; Jochim 1983). While others have suggested that small game such as hare also made a significant contribution to the diet of Magdalenian hunters at different points in time (Jones 2007). The extent to which Magdalenian hunter-gatherers relied upon small game, plants, and aquatic resources is presently open to debate, yet few would argue against to notion that they provided an important, albeit, secondary component to subsistence economies. However, the majority of researchers working with Magdalenian assemblages still consider the hunting of large game mammals to be the primary economic focus.

Specialization within Magdalenian hunting strategies has also received a great deal of attention. It is common for individual faunal assemblages to be dominated by a single species, which is frequently viewed in terms of specialized hunting tactics. Yet, interpreting the meaning for such dominance is not always straightforward and single species dominance also has been viewed as reflecting local level environmental change as opposed to hunting specialization (Grayson et al. 2001). For instance, the transition from caribou to red deer dominated fauna in southwest Germany between 13,000 and 11,000 BP clearly reflects the encroachment of woodland environments and northward retreat of the park/tundra ecotone (Fisher 2000; Jochim et al. 1999). However, the question is whether or not hunting strategies were specialized for the pursuit of a particular species. For instance, Gordon (1988) argues that specialized hunting tactics for the interception of migratory caribou herds is the basis for the overwhelming dominance of caribou among French Madgalenian assemblages, a view commonly shared among many researchers working with Magdalenian assemblages in north-central Europe (Audouze and Enloe 1997; Bratlund 1996; Fisher 2000; Jochim et al. 1999; Thacker 1997; Weinstock 2002). Still others, most notably Grayson et al. (2001), argue that increased encounter rates of caribou, caused by a decline in the frequency of other species during a period of climatic cooling, is

responsible for the sharp increase in caribou remains observed among assemblages in southwestern France. Implicit in Grayson et al.'s (2001) discussion is that increased percentages of caribou within faunal assemblages would occur irrespective of any organizational changes in hunting strategies such as a herd following or herd intercept strategy.

The view advocated by Grayson et al. (2001), if applied to assemblages in north-central Europe, is seemingly in contradiction to several other lines of evidence. First, Bratlund's (1996) analysis of hunting lesions on caribou from Stellmoor and Meiendorf in northern Germany suggest the intercept hunting of swimming caribou. Secondly, this interpretation is further supported by the topographic location of the sites of Stellmoor and Meiendorf within a tunnel valley that would serve to channel game movements. Similar topographic settings for large caribou hunting sites are repeated among Magdalenian sites in both the Paris Basin of France (Audouze and Enloe 1991) and Rhine Basin in southwest Germany (Jochim et al. 2000; Weinger 1989). The fact that sites located away from the major river valleys in both areas contain evidence for horse predation also suggest that topographic positioning of lowland sites are indeed related to hunting strategies (Audouze 2007; Weinger 1989). This would suggest that the open air sites of north-central Europe located in major alluvial valleys were situated specifically to intercept migratory caribou herds. Lastly, age-sex ratios examined by Weinstock (2002) are suggestive that selective predation strategies were, in fact, being utilized by Magdalenian hunters. When the available body of data is viewed collectively, the emergent picture of Magdalenian subsistence economies in north-central Europe is one of specialized caribou hunting supplemented seasonally by horse predation.

#### 4.3.2 PARIS BASIN MAGDALENIAN

In light of the available evidence, it is reasonable to suggest that Magdalenian hunters occupying north-central Europe between 13,000 – 11,000 BP employed organized hunting tactics to specifically prey upon migratory caribou herds. Archaeological data reflecting this aspect of Magdalenian subsistence economies is perhaps most apparent within the Paris Basin of France. Evidence for intensive caribou hunting in the Paris Basin comes from several well documented sites including Etiolles (Audouze 1987; Olive 1992), Marsangy (Audouze 1987; Valentine and Pigeot 2000), Pincevent (Audouze and Enloe 1991; Enloe 1991; Enloe et al. 1994; Leori-Gourhan and Brezillon 1972), and Verberie (Audouze et al. 1991; Audouze and Enloe 1997; Enloe 1997; Enloe and David 1997). Each of these sites contains identifiable living floors and, at Pincevent and Verberie in particular, an overwhelming dominance of caribou remains. The importance of Pincevent and Verberie are that both provide high resolution data regarding intensive caribou hunting activities within the Paris Basin (Audouze and Enloe 1997).

Pincevent, located in the alluvial plain of the Seine River near its confluences with the Loing and Yonne Rivers, possesses several discreet living surfaces that have been professionally excavated (Leori-Gourhan and Brezillon 1972). These living surfaces reveal the repeated occupation of the locality by Magdalenian caribou hunters and analysis of the caribou remains from Pincevent provides important observations regarding hunting strategies practiced by Magdalenian foragers in the Paris Basin (Enloe 1991). The wide range of anatomical elements present in the Pincevent assemblage, including vertebrae and other low utility parts, is suggestive that kills were made nearby rather than being introduced to the site secondarily through transport or meat caches (Enloe 1991; Enloe et al. 1994). The proximity of the kill location to Pincevent did not preclude the transport of low utility elements back to the site, although the absence of

articulated vertebral columns suggests that some, albeit limited, field butchering probably occurred off site (Enloe 1991, 1997:96). The close clustering of tooth crown data and absence of fetal or newborn calf remains is suggestive that individuals were introduced to site in close succession sometime during September through November, indicative of the interception of migrating bands of caribou (Audouze and Enloe 1991:65; Enloe and David 1997:62).

Verberie is located roughly 100 km north of Pincevent along the Oise River and represents the most northerly of the known Paris Basin Magdalenian sites (Audouze et al. 1981). Tooth crown and eruption data indicate a consistent mid-August to mid-October age for many of the individuals entering the Verberie record (Enloe 1997:99; Enloe and David 1997:63). The tooth crown data, along with the demographic structure of the faunal assemblage, is consistent with the notion that the predation of caribou at Verberie was also associated with intercept hunting during the fall migration (Audouze and Enloe 1991:65). The presence of articulated vertebral columns positioned alongside empty areas appears to represent instances of primary butchering of caribou from a nearby kill site, in much greater proximity than at Pincevent (Audouze and Enloe 1991:66; Enloe 1997:96).

Complimenting the numerous valley sites are a more restricted number of sites located along upland slopes. Of these sites Les Tarterets and Ville-Saint-Jacques are the best known and contain diverse faunal assemblages dominated by horse rather than caribou (Audouze 2007; Bignon 2006). The dominance of horse is not surprising as these areas would be located further away from predictable caribou migration routes and mirror data from Germany (Weinger 1989). Seasonality data is less clear from these upland sites, but it is assumed they represent winter and early spring occupations when caribou would be the least available in the region (Bignon 2006).



#### 4.3.3 STORAGE, FOOD SHARING, AND MOBILITY

While the large faunal assemblages at Pincevent and Verberie provide ample evidence to infer the intercept hunting of caribou herds during the fall migration, inferring the overall organization of Paris Basin Magdalenian subsistence economies is less clear. Risk minimization and mobility are two important strategies that are part of the overall economic system. Key questions that remain are what types of risk minimizing strategy were practiced? And how is mobility integrated within the economic system?

As discussed in chapter three, intensive caribou hunting societies are known to rely to different degrees on practical storage as a risk minimizing strategy. While the Nunamiut in particular invested heavily in accumulating stores of caribou meat to overcome scheduling conflicts in the availability of caribou, this is not always the case (Binford 1980). Nunamiut ethnography certainly makes it apparent that food was generally stored and moved to consumers when needed (Binford 1978, 1980). To a lesser extent the Caribou Inuit also relied on practical storage, however, the availability of fish was certainly an important alternative (Arima 1984). Inuit caribou hunting economies involving a moderate or heavy investment in food storage stand in sharp contrast to the traditional Ethen-eldeli and Innu herd following adaptations where only a minimal and short-term investment in food storage was likely ever practiced (Rogers and Leacock 1981; Smith 1981). Rather than store food, the Ethen-eldeli, as well as other northern Athapaskan and Algonquian caribou hunters, minimize risk by engaging in the widespread sharing of food between local bands. As a result, the strategy tended to be one of moving consumers to food. Mobility strategies also differed among these two general caribou hunting economic systems. For those groups reliant upon food stores the tendency is for food to be moved to consumers, meaning only producers would practice a significant degree of mobility.

This is frequently described as logistical mobility and, in fact, the Nunamiut serve as the archetypal example of logistically organized hunter-gatherers (Binford 1980). In contrast, mobility among northern Athapaskan and Innu caribou hunters involved both producers and non-producers where, generally speaking, the entire residential unit is mobile.

Evidence for the practical storage of caribou meat is limited within the Paris Basin archaeological record. Enloe and David (1997, see also Enloe 1997) cite Binford's (1978) data on Nunamiut butchering practices to argue that the low frequency of distal rib fragments and cut mark distribution suggests the preparation of rib slabs for storage. However, even Enloe and David (1997:64) freely admit that the rib element data is equivocal and, to date, evidence for meat caches remains conspicuously absent from the Paris Basin Magdalenian archaeological record (Audouze 2007:11-12). Even if rib slabs were being prepared for storage, these apparently are the only anatomical units that reflect this strategy, suggesting that if storage was practiced it was limited and possibly only short-term in scope. Likewise, when viewed as a whole there is almost no evidence for the large scale, systematic preparation of caribou (or horse for that matter) for long term storage, along with a general absence of storage features on Paris Basin Magdalenian sites (Audouze 2007).

Evidence for food sharing is more apparent. Detailed faunal analysis involving carcass refitting at Pincevent (Enloe et al. 1994) and Verberie (Enloe 1997) have demonstrated the repeated movement of large meat packages between hearths and are thought to reflect the sharing of meat between households. Although inter-household sharing is clearly apparent among the faunal remains at Pincevent, the importance of sharing at Verberie is similarly evident and demonstrates the varied social contexts that food sharing took place within (Enloe 2004). The picture that emerges, at least at Pincevent and Verberie, is the interception of migrating caribou

during the fall, with several residential units (local bands?) camped near the kill. Caribou were consumed and meat shared between those residential groups present (Enloe 2004). From this perspective risk pooling behavior such as sharing, as opposed to risk assuming behavior like food storage, appears to be the primary risk minimizing mechanism practiced among the Paris Basin Magdalenian.

Mobility strategies are more difficult to interpret, however, in a recent summary Francoise Audouze (2007) argues for a “serial specialist” model that suggests Paris Basin Magdalenian caribou hunters tended to emphasize residential mobility. According to his “serial specialist” model, there is little faunal data to indicate the transport of meat back to base camps by special task groups (Audouze 2007:10-11). Secondly, in nearly every instance sites contain archaeological signatures such as amateur flintknapping and non-extractive tools that suggest the presence of the entire residential group and not just a specialized task group (Audouze 2007:9-11). Thus, while earlier interpretations have favored a collector model, based largely on analogy with Nunamiut butchering practices (Audouze and Enloe 1991, cf. Binford 1980), reanalysis of the available data support a “serial specialist” model suggesting the norm was for residentially mobile groups occupying the region year round. These groups subsisted primarily on caribou, which was supplemented by horse hunting during late winter and early spring (Audouze 2007).

#### 4.3.4 ECONOMIC ORGANIZATION OF PARIS BASIN MAGDALENIAN

Despite limited evidence for the removal of rib slabs, possibly for short-term storage through drying, there is no data supporting a large scale investment in storage to overcome temporal discontinuities in caribou availability (Audouze 2007:7). At least among the ethnographically known caribou hunting societies surveyed in the previous chapter, food storage

is a risk minimizing strategy that is more closely associated with a logistically organized mobility system. Instead, Paris Basin caribou hunters appear to have employed a residentially organized mobility strategy and engaged in food sharing as their primary risk minimizing strategy (Audouze 2007:14-16).

The revised picture of Paris Basin Magdalenian that has emerged is also more in line with interpretations for Magdalenian subsistence strategies within adjacent portions of north-central Europe. Holliday (1998:718) draws upon a similar ethnographic base as Audouze (2007) when he suggests Late Glacial foragers of southwest Germany practiced an “edge of woods” strategy that involved residential movements along the forest edge and out into an open parkland or tundra zone. According to Holliday (1998) Magdalenian groups would have been able to exploit concentrations of resources near the forest edge and utilized residential mobility, instead of food storage, to overcome scheduling conflicts by moving from resource patch to resource patch. Fisher (2000:23-27) greatly expands upon Holliday’s (1998) “edge of the woods” model to also emphasize the importance of residential mobility among Magdalenian foragers within southwest Germany. Her work is important in the sense that she was able to draw in data from the archaeological record to show that changes in lithic technology from the Magdalenian through the Mesolithic correspond to the shift away from an “edge of the woods” strategy (Fisher 2000, 2006).

#### 4.3.5 SETTLEMENT AND MOBILITY STRATEGIES

Like most intensive caribou hunting societies, the predation of caribou during the Paris Basin Magdalenian included the interception of migrating caribou during the fall (Audouze and Enloe 1991:65). Consequently the importance of the fall caribou hunt had a significant effect on

Magdalenian settlement patterns within the Paris Basin (Audouze 1987; Audouze and Enloe 1991; Enloe and David 1997). These fall hunting sites exhibit several commonalities including their location in the major alluvial valleys and multiple re-occupations of the same locality during the same season (Audouze and Enloe 1991:64-65). These two characteristics make them comparable to the ethnographically known fall hunting sites surveyed in the previous chapter that also show a repeated fall occupations of certain topographically circumscribed localities, namely major water crossings.

Aside from the well documented interception of migratory caribou during the fall, the remaining components of Magdalenian settlement and mobility strategies are less clear. However, there is enough data to reconstruct the year round occupation of the region that included residential movements within the major alluvial valleys and along the upland slopes on the margins of the Paris Basin (Audouze 2007). Archaeological data suggests that the use of these zones coincided with different economic goals, and may have been patterned seasonally (Audouze 2007:7-9; Bignon 2006:197).

Predation of horse also occurred virtually year round, although, seasonality data suggest that there is a peak in horse hunting during late winter and early spring (Bignon 2006:198). This would be a period when caribou would be either least available or least desirable (Spiess 1979). In fact horse overwhelmingly provided the bulk of the useable meat introduced to the sites of Le Grand Canton and Tureau des Gardes (Bignon 2006). However, the abundant horse remains at both sites have been introduced to the site at different points during the year and best reflect the continuous, opportunistic predation of horse herds (Bignon 2006:197).

Additional sites located in the alluvial valleys include Etiolles and Le Tarterets where a diverse and limited fauna suggest a spring occupation (Audouze 2007:8). There is clear evidence

that Etiolles served as an important locality for the procurement and reduction of high quality flints (Coudret et al. 1994; Olive 1992). The uplands on the margins of the Paris Basin were also utilized by Paris Basin Magdalenian peoples and include the occupation of several southern facing caves in the Arcy-Sur-Cure region of the Yonne River (Schmider et al. 1995). Like Etiolles and Le Tarterets, faunal remains from La Lagopede and La Marmotte are diverse and indicate the exploitation of small game animals, including marmot and hare, along with caribou and horse (Bignon 2006:191; Schmider et al. 1995:67-70, 91-92). Limited seasonality data suggest the occupation of these caves reflect a winter through early spring occupation (Schmider et al. 1995:70).

Lithic raw material procurement strategies corroborate the seasonality data by also reflecting a general pattern of the year-round occupation of the Paris Basin (Mauger 1994; Schewenger 2006). Sourcing of lithic raw materials consistently shows that the primary raw materials utilized by Magdalenian peoples were acquired within the local vicinity of each site (Mauger 1994:79). Most sites possess evidence for the direct procurement of locally available raw material nodules and, at least in the case of Etiolles, appear to be specifically positioned to be able to do so (Mauger 1994:79-82). Non-local raw materials, when present, were procured almost exclusively from Tertiary and Cretaceous deposits within the Paris Basin (Mauger 1994:88-92). Given the accessibility of high quality flints throughout the Paris Basin, it comes as little surprise that flint was rarely moved in excess of 130 km from their sources (Whallon 2006:268).

These data suggest that the raw materials entering the lithic technological system were either directly procured from regional sources (Mauger 1994:92) or had been circulated through a regional scale exchange network (Schewenger 2006). At Pincevent curated raw materials were

transported onto the site from sources less than 100 km from the site, albeit from multiple directions (Mauger 1994:90-91). While speculative, I feel that the Pincevent data is best viewed as reflecting the aggregation of multiple local bands or hunting units (cf. Helm 1965) at the site for the purposes of hunting caribou during the fall migration. From this perspective the appearance of curated raw materials from different directions signifies previous movements within the Paris Basin by local bands prior to aggregation at Pincevent. Multiple contemporaneous hearths at Pincevent and Verberie also suggest aggregation for an economic purpose. In contrast, at Etiolles there are contemporaneous hearths in one level while single hearths are present in other levels (Olive 1992) and suggest that, aside from the fall caribou hunt, there was considerable fluidity in the aggregation and dispersal of local bands for both economic and non-utilitarian purposes (Whallon 2006). Thus, when viewed as a whole, the spatially bounded movement of Paris Basin raw materials suggests a roughly 25,000 km<sup>2</sup> area (Figure 4.2) that was utilized by what would appear to correspond to a regional or maximal band (Kelly 1995:209; Whallon 2006; Wobst 1974).

#### 4.3.6 INTER-SITE PATTERNING

Open air sites within the alluvial valleys of the Paris Basin are remarkable for their degree of preservation and in several instances have allowed for detailed pictures of intra-site activities to be reconstructed (Audouze and Enloe 1997). Included in these reconstructions are notable domestic spaces, lithic workshops, zones of butchering, and areas of food preparation and consumption. Domestic spaces often include central hearth features (Audouze 1987), the patterned manufacture of stone tools with the signatures of both specialists and non-specialists (Audouze 2007; Coudret et al. 1994), faunal evidence reflecting the sharing and consumption of

meat (Enloe 1991), and in some cases evidence for the cleaning out of these spaces (Leroi-Brezillion 1979; Olive 1994). Specialized lithic activity areas are also distinguishable as clusters of lithic debitage, expended cores, and rejected byproducts of manufacture (Coudret et al. 1994; Olive 1992).

Detailed analysis of microstratigraphy and systematic refitting has been invaluable for evaluating the relationship of activity areas on individual Paris Basin sites through space and time (Audouze and Enloe 1997). Nearly every excavated site shows evidence for repeated re-occupations and many possess spatially distinct activity areas that appear to be contemporaneously occupied (Audouze 1987). Pincevent has received the most detailed investigations in this direction and has provided considerable data regarding the use of space by Paris Basin Magdalenian foragers (Enloe 1993; Leroi-Gourhan and Brezillion 1979; Simek 1979). In particular, Enloe (1993, 2003) has examined the circulation of caribou elements between eight contemporaneous hearths in Level IV-20 that indicates food sharing between groups of varying spatial (and likely social) distances from one another. There is also evidence for two contemporaneously occupied hearths at Verberie, although food sharing occurred in a different context involving the communal consumption of caribou and disposal of elements in a single large midden (Enloe 2003). The relationship between hearths at Pincevent, and perhaps to a lesser extent Verberie, signifies that multiple domestic groups have aggregated together in conjunction with the fall caribou hunt. The distribution of elements of varying meat utility in Level IV-20 at Pincevent suggests that both producer and non-producer households were present and correspond to an aggregation involving a broad segment of Paris Basin Magdalenian society (Enloe 2003).



Refits between hearths and activity areas have also been undertaken at Etiolles, however the nature of activities carried out there suggest a different pattern of occupation. All total seven domestic hearths and 11 specialized activity areas have been identified at Etiolles (Coudret et al. 1994; Olive 1992). Unlike Pincevent and Verberie where refits indicate the sharing of food between aggregated social units, the refits at Etiolles largely appear to link domestic areas with specialized lithic workshops and were able to track the circulation of cores and tools between these areas (Olive 1992). Although, microstratigraphy has shown that at least some of the domestic areas (P15 and U5) were occupied contemporaneously. Overall there is a circular distribution of the activity areas at Etiolles and some of these areas (P15 and U5) appear to have been occupied contemporaneously. However, site stratigraphy strongly suggests that the circular pattern is an artifact of the sequential re-occupation of the site. Instead domestic spaces appear to be positioned back away from the terrace edge, with related specialized lithic activity areas positioned in front nearer to, and even along, the terrace slope. A linear arrangement of domestic areas along the terrace edge has also been identified at Marsangy (Schmider 1994). At Marsangy evidence suggests that three central hearths were occupied at the same time, while four additional hearths likely represent different occupations of the site. Table 4.3 summarizes data regarding intersite patterning on excavated Magdalenian sites from the Paris Basin.

Table 4.3. Internal patterning on Paris Basin Magdalenian sites

Site	Total Hearths (Contemporaneous)	Activity areas	Organization	Reference
Etiolles	7 (2)	11	Linear	Coudret et al. 1994
Marsangy	7 (3)		Linear	Schmider 1994
Pincevent IV-20	8 (8)		Semi-circular	Enloe 2003
Verberie	2 (2)		Semi-circular?	Enloe 2003
La Lagopede	1 (1)		Singular	Schmider et al. 1995

#### 4.3.7 ORGANIZATION OF LITHIC TECHNOLOGY

Stone tool technologies employed by Paris Basin Magdalenian foragers centered on a sophisticated blade core industry (Audouze 1987). In fact, while Magdalenian lithic assemblages throughout western and central Europe can be accurately characterized as blade core industries, the Paris Basin stands out as being unusually reliant upon the production of long blades (Valentine and Pigeot 2000). These long blades were utilized as tool blanks for virtually the entire lithic tool-kit including points, scrapers, burins, and becs (Audouze 1987). Reliance on blades as blanks for a variety of tool types is not unusual into itself and such flexibility is an inherent advantage of a blade core industry (Fisher 2000; Kuhn 1989). However, within the Paris Basin the near exclusion of irregular flakes and splintered pieces as tool blanks, even in situations where assemblages appear to be suffering from raw material shortages, is unusual (Valentine and Pigeot 2000).

This obsessive reliance on long blades is also reflected in the chain of operations surrounding blade manufacture in the Paris Basin where the unidirectional removal of blades is clearly favored (Valentine and Pigeot 2000). As Valentine and Pigeot (2000) discuss, removal of blades from a prepared core in a single direction takes a great deal more skill than removals from multiple directions. This is because unidirectional cores are more prone to errors that can reduce the life of a single core and often can be difficult to rejuvenate. Yet, when executed properly unidirectional cores can produce a larger number of longer blades when compared to bi-directional blade cores. In other words, Madgalenian flintknappers within the Paris Basin were more interested in the consistent production of long blades to the extent that they were willing to risk ruining cores, rather than adopt a more conservational strategy that would result in the production of smaller blades (Valentine and Pigeot 2000).

Versatility or flexibility is not an adequate explanation for such a reliance on long blades, since even shorter blades are versatile as tool blanks. Likewise, shorter blades can be just as reliable as longer blades if produced in anticipation of intensive periods of activity. From this perspective then the principal trade off for investing risk in the production of longer blades is a reduction in the time needed to maintain the tool-kit. This is because longer blades don't have to be replaced as frequently. Such an emphasis on designing tools to be maintainable is frequently associated with high rates of residential mobility among foragers (Bleed 1989; Kuhn 1994; Torrence 1989).

The timing of blade production is also an important consideration to the overall organization of the lithic technological system. While we observe the production of longer blades as a purposeful action to make tool-kits more versatile and maintainable, it is also important to note that the production of large blades does not appear to be a continuous process. Instead valley sites such as Etioilles and Marsangy are distinguished by the apparent focus on producing large numbers of blades (Audouze and Enloe 1991; Olive 1992; Schmider 1997).

Overproduction of blades most likely reflects the practice of "gearing up" that typically occurs in anticipation of intensive periods of use (Kuhn 1989, 1994). The episodes of gearing up suggested by the assemblages at Etioilles and Marsangy can be contrasted with the production of tools at sites located in upland areas on the periphery of the Paris Basin alluvial valleys. At these sites, such as La Lagopede, Ville-Saint-Jacques, and Le Tartents, there is evidence for the replacement of tools within the lithic toolkit along with subsistence activities (Schmider 1994; Schmider et al. 1995). Rather than reflecting episodes of gearing-up, the archaeological signature at these sites is more akin to the continuous maintenance of toolkits, which result in greater variability and less concentrated episodes of discard (Kuhn 1989, 1994).

While the production of long blades suggests toolkits overall were designed with versatility and maintainability in mind, the scheduling of blade production indicates that, at certain times of the year, ensuring the reliability of the toolkit was an important concern. Organization of the stone tool industry in this manner would be advantageous for an economy centered on the pursuit of a dispersed and mobile prey that is punctuated by one or more episodes of intensive resource procurement. This interpretation is certainly in line with the inferred reliance on caribou and horse by Paris Basin Magdalenian foragers. Throughout much of the year the pursuit of caribou and horse was likely a continuous process. Even the sizeable assemblages of horse from Grand Canton and Tureau des Gardes were accumulated throughout the year, which is indicative of a continuous hunting strategy introducing small numbers of animals during all seasons (Bignon 2006; Enloe 2003:29). Yet, the fall caribou hunt does represent an intensive and critical point in the economic system and analysis of caribou remains from Pincevent and Verberie clearly indicate that numerous individuals were accumulated during a short period of intensive hunting during the fall (Enloe 1993, 2003). Gearing up of the lithic toolkit at the lowland sites of Etioilles and Marsangy can reasonably be viewed as having been done so in anticipation of the important caribou hunting period, while archaeological data elsewhere suggests the continuous maintenance of lithic toolkits during the remaining portions of the year.

Fisher (2000) makes similar observations regarding the organization of lithic technology for Magdalenian foragers inhabiting southwestern Germany. There she sees evidence for the over production of backed blades on lowland sites as reflecting the gearing up of hunting implements in anticipation of an intensive period of caribou hunting (Fisher 2000:273). Overproduction of blades on lowland sites are contrasted to upland sites during the same period

where the continuous maintenance of lithic toolkits appear to be the norm and presumably represent the continuous hunting of dispersed prey (Fisher 2000:273-274).

## **Chapter 5**

### **RESIDENTIALLY ORGANIZED CARIBOU HUNTERS: A MODEL**

#### **5.1 INTRODUCTION**

The model described here outlines a probable set of concerns shared among Late Glacial specialized caribou hunters that would influence decisions about mobility and technological strategies. Given the obvious economic role of stone tools many archaeologists understandably emphasize economic concerns including mobility, diet breadth, foraging efficiency, and risk management as having the greatest influence on the management of lithic technologies. Because such management decisions in general, and decisions to discard tools in particular, lead directly to the formation of the archaeological record, modeling them is the primary goal of this chapter. As important as achieving this proximate goal is establishing bridging arguments to link technological decision making with the material and non-material concerns of Late Glacial foragers inhabiting the lower Great Lakes region.

While we can create a model for the technological organization of northern latitude large game foragers, as Bettinger (1980:196, see also Bamforth 1986:217) points out, our models still need to be adapted to suit a specific local context. For example, let us suppose that both Paris Basin Magdalenian and Great Lakes Paleoindian peoples were responding to the same suite of concerns relating to the changing Late Glacial environment and for the sake of argument let us suppose those concerns led to similar management decisions in regard to their respective lithic technological systems. Our models still need to be adapted to suit the specific local context being investigated because the former employed a blade core technology with ready access to high quality flints distributed widely throughout the landscape, while the latter employed a biface/core

technology in an environment with a much more restricted distribution of lithic raw materials across the landscape. Thus, while the behavior of foragers can be generalized, some behaviors are contingent upon historical and geographical factors unique to a given local context.

## 5.2 ECOLOGICAL PARAMETERS: LATE GLACIAL CARIBOU ECOLOGY OF THE LOWER GREAT LAKES

Recent genetic data suggest that caribou herds present south of the LIS during the last glaciations are likely to be the population that are ancestral to modern woodland caribou and not ancestral to the tundra adapted barren-ground caribou (Flagstad and Roed 2003). This genetic data becomes important when modeling the behavior of Late Glacial caribou herds in the lower Great Lakes because there are notable differences in the scale of migration and aggregation between the woodland and barren-ground sub-species. It is generally recognized that woodland caribou undertake a more limited, at least in term of linear distance, migration. Radio collar data suggest that extant woodland caribou inhabiting boreal forest environments year round migrate at most 100 km annually and much of this wandering occurs among small cow-calf bands (Cumming and Beange 1987; Rettie and Messier 2001). In addition, it is also generally accepted that the size of woodland caribou herds, not to mention individual bands, are consistently smaller than those observed among the barren-ground caribou.

Although genetic evidence is important, generalizations about the behavioral differences between woodland and barren-ground caribou need to be carefully evaluated on a herd by herd basis. The classic barren-ground herds occupying the area west of Hudson Bay do, in fact, undertake extremely long distance (>500 km) seasonal migrations, occupy territories in excess of 120,000 km<sup>2</sup>, and are commonly encountered in very large bands (Thompson and Fischer 1979).

Yet, other herds of barren-ground caribou, such as the Bluenose herd north of Great Slave Lake and the Lorrillard and Wagner Bay herds of the northern Hudson Bay region migrate less than 200 km and occupy territories of less than 50,000 km<sup>2</sup> in size (Heard et al. 1986). In contrast, the George River Herd of Labrador, genetically identified as woodland caribou, undertake seasonal migrations upwards of 200-300 km to utilize calving grounds on the tundra of northern Labrador (Messier et al. 1988). The George River herd inhabits an annual territory in excess of 160,000 km<sup>2</sup>, yet, the nearby Red Wine Mountain herd in adjacent Quebec only migrates about 90 km seasonally and inhabits a territory of 25,000 km<sup>2</sup> (Brown and Theberge 1990). The ranges of individual woodland caribou inhabiting the mid-Boreal upland of central Saskatchewan are even more restrictive and are known to range annually across territories between 200-1200 km<sup>2</sup> in size (Rettie and Messier 2001:1936).

It is obvious that migratory behavior and territory of caribou herds are variable and to some extent are conditioned by population density and environment. The behavior of the George River Herd is perhaps the most pertinent example to our current discussion. Members of the herd are genetically identified as woodland caribou and thus have likely descended from populations that inhabited the area south of the LIS (Flagstad and Roed 2003). However, the migratory behavior of the George River Herd is more similar to the classic barren-ground caribou herds west of Hudson Bay (Messier et al. 1988). This is in part because the George River herd inhabits the relatively open landscape of northern Quebec and Labrador that is comprised of the transitional forest and tundra ecological zones (Brown et al. 1986; Messier et al. 1988). Consequently the herd undertakes long distance migrations between the two ecological zones. Similarly, the genetically related Late Glacial caribou herds in the lower Great Lakes region also inhabited an open landscape dominated by spruce and sedge parkland. In this instance it may be



reasonable to expect those herds to also undertake comparatively large scale migrations within this landscape, particularly in light of seasonality data which will be discussed more below.

Despite variability in the behavioral ecology of caribou, wildlife research has provided some understanding of the underlying causes producing such variability (Brown and Theberge 1990; Ferguson et al. 1988; James and Stuart-Smith 2000; James et al. 2004; Lima and Dill 1990). Overall these causal variables influence the selection of habitat by caribou and the magnitude of their migratory and aggregation behaviors. The ability to discern behavioral patterning is crucial to offering an informed understanding of the Late Glacial behavior of the species in the lower Great Lakes region.

One important causal variable is the observation that caribou behavior appears to be particularly responsive to predator avoidance within specific topographic and environmental contexts (e.g. Lima and Dill 1990). Antipredator strategies employed by caribou vary in regard to their specific environmental context and can include migration, changes in local mobility (e.g. less mobility or erratic movements), spacing from other ungulates, and selection of specific habitats (Bergerud 1996; Bergerud and Page 1987; Ferguson et al. 1988; Fryxell et al. 1988). Likewise, modern radio collar data shows that caribou avoid linear corridors, such as roads, pipe lines, or power lines, within their ranges in part because wolves frequently utilize these corridors to facilitate travel (James and Stuart-Smith 2000). In much the same way the tendency of caribou to migrate either linearly or attitudinally to reach tundra areas for calving in the spring not only allows for relief from biting flies, but also distances caribou from wolves that, at the time, are restricted to a circumscribed area around their dens at the tree line because of their own litters of pups (Skoog 1968).

Likewise, the diet of caribou is remarkably broad and incorporates lichens, sedges, forbs, and deciduous shrubs (Skoog 1968). The ability of caribou to exploit habitats that would be marginal to other species of ungulates is important in the sense that it enables caribou to space themselves from other species of large ungulate (Ferguson et al. 1988; James et al. 2004). Such spacing is a response to the fact that predator populations, namely wolves, are highest in those areas where the ranges of multiple species of ungulate overlap and thus increasing the density of available prey (Schaefer et al. 1999:580). Some have even suggested that ongoing retraction of caribou ranges are strongly associated with recent expansions of moose populations (Bergerud 1996; Seip 1992). Among modern caribou populations this entails avoidance of areas occupied by moose and white-tailed deer. Within the lower Great Lakes region during the Late Glacial period such spacing behavior may have resulted in the avoidance of certain areas occupied by other species of ungulate such as elk, stag moose, and white-tailed deer, along with mammoth and mastodons. In fact, such spacing is somewhat apparent in the general distribution of Late Glacial caribou finds discussed in chapter two (see Figure 2.4).

The widespread availability of sedges within the spruce-sedge parkland would have provided ample habitat for caribou to exploit. In addition, much of the recently de-glaciated terrain would have remained in an early stage of plant succession with poorly formed soils atop glacial deposits such as eskers and drumlins, somewhat similar to north central Quebec today where the remnants of the LSI lingered the latest (Kapp 1999). Considering the known dietary habits of caribou, such a landscape would have provided an important niche for both caribou and probably the American mastodon as well (e.g. Saunders 1996; Saunders et al. 2010). After the landscape began to close and the spruce-sedge parkland became replaced first by an increasingly spruce dominated forest and later by the westward expansion of pine during the Younger Dryas

(Hupy and Yansa 2009). In light of these habitat changes it is possible that caribou shifted their range northward to continue to exploit open areas present within recently de-glaciated landscapes. Alternatively, some herds may have been able to adjust their behavior to exploit the spruce forest year round in a manner similar to modern woodland caribou herds that resided year round the boreal forest (Brown et al. 1986; Cumming and Beange 1987; Rettie and Messier 2001; Stuart-Smith et al. 1997).

The greater seasonality present within the lower Great Lakes landscape also serves as a potential source of influence on caribou movements. Climatic modeling discussed above suggests that colder winters and warmer summers may have persisted throughout the Late Glacial period (Kutzbach et al. 1998; Webb et al. 1998). This is a potentially important environmental variable for a species that is known to undertake long distance seasonal movements. Although temperature itself is unlikely to have a direct influence on caribou movements, the potential to extend the availability of high quality forage by migrating southward could be an important factor influencing movements. In conjunction with greater seasonality, the potential for areas to receive heavy snow cover may similarly influence caribou movements (Pruit 1959). Winter feeding strategies employed by caribou often seek areas with less snow cover that provide greater access to ground lichens (Antoniak and Cumming 1998; Pruit 1959). Greater seasonality, including colder winters, would suggest the potential for snow cover to extend well into spring, a time when having access to quality forage is critical for the survival rate of bucks that begin winter with fat stores already depleted from the fall rut (Skoog 1968).

Lastly, the influence of the physical landscape of the lower Great Lakes on caribou movements has been discussed by several archaeologists (Krist and Brown 1994; Loebel 2006; Stewart 2004; Stork 1982). Both Krist and Brown (1994) and Loebel (2006) view topography as

having a strong influence on structuring the movements of caribou herds. Loebel (2006) for instance suggests that the well developed system of moraines in northeast Illinois would have acted as a natural funnel for migrating caribou herds. Likewise, Krist and Brown (1994) utilized GIS to model least cost paths in order to predict caribou movements in northern Michigan. Certainly within the very wet Late Glacial landscape it is reasonable to expect an emphasis on the use of well drained landforms like moraines and eskers as travel routes (Loebel 2006). However, this also would be true for all terrestrial mammals, including humans, and so should not be used by itself as evidence for caribou predation. In fact, Burch (1972:346, see also Bergman et al. 2000) cautions against the assumption that caribou favored least cost pathways noting:

In the case of tarandus [*Rangifer tarandus*] there is a serious problem because two basic facts about these animals are (1) they can go just about anywhere they please, and that (2) their movements are erratic aside from the broad outlines of the spring and fall migrations. Tarandus are frequently said to follow the lines of least topographic resistance during the course of their annual migrations.... Unfortunately, this is true only when the lines of least topographic resistance and the intended route of movement happen to coincide.

The frequent use of boulder lines, fences, pounds, and communal drives observed in the ethnographic record (Brink 2005; Gubser 1965; Morrison 1981; Osgood 1937; Stewart et al. 2004; Townsend 1911) would certainly attest to the uncertainty accompanying a reliance on topography alone to accurately predict caribou movements.

### 5.3 CULTURAL PARAMETERS: SPECIALIZED CARIBOU HUNTING STRATEGIES

Herd following and herd interception are two strategies employed by specialized caribou hunting societies that were identified in chapter three. Herd following was practiced by Dene and Innu foragers who employed high residential mobility in order to maintain contact with caribou

herds virtually year round. This does not mean they maintained continuous, daily contact with caribou herds as the term might imply (see Burch 1972, 1991 for discussion), but rather that groups relocated themselves seasonally to be within both the summer and winter ranges of the caribou. Additionally, these groups also relocated to position themselves to intercept migrating caribou in the fall. The second strategy outlined in chapter three involves an economy organized principally around the interception of migrating caribou herds and was practiced during the historic era by several Inuit speaking peoples. Unlike herd following peoples, groups practicing a herd interception strategy did not relocate seasonally to exploit caribou herds year round, but instead relied on practical storage and second line resources to endure periods when caribou were absent.

Both economic systems relied on caribou as the staple resource supplemented by musk-ox, dall sheep, moose, and fish. Caribou not only provided the major caloric input for the year, but also represented a critical source of hide and bone. The value of caribou as both food and non-food clearly peaked during the large fall migration for both economic systems and the fall migration formed a critical juncture in the seasonal round of any specialized caribou hunting peoples. The overwhelming importance of the fall caribou hunt is also reflected by the fact that caribou served as the economic basis for social aggregation.

However, there are major differences between the two economic systems. High residential mobility and food sharing served as the primary risk minimizing strategies among the Dene and Innu practicing a herd following strategy (Burch 1991; Gordon 1996; Loring 1992, 1997). In contrast, Inuit peoples tended to focus on the interception of caribou at major water crossings, utilized water based kayak hunts to take large numbers of animals, and invested heavily in practical storage to overcome periods when caribou were absent (Arima 1984, 1975;

Binford 1978, 1993; Friesen 2004). As a consequence, mobility strategies employed by Inuit caribou hunters involved greater logistical mobility and less frequent residential moves (Binford 1978, 2001). Although the magnitude of residential mobility practiced by Inuit caribou hunters remains among the highest of any hunting and gathering society, this is largely the result of the large territories and low population densities necessary for intensive caribou hunting to be a viable economic strategy (Binford 2001; Burch 1972).

Demographic pressures and historical factors such as a legacy of large sea mammal hunting probably contributed significantly to the development of the second mode of specialized caribou hunting practiced by Inuit speaking peoples (Friesen 2004). In fact the role of population pressure is commonly identified as a key factor in societies developing mobility systems with a heavy logistical component (Binford 1980, Kelly 1992:52). In contrast systems exhibiting a high rate of residential mobility may actually be more efficient in some instances and result in reductions of both labor and risk (Hitchcock 1982; Kelly 1992:52-54).

Because we can assume that neither demographic pressures nor an ideology of large sea mammal hunting influenced Paleoindian peoples of the lower Great Lakes, the expectation is for a system favoring residential, as opposed to logistical, mobility. It is from this perspective that the residentially mobile Dene and Innu ethnographic examples serve as a more appropriate analog for developing a testable model to evaluate the degree to which Paleoindian peoples of the lower Great Lakes may have relied on caribou as a resource. Reinforcing this view is the recognition that both comparative archaeological case studies reviewed in chapter four correspond well to aspects of the Dene/Innu herd following strategy.

### 5.3.1 HERD FOLLOWING STRATEGIES

Several dimensions of specialized caribou hunting economies have relevance for the investigation of archaeologically known hunter-gatherers and include territory size, land use and mobility strategies, hunting techniques, and risk minimizing strategies. It is from the perspective here that each of these dimensions will have influenced the formation of the Paleoindian archaeological record in observable ways. For instance, territory size and land use may be inferred from the location of archaeological sites and the movement of lithic raw materials (e.g. Loebel 2006). Likewise, mobility and risk minimizing strategies are important concerns that influence the organization of stone tool technologies, which are also observable in the archaeological record (Carr 1994; Ellis and Spence 1997; Nelson 1991). The expected signature can then be evaluated using the archaeological record to evaluate the possibility of lower Great Lakes Paleoindians having practiced a caribou hunting economy.

Burch (1991) provides an outline of the traditional Ethen-eldeli caribou hunting economy, which was in many ways the most dramatic instance of herd following. Traditionally, the Ethen-eldeli undertook rapid and long distance residential movements onto the tundra. These movements coincided with the annual spring migration of barren-ground caribou herds and were carried out to relocate both hunters and consumers to the vicinity of the summer ranges of the caribou herds. Although this provided access to fresh caribou meat year round, this strategy was also probably important for the ability of Dene hunters to gather information regarding caribou movements. Using this information, the Dene would begin their southward migration back toward the tree line in advance of the fall caribou migration (Burch 1991:442). It should be noted here that a similar structure is also observed in the case of Innu mobility, with at least one HBC trader remarking that the nineteenth century Innu behaved like wolves; this observation was

made in reference to their annoying habit of following caribou for food rather than seeking furs for profit (Loring 1992:156-157).

### 5.3.2 TERRITORY SIZE, MOBILITY MAGNITUDE AND FREQUENCY

It should come as little surprise that the scale of mobility employed by peoples practicing a herd following strategy mirrors that of the caribou herds they follow. If we accept Burch's (1991) composite picture of Dene mobility as reasonably accurate and we have no reason not to then generally speaking territory size will remain very large, mobility frequency high, and mobility magnitude very high (Table 5.1). Likewise, accounts regarding Innu mobility summarized by Loring (1992) also suggest a high degree of mobility frequency and magnitude, although the overall territory encompassed by the Innu is substantially smaller than that observed among the Dene. To be fair, the Dene adaptation reflects a situation that was established prior to contact with European fur traders and lacked any significant population pressures restricting mobility. In contrast, the Innu were responding to both Inuit and European colonization of the Labrador coast and, despite complaints from HBC traders, were to some extent tethered to European settlements at Voisley Bay and Fort Chimo, located along the eastern and northern Labrador shoreline respectively (Loring 1992).

On the other hand, quantification of mobility magnitude for hunter-gatherers is difficult to assess, although both Binford (2001) and Kelly (1983) have made notable attempts to do so. One problem with quantifying mobility magnitude is that criteria for distinguishing between residential mobility and special purpose trips are difficult to apply cross culturally. For instance, according to Binford (2001), who cites Amsden (1977), the total distance for Nunamiut residential mobility is approximately 500 miles (800 km). However, Amsden's (1977) estimate



takes into consideration long distance trips to the coast in order to trade, a journey as noted elsewhere (e.g. Hall 1976) that not everyone makes and that does not occur on a yearly basis. Those Nunamiut remaining in the interior moved about the Brooks Range at a considerably reduced magnitude in pursuit of caribou (Gubser 1965; Ingstad 1954). Although the Nunamiut are the most residentially mobile in summer (Binford 1978), if one excludes these long distance special purpose trips to the coast, the average annual magnitude of their residential mobility is substantially less than that reported by Binford (2001) or even Kelly (1983). According to Binford's (1978) own field data, during the remainder of the year the Nunamiut typically occupy a single residential base camp and make logistical movements out of the camp to hunt caribou or recover meat from caches.

In contrast, Binford (2001:274, Table 8.04) estimates Ethen-eldeli mobility at 450 miles (725 km), citing Fidler's (1934) account which only covers the period between September and April 1791-1792. Fortunately Gaste's (1868, cited in Burch 1991) account covers the intervening period of May through September. Father Gaste's account suggests that the estimate for the round trip of the early spring to early fall movements out onto the tundra and back to the treeline are upwards of 1000 km (Burch 1991). More importantly, it is apparent these very large movements were not special purpose trips, unlike Nunamiut visits to the coast for trading, but were undertaken annually by the entire residential unit. Moreover, this estimate is on the low side as it does not account for any residential movements that occurred once groups relocated to the tundra calving grounds of the Kaminuriak and Beverly herds. Combined with Fidler's (1791-1792) late fall to early spring estimates, the total magnitude of Dene mobility may be as much as 1750 km yearly or three times Binford's (2001) estimate! The fact that the accounts of both Gaste and Fidler were made without the aid of modern transportation (e.g. snowmobiles) lends

additional weight to the applicability of these estimates to inform our understanding about the movements of highly mobile hunter-gatherers known from the archaeological record.

Mobility frequency is similarly difficult to quantify. In the instance of the Dene migration northward it took 44 days for Gaste's party to travel 500 km, although they were not traveling on all of those days (Burch 1991:443). More probably, the group traveled consecutive days and then stayed put for a few days due to weather or to forage for food and non-food resources (Burch 1991:443). It is apparent from both Gaste's and Hearne's experiences with the Dene that this form of residential mobility occurred from spring through to the onset of the fall caribou hunt (Burch 1991). The period surrounding the fall caribou hunt is the least mobile point in the Dene annual round. Distance traveled per move during the summer was likely as much as 30 km (Burch 1991:443, citing Herne's estimates). This magnitude would suggest that Gaste's party traveled roughly 15 out of 44 days, a frequency also very similar to Hearne's experiences (Burch 1991:443). If that estimate is doubled to account for the move back to the tree line, then the frequency of Dene residential mobility from spring through late fall was about 30 residential moves for a round trip journey of roughly 1000 km. Once Fidler's (cited in Helm 1993) estimates for winter mobility are factored in, the scale of residential movement traditionally practiced by the Dene prior to the contact era was probably more on the order of 48 residential moves covering 1750 km.

Data regarding mobility frequency and magnitude are on the extreme end of the spectrum for known hunter-gatherers (Table 5.1). However, these estimates seem reasonable given the apparent herd following economic strategy outlined by Burch (1991). Hunting strategies employed by the Dene involved a combination of individual and communal tactics to exploit bands of caribou once encountered (Friesen 2004; Smith 1981). In addition, annual intercept

Table 5.1: Summary of the organizational variability among known specialized caribou hunters  
(metric data from Binford 2001; Burch 1991; Helm 1993; Kelly 1983. Non-metric data summarized from chapter three)

	Ethen-eldeli	Innu (Naskapi)	Caribou Inuit	Nunamiut
Caribou Hunting	Herd Following	Herd Following	Herd Interception	Herd Interception
Residential Mobility	Very High	High	Moderate	Moderate
Logistical mobility	Low	Moderate	Moderate	High
Mobility magnitude	1750 km	675 km	700 km	800 km
Mobility Frequency	>30 moves	15-20	15-20	10-15
Territory size/density	619,400 km <sup>2</sup> (0.0046 people/km <sup>2</sup> )	96,000 km <sup>2</sup> (0.0042 people/km <sup>2</sup> )	236,500 km <sup>2</sup> (0.0030 people/km <sup>2</sup> )	24,900 km <sup>2</sup> (0.0096 people/km <sup>2</sup> )
Maximum observed household size	9.00	8.1	7.4	7.5
Population during dispersed period	23 (2 – 3 households)	23 (2-3 households)	19.5 (2-3 households)	8.9 (1-2 households)
Population during annual migration	75 (8-9 households)	39 (4-5 households)	40 (5-6 households)	31.1 (4-5 households)
Periodic regional aggregation	295 (32-33 households)	117 (14-15 households)	75 (10-11 households)	75 (10-11 households)

Table 5.1. (Cont'd)

	Ethen-eldeli	Innu (Naskapi)	Caribou Inuit	Nunamiut
Herd following	Yes, occupies summer and winter range of Kamaniruiak herd	Yes, occupies summer and winter range of George River herd	Limited to summer range of Beverly and Kaminuriak herds	Limited to summer range of Arctic herd
Intercept strategy	Primarily terrestrial; occasional use of canoes	Terrestrial hunting; occasional use of canoe	Primarily kayak based hunting, limited terrestrial	Terrestrial and kayak based hunting
Ideology and risk management	Sharing, Risk pooling	Sharing, Risk pooling	Practical Storage, risk assuming	Practical Storage, risk assuming
Practical Storage	Minimal; No long-term storage	Minimal; No long-term storage	Moderate; Short and long term storage	Heavy; Short and long-term storage
Language Group	Athapaskan	Algonquian	Inuiput	Inuiput
Group Membership	Open-fluid	Open-fluid	Kin-based	Kin-based

hunting of migrating caribou occurred primarily during the fall as Dene groups positioned themselves to intercept herds prior to their movement into the tree line (Burch 1991; Gordon 1996; Smith 1981). As discussed above these intercept strategies did not include a kayak based hunt. Although water crossings were favored intercept localities, the Dene were just as apt to hunt caribou terrestrially once they moved ashore as they were to employ canoes to lance swimming caribou (Friesen 2004). Subsequent to the fall hunt food was consumed immediately or dried for transport, but rarely, if ever, cached long term for future retrieval. Surplus meat was shared with others reflecting the Ethen-eldeli reliance on risk pooling to mitigate periods of hardship.

### 5.3.3 SUBSISTENCE, MOBILITY, AND LITHIC TECHNOLOGY

Modeling the relationship between hunter-gatherer lifeways and the archaeological record of hunting and gathering societies should focus on how several interdependent cultural systems articulate together. For hunter-gatherers the close relationship between systems of mobility and subsistence has long been recognized and formal attempts to define the relationship between mobility and subsistence long predate Binford's (1980) now standard distinction between foragers and collectors (Kelly 1992). However, as Kelly (1992:45) points out these concepts were never meant to be seen as behavioral types. Although mobility and subsistence are closely connected, particularly among hunting and gathering societies, they are still independent systems. While decisions to move are frequently, if not predominantly, made on the basis of economic considerations, they can also be for the purposes of maintaining social ties, carrying

out religious or ideological duties, trade, information exchange, diffusing social tension, or any combination of these factors (Whallon 2006).

Similarly, subsistence operates as a separate system and while declining returns from foraging can be an important impetus for residential movement, as the example listed above show, it is not always the cause of residential movements. For example, a decision may be made to shift to alternative resources rather than move (Halstead and O'Shea 1989; Mandryk 1993). It is this second scenario that highlights an important element in the articulation between mobility and subsistence: subsistence strategies often place the goals of individuals and task-groups against one another (Egan 1993). Negotiating these differing economic goals can factor strongly into decisions to move residential camps, engage in logistical movements, or stay put and exploit different resources.

Nevertheless, it is evident that hunter-gatherer mobility and subsistence systems annually intersect in regular ways. This is best understood in terms of the "seasonal round" and is the scale at which most ethnographic and archaeological analyses attempt to describe the articulation between mobility and subsistence strategies (Egan 1993; Jochim 1976, 1998). It is also at this scale that the most meaningful middle range links between mobility and subsistence have been made (Binford 1980; Kelly 1992).

Complicating things further is the recognition that a third system, technology, interfaces with both mobility and subsistence systems. The intersection between technology and subsistence is readily apparent. A portion of prehistoric technologies are clearly designed to aid in subsistence pursuits, while others are intended to aid in processing the products of subsistence activities. Nevertheless, there are a multitude of specific tool designs suitable to address

extractive and processing goals, which means that the selection of one technological design over another is also responsive to other concerns including, but certainly not restricted to, mobility. Because this study concerns itself with an archaeological record nearly exclusively comprised of stone tools and the byproducts of their manufacture, I will restrict my discussion specifically to the lithic technological system, but acknowledge that the same concerns affect the organization of technologies using a variety of mediums including bone, wood, hide, and plant fiber.

#### 5.4 ORGANIZATION OF LITHIC TECHNOLOGY: THEORY AND PRACTICE

Kuhn (1994) envisions stone tools used by mobile hunter-gatherers as representing several broad categories, including mobile tool-kits, or what Binford (1979) refers to as personal gear, curated toolkits associated with residential base camps and/or special purpose sites (e.g. hunting stands, caches), and expediently produced tools. It should be noted that these categories are not meant to be exclusive within respect to one another. Instead each is an important component of the technological system and operates in tandem with the other two components. In fact, it is the overlapping nature of these components that provides reliability and versatility to the system. This overlap can be expressed in terms of anticipated and situational needs (Binford 1979; Ellis 1984). Mobile tool-kits are designed to satisfy the anticipated needs of foragers, yet shortfalls in the number of tools on hand or situational needs are inevitable and will eventually strain mobile tool-kits. In response to situational needs mobile tool-kits can be replenished or supplemented by both curated items and expediently produced tools. The inherent overlap ensures that, regardless of what anticipated or situational needs arise, there will be enough tools on hand to satisfy the basic requirements of a population; namely food, shelter, and clothing.

#### 5.4.1 RISKY BUSINESS: FORMAL VS. EXPEDIENT TECHNOLOGIES

The most obvious distinction between the curated and expedient technologies is that curated toolkits are designed to satisfy anticipated needs, while expedient technologies arise in response to situational needs. In situations in which greater risk is accrued from a shortfall, one can expect a greater emphasis on the part of the technological system designed to address anticipated needs. One advantage is that the supply of formal tools within mobile and curated tool-kits enables tools to be designed with reliability and maintainability in mind, whereas expedient tools are generally produced with only the goal of functionality. In contrast, in less risky situations there may be a greater reliance on the situational use of expedient technologies and less need for well designed formal tools. This is similar to Bamforth's (1986) argument that raw material availability will differentially structure the reliance on curated and expedient technologies. However, it is not the availability of raw material *per se* that influences this organizational decision, but rather the fact that in situations in which raw materials are abundantly available there is a decreased risk of being stuck without enough raw materials on hand to produce the required number and types of tools.

Similarly increasing sedentism has also been argued to influence decisions to rely more heavily on expedient technologies, where as more residentially mobile peoples will emphasize mobile and curated tool-kits (Kelly and Todd 1988). As Surovell (2009:137-141) discusses, during longer residential occupations people are able to stockpile a surplus of raw materials at the residential locality, thereby artificially creating a nearby lithic source with the advantage being that the overall costs (energy, time, risk) of acquiring materials are diluted by the longer duration of the residential occupation. In other words, the reduced costs of generating a surplus



during longer residential occupations lessen the risks of a lithic shortfall and less risk is likely to result in a greater reliance on expedient technologies.

#### 5.4.2 SCHEDULING: SEASONAL SHOPPERS VS. BARGAIN HUNTERS

Setting expedient technology aside for the moment, a distinction can also be made between the provisioning of people as opposed to the provisioning places in respect to the scheduling of when formal tools are produced (Fisher 2000; Kuhn 1994). Within this framework, provisioning people is viewed as a response to environments with less predictability in the location and timing of resource extraction (Kuhn 1994). In contrast, with greater predictability, or at least a greater targeting of specific reliable resource patches, comes the ability to provisioning places on the landscape (Kuhn 1994).

The difference between provisioning places and people archaeologically is illustrated by Surovell's (2009:192-193) application of the marginal value theorem to the organization of lithic technology. The unpredictability that results in decisions to provision people also affects decisions to discard tools from the toolkit. In this instance raw material availability may be restricted as a result of increased residential mobility, and the modeled result is a greater duration of time that tools are maintained in the toolkit prior to their being discarded. Conversely, the provisioning of places also ensures a more reliable supply of raw materials at a residential location with the modeled effect being an increased rate of discard. Thus, the provisioning of people or places results in different lengths of time for tools to remain in the toolkit (Kuhn 1994; Surovell 2009:193). Moreover, these differences should be observable archaeologically via

indices designed to quantify the extent to which discarded tools have been maintained prior to discard.

#### 5.4.3 TOOL DESIGN: VERSATILITY

According to Kuhn (1994), mobile tool-kits should be versatile and designed to satisfy the general technological requirements for resource extraction. Because these needs may vary seasonally or in anticipation of other specific needs, the actual composition of lithic toolkits can be expected to vary. Binford's (1976) technological inventories of Nunamiut logistical forays make it clear that mobile toolkits will vary in size and composition depending on the anticipated length of the foray. However, there are certain core classes of tools, namely the versatile axe, that are present on each trip regardless of anticipated length (Binford 1976). In much the same way, Kuhn's (1994) formal model enables an estimation of the core composition of mobile toolkits employed by hunter-gatherers, which will vary in response to the organization of the economic system. That is, variability stems from decisions about the types of resources targeted and whether or not these resources are being exploited through daily foraging or special purpose trips (i.e. residential or logistical mobility).

#### 5.4.4 TOOL DESIGN: RELIABILITY VS. MAINTAINABILITY

The design of formal tools used by mobile hunter-gatherers is also influenced by economic decisions related to time. Those groups emphasizing residential mobility often target more widely dispersed resources that are less predictable. Just as this condition produces a need to provision people, this situation also influences the design of tools to become more

maintainable. As Bleed (1986) argues, the daily foraging by residentially organized hunter-gatherers results in a great deal of free time and a reduced risk if resources are not procured. However, as discussed above, the costs of replacing a tool are higher. In this situation tools are designed to be more maintainable by their user. On the other end of the idealized spectrum are those hunter-gatherers that are logistically organized or rely on a short period of intensive resource extraction. In these situations because the time available for resource extraction or processing is more circumscribed then there is a greater risk in the event of tool failure. The result is the design of tools to be more reliable with the toolkit maintained in an optimal state of repair prior to the intensive period of activity (i.e. geared up, see Fisher 2000; Kuhn 1994).

## 5.5 LATE GLACIAL CARIBOU HUNTERS OF THE LOWER GREAT LAKES REGION

Caribou hunters employing a herd following strategy attempt to maintain regular, year-round contact with migratory caribou herds. As a consequence mobility strategies necessarily reflect those of the herd(s) they prey upon. This is evident among the Ethen-eldeli and Innu where differences in the magnitude of mobility can be related to similar mobility differences between the Kaminuriak and George River herds.

What then were the scale, timing, and pace of mobility undertaken by Late Glacial caribou herds in the Great Lakes region? The distribution of known Late Glacial caribou finds in the lower Great Lakes is extensive and stretches in a general northeast pattern from north-central Indiana to southern Ontario (FAUNMAP 2009; Holman 2001; Jackson 1982). While this estimate should be considered conservative, the size of the estimated territory lies comfortably within the known range of modern caribou ranges in North America discussed in chapter two.

When compared to modern woodland caribou the estimated territory size is quite large, the exception being the highly mobile George River Herd, which maintains a range several times larger than the one estimated here (Messier et al. 1988). The distribution of known Late Glacial caribou finds does raise the possibility that within the lower Great Lakes Late Glacial caribou herds did migrate across a sizable area.

Assuming the structure of Late Glacial caribou movements are analogous to modern populations then it can be expected that across this range caribou would migrate northward to calving grounds during the early spring. It would be expected that caribou herds would spend the duration of the summer within the northern portion of the spruce-sedge parkland, targeting open sedge meadows for feeding while relying on spruce stands for shelter and cover. Dispersal into small cow-calf bands typically follows calving before the herd aggregates once again in mid-summer (Spiess 1979). This mass aggregation is generally social in nature and the herd disperses into smaller bands during late summer and early fall prior to coming together once more for the rut (Spiess 1979). Immediately following the rut the massive fall migration southward begins as the caribou relocate to winter within the more sheltered, closed forests of the southern Great Lakes region.

The modeled response by foragers practicing a herd following strategy would be to also relocate northward during the spring to position themselves within the summer range of the caribou herds. These movements are expected to be rapid and cover a large distance (i.e. >300 km). Opportunistic predation of the caribou would continue throughout the summer. By late summer the modeled response would be for groups to position themselves for the interception of the large fall migration. Like any specialized caribou hunting peoples the fall migration

represents a critical juncture in the seasonal round as both fat content and hide quality were optimal at this time. After the fall migration was complete processing of meat, marrow, and, perhaps more importantly, hides would take place through the remainder of late fall and early winter. Subsequently groups would eventually disperse across the southern wintering range of the caribou.

Interception of fall migrating caribou requires a high volume of information to accurately predict caribou movements and there is some variability in human responses to fall intercept hunting. The Ethen-eldeli would move southward in advance of the caribou to intercept migrating caribou shortly before the caribou reached the treeline. The result was a broad, thin front as the Dene fanned out to ensure interception. It is assumed then that when encountered more caribou would be taken than absolutely needed. Groups without a successful caribou hunt would subsequently relocate. A similar practice of overharvest and sharing is well documented for the Innu. Although in Labrador the specific localities for a successful intercept hunt were more restricted and tend to concentrate around Indian House Lake on the George River. Repeated reoccupations of Pincevent also indicate that fall caribou hunting among Magdalenian groups in north-central Europe focused on predictable places in the landscape, harvested large numbers of individuals, and practiced food sharing (Enloe 2004). Likewise there is a considerable consistency in the presumed fall intercept localities being positioned within the bottomlands of the major alluvial valleys in the region throughout central Europe at the time (Fisher 2000; Jochim 1998; Wenger 1989).

It is considerably more difficult to model the nature of fall intercept hunting among herd followers within the Great Lakes region during the Late Glacial. First, a well defined tree line

was likely not present, which served to anchor the Dene intercept strategy as observed from ethnographic and archaeological data (Gordon 1996). Secondly, predictable water crossings are not easily recognized and may not have been a characteristic feature of caribou hunting in the Great Lakes region, although some have suggested the use of such features in southern Ontario (Stewart 2004:104-106) and at a submerged locality in Lake Huron (O'Shea and Meadows 2009). In contrast, Loebel (2006) argues that the wet, Late Glacial landscape would have favored migration across elevated and presumably more dry systems of moraines and eskers within northeastern Illinois. The fundamental basis of Loebel's (2006) arguments would also hold for southern Michigan and southern Ontario that also has well defined systems of moraines that could have channeled the movement of caribou herds (Krist 2001; Simons 1997). At a different scale of consideration, the southern Ontario peninsula bordered by Lake Huron and Lake Erie may have resulted in somewhat greater predictability for the interception of migratory caribou by concentrating movements within a spatially bounded area. Within this area, the ability to predict caribou movements is also thought to have increased over time as the spruce-sedge parkland began closing after 11,800 BP (Ellis et al. 2011). As the forested interior began to close, it has been argued that caribou movements became concentrated in areas near the Lake Algonquian shoreline that remained more open (Ellis and Deller 1997; Ellis et al. 2011; Hanson 2010; Jackson and McKillop 1991).

It should be evident that migration routes utilized by caribou during the Late Glacial period in the lower Great Lakes region were not as easily predictable as those discussed in chapters two and three. In fact, Burch (1972) cautions against the assumption that caribou migrations were always predictable and there are numerous examples of hardship faced when

migrations failed to appear as predicted. Moreover, the instability of the Late Glacial environment also likely introduced an element of uncertainty to caribou migration patterns. The modeled response would place a premium of information exchange and risk mitigation.

It should also be noted that repeated selection of favored water crossings as observed among Innu (Loring 1997) and Paris Basin Magdalenian (Audouze and Enloe 1991) caribou hunters may not have been a viable strategy within some portions of the lower Great Lakes landscape. While the narrower southern Ontario peninsula and associated embayments along the Great Lakes shoreline could have provided predictable crossings, the geographic setting in southern Michigan is considerably wider and may have lacked any significant barriers to caribou movements such as large open bodies of water. Although the major systems of moraines in southern Michigan have the potential to channel game movement (e.g. Simons 1997), it is unclear as to the extent to which these landform features may have done so. As a consequence Late Glacial caribou hunters in southern Michigan may have been forced to rely on a pattern more similar to the traditional Dene strategy of fanning out across the migration front and aggregation after a successful hunt may have been one way to deal with this increased uncertainty.

The modeled behavior of herd followers within the lower Great Lakes region is that, through much of the year, there would be an emphasis on a high residential mobility in terms of both frequency and magnitude. Not all of this mobility would have been related to subsistence pursuits though. As Whallon (2006) points out a considerable amount of ‘visiting’ may have been necessary to ensure sufficient flows of information about caribou movements could be maintained between otherwise dispersed bands of foragers. Aggregation almost certainly occurred in conjunction with the fall caribou hunt, but often may have resulted after the

successful hunt rather than in anticipation of the event. Such a scenario supports the model by reflecting the idea that sharing represented the primary risk minimizing strategy among those practicing a herd following strategy. Likewise, as discussed in chapter two, aggregation may not have been a requirement for extracting large numbers of caribou during the fall migration and a small group of hunters can take a large number of animals. Yet, aggregation would be important to concentrate the labor necessary to fully process meat, marrow, and hides; not to mention strengthening social networks that tied dispersed bands of hunters together.

## 5.6 ARCHAEOLOGICAL EXPECTATIONS

The implications of this model are that several organizational strategies are expected to have been employed by herd followers during the seasonal round. First and foremost the high rate of residential mobility practiced among groups targeting a dispersed and mobile prey during the winter through summer months suggests that foragers would seek to provision people with a mobile lithic toolkit designed with maintainability in mind. The decreased predictability during the Late Glacial period discussed above would only serve to further emphasize the need for a mobile and maintainable toolkit. In contrast, in preparation of and during the fall caribou hunt the model suggests than an increased emphasis on ensuring reliability within the toolkit can be expected (Bleed 1986). This is because the fall caribou hunt represents an exceedingly important juncture in the seasonal round. Fisher (2000, see also Kuhn 1989, 1994) envisions reliability in this sense as relating to the standardized production of tools or “gearing up” in advance of the caribou hunt.



### 5.6.1 ASSEMBLAGE LEVEL EXPECTATIONS

#### 5.6.1.1 STANDARDIZATION

These contrasting organizational strategies should produce patterning at the assemblage level in a similar direction as observed among Late Glacial assemblages within southwestern Germany (Fisher 2000). Among the German Upper Paleolithic sample she reviewed, Fisher (2000) observed variability in the standardized production of microliths between upland and lowland sites. She attributes the cause of these differences to alternative foraging strategies with lowland sites reflecting a greater degree of standardized production in preparation for the fall caribou hunt. The emphasis on reliable tools among lowland sites contrasted the greater emphasis on maintainability in the upland areas, which resulted in a decrease in standardized production observed among upland assemblages.

Standardization is a quantifiable aspect of archaeological assemblages, although its application to assemblages comprised of stone tools is not always done so in a direct manner. This is because stone as a medium introduces an inherent degree of variability as opposed to materials like pottery (Eerkens and Bettinger 2001; Lovis 2009). Nevertheless, analysis of coefficients of variation (CV) has proven to be an effective way to assess the degree to which the production of tools were standardized (Brouwer 2009; Carr 2004; Eerkens and Bettinger 2001; Fisher 2000; Lovis 2009). Standardization also may be assessed according to the degree to which finished tools correspond to an idealized morphology or type (Fisher 2000), technological signatures identifiable from the byproducts of manufacture (Brouwer 2009; Carr 2004), or attributes reflecting the intentional selection of tool blanks (Lovis 2009).

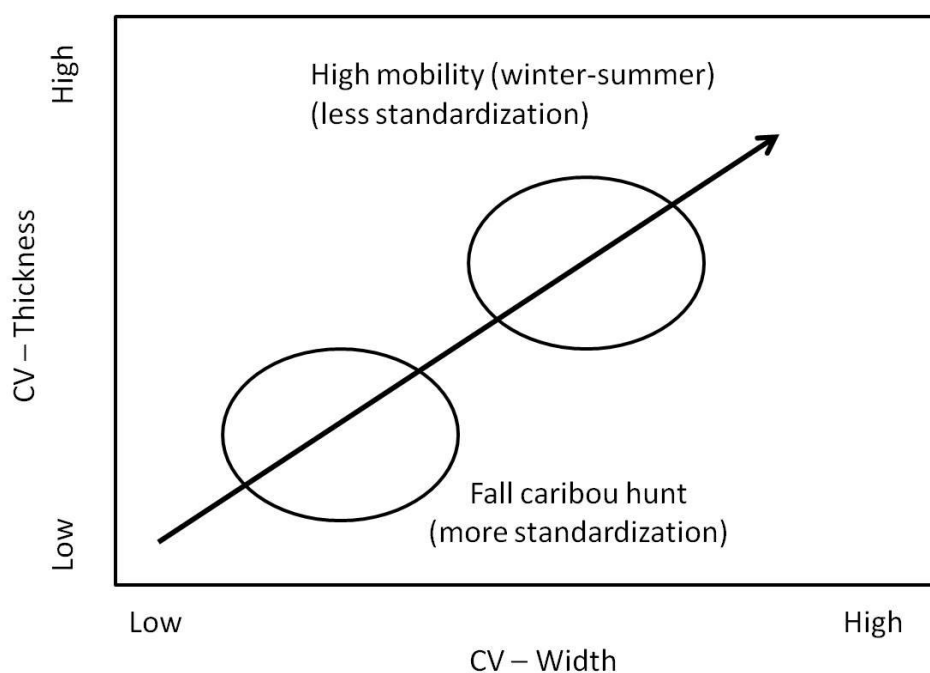


Figure 5.1: Hypothesized differences in assemblage standardization

The expectations derived from the model are that tools prepared in anticipation of the fall caribou hunt should exhibit a comparably high degree of standardization. Standardization in this instance is a consequence of the greater risk accrued during the important but temporally punctuated fall migration. The need for reliable tools in this instance is achieved by restricting the design parameters of what constitutes an acceptable tool or tool blank (Bleed 1986). Although the model predicts standardization associated with the fall caribou hunt, this expectation does not extend uniformly to tools produced during the remaining portions of the seasonal round. Tools manufactured and used during the remainder of the year are expected to have been manufactured with mobility as the primary concern. As a result tools designed with mobility as the primary concern would shift emphasis toward maintainability and flexibility. The expected archaeological signature of this shift would be the production of larger, but not

necessarily standardized, needed to provision people with a mobile, maintainable toolkit (cf. Kuhn 1994, see also Surovell 2009 for discussion).

#### 5.6.1.2 RICHNESS AND EVENNESS

Along with standardization, measures of assemblage richness and evenness provide insight to the overall organization of stone tool technologies (Baxter 2001; Bobrowsky and Ball 1989; Kaufman 1998; Shott 1997; Surovell 2009). Richness measures the overall numbers of different tools present within an archaeological assemblage and in the context of this research is viewed as a proxy indicator for the composition of mobile toolkits (Shott 1997). Evenness measures a different dimension of stone tool assemblages, namely the distribution of numbers of tools across all tool classes present (Shott 1997). Unlike richness, evenness is a good indicator of the range and relative importance of activities undertaken at individual archaeological sites (Shott 1997).

The model discussed above predicts the use of residential mobility to engage in the focal predation of caribou. One expectation of this model is that the emphasis placed on residential mobility should result in the use of mobile toolkits (Kuhn 1994; Surovell 2009). Thus the total population of tools maintained in the mobile toolkit and transported from site to site is not expected to vary substantially. This should not be confused with the argument that the types of activities performed at each site were the same, only that the composition of the mobile toolkit transported from site to site would be similar. To illustrate this better, the converse would be true if the model predicted greater logistical mobility, which it does not. Greater emphasis on logistical mobility would allow for both the provisioning of places and greater modification of

mobile toolkits to suit the goals of specialized task groups and by extension result in different populations of tools moved from site to site (Kuhn 1994; Surovell 2009). However, since the model predicts an emphasis on residential mobility, and as a consequence the provisioning of people, we can expect less variability in the types of tools transported between sites even if there is variability in which tools are being used.

The above argument mirrors Audouze's (2007) observations regarding the considerable consistency among the archaeological signatures of individual Paris Basin Magdalenian sites. He attributes that consistency to frequent residential movements that includes the entire domestic groups. Both Audouze (2007) and Valentine and Pigeot (2000) have observed that the lithic assemblages of individual Magdalenian sites are generally uniform in the overall types of tools present and technological strategies resulting from the intentional production of large blades. Although large fall hunting sites like Pincevent certainly have substantially larger stone tool assemblages, even so individual hearths at the site reflect the presence of multiple domestic groups. Comparison of assemblages centered on individual hearths at Pincevent show that they resemble one another in composition. Not only are the hearths at Pincevent comparable to one another, but they are also similar to individual activity areas present on smaller sites like Etiolles that are not related to the fall caribou hunt (Audouze 2007).

What archaeological expectation can be derived from the above discussion? Because the population of tools transported as part of a mobile toolkit is hypothesized to be similar from site to site then measures of assemblage richness should positively correlate to duration of occupation. In other words, the longer a site is occupied the greater the probability for more types of tools to become exhausted and discarded (Surovell 2009). This more accurately

describes the well known relationship between assemblage size and assemblage richness. If we assume the population of tools transported into two sites is the same, the probability that a tool will enter the archaeological record is a function of the number of episodes of use. Thus, if a site were occupied twice as long then we can expect that the probability that a tool will enter the archaeological record to increase as a function of the length of occupation (Surovell 2009). Needless to say the expected archaeological signature derived from the model of specialized caribou hunting presented here suggests that there will be a positive relationship between duration of occupation and the richness of tool types in the assemblage and that this relationship reflects the organizational strategy to provision people with a mobile toolkit (Kuhn 1994).

Unfortunately, archaeological sampling can also have a similar affect on assemblage richness. Larger sample sizes should also appreciably increase the probability that more types of tools within the archaeological population will become recovered. Again the relationship between assemblage size and measures of assemblage richness has been the subject of considerable discussion (Baxter 2001; Kaufman 1998). The questions that arise from this discussion are to what extent sample size has affected richness, how much can richness be scaled to duration of occupation, and what effect if any has reoccupation produced? Again, the key distinction is not scaling richness measures with assemblage size, but rather scaling richness measures in comparison of duration of occupation(s). Unfortunately given the nature of archaeological record this is easier said than done. However, if we use assemblage size as a proxy measure of duration of occupation we need to be explicit about two important assumptions inherent in doing so: first does our sample size accurately reflect assemblage size and secondly is assemblage size an accurate reflection of the duration of occupation. Only then may measures of

assemblage richness be used to meaningfully compare the human activities that resulted in the formation of archaeological sites (Baxter 2001; Kaufman 1998; Surovell 2009).

To compensate for the affect of sample size I will employ Menhinick's Index ( $k/\sqrt{N}$ ) that standardizes measures of toolkit diversity in relation to assemblage size (Kaufman 1998:77). Menhinick's Index divides the total number of tool classes ( $k$ ) by the square root of the total number of tools present in the assemblage ( $N$ ). One advantage of using Menhinick's Index is its relative simplicity for calculating diversity and the fact that the use of the index has become increasingly common in the archaeological literature (Baxter 2001; Bobrowsky and Ball 1989; Kaufman 1998; Shott 1997).

In contrast to richness, measures of assemblage evenness are expected to differ from site to site. For instance, the production of reliable extractive tools in preparation for the fall caribou hunt is modeled above. The expected archaeological signature of such gearing up would be for the uneven presence of extractive tools such as projectile points resulting from manufacturing failures and the discard of less reliable implements (e.g. resharpened but not necessarily exhausted points). Subsequent to the fall caribou hunt it is argued here that aggregation is a necessary practice that serves two purposes. First it enables the distribute meat through social networks and secondly amasses the necessary labor for preparing hides. The expected archaeological signature would be for an uneven presence of processing tools such as scrapers and bifacial knives. Finally, during the remainder of the year assemblages are expected to reflect greater evenness as the model predicts that tools will enter the archaeological record as the result of continuous maintenance of lithic toolkits.

### 5.6.2 SITE LEVEL EXPECTATIONS

Spatial patterning on artifacts within individual sites provides information that compliments the more detailed technological analysis of assemblages described above and correspondence between the two can strengthen the analyses undertaken in the next chapter by providing a second independent line of evidence. Examining the spatial patterning of artifacts across individual sites helps provide insights about past social structures present among caribou hunting societies. These social structures, including gender, kinship and band composition, influence the organization and use of space on individual sites and are understood to manifest themselves at different scales of analysis (e.g. O’Gorman 2010). In recognition of the scalar nature to social structures, data pertaining to the social landscapes at the site level will be examined here at two differing scales; that of the individual household and the interrelationship between multiple households.

#### 5.6.2.1 HOUSEHOLD PATTERNING

From the perspective of the present study the spatial organization of individual households or activity areas reflect elements of individual identities such as age and gender roles. Waugesbeck (2005) has cautioned Paleoindian researchers about the implicit emphasis on male dominated activities at the expense of women and children, and admittedly up until now the explicit focus on caribou hunting by the present research can certainly be accused of contributing to the problem. The debate over gender within Paleoindian studies is firmly entrenched within a similar debate concerning specialized hunting versus generalized forager models of Paleoindian subsistence strategies. The role of women in this debate is predicated on the assumption that

women gather plant resources and the absence of plant remains from archaeological contexts either supports focal hunting models (e.g. proboscideans, bison, and caribou) or is simply a product of sampling and preservation biases. Without any explicit attention to the role of women (and children) beyond gathering plant resources, the absence of plant remains from archaeological contexts effectively silences the voice of women in the archaeological record as well.

Waugesbeck's (2005) analysis of female labor among foraging societies has shown that for societies largely dependent upon meat in their diet the amount of time females spend foraging decreases. However, the trade off is a subsequent increase in the number of support related activities performed predominantly by females. Interestingly, among the sample of foragers examined by Waugesbeck (2005), as the percentage of meat consumption increases there is also a corresponding increase in female only tasks and a decrease in tasks performed by either gender. In other words, there is a greater and more defined separation between male and female labor as activities such as shelter construction, burden carrying, and leather working join the more stereotypical plant gathering and child rearing as largely female activities (Glover 1958:35; Waugesbeck 2005).

The emphasis on large game hunting in the present model means that we can also expect a similar increase in the number and types of activities that constitute female labor. It can also be suggested that with an increasingly defined gap between male and female labor, then a more defined use of space may be expected. Interestingly fine grained analyses of activity areas at Etiolles in the Paris Basin are suggestive that Magdalenian foragers did have a highly structured use of space. Olive's (1992:140) discussion of Etiolles identifies two distinct areas of blade



production, one skilled area centered on the hearth and ringed by less skilled production and a second area spatially distinct from the hearth but linked through refitting. Given the expectation for an increasingly greater variety of roles adopted by females among such hunting dependant foragers, an alternative reading of the Etiolles data would be that the two skilled blade production areas reflect separate male and female zones of flintknapping.

Because residential mobility is emphasized in this model, we should see the consistent signature of female labor at virtually all sites except those that can be unequivocally identified as the immediate kill localities and even then a kill does not preclude any subsequent residential relocation to the immediate vicinity of the kill (Brumbach and Jarvenpa 1997). The clearest signatures of female labor are likely to include small game procurement, hide preparation, secondary butchering of caribou, and bone grease manufacture. This list is admittedly conservative and the omission of activities such as structure building and possibly flintknapping is not done to ignore the cautionary tales of Waugesbeck (2005) and Brumbach and Jarvena (1997) only that both those activities were also likely cared out by males.

#### 5.6.2.2 INTRA-SITE PATTERNING AND AGGREGATION

Past social structures are also manifested through intra-site patterning of artifacts. At this scale patterning informs us about the structure of the residential communities present at individual sites. Among the ethnographic cases reviewed in chapter three it is apparent that the importance of the fall caribou hunt extends beyond its obvious economic role. In fact, among those groups identified as specialized caribou hunters it is acknowledged that one important characteristic of caribou hunting is that it also served as the economic basis for social

aggregation, particularly during the fall. Thus the fall caribou hunt not only provides a sufficient subsistence base, but also provides other economic incentives, such as the need to concentrate labor to process meat and hides. It is these economic considerations that facilitate the ability for specialized caribou hunting peoples to aggregate at various regional scales.

Social aggregation is a practice shared among virtually all foraging societies when otherwise fragmented and dispersed social groups periodically come together. The specific rationale and economic basis of aggregation varies widely, but the fact remains that social aggregations of some sort occur. Among sub-arctic and arctic foragers that constitute the ethnographic basis of this study, the size of such social units is frequently noted to include a minimal band of 25 and a regional band of 500 (Kelly 1995:209; Whallon 2006; Wobst 1974). The former is often seen to be the ideal size of the individual hunting band or minimal band, while the latter reflects the minimal size of the regional social network needed in order to maintain a stable population (Wobst 1974).

Among caribou hunting peoples, each minimal band is integrated into a wide ranging social network through kinship ties, gift exchange, and network mobility (i.e. 'visiting'). One caveat is that the minimal-regional band dichotomy is often portrayed as a static spatial entity. Instead the boundaries between the minimal bands and the boundaries between regional bands are intentionally kept fluid and flexible. In this sense the band is a continually emergent property within a system based on ensuring the flow of environmental information and minimization of risk. To this end the regional band serves the dual role of ensuring there is recourse for individuals during times of scarcity and to disseminate information about game abundance, game movements, and who is hunting where in order to minimize incurring conditions of scarcity

(Kelly 1995; Whallon 2006; Wobst 1974). In fact, it appears that the scale at which interaction between social groups occurs is predicated by the scale at which environmental scarcity is most likely to occur (Whallon 2006).

Table 5.2. Summary of ethnographic data on caribou hunter group size (from Binford 2001)

Ethnographic Case	Most dispersed	Most Aggregated	Regional Aggregation	Area (km <sup>2</sup> )	Density/km <sup>2</sup>
Beaver	20	58	110	194700	0.0051
Slave	13	39	220	245370	0.0100
Hare	13	26	120	173400	0.0033
Kutchin	32	78		286100	0.0170
Satudene	12	29		150000	0.0055
Chippewyan	23	75	295	619400	0.0046
Naskapi	23	39	117	96000	0.0042
Dogrib	22	60		180900	0.0088
Averages	20	51	172	243234	0.0073
# households @ 6/household	3	9	29		

Although considerable work has been done to quantify the ideal demographic size of the minimal and regional bands and most often includes the application of Horn's model to reify the magic numbers of 25 and 500. Examining data on group size provided by Binford (2001:Table 8.01) shows that there is some regularity among sub-arctic peoples who rely on caribou as a large portion of their annual food. Data from the Nunamiut and Caribou Inuit are intentionally excluded for reasons discussed in chapter three. This list includes data on those sub-arctic groups most representative ethnographic data for residentially organized specialized caribou hunters modeled here (Table 5.2). According to these data we can expect the normal group size to

fluctuate between an average of 18 and 53 individuals, with the latter reflecting normal annual aggregation in conjunction with the fall caribou hunt, while the former represents dispersal of individual social groups during winter through spring/early summer. Likewise, Binford's (2001) data also contains information of periodic regional aggregations that reflect the joining of multiple regional bands. The expected average group size in this instance would be 172 individuals, but would not be expected to occur on an annual basis.

However, rarely do we excavate individual people in the archeological record. Rather the most recognizable archaeological signature of the size and structure of the residential community is the number of identifiable households. Assuming an average of six people per residential structure then we can expect sites to range between three households and nine households annually, with the later reflecting aggregation associated with the fall caribou hunt. Likewise occasional regional aggregations up to 29 households may be expected. Although this estimate is higher than Shott's (2004) estimate of five, the use of six individuals per household here is more in line with ethnographic data from Wilson and Rasic (2008) and William Duncan Strong (Leacock and Rothschild 1994) and conservative compared to the upper estimates of 8.1 and 9.0 individuals per household listed in Binford (2001:Table 8.08) for the Innu and Ethen-eldeli, respectively. In fact, during Strong's (Leacock and Rothschild 1994) stay with the Davis Inlet Band (minimal band) of the Innu during the winter of 1922, two tents were occupied by an average of six individuals throughout much of the winter. Although the settlement later expanded to three tents once relatives came to visit.

The ethnographic data on group size for residentially organized caribou hunters also corresponds well to archaeological data derived from the Paris Basin Magdalenian. Refits

between households at Marsangy in the Paris Basin indicate that two of the central hearths were occupied contemporaneously, while the other activity areas appear to represent non-contemporary episodes of occupation with only one or two hearths present. Yet, at Pincevent where the available faunal evidence clearly points toward fall caribou hunting within level IV there are minimally six contemporaneous hearths linked together through refits and appear to include producing and non-producing households as reflected by the sharing of meat (Enloe 2001). In light of the ethnographic data on caribou hunters discussed above and seasonality data derived from the faunal remains at the site, it seems reasonable to infer that Pincevent reflects an episode of annual social aggregation of the regional band that have come together in conjunction with the fall caribou hunt. The six households at Pincevent contrast with the two identified at Marsangy that, based on seasonality data from Bigon (2006), probably reflect a dispersed part of the seasonal round. To date, a site that could be considered representative of occasional aggregation between regional bands (i.e. 29 households) has not been identified in the Paris Basin archaeological record. Although the consistent presence of exotic shells and raw materials suggests that such interaction between regional bands certainly did occur.

Shott (2004) has systematically outlined the difficulties in identifying aggregation within the Paleoindian archaeological record. The most obvious of these considerations is identifying the difference between multiple occupations and a single, large aggregation. Equally as problematic are the methodological approaches archaeologists use to identify activity areas in the first place. Theoretically multiple occupations are likely to result in overlapping spatial clusters while a single aggregation is more likely to have consistent spacing between activity areas (Wilson and Rasic 2008). As Shott (2004:95) cautions we need to quantitatively demonstrate,

rather than assume, a site represents an aggregation. In an effort to address this long standing problem in archaeological interpretation data on activity area spacing, size, overlap, and refitting should provide an independent measure to help assess the degree to which individual sites reflect occupation by dispersed social groups (2-3 households), aggregation (8-9 households) or aggregations between regional bands (29 households).

### 5.6.3 REGIONAL SCALE PATTERNING

#### 5.6.3.1 TERRITORY SIZE

Residential communities are linked through region wide social networks and regional scale data can provide information regarding the structure of these social networks. Whallon (2006) discusses the varying social and economic factors influencing interaction among hunter-gatherers. Because his discussion of non-utilitarian mobility includes caribou hunting peoples of the Upper Paleolithic it is particularly relevant to this study. According to Whallon (2006) mobility between minimal bands and between adjacent regional bands are important to maintain social networks. Non-utilitarian mobility includes frequent visiting between groups that is intended to facilitate the flow of environmental information and to reaffirm existing social networks. The organization of information and social network mobility depends on the structure of the regional environments (Whallon 2006:262-264). As was discussed in chapter two, the Late Glacial environments of the lower Great Lakes were likely to have been patchy or heterogenous and thus dissimilar between adjacent regions. Likewise, as has been frequently noted, populations of individual caribou herds are known to fluctuate widely and often do so independent of adjacent herds (Burch 1972; Spiess 1979). Thus there is low correlation between

the resources of adjacent region and the potential for high regional variation in resource availability. As a consequence the expectation is for frequent network mobility between adjacent regions along with only occasional mobility between far removed regions (Whallon 2006:264).

The model for residentially organized caribou hunters emphasizes risk pooling as the primary risk minimizing mechanism, rather than the storage of resources. While we may expect the general absence of long term food storage features on Paleoindian archaeological sites, we may also expect a positive material cultural signature of risk pooling as well. As implied by Whallon's (2006) discussion, risk pooling is likely to manifest itself differently within and between adjacent regions. Within the scale of the regional band we can expect a relatively homogenous material cultural signature that serves to signal membership in the risk pooling group (Wiessner 1982, 1983). This is because the regional band represents the most common scale at which risk pooling occurs, as demonstrated by the annual aggregation of the regional band in conjunction with the fall caribou hunt and the notable sharing between band members (see chapter three). Although Whallon's (2006) framework predicts frequent network mobility between adjacent regional bands, this still occurs less frequently than interaction within the regional band. Nonetheless, such network mobility also represents the pooling of risk only this time at larger spatial (between regions) and temporal (inter-annually) scales. As discussed earlier in the section of toolkit design, such scalar redundancy in risk pooling is a critical strategy for ensuring the overall reliability of the system. The less frequent, but still important, risk pooling between regional bands is likely to have been maintained through gift giving, ritual feasting, and exogamous marriage (Hayden 1982; Whallon 2006).

Because the residentially organized caribou hunter model presented predicts a high rate and magnitude of mobility, relatively sizeable territories are likely to have been exploited. Available ethnographic data on specialized caribou hunting peoples of North America indicate that very low ( $<.005$  people/km<sup>2</sup>) population densities are not uncommon (Binford 2001:Table 4.06; Burch 1972). This means the size of territory that can be considered to encompass a regional band is likely to be quite large. To predict territory size from the model of residentially organized herd followers I will use an estimate of 0.0073 people/km<sup>2</sup> derived from the available ethnographic data summarized above (Table 5.2). The size of the regional band is the second variable in estimating territory size. The ethnographic data summarized here suggest periodic regional aggregation between 110-295 (172 average) people, which is similar to Wobst's (1974) estimate for a one-tier regional band consisting of seven local bands. This would represent an average territory of about 23,500 km<sup>2</sup> or 154 km by 154 km. However, If we accept Whallon (2006) and Wobst's (1974) estimates for the size of a two-tier regional band numbering between 475-500, then the expected territory occupied by a regional band of residentially mobile herd followers would be as much as 68,500 km<sup>2</sup>, or roughly an area 260 km by 260 km. Regardless, both estimates represent very large territories occupied by highly mobile peoples. It should also be noted that both of these estimates are well within the ranges for sustainable hunting of a caribou herd calculated in chapter three (see Table 3.1).

The implications of these estimates are that we can expect to see material cultural evidence indicative of risk pooling among regional band members within the archaeological record at a magnitude of roughly 150 - 250 km. These data should include consistent stylistic elements of artifacts including projectile point morphology and lithic raw materials that extend



across this distance (Carr 2005; Ruggles 2001). It should be noted that my high estimate of 250 km for a two-tiered band structure differs from Whallon (2006:268), who views this distance as reflecting interaction between adjacent bands. However, the estimates used here are based on the expected population density for residentially mobile caribou hunters and conforms well to the ethnographic record. Interestingly Whallon's (2006:Table 1) data on the movement of shells within the Magdalenian, argued here to represent residentially mobile herd followers, indicate a high frequency of movement up to 250 km before dropping off sharply.

#### 5.6.3.2 SEASONAL PATTERNS OF MOVEMENT

The economic basis of a residentially mobile herd following strategy is predicated on the general predictability of caribou movements between seasons. While the specific locations where caribou herds can be found will vary from year to year, as will their specific migration routes, there is still enough predictability to condition human population movements on the regional scale with the expectation of being able to locate caribou at their destination. We know from Burch's (1991) discussion of this strategy that these movements will be rapid and can cover extremely large distances if needed. The ecological data examined in chapter two similarly suggests that the open spruce-sedge parkland began to close after 11,500 BP, but that region specific openings in this environment probably still remained through the end of the Younger Dryas (Ellis et al. 2011). Climatic models suggest that solar insolation also produced greater seasonality during this period (Webb et al. 2003). One potential effect of greater seasonality may have been an increased magnitude in north to south migrations as moving greater distances south would be required to avoid the harshest winter conditions and warmer summers would extend the

availability of quality forage further north. Finally, the distribution of Late Glacial caribou remains in the faunal record indicates a broad north to south distribution that encompasses northwestern Indiana, central Ohio, southern Michigan, and southern Ontario. Although very sparse these data are also suggestive that individual caribou herds in the lower Great Lakes may have undertaken migrations on the order of 500 km north to south.

#### 5.6.4 SUMMARY OF ARCHAEOLOGICAL EXPECTATIONS

Expectations derived from the RMHF model presented here encompassed three scales of analysis. At the assemblage level predictions regarding the organization of lithic technological strategies were made. These include expectations for seasonal differences in the degree to which assemblages are standardized and predictable differences in measures of assemblage evenness and richness. Similarly at the site level we can also expect the consistent signature reflecting movements of entire domestic groups rather than emphasis on logistical mobility where specialized and perhaps gendered task groups may result. Similarly, there is an expectation for the regular aggregation of multiple social groups in conjunction with the fall caribou hunt. This expectation for internal site patterning representing dispersed and aggregated portions of settlement and mobility strategies should also correspond to the expected assemblage level variability in the organization of technology just discussed. Finally, at the regional scale the prediction is for large but sparsely populated territories occupied by regional bands consisting of either one (7) or two (19) tiers of local or minimal bands. Long distance residential movement throughout these territories should occur along a general north-south pattern of movement that corresponds to seasonal movements of caribou herds.

Although the expectation for long distance north-south population movements restates a common assumption within the Paleoindian literature for the midwestern and northeastern United States, within the context of the RMHF model outlined here this expectation is reasonable considering the available environmental and ethnographic data. Yet, to be fair, it should be noted that greater seasonality during the Late Glacial would probably condition north-south movements by Paleoindian foragers regardless of prey. This point emphasizes the necessity for multiple lines of evidence that encompass several scales of analysis. Alternative expectations can certainly be provided for each line of evidence presented in this section and to do so would greatly exceed the scope of this project. However, the main goal was to formally define expectations for the RMHF model that utilizes archaeological data from multiple scales of consideration. These expectations also reflect independent economic, technological, and social facets of hunter-gatherer behavior. No single line of evidence should be considered sufficient to support or reject the RMHF model presented here, but rather the model's explanatory strength should be based on a consideration of the multiple lines of evidence.

## CHAPTER 6

### THE LOWER GREAT LAKES PALEOINDIAN ARCHAEOLOGICAL RECORD

#### 6.1 INTRODUCTION

There is an extensive archaeological database that documents the Paleoindian period in the lower Great Lakes and has accumulated as a result of large scale projects carried out since the 1970s (Deller 1988; Deller and Ellis 1984, 1996; Ellis and Deller 2000; Jackson 1996, 1998; Roosa 1977; Shott 1986, 1997; Simons 1997; Simons et al. 1984; Stork 1979, 1997; Stork and Spiess 1994; Voss 1977). One major result of these projects has been the recognition that a series of Paleoindian cultural complexes define the archaeological record of this region. These complexes include Gainey, Parkhill, Crowfield, and Holcombe, and are generally thought to be time transgressive (Table 6.1). Relative dating of these complexes is based on artifact serration and geochronology and although these complexes are identified through the recognition of fluted point types, it is understood that these represent a continuum rather than discrete types (Ellis and Deller 1997). It should be expected then that any associated changes in cultural systematics also reflect a continuum of behavior.

Table 6.1. Major Paleoindian Complexes in the lower Great Lakes Region  
(from Ellis and Deller 1997)

Complex	Age (BP)
Gainey	11,500-11,000
Parkhill	11,000 – 10,400
Crowfield	<10,400
Holcombe	<10,400

The Gainey complex (Figure 6.1) represents the earliest Paleoindian manifestation in the region and is best identified through the presence of large, parallel-sided fluted points. Gainey probably represents a regional manifestation of related groups employing parallel-sided fluted points prevalent throughout Eastern North America during the late Pleistocene (Ellis and Deller 1997). Technologically these eastern groups are related to western Clovis, although Gainey lacks the large blades that characterize Clovis technology in the west. Based on these technological similarities Gainey is presumed to be contemporaneous with Clovis or date shortly thereafter ca. 11,500-11,000 BP (Ellis and Deller 1997). Regionally this complex derives its name from the Gainey site located in southern Michigan (Simons et al. 1984).

The Parkhill complex is best known from excavations at several large sites in southern Ontario including the Parkhill, Thedford II, and Fisher (Figure 6.2). Sites attributed to this complex are generally recognized by the presence of Barnes type fluted projectile points and an apparent preference for occupation near the Lake Algonquian shoreline, at least in southern Ontario (Ellis and Deller 1997; Ellis et al. 2011). Differences between Barnes fluted projectile points and those of the Gainey complex include a decrease in size and expansion of the lateral margins creating face angles greater than 90 degrees (Ellis and Deller 2000). Many of these points also possess distinctive fishtailing among other traits (Wright and Roosa 1966). Research has made it clear however that these traits do not result in discrete types, but are organized along a continuum with the trend being for smaller, thinner points with increasing lateral expansion from the base (Ellis and Deller 1997). Based on the typological interpretation of Barnes as post-Gainey along with the strong relationship between the main Lake Algonquian shoreline and the

Parkhill complex, it is thought that this period dates between 11,000-10,400 BP (Ellis and Deller 1997).

Table 6.2 Sites with data included in the analysis

Site	Phase	Reference
Butler	Gainey	Shott 1997; Simons 1997
Ferguson	Gainey	Deller 1988
Gainey	Gainey	Shott 1997; Simons et al. 1984; Simons 1997
Halstead	Gainey	Jackson 1998
Murphy	Gainey	Jackson 1996
Sandy Ridge	Gainey	Jackson 1998
Snary	Gainey	Wortner and Ellis 1993
Udora	Gainey	Storck and Spiess 1994; Storck and Tomenchuk 1990
Weed	Gainey	Deller 1988
Banting	Parkhill	Storck 1979
Barnes	Parkhill	Wright and Roosa 1966; Voss 1977
Dixon	Parkhill	Deller 1988
Fisher	Parkhill	Storck 1997
Hussey	Parkhill	Storck 1979
Leavitt	Parkhill	Shott 1993
Mawson	Parkhill	Deller 1988
McLeod	Parkhill	Deller 1988; Muller 1999
Mullin	Parkhill	Deller 1988
Parkhill	Parkhill	Ellis and Deller 2000
Schofield	Parkhill	Deller 1988
Scott Glen	Parkhill	Deller 1988
Thedford II	Parkhill	Deller and Ellis 1992
Wight	Parkhill	Deller 1988
Alder Creek	Crowfield	Timmins 1994
Bolton	Crowfield	Deller and Ellis 1996
Caradoc	Holcombe	Ellis and Deller 2002
Crowfield	Crowfield	Deller and Ellis 1984
Fowler	Holcombe	Woodley 2004
Holcombe Beach	Holcombe	Fitting et al. 1966
Strathroy	Holcombe	Deller 1988
Tedball	Holcombe	Deller 1988
Zander	Crowfield	Stewart 1984

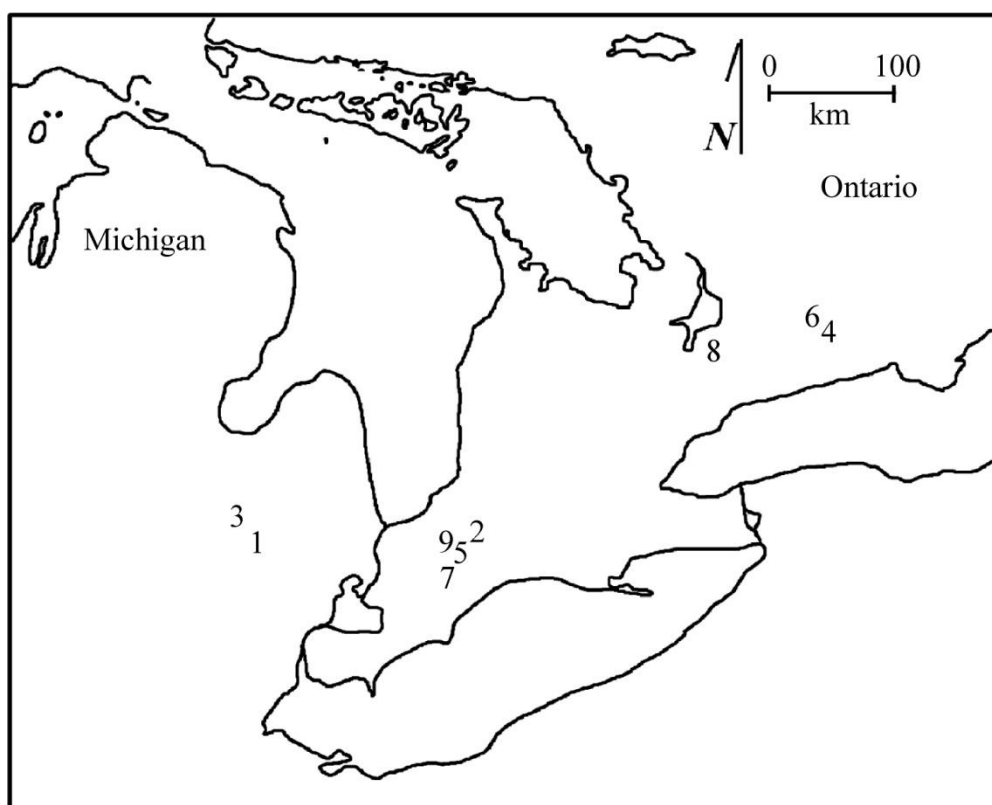


Figure 6.1: Location of Gainey phase sites mentioned in the analysis. Sites: 1 – Butler; 2 – Ferguson; 3 – Gainey; 4 – Halstead; 5 – Murphy; 6 – Sandy Ridge; 7 – Snary; 8 – Udora; 9 – Weed.

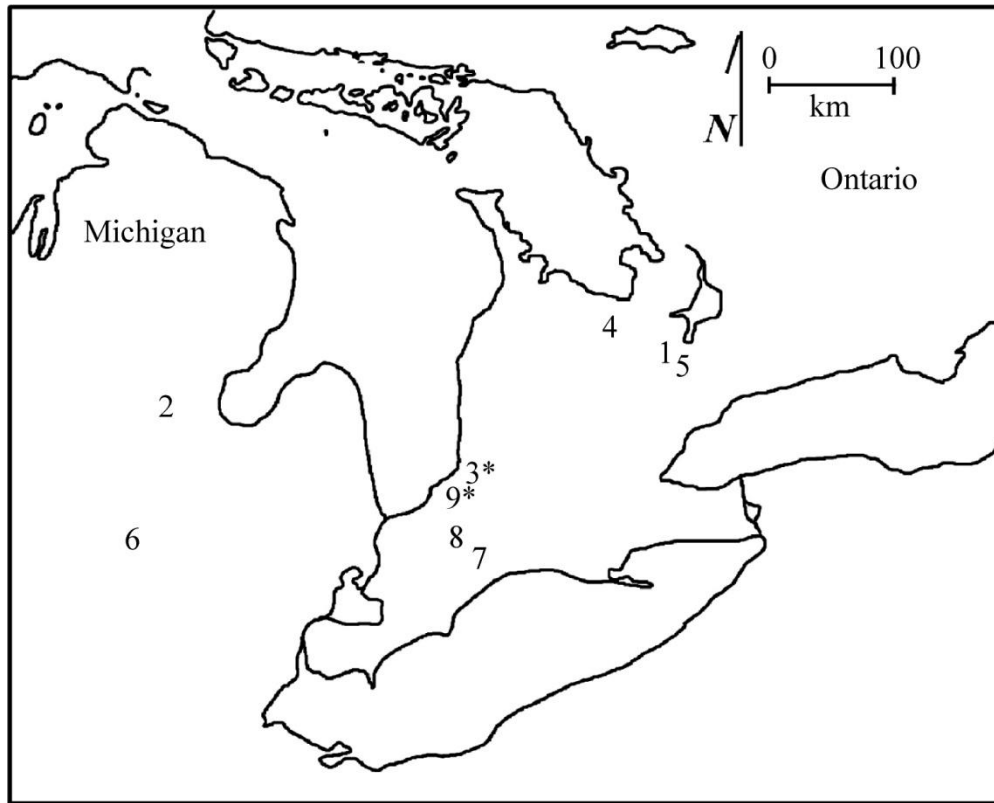


Figure 6.2: Location of Parkhill phase sites included in the analysis. \*Denotes location of site complexes with multiple sites within < 10 km. Sites: 1 – Banting; 2 – Barnes; 3 – Parkhill complex (Parkhill, Dixon, Mawson, Mcloed, Schofield sites); 4 – Fisher; 5 – Hussey; 6 – Leavitt; 7 – Mullin; 8 – Scott Glen; 9 – Thedford Complex (Thedford II, Wright sites).



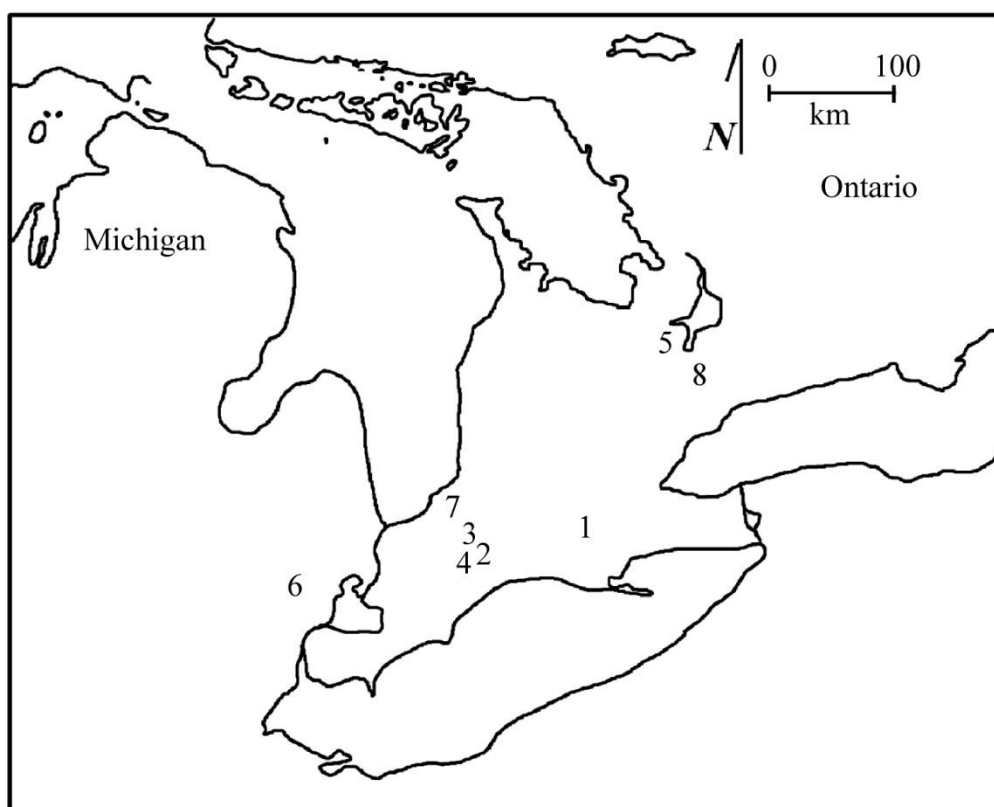


Figure 6.3: Location of Crowfield and Holcombe phase sites included in the analysis. Sites: 1 – Alder Creek; 2 – Bolton; 3 – Caradoc and Strathroy; 4 – Crowfield; 5 – Fowler; 6 – Holcombe Beach and Holcombe II; 7 – Tedball; 8 – Zander.

Two additional Paleoindian complexes in the region, Crowfield and Holcombe (Figure 6.3), have been identified on the basis of continued technological changes. The Crowfield complex in particular is best known from the type site in southern Ontario that lends its name to the complex and that produced the remains of a large heat fractured cache of stone tools (Deller and Ellis 1984). Several smaller sites, including Alder Creek (Timmins 1994) and Zander (Stewart 1984) have also produced abundant Crowfield materials. As a whole this period is less well known than the earlier Gainey or Parkhill complexes. Further, the temporal relationship with Holcombe is also an important question and the two complexes may overlap in time. Based on the accepted projectile point chronology for the region, Crowfield and Holcombe represent the terminal fluted point occupation in the lower Great Lakes region (Deller 1988; Ellis and Deller 1997). In fact many Holcombe points are rather poorly fluted and are, in many instances, perhaps better described as basally thinned (Fitting et al. 1966). Likewise, the Holcombe affiliated Tedball site in southern Ontario actually lies below (i.e. post-dates) the main Algonquian shoreline and corroborates the interpretation that the Holcombe complex dates after 10,400 BP (Deller 1988).

## 6.2 ASSEMBLAGE LEVEL ANALYSIS

The archaeological sample evaluated here includes 55 stone tool assemblages from 31 different Paleoindian sites located in southern Michigan and southern Ontario. This sample includes representative sites from each of the major Paleoindian complexes identified for the region (Table 6.2, See Appendix for raw data). The majority of assemblages included in the sample resulted from systematic, professional excavation and provide a robust database from

which variability in the composition of archaeological assemblages can be explored. The assemblage level analysis will focus on three related dimensions of assemblage variability; standardization, richness, and evenness. Richness and evenness represent two different measures of assemblage composition. All together these three dimensions of assemblage variability permit evaluation of different aspects of the residually mobile caribou hunting (RMCH) model.

#### 6.2.1 STANDARDIZATION

A model for residually mobile specialized caribou hunting societies was presented in the previous chapter and hypothesized that differences in standardized tool production should be evident among archaeological sites resulting from populations practicing this economic strategy. The specific logic underlying this hypothesis is that the fall caribou hunt represents a critical juncture in the annual round for all full-time caribou hunting peoples. The importance of the fall caribou hunt lies not just in providing an abundant supply of fat and protein, but also raw materials such as hides, antler, and bone. The expectation is that as risk of tool failure increases with the fall caribou hunt there will be increased emphasis on the production of reliable tools. By extension, an emphasis on reliability is expected to result in the increased standardization of tools, particularly extractive tools such as projectile points.

To examine this hypothesis metric data on the basal widths of fluted projectile points are compared between individual Paleoindian sites. This approach is favored for two underlying reasons. First, basal width is thought to represent an important variable in the hafting of projectile points and thus linked to the performance and reliability of the weapon system. Secondly because the basal portions of projectile points are encompassed in the haft, they are

less likely to have been affected by resharpening of projectile points, which has the potential to increase variability in other measurements such as maximum length and width. From this perspective basal width is a functionally relevant measurement influenced by the desire to produce a reliable weapon system and serves as an accurate indicator for the level of variability in an assemblage of projectile points.

Metric data on Paleoindian projectile points from archaeological sites in southern Michigan and southern Ontario are summarized in Table 6.3 and coefficients of variation (CV, [standard deviation/sample mean]\*100) were calculated for individual stone tool assemblages. CV ranged from a low of 7.2 percent to a high of 32.6 percent, although the Leavitt assemblage (32.6 percent) may be erroneously high. At Leavitt, the comparatively high variability is due to a single biface that, based on metric data, is typologically more closely related to Gainey rather than Barnes. The remaining two smaller bifaces both have narrower bases and larger face angles that are characteristic of the Barnes type. By removing the larger biface from the Leavitt sample, the CV for the assemblage drops to 19.9 percent and includes only the two smaller bifaces that are unequivocally Barnes points. This CV is considerably more in line with the rest of the site assemblages that range from 7.2 percent to 14.8 percent, but still means that Leavitt represents the most variable assemblage examined here.

Table 6.3. Summary of metric data for basal width (mm) on fluted bifaces (sources for original data listed in Table 6.2)

	Gainey Isolates	Leavitt*	Parkhill (Area B)	Parkhill site total	Fisher	Thedford II	Barnes	Barnes Isolates	Holcombe	Crowfield	Holcombe II
n	14	2	13	27	13	4	7	4	79	12	6
Phase	Gainey	Parkhill	Parkhill	Parkhill	Parkhill	Parkhill	Parkhill	Parkhill	C/H	C/H	C/H
Average	25.3	15.3	16.8	16.8	15.0	18.4	18.0	18.9	18.8	17.9	18.0
Stdev	1.81	3.04	1.57	1.40	1.41	1.35	2.45	2.10	2.09	2.65	2.00
CV	7.17	19.94	9.32	8.38	9.40	7.35	13.61	11.11	11.08	14.81	11.11

\*Leavitt data presented with unusually large specimen dropped from the totals.

Table 6.4 Results of D'AD tests comparing differences in standardization among basal width between sites

	Leavitt*	Parkhill (Area B)	Parkhill site total	Fisher	Thedford II	Barnes	Holcombe	Barnes Isolates	Gainey Isolates	Crowfield	Holcombe II
Leavitt		1.982 (p = .16)	3.269 (p = .07)	1.928 (p = .16)	2.113 (p=.15)	.426 (p=.51)	1.205 (p = .27)	.637 (p=.42)	<b>4.574</b> <b>(p=.03)</b>	.199 (p=.66)	.795 (p=.37)
Parkhill (Area B)	1.982 (p = .16)		.202 (p = .65)	.001 (p=.98)	.232 (p=.63)	1.242 (p=.27)	.535 (p=.46)	.160 (p=.69)	.848 (p=.36)	2.351 (p=.13)	.228 (p=.63)
Parkhill site total	3.269 (p = .07)	.202 (p = .65)		0.223 (p=.64)	0.082 (p=.77)	2.994 (p=.08)	2.582 (p=.11)	.527 (p=.47)	.392 (p=.53)	<b>5.911</b> <b>(p =.02)</b>	.794 (p=.37)
Fisher	1.928 (p = .16)	.001 (p=.98)	0.223 (p=.64)		.246 (p=.62)	1.188 (p=.28)	.490 (p=.48)	.145 (p=.70)	.900 (p=.34)	2.273 (p=.13)	.207 (p=.65)
Thedford II	2.113 (p=.15)	.232 (p=.63)	0.082 (p=.77)	.246 (p=.62)		1.151 (p=.28)	.658 (p=.42)	.490 (p=.48)	.003 (p = .96)	1.453 (p=.23)	.554 (p=.46)
Barnes	.426 (p=.51)	1.242 (p=.27)	2.994 (p=.08)	1.188 (p=.28)	1.151 (p=.28)		.546 (p=.46)	.149 (p=.70)	<b>3.950</b> <b>(p=.05)</b>	.052 (p=.82)	.212 (p=.65)
Holcombe	1.205 (p = .27)	.535 (p=.46)	2.582 (p=.11)	.490 (p= .48)	.658 (p=.42)	.546 (p=.46)		.000 (p=1.00)	3.015 (p=.08)	1.952 (p=.16)	.000 (p=.99)
Barnes Isolates	.637 (p=.42)	.160 (p=.69)	.527 (p=.47)	.145 (p=.70)	.490 (p=.48)	.149 (p=.70)	.000 (p=1.00)		1.193 (p=.27)	.316 (p=.57)	.000 (p=1.00)
Gainey Isolates	<b>4.574</b> <b>(p=.03)</b>	.848 (p=.36)	.392 (p=.53)	.900 (p=.34)	.003 (p = .96)	<b>3.950</b> <b>(p=.05)</b>	3.015 (p=.08)	1.193 (p=.27)		<b>5.967</b> <b>(p=.01)</b>	1.620 (p=.20)
Crowfield	.199 (p=.66)	2.351 (p=.13)	<b>5.911</b> <b>(p =.02)</b>	2.273 (p=.13)	1.453 (p=.23)	.052 (p=.82)	1.952 (p=.16)	.316 (p=.57)	<b>5.967</b> <b>(p=.01)</b>		.486 (p=.49)
Holcombe II	.795 (p=.37)	.228 (p=.63)	.794 (p=.37)	.207 (p=.65)	.554 (p=.46)	.212 (p=.65)	.000 (p=.99)	.000 (p=1.00)	1.620 (p=.20)	.486 (p=.49)	

The range of CV represented indicates there is some variability between individual assemblages. When the assemblages are compared temporally we see very low CV among both the Gainey isolates and the larger Barnes assemblages from Parkhill, Fisher, and Thedford II. In contrast, the later dating Crowfield and Holcombe assemblages exhibit consistently higher CV (11.1-14.8 percent). These data suggest the overall trend is for a loss of standardization over time, especially when considering that the most standardized assemblage is the sample of Gainey Isolates (7.2 percent).

Table 6.4 summarizes the results of repeated pair-wise D'AD tests, which is a statistical test for differences among CV that is sensitive to sample size (Eerkens and Bettinger 2001). These tests indicate there are statistically significant differences between the Gainey Isolates when compared to the Leavitt, Crowfield, and Barnes site assemblages. Likewise, there is also a significant difference between the Parkhill and Crowfield assemblages. Because each of these significant results compares an earlier assemblage exhibiting less variability against a later assemblage with more variability, these data reaffirm the trend for less standardization over time.

Only the Barnes assemblages provide a large enough sample to evaluate the potential for seasonal differences in standardization hypothesis outlined in chapter five. Interestingly the Parkhill, Fisher, and Thedford II assemblages are each characterized by low CVs of <9.5 percent. These three sites contrast with the remaining Barnes assemblages including isolated finds that all have CV of >11 percent. However, D'AD tests indicate these differences are not statistically significant. Although in the case of the Leavitt site the very low sample size makes it very difficult to return a significant result using the D'AD statistic, nevertheless comparing Leavitt with the Parkhill assemblage does produce a result ( $p=.07$ ) that approaches the 95 percent

confidence mark. These data suggest that there are some differences in individual Barnes sites, at least in regard to standardization of extractive tools. These include sites with highly standardized basal widths located in close proximity to the Lake Algonquian shoreline (Fisher, Parkhill, Thedford II) in contrast to sites with less standardized basal widths that are positioned more to the interior (Barnes, Leavitt). Similarly, the isolated Barnes points predominantly came from interior areas and exhibit a higher CV of >11 percent.

### 6.2.2 ASSEMBLAGE COMPOSITION

This section focuses on examining measures of assemblage richness and evenness from the sample of Paleoindian archaeological sites in the lower Great Lakes and comparing those measurements against the expected patterning modeled in chapter five. To ensure that each assemblage is comparable to one another it was also necessary to standardize tool classes and tool counts. Fortunately Paleoindian systematics for the lower Great Lakes exhibits a considerable degree of similarity in the artifact typologies used by researchers. This enabled relatively easy comparison between individual assemblages. Nevertheless, there is still some variability as different analysts and different projects will emphasize some material cultural traits over others. Tools from each assemblage were assigned to one of 18 classes of stone tools that include a variety of bifacial and unifacial tool classes along with a single category for cores (Table 6.5). Where available, data on debitage and channel flake counts were also assembled.

Complimenting this long list of 18 tool classes is a short list comprised of seven commonly recognized tool classes, which updates an earlier analysis of Paleoindian assemblage composition performed by Shott (1997). The shorter list was assembled because a small number



of sites in the region, including the important Gainey type site, do not have detailed results of excavations available to include them in the long list. The short list affords an opportunity to expand the number of assemblages in the sample and provides a means to cross check assemblage data to determine if patterning is a product of our artifact typologies or the result of structural variability in the archaeological record.

Table 6.5. Tool Classes included in the analysis

Long List	Short List
Preforms	Fluted biface
Fluted points	Other biface
Backed bifaces	End scraper
Alternatively beveled bifaces	Side scraper
Other bifaces/biface fragment	Graver
Channel flake points/miniature end scrapers	Pièces esquillée
End scrapers	Other unifaces/retouched flake
Narrowed/offset end scrapers	
Side scrapers	
Concave side scrapers	
Gravers/micro-piercers	
Drills	
Becs/burins/hafted perforators	
Denticulates/notches/borers	
Other unifaces/uniface fragment	
Utilized/retouched flakes	
Pièces esquillée	
Cores	

The long and short lists are intended to standardize archaeological systematics and facilitate comparison between assemblages. For this reason the categories included in both lists should be considered to be tool classes rather than an exhaustive list of tool types. For that reason

several of the categories used in this study have multiple names that reflect both variability in terminology and internal variability within a single class of related tool types. As an example, the category of bec/burin/hafted perforator includes a distinctive category of tools that are best described by the Upper Paleolithic term *bec* or “beak.” These tools each include a sturdy, angular projection used for grooving or gouging activities. Elsewhere tools of this category have been described as beaked scrapers (Stewart 1984; Stork 1979; 1997). Hafted perforators differ from beaks primarily because the lower portion of the tool shows intentional modification through retouching, presumably to facilitate hafting. In this regard beaks appear to reflect more expedient production of an angular surface for use as a hand held tool, while hafted perforators may be a hafted version of the same tool (Ellis and Deller 2000:131-132). Hafted perforators also would include Peter Stork’s category of Type I Beaked Scraper from the Fisher site (Stork 1997:Plate 3.12 h-k). In several rare instances production of a strong angular projection includes tools described as burin-like or chisel-like tools (Wright and Roosa 1966:856). However, these differ from the Upper Paleolithic tradition in the sense that burination within lower Great Lakes Paleoindian assemblages is neither widespread nor was apparently routinely practiced on specifically selected tool blanks. In fact, bending and/or radial fracturing and subsequent recycling of snapped tool edges was likely a more common strategy than burination was in order to produce a similar “chisel-like” functional edge (Ellis and Deller 2004:72 Wright and Roosa 1966:856). The strong and often angular tips on beaked scrapers and hafted perforators likely served a related function and are obviously a more widespread and intentional tool form. Use wear analysis by Tomenchuk (1997) suggests these tools were used for various grooving activities and in a twisting manner. For these reasons they are grouped here in a single category.

Other categories, such as gravers and micro-piercers, obscure internal variation out of necessity. Gravers recovered from lower Great Lakes Paleoindian sites often have multiple graver spurs and some differences in the location of wear, but nevertheless include objects that were probably used for related types of activities (Tomenchuk and Stork 1997). Inconsistent reporting of the number of spurs and location of wear between assemblages precludes any further sub-division of this category. Still other categories like narrowed/off-set end scrapers most likely reflect specialized hide-working activities, and the category of miniature end scrapers/channel flake points have been argued to have served as toys, ritual objects, charms, or all three (Ellis 1994). The specialized forms contained in these two categories are readily apparent and so are included in the long list as separate categories.

Finally, recycling of tools is a common occurrence on many Paleoindian sites and can have a substantial effect on assemblage composition. This is certainly an important dimension to understanding the organization of chipped stone tool economies, but unfortunately one that lies beyond the scope of the present research. Although some analysts have identified both the recycled tool and the original tool form and included both in their tool counts (Deller and Ellis 1992; Ellis and Deller 2000), for the purposes of this study I count these tools here as a single tool and, when possible, these were assigned to the most recent form utilized (i.e. the recycled form).

#### 6.2.2.1 ASSEMBLAGE RICHNESS

Following Shott (1997) richness is represented by the total number of tool classes present in an assemblage. According to the RMCH model the expectation is for sites to exhibit minimal

variability in the richness of individual assemblages. This expectation is because the model emphasizes a heavy organizational investment in residential mobility. As a result movements of the entire domestic group should occur and any special purpose sites would be restricted to short-term extractive localities within the foraging radius of residential camps (Binford 1980).

Likewise an emphasis on residential mobility should also result in an organizational emphasis on toolkits designed to provision people rather than places (Kuhn 1994). In particular, an organizational emphasis on the provisioning of people should result in standard toolkits with similar compositions to have been transported from site to site. The implication being that assemblage richness can be expected to relate most directly to size of the group and duration of occupation, with longer occupations resulting in an increased chance that a particular class of tool will become discarded in the archaeological record.

Figures 6.4 and 6.5 depict the relationship between richness and assemblage size for the long and short lists respectively. Both figures indicate that richness correlates positively with assemblage size. This relationship has a strong log linear curve to it and log transforming assemblage size displays the consistent linear nature of this relationship. Importantly, the shape and significance of the correlation holds constant across all three chronological divisions. This pattern also occurs regardless if the long or short list is used, which suggests that assemblage richness is not a product of our artifact typologies, but instead reflects the structure of the archaeological data themselves. Pearson's correlation coefficients confirm that the linear relationship between richness and log assemblage size exhibit a strong positive correlation that is statistically significant beyond the .05 level (Table 6.6).

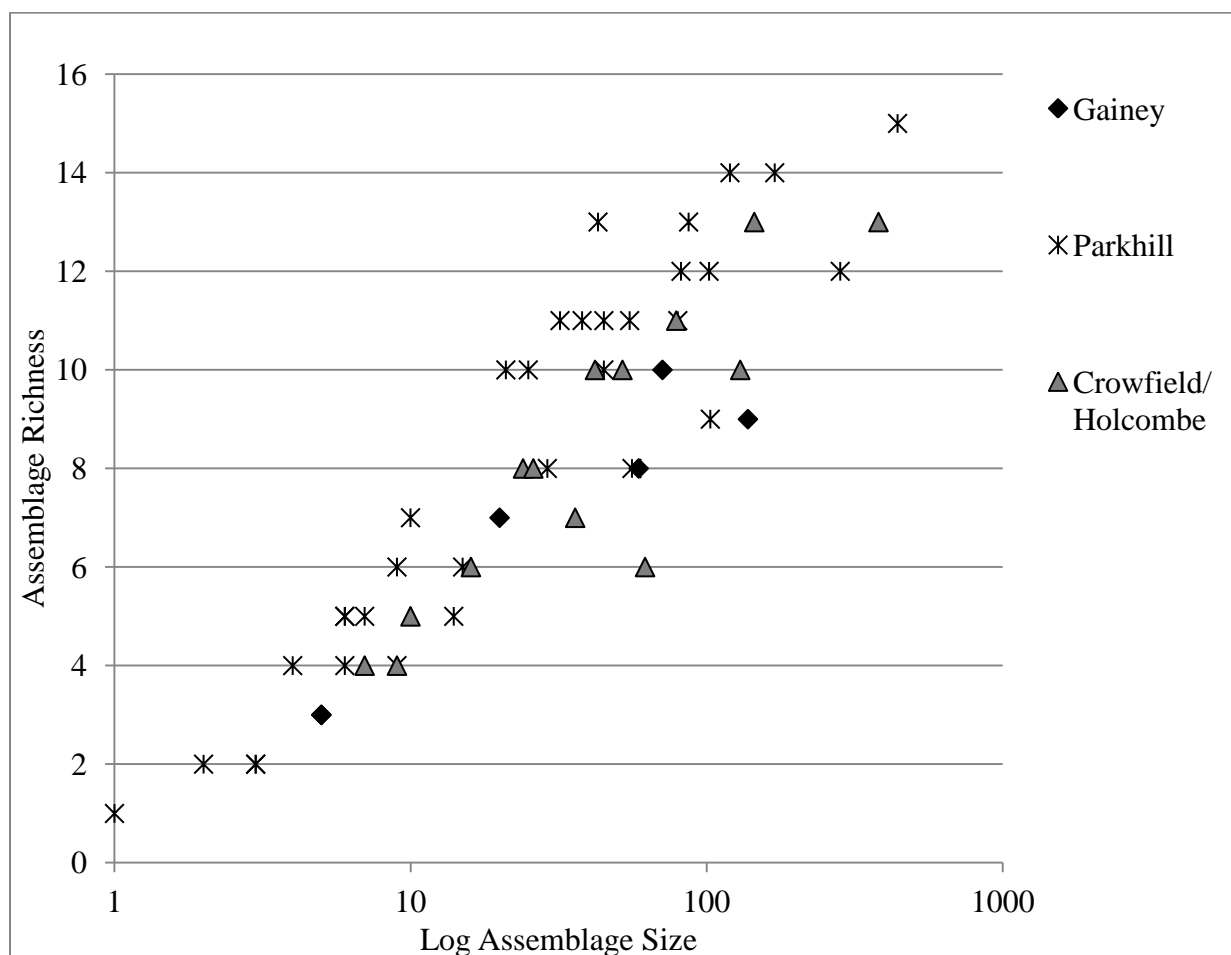


Figure 6.4. Relationship between assemblage richness and assemblage size.  
 Note: Richness calculated from the longer list of possible tool classes in Table 6.5

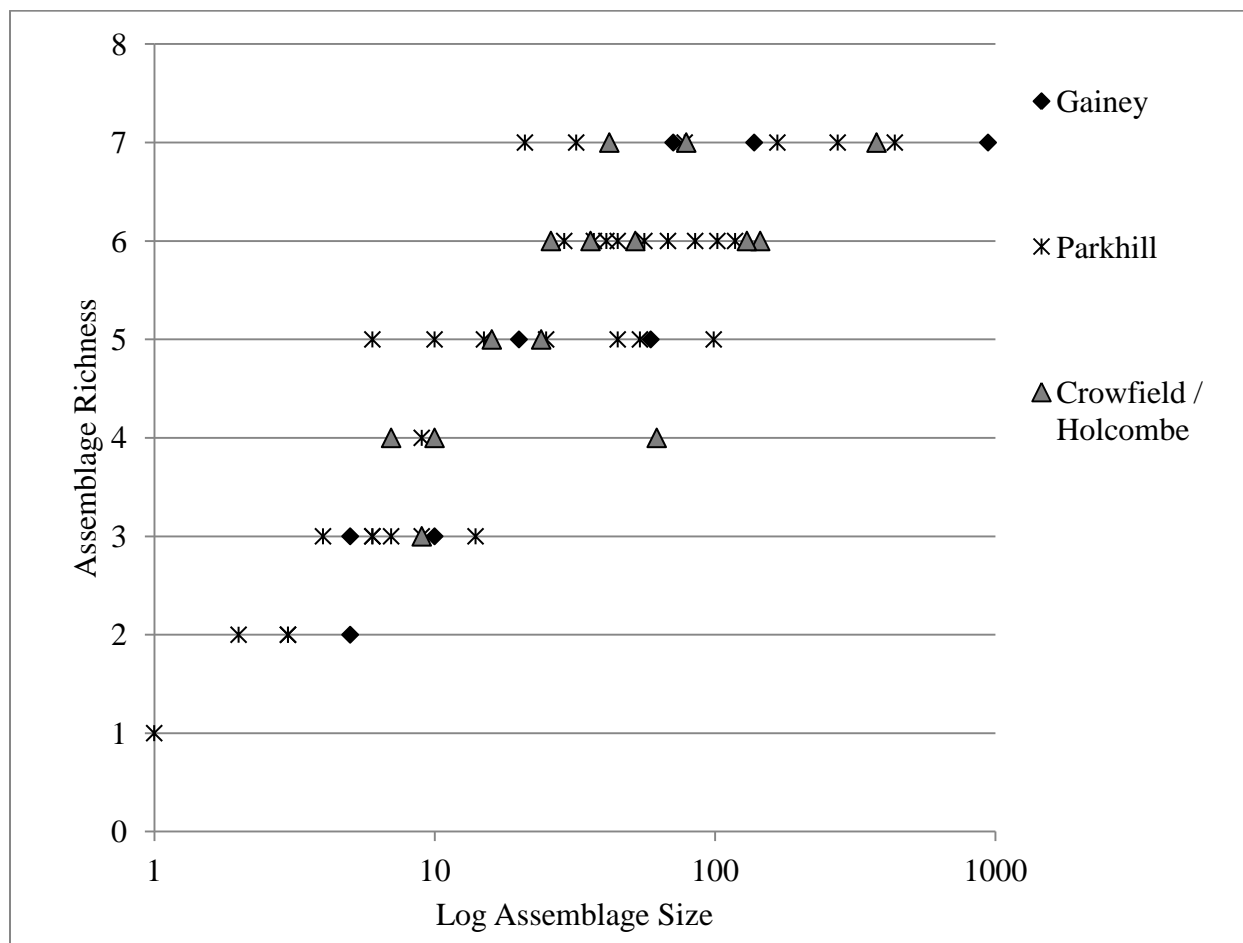


Table 6.6. Results of Pearson's correlation comparing richness and log assemblage size

Phase	Long List		Short List	
	r	p (<.05)	r	p (<.05)
Gainey	0.943	Y	0.894	Y
Parkhill	0.935	Y	0.873	Y
Crowfield/Holcombe	0.898	Y	0.728	Y

One potential limitation of these data is the effect of sample size on assemblage richness. Obviously larger archaeological samples increase the likelihood that different tool types will be recovered. When archaeological excavations produce large samples this increases confidence that the artifact classes present on a site are accurately represented in our archaeological samples. However, with smaller archaeological samples we incur the increased risk of incorrectly identifying the actual relationship between richness and assemblage size. Shott (1997) also emphasizes this point and calculated the expected samples sizes needed to confidently recover artifacts from the different classes of tools used in his study. His results are encouraging because the estimates he produced suggest that even relatively modest assemblage sizes can be expected to produce items from the rarer artifact classes.

While acknowledging sample size as a concern, it is important to observe that multiple loci from the same site are included in the database and these assemblages have been subjected to intensive, professional excavations (Deller and Ellis 1992; Ellis and Deller 2000; Stork 1997). In fact, many smaller sites have also received intensive professional excavation (e.g. Deller 1988; Deller and Ellis 1996; Jackson 1996, 1998), and lends support to the notion that the available assemblage data provide a reasonably accurate representation of the archaeological

record, rather than being an artifact of archaeological sampling. To further evaluate the effect of archaeological sampling on these data, a Pearson's correlation was performed to compare area excavated with both richness and assemblage size. Results of the Pearson's tests indicate that only a weak linear relationship exists between area excavated ( $m^2$ ) and both richness ( $r = 0.380$ ) and assemblage size ( $r = 0.377$ ). In short, while the  $r^2$  values indicate that area excavated does explain a small amount of variability, approximately 14 percent, there is a much stronger association between richness and assemblage size. This lends further support to the appropriateness of these data to explore dimensions of assemblage variability.

Data pertaining to assemblage richness evaluated here supports the notion that richness is influenced more by the assemblage size and likely duration of occupation rather than modern archaeological sampling practices. These data also support the expectation that the provisioning of people was the primary organizational strategy for lithic toolkits. This is because there are no assemblages that appear to be unusually more or less rich than would be expected if specific places were provisioned in anticipation of specific activities. To further illustrate this point, even the caches of artifacts from Crowfield and Caradoc correspond to the observed pattern and support arguments by the excavators that the caches reflect personal toolkits (Deller and Ellis 1984; Ellis and Deller 2004). Since these caches were intentionally destroyed it makes little sense that they were used to provision places.

The only exceptions from southern Ontario may be the biface cache from Area A-northeast at Thedford II (Deller and Ellis 1992) and a cache of unifacial tools recovered from Area A-east at Udora (Stork and Tomenchuk 1990) that were left at specific localities in anticipation of future use. In southern Michigan, the Hatt (Simmons 1997), Round Lake (Carr



and Lovis 2011), and Vibber (Wright and Roosa 1966) biface caches also may be exceptions. It is difficult to evaluate the temporal placement of these caches, let alone the overall role of these biface caches had in the organization of lithic toolkits. Although it is suggestive that they may have been employed to a greater extent in southern Michigan perhaps because available lithic raw materials are more localized there than in southern Ontario.

#### 6.2.2.2 ASSEMBLAGE EVENNESS

Assemblage evenness is assessed here by examining CV, which document the distribution of tools across each of the artifact classes present. An assemblage with a high CV means that the assemblage is dominated by only a few classes of tool, while more evenly distributed assemblages will exhibit a comparably low CV. The expectation stemming from the RMCH model is that assemblage evenness is likely to vary during the year, such as the expectation that CV will be higher at sites reflecting gearing up in advance of the fall caribou hunt. Preparation in advance of the hunt is expected to produce a less even assemblage (a higher CV) because the assemblage is dominated by the manufacture of extractive tools. Sites reflecting occupation during the remaining parts of the year are expected to produce more even assemblages; albeit with some variability between individual assemblages as the result of differences in rates individual tools classes enter the archaeological record.

While it is tempting to correlate the frequency of fluted bifaces and assemblage evenness to examine episodes of gearing up prior to the fall caribou hunt, comparing evenness to the frequency of channel flakes may be a more accurate measure. Although some bifaces can be expected to have been broken during manufacture and less reliable or moderately worn

implements discarded, bifaces manufactured during an episode of gearing up are most likely to have been transported away from the site. High frequencies of discarded bases may be more indicative of post-hunting maintenance and should correspond with higher frequencies of processing implements. Conversely channel flakes are a more accurate reflection of the intensity to which extractive items were manufactured. To best exemplify this relationship the Pearson's coefficient indicates that channel flake frequency correlates considerably more strongly with preforms ( $n = 28$ ;  $r = 0.94$ ) than fluted bifaces ( $n = 27$ ;  $r = 0.56$ ).

Table 6.7. Summary data comparing channel flakes and assemblage evenness

		n	Mean # channel flakes	Mean CV*	Std. Dev.
Group 1	<25 channel flakes	26	6.50	0.97	0.35
Group 2	>25 channel flakes	8	161.25	1.06	0.32
$t = 0.6407$ ; $df = 32$ ; $p = 0.53$					

\*CV calculated from the longer list of tool classes (see Table 6.5)

Table 6.7 summarizes data from excavated assemblages that reported channel flakes, including those that reported an absence of channel flakes. The frequency of channel flake recovery varies widely and ranges from zero to several hundred. It is reasonable to expect some biface production throughout the year and by extension the presence of even moderate numbers of channel flakes on such sites. However, during episodes of gearing up, larger numbers of channel flakes should be expected due to the increased production of extractive tools. To evaluate evenness, the CV for sites with channel flake data were divided into two categories; sites with greater and less than 25 channel flakes. Although the mean CV for the greater than 25

group is slightly higher, indicating more uneven assemblages, results of a t-test ( $t = 0.6407$ ;  $df = 32$ ;  $p = 0.53$ ) indicate that this differences between the two groups is not statistically significant. In fact, overall there appears to be very little correlation between assemblage evenness and frequency of channel flakes ( $n = 34$ ;  $r = 0.157$ ).

### 6.3 SITE LEVEL ANALYSIS

Analysis of site level expectations focus on understanding how Paleoindian groups in the lower Great Lakes region organized domestic space. By evaluating how domestic space is organized it should be possible to make inferences about past social structures and by extension assess the extent to which Paleoindian social structures compare to those outlined in the RMCH model. To accomplish this goal the organization of domestic spaces is investigated along two dimensions. The first dimension is at the household level and includes the expectation that the archaeological signature of females and children should be consistently present at Paleoindian archaeological sites. Increasing the scale of analysis beyond the individual household, the second dimension to the site level analysis involves estimating the size of the domestic group present at individual sites. If practiced by lower Great Lakes Paleoindians, evidence for risk pooling activities should be manifested at this scale of analysis.

#### 6.3.1 HOUSEHOLD PATTERNING

Expected patterning at the household level is based on two components of the RMCH model discussed above; movement of the entire domestic group and an organizational focus on provisioning of people. Because the model predicts high residential mobility it is likely that the

entire domestic group will regularly move from resource patch to resource patch. Moreover, a result of these residential movements is the expectation that the composition of lithic toolkits will be organized around provisioning people with a mobile toolkit rather than provisioning places (Kuhn 1994). One archaeological signature of such mobile toolkits would be for a similar range of activities to potentially occur at every lower Great Lakes Paleoindian site, rather than different signatures accounting for residential base camps and specialized logistical sites. This component to the model has already been tested above by examining measures of assemblage richness and evenness. As discussed above, the available richness data corresponds very closely to site size and likely duration, a pattern more likely to be associated with residentially organized hunter-gatherers favoring a strategy to provision people rather than places.

More specifically in terms of analyzing household patterning is the recognition that among hunter-gatherer societies labor is primarily organized on the basis of gender and age (Bird and Bird 2008; Jarvenpa and Brumbach 2006a; Sassaman 1992). Although the number of, and exclusivity, of gender specific tasks varies widely, among societies heavily reliant upon the hunting of large game there is an increase in the number of tasks performed exclusively by females (Waugesbeck 2005). While many of these female specific tasks are related to transformative activities such as butchering and hide-working (e.g. Brumbach and Jarvenpa 2006a; Waugesbeck 2005), female task groups may also be expected to engage in some limited hunting (Bird and Bird 2008). Although it is important to note that the specific prey targeted by female hunters, such as a focus on small game rather than caribou, will differ from all-male or mixed-gender task groups because of the different goals guiding prey choice (Bird and Bird 2008).

Because the model also predicts the emphasis on caribou hunting as the primary food source we can expect the expanded role of females undertaking non-subsistence related tasks, which is supported by the available ethnographic record (Brumbach and Jarvenpa 2006a, 2006b; Waugesbeck 2005). The implications are that among residentially organized groups the presence of tools indicative of female labor should be consistently represented in the artifact assemblages. This expectation would differ for groups that are more logistically organized where task and gender specific sites in all likelihood would be part of the logistical system.

One dimension to this analysis is obviously the assumption that not only do end scrapers represent occurrences of hide-working, but that hide-working was undertaken predominately by females. As noted before the model predicts increased task differentiation by females, but this is circular logic as the model would be providing interpretations for data that it is supposed to be testing. Nonetheless, hide-working in the ethnographic record of sub-arctic hunter-gathers is consistently described as an exclusively female task (Glavatskaya 2006:129-130; Jarvenpa and Brumbach 2006c:65-67). Thus, regardless if we argue that other diversified tasks were performed by females or not, hide-working is likely to be one task that is clearly gendered. By extension, ethnographic, experimental, and use-wear studies provide a compelling argument that end scrapers are, in fact, related to hide-working (Donahue 1988:363; Ellis and Deller 2000:244; Gallagher 1977; Storck and Tomenchuk 1990:78; Symens 1986). These two lines of reasoning offer strong support for the assumption end scrapers in the archaeological sample is the most visible class of artifacts representative of female labor.

Conversely, there is also the assumption that fluted points represent male activities. There is a growing body of literature that emphasizes the expanded role that females play in the food

extraction process (Bird and Bird 2008). There is also the increased recognition that “transformative” tasks such as butchering and drying meat are a critical component to the economic system and that such “transformative” activities were performed largely by women (Jarvenpa and Brumbach 2006b, 2006c). The implications of this perspective are that assuming fluted points represent male activities may be a more tenuous assumption than is relating end scrapers to female labor. Although fluted points were clearly used in a variety of tasks, breakage patterns do suggest that their primary use was as extractive implements. Moreover, adopting a ballistics approach to viewing these weapons lends support to the argument that they were used to hunt large game animals (White 2006). Using the same ethnographic sources as above, large game hunting, such as moose and caribou, does appear to have been restricted as a male activity (Glavatskaya 2006:123-125; Jarvenpa and Brumbach 2006c:59). While this gendered view of fluted points may hold, given the observed role of women in processing activities such as cutting meat into thin strips for drying, other bifacial tool forms could certainly reflect female labor.

Excavated Paleoindian assemblages in the sample provide data on the relative frequency of fluted bifaces, end scrapers, and overall numbers of unifacial tools within assemblages (Table 6.8). These data specifically evaluate the hypothesis that Paleoindians in the lower Great Lakes primarily practiced residential mobility and that sites should consistently provide evidence for the presence of entire domestic groups. In other words we should observe a consistent presence of female labor at archaeological sites resulting from residentially organized peoples. These data indicate that the frequency of end scrapers on lower Great Lakes Paleoindian sites remains very high, although this frequency does decline noticeably during the Crowfield/Holcombe phase. Nevertheless, unifacial tools are present on every archaeological site in the sample examined

here. Interestingly, the frequency of fluted bifaces remains below that of end scrapers in the Gainey sample and percentages are nearly identical during the subsequent Parkhill phase.

Table 6.8. Relative frequency of fluted bifaces and end scrapers by phase

Phase	# assemblages	% w/ fluted bifaces	% w/ end scrapers	% w/ unifaces
Gainey	8	75%	100%	100%
Parkhill	21	95%	90%	100%
Crowfield/Holcombe	10	100%	70%	100%

Note: Counts only include excavated assemblages

One limitation of these data is archaeological sampling practices. By relying on only excavated sites we have the potential to ignore certain types of sites, particularly small isolated kill sites. These are exactly the types of sites where end scrapers and unifaces would not be expected. Understandably excavations typically focus on those sites likely to produce large archaeological datasets, while smaller sites are underrepresented. The exception to this has been the targeting of several small, interior sites in southern Ontario (Deller 1988). For example, the Ferguson site in southern Ontario produced a lone uniface from the site, which was actually recovered in a shallow depression along with a Hi-Lo point and thus might not be associated with the Gainey component there (Deller 1988:133). However, in the context of the arguments presented in this section, excavations at Ferguson did recover a distinctive uniface resharpening flake that indicates at least one uniface passed through the site, but was not discarded there.

### 6.3.2 INTRA-SITE PATTERNING AND GROUP SIZE

In the context of this research intra-site patterning provides evidence for the structure of social networks maintained by the Paleoindian inhabitants of the lower Great Lakes region. Inter-site patterning is interpreted here within a framework regarding social structures among RMCH derived from ethnographic data, which was summarized in chapter five. Expectations derived within this framework suggest that site size should range from 20 individuals during dispersed parts of the year to upwards of 50 individuals during periodic seasonal aggregations. Among caribou hunters this period of aggregation coincides with the fall caribou hunt. The viewpoint advocated in the RMCH model is that groupings of 20 and 50 individuals represent the regular, annual fluctuation in band size. Interaction between regional groups is also expected to be manifested in different ways. Whallon (2006) advocates visiting as one common strategy used to maintain ties between adjacent groups and visiting is known to occur both within and between regional bands. Likewise, ethnographic data indicate that episodes of social aggregation between regional bands also occur and in these instances the expectation would be for the aggregation of between 150-175 individuals or roughly 29 households.

Table 6.9 presents data on the number of loci identified among excavated Paleoindian sites in the sample evaluated here. These data make it clear that multiple loci are the norm, rather than the exception. Only four excavated sites contain a single identifiable activity area. Two of those sites (Crowfield and Caradoc) represent probable instances of special purpose ceremonial loci (Deller and Ellis 1984; Ellis and Deller 2004). The remaining two sites (Weed and Ferguson) were identified on the basis of surface collections, but subsequent test excavations were limited by their failure to locate more extensive cultural deposits (Deller 1988).



Table 6.9. Number of loci identified at excavated Paleoindian sites in lower Great Lakes region  
(source of data listed in Table 6.2)

Site Name	Loci	Phase
Ferguson	1	Gainey
Weed	1	Gainey
Murphy	2	Gainey
Halstead	3	Gainey
Sandy Ridge	2	Gainey
Banting	6	Gainey*
Gainey	7	Gainey
Udora	11	Gainey*
Butler	-	Gainey
Barnes	2	Parkhill
Leavitt	2	Parkhill
McLeod	4	Parkhill*
Theford II	6	Parkhill
Parkhill	9	Parkhill
Fisher	19	Parkhill
Caradoc	1	Crowfield/Holcombe
Crowfield	1	Crowfield/Holcombe
Bolton	2	Crowfield/Holcombe
Zander	2	Crowfield/Holcombe
Holcombe Beach	2	Crowfield/Holcombe
Fowler	3	Crowfield/Holcombe
Alder Creek	3	Crowfield/Holcombe
Hussey	4	Crowfield/Holcombe*

\* Sites contain diagnostics from multiple phases, which indicate reoccupation. The primary phase of occupation, as identified by the principal investigators, is indicated here.

Interestingly the Weed and Ferguson excavations are similar to the contemporaneous Gainey phase Murphy site, where initial excavations also failed to locate additional cultural deposits (Jackson 1996). At Murphy, however, subsequent excavations located a second activity area not previously identified through surface collections and raise the possibility that similar areas went unidentified by the limited testing at Weed and Ferguson.

The modal size for Paleoindian sites within the region is for there to be two or three identifiable concentrations of artifacts ( $n = 10$ ; 43.5 percent), including clusters of lithic debitage, tools, and uniface resharpening flakes. In many instances these concentrations are associated with paired subsurface features suggestive of hearth centered domestic areas that may represent individual household units. At Leavitt, paired features were associated with two small but spatially distinct concentrations of excavated cultural material (Shott 1993). Tools and debitage recovered from these two concentrations are similar enough to suggest that these represent paired areas with similar ranges of domestic tasks being performed there. This pattern of paired loci is also evident at other sites such as Barnes and Sandy Ridge (Jackson 1998; Voss 1977).

Yet, there are exceptions to this pattern with some sites that contain two or three loci exhibiting evidence for spatial segregation of activities. This is best exemplified at the Halstead site where three loci were identified and only one contains an identifiable feature (Jackson 1998). The two southernmost areas contain concentrations of uniface resharpening flakes and discarded unifacial tools. In contrast, the northernmost area contains a much greater concentration of bifacial debris. The spatial separation of bifacial debris suggests repair of armaments occurred there, but not elsewhere on the site. Likewise the general absence of unifacial resharpening flakes from this area suggests that bifacial work represents segregation of that particular activity

within the site. Nevertheless, there are still two potential areas representative of general domestic activities present at the site. Still, the excavations at Halstead raise an important caveat, that a one to one relationship between identifiable archaeological loci and households is not likely to occur; nor should we expect such relationship.

Keeping this limitation in mind, most of the available evidence present does suggest that the small, excavated Paleoindian sites within the lower Great Lakes region are characterized by two or three loci each containing evidence for a range of domestic activities. Occasionally special purpose activities are segregated, but the trend is for sites with small numbers, often only paired, households. When comparing these data with expectations from the RMCH model, there appears to be some correspondence with the size of small dispersed settlement sizes. If we maintain the estimate of six individuals per household this sample of small sites ranges from 12 to 18 individuals. Even if we adopt Binford's (2001) higher estimate of eight individuals per household, numbers only increase to 16-24 individuals and does not increase numbers beyond that documented ethnographically for residually mobile caribou hunters during the dispersed periods of the year (see Table 5.2).

Such low, dispersed population numbers are frequently attributed to Paleoindians because they represent a colonizing population (Dincauze 1993). However, in the context of this study, the low population densities maintained during dispersed periods of the year also corresponds to the remarkably low population densities among specialized caribou hunting peoples observed in the ethnographic record (Burch 1972; Spiess 1979). The need for low densities is tied directly to herd recruitment rates discussed in chapter three and the minimal per capita requirements for food and hides (see Table 3.1). Thus, low population densities among specialized caribou hunters

would be required to ensure sustainable harvest of herds even without considering external factors such as catastrophic loss due to weather conditions or animal predation.

### 6.3.3 SOCIAL AGGREGATION

In contrast to the numerous small sites, the archaeological record of the lower Great Lakes contains several larger Paleoindian sites. These large sites are distinguished through the presence of six or more spatially distinct loci or activity areas. These sites present an important interpretive dilemma for Paleoindian research in the region and in the context of this study there is a need to understand if these sites represent periodic aggregations related to the fall caribou hunt, occasional aggregation of related regional bands, or are the result of reoccupation. In fact, much of the literature dealing with Paleoindian social structures for both the Great Lakes and Northeast regions has focused on the issue of whether or not these large multi-locus sites represent episodes of social aggregations (Dincauze 1993; Ellis and Deller 2000; Robinson et al. 2009; Shott 2004; Simons 1997; Simons et al. 1984; Stewart 1997). The result has been an important debate in Paleoindian research.

The prevailing hypothesis is that large sites with multiple loci are the result of population aggregation (Dincauze 1993; Robinson et al. 2009; Shott 2004; Simons 1997; Simons et al. 1984). Most commonly aggregation is seen to be the result of caribou hunting, although Dincauze (1993) does suggest these sites may instead reflect pioneering stations related to human colonization. Despite the strong arguments for aggregation, the alternative hypothesis, that multiple loci are the result of reoccupation, is a very real possibility and should not be rejected on the basis of limited evidence. This alternative hypothesis has been proposed for the

later dating Parkhill sites in southern Ontario (Ellis and Deller 2000; Storck 1997) and has been the focus of Shott's (2004) recent review of social aggregation among Paleoindian peoples.

Shott (2004) outlines several important methodological issues concerning the identification of aggregation sites. The central focus of his critique is the difficulty in relating loci together as contemporaneous units and the problems with identifying discreet loci in the first place. Although data such as the lack of overlap between areas have been used in the past to argue for aggregation, these data suffer from equifinality:

However defined or recognized, loci are always spatially discreet entities, their definition forbidding overlap between them. Practically, in excavated sites locus boundaries are the boundaries of excavation blocks that cannot overlap unless the same unites are excavated twice, absurd even if possible. If two blocks merge in pursuit of artifact clusters, they become a single larger block. If they do not merge, they remain separate, trivially. The conclusion that loci do no overlap is a tautology entailed by the method used to define them (Shott 2004:78-79).

In addition to this methodological problem, the fact that hunter-gatherers may intentionally locate themselves away from the trash left by previous occupations is a behavioral process also leading to the lack of overlap (Shott 2004). Conversely, there is little reason to assume equal spacing between loci. Closely related relatives may position themselves in such tight proximity to one another that the debris of their occupation may actually blend together into a single large cluster. This would be particularly true if one household lacked hunters (e.g. elderly and widows) as is suggested by Enloe's (2004) analysis of meat sharing at Pincevent.

The interrelationship between multiple variables is necessary to develop a strong argument for or against sites representing social aggregation (Shott 2004). Important lines of evidence that allow the aggregation hypothesis to be evaluated include spacing of loci, consistency in loci size, lack of overlap between loci, and the overall spatial layout (Shott 2004).

Even with these other variables, refits of artifacts between loci still represents the most direct line of evidence that can be used to establish contemporaneous occupation. Unfortunately other potentially important variables such as stratigraphic context and dates are generally unavailable for sites in the Great Lakes region, which are the result of modern agricultural practices and poor organic preservation. It is important to note that none of these lines of evidence, refits included, represent unequivocal evidence of aggregation into themselves.

Fisher is the largest such site in the region and research during the 1980s identified 19 spatially separate loci. These loci are scattered across a 500 meter stretch of the former Lake Algonquian shoreline and are commonly grouped together into three distinct clusters (Stewart 1997:Figure 5.1; Stork 1997:Figure 2.2). Although none of the loci or clusters overlap with one another, their broad, irregular spacing and lack of any clear internal organization have been cited as evidence to suggesting the loci resulted from multiple reoccupations. More detailed analysis of the assemblages was undertaken by Stewart (1997) to evaluate the possibility that some areas are interrelated to one another. His conclusions support the general assessment that the Fisher site in general is the result of multiple occupations, although some areas such as Areas C and C-east may represent a contemporaneous occupation. In fact, there is evidence to suggest that areas with a high frequency of bifacial reduction such as Area C-east are paired with a more general domestic area (Area C). However, no more than two loci have been linked in this manner. Interestingly, one of the largest areas at Fisher (Area B) exhibits two distinct concentrations of cultural material (Stork 1997:Figures 2.4, 2.5) and in this regard its structure resembles that of the individual small sites with paired activity areas discussed above.

Udora is more difficult to assess as the site has not been discussed in great detail aside from the excavations in Area A-east. Eleven concentrations of surface materials along with the one subsurface concentration (A-east) have been documented (Storck and Spiess 1994). Published site maps indicate these are spaced regularly across the Lake Algonquian shoreline and form two parallel rows that are bisected by a small ravine (Stork and Spiess 1994:Figure 2). The reality of this regular size and spacing is hard to independently confirm and unpublished field notes do not provide information about the size of individual loci and their spacing. Although it is clear that each do represent spatially discrete clusters of cultural materials. To date there are no refits between individual areas, although this is also equivocal since systematic attempts to refit artifacts has not been undertaken. As a result, there is a lack of corroborating evidence to support an interpretation that the parallel rows represent planned intentional organization as opposed to sequential reoccupation. Certainly the potential for regular spacing, size, and organization of loci at Udora is interesting and does raise the possibility that they are the result of social aggregation. Nevertheless, reoccupation of the site is clearly demonstrated by the presence of two different fluted point types in the Udora assemblage (Ellis and Deller 1997; Shott 2004).

Banting includes at least six loci scattered along a prominent drumlin and excavations have further divided one of these areas (A) into multiple zones (Storck 1979). The loci are concentrated on the eastern end of the drumlin, which also serves to constrain their internal organization. Limited testing of areas A and B do not indicate that any internal division of activities occurred between those two areas. Diagnostic artifacts include both Gainey and Crowfield phase bifaces that indicate the site was reoccupied at least once.

Fieldwork at the Parkhill site identified 12 loci spaced along the former Lake Algonquian shoreline with one area (D) located along the opposite side of a small gully from the remaining areas (Ellis and Deller 2000). Modern plowing has distorted the actual size of the activity areas at Parkhill, although most appear to be approximately 300 m<sup>2</sup> in size. The exceptions to this are two areas (D and B) that are over 2000 m<sup>2</sup>. Likewise, spacing between loci also varies. Some are spaced in a regular linear manner, such as Areas B, E, C, A/J, while the remaining loci are spaced a much greater distance apart (Ellis and Deller 2000; Shott 2004). The only obvious internal organization includes the four linearly arranged areas, while the remaining loci are spaced back away from the shoreline. This is not unlike Udora, where loci were also arranged both adjacent to the slope and back away from the shoreline, a feature reminiscent of the organization at the French Magdalenian site of Etiolles discussed in chapter three (Olive 1992). Nevertheless, only two areas of the site linked by refits (B and D) are located at opposite ends of the site and separated by a shallow gully (Ellis and Deller 2000).

Area D is the largest locus at the site and contains a diverse tool assemblage, which suggests a location where diverse domestic activities were carried out (Ellis and Deller 2000). In this respect Area D closely resembles the individual small Paleoindian sites discussed above and may have some internal separation in activity, again not unlike the individual small Paleoindian sites. In contrast, Area B contains a dense concentration of bifacial flaking debris including channel flakes and broken fluted performs (Ellis and Deller 2000). It is clear that this area represents a specialized location related to the production of fluted bifaces. A similar division between specialized biface production and more general tool use has been proposed at Fisher (e.g. Areas C and C-east) and is also reminiscent of the patterning at Halstead where bifacial



debris were concentrated in the northernmost area of the site. It is interesting to note that at all three sites (Parkhill, Fisher, and Halstead) the specialized production of hunting implements are linked to more general domestic loci as would be expected in the residentially mobile model presented in chapter five.

Thedford II represents the strongest evidence for social aggregation even though the size of the site remains small when compared to the other large sites known from the region. Deller and Ellis (1992) have identified six discrete clusters of cultural material, four of which were almost entirely excavated. The size and layout of these clusters led Deller and Ellis (1992:121) to argue that the areas represent five domestic loci organized around a central common area. Such spatial organization is common among many hunter-gatherer sites and refits present a compelling second line of evidence suggesting that these areas were occupied contemporaneously.

Interestingly, one of these areas (A-northeast) contains a notably high percentage of Bayport chert, a material which also occurs within area A-southwest. Likewise Area A-northeast is also linked to A-east through refits (Deller and Ellis 1992:Figure 74). The presence of Bayport chert debitage and tools in southern Ontario is interesting considering the raw material is most common on Paleoindian sites in southern Michigan. In short, there are three important lines of evidence at Thedford II that can be used to support an aggregation hypothesis. The small, but regular spacing of loci organized in a circular manner, refits suggesting areas are contemporaneous, and the presence of non-local raw materials provides the clearest evidence, to date, for visiting between members of adjacent regional-bands.

Table 6.10. Summary of evidence for aggregation reviewed here  
(sources of data listed in Table 6.2)

Site	Loci	# of loci linked w/ refits	Diagnostics from multiple phases	Loci related through other links
Fisher	19	1	N	2
Banting	6	1	Y	1
Udora	11	1	Y	1
Parkhill	12	2	N	2
Thedford II	6	3	N	5

#### 6.4 REGIONAL LEVEL ANALYSIS

Bedrock sources of high quality lithic raw materials are restricted to a few localities within the lower Great Lakes region. This is because much of the area is covered by extensive deposits of glacial till and outwash. Although suitable raw materials are present within glacial tills, these materials typically are of small size and inconsistent quality so as to not have factored significantly in Paleoindian lithic technology. Rather there appears to be a consistent use of the few primary source areas by Paleoindians who favored the ability to produce large tool blanks on homogeneously high quality lithic raw materials. Moreover, these primary sources also result in visually distinctive tool stones.

The major lithic raw materials utilized by lower Great Lakes Paleoindians include Bayport formation chert from the Saginaw Bay region of Michigan, Fossil Hill formation chert that outcrops near Collingwood in southern Ontario, and Onondaga formation chert that outcrops in a band extending along the north shore of Lake Erie and into upstate New York (Figure 6.6). These three sources occur within all three Paleoindian phases examined so far. In addition to these three materials, during the earliest Gainey phase populations made use of Upper Mercer

chert from east-central Ohio, while sources of Kettle Point chert in southern Ontario would have become available only after 10,400 BP once the level of Lake Algonquian began to drop (Ellis 1989). Tankerseley (1989) provides summary descriptions of each of these raw material sources, each of which can be readily distinguished from one another on the basis of coloring, texture, and macroscopic inclusions.

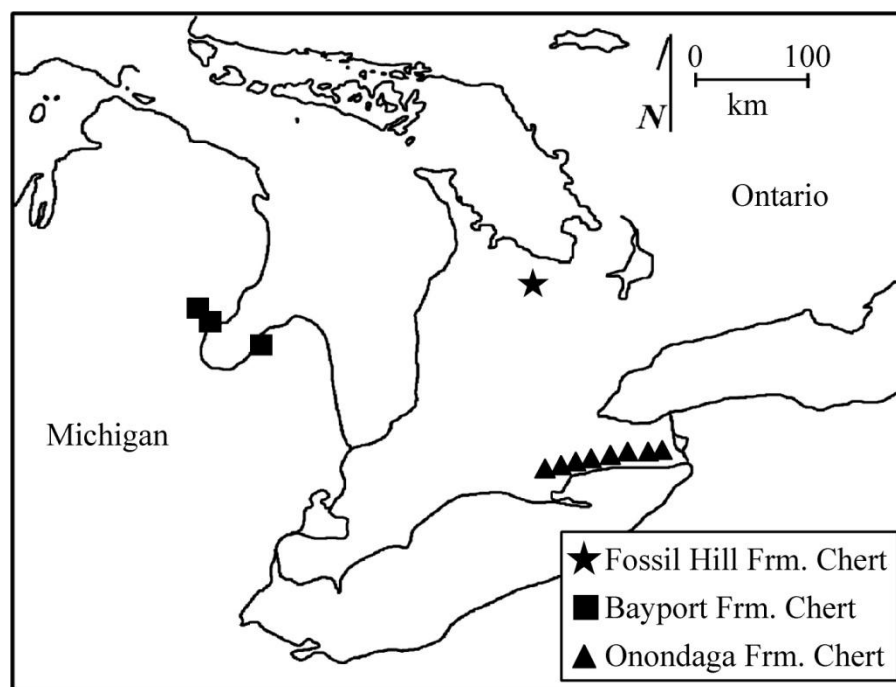


Figure 6.6. Location of primary lithic raw material source areas used by lower Great Lakes Paleoindians (adapted from Ellis 1989)

Examining the distribution of lithic raw materials between sites presents an important line of evidence with which to infer regional scale patterns. This is because Paleoindian groups in the region appear to have been preferentially exploiting these few primary sources of high quality tool stone. Their visual distinctiveness means raw materials from individual archaeological sites

can be attributed to their respective primary source areas. In the case of Bayport and Fossil Hill formation cherts these source areas are also somewhat geographically restricted, even though specific Paleoindian age quarries have yet to be located. Conversely, Onondaga formation chert outcrops within a several hundred kilometer band from southern Ontario into upstate New York. When collecting data on raw material movements it is common practice to measure distance from individual archaeological sites to the closest geographically available source locality. Despite the limitations of not being able to identify specific quarry localities, this method still provides sufficient data to evaluate regional scale patterns of movement.

#### 6.4.1 TERRITORY SIZE

Chapter five distinguished between risk pooling behavior within regional bands (one- or two-tiers) versus risk pooling between regional bands (Whallon 2006). Risk pooling within regional bands is expected to be frequent among closely related groups of individuals and the maintenance of social ties within the regional band is continually reinforced through seasonal aggregations of minimal hunting bands that comprise the regional band. Habitual activities such as food sharing, movement of individuals between groups, and collectively held knowledge and traditional practices reproduce a strong sense of shared group identity. An estimate of 172 individuals for a one-tiered band was estimated in chapter five. This estimate corresponds with ethnographic data that suggests periodic regional aggregation among specialized caribou hunters occurred at this scale (Table 5.2). Among ethnographically known specialized caribou hunters who characteristically maintain some of the lowest population densities recorded, a one-tier regional band of 172 individuals should encompass a territory of roughly 23,500 km<sup>2</sup>.

The archaeological expectations for a regional band of residentially mobile caribou hunters include aggregation among band members and a material cultural signature reflecting a common group identity. Social aggregation was discussed in the previous section, so the analysis here will focus on the material cultural signatures of group identity. This second line of evidence is particularly important among those populations that practice risk pooling, where maintaining a homogenous sense of group membership facilitates sharing (Wiessner 1982, 1983).

The overwhelming use of stone from a single source is a distinctive characteristic of Paleoindian assemblages in the lower Great Lakes region (Ellis 1989; Meltzer 1984). What distinguishes this pattern of lithic raw material consumption is the fact that this single source of lithic raw material was used to manufacture virtually the entire tool assemblage, rather than being restricted to only certain classes of tools. Ellis (1984, 1989) first proposed that this restrictive use of a single lithic raw material source represents a social strategy to reinforce a sense of shared identity among members of a risk pooling group. Deller (1988:214) also suggests that different lithic sources represented different “band territories.” Subsequent research by both Ruggles (2001) and Carr (2005) has confirmed that lithic raw materials operate as a stylistic marker in the Great Lakes region and may reflect group membership in a manner suggested by Ellis (1989).

Table 6.11. Summary of primary raw materials recovered from sites  
(sources of data listed in Table 6.2)

Site	Phase	Material	%	Distance from source km
Fisher	Parkhill	Fossil Hill	90	25
Bolton	C/H	Onondaga	95	95
Crowfield	C/H	Onondaga	83	100
Udora A-east	Gainey	Fossil Hill	Most	100
Barnes	Parkhill	Bayport	95	100
Zander	C/H	Onondaga	70	125
Leavitt	Parkhill	Bayport	95	125
Alder Creek	C/H	Fossil Hill	70	125
Butler	Gainey	Bayport	Most	145
Fowler	C/H	Onondaga	65	160
Holcombe Beach	C/H	Bayport	96	165
Halstead	Gainey	Fossil Hill	85	170
Parkhill	Parkhill	Fossil Hill	88	170
McLeod	Parkhill	Fossil Hill	97	170
Dixon	Parkhill	Fossil Hill	92	170
Caradoc	C/H	Bayport	100	175
Sandy Ridge	Gainey	Fossil Hill	70	175
Thedford II	Parkhill	Fossil Hill	85	180
Murphy	Gainey	Fossil Hill	95	215
Snary	Gainey	Fossil Hill	>90	250
Gainey	Gainey	Upper Mercer	Most	380

Given the strong likelihood that lithic raw materials do serve as a stylistic marker in the lower Great Lakes region, their spatial distribution and distance transported from primary source areas can be used to infer the size of territories occupied by regional bands. Table 6.11 lists those sites from the region that are dominated by a single source of lithic raw materials. Only the Fisher site is located in close proximity to a lithic source, while the vast majority of sites reflect material having been transported upwards of 100-180 km from their source. At the extreme end

of this pattern are the assemblages from the Gainey site, which is dominated by Upper Mercer chert from west-central Ohio that has been transported over 350 km to the north (Simons 1997). Similar occurrences of Upper Mercer chert occur in minor amounts on Gainey phase sites in southern Ontario and help distinguish sites of that phase (Jackson 1996, 1998).

Table 6.12. Average of distance to source by phase

Phase	Average distance (km)
Gainey	205
Parkhill	139
Crowfield/Holcombe	135

Gainey phase sites represent the most extreme examples of transport and are the only sites that provide evidence for population movements of over 200 km (Table 6.12). In contrast to Gainey, the average distance raw materials are being transported during the two subsequent phases is considerably shorter. Raw material transport during both Parkhill and the Crowfield/Holcombe phases were an average of 139 and 135 km respectively. These data indicate a probable reduction in territory size after the Gainey phase. Likewise, the nearly identical magnitude of transport between the two later dating phases suggests stability in territory size.

The largest sample of data concerns the distribution of Fossil Hill chert during the Parkhill phase and provides the most reliable opportunity to estimate territory size. It is clear that there is a redundant pattern of movement between the Fossil Hill source area and a cluster of sites in the Grand Bend region of southern Ontario that include Parkhill, Thedford II, Dixon

(Deller and Ellis 1992; Ellis and Deller 2000). Likewise transport of Fossil Hill chert occurred to a more limited distance east of the source area and includes the occasional occurrence of Parkhill phase materials in the Lake Simcoe region east of the Fossil Hill source area (Stork 1979, 1997). When considered as a whole, this northeast–southwest distribution of Fossil Hill chert extends some 225 km in length. Similarly occurrences of Fossil Hill chert during the Parkhill phase also appear to be restricted within the northern half of the southwestern Ontario peninsula and can be encompassed by a northeast-southwest band roughly 125-150 km in width. These data indicate the known distribution of sites exhibiting a very high percentage of Fossil Hill formation chert encompasses a territory of approximately 28,125 km<sup>2</sup> to 33,750 km<sup>2</sup>. Because this known distribution includes those sites with high percentages of Fossil Hill chert, it is expected that this territory was exploited by members of a regional band that made regular, periodic visits to the Fossil Hill chert source area located in the Collingwood region of southern Ontario (Ellis 1989).

This estimate of territory size hinges on several important assumptions. First, it assumes that movements of raw materials to these sites represent the actual range of normal population movements and is not the result of exchange, inter-annual shifts in territory, or infrequent special purpose trips. Also, estimates could actually be low and not account for other, more distant population movements that did not result in the discard of lithic raw materials (Ellis 1989). Despite these concerns, the fact that multiple assemblages located upwards of 170 km are dominated so completely (>80%) by Fossil Hill formation chert provides evidence that supports an argument for these distances actually representing regular population movements instead of exchange. This is because reliance upon exchange to account for such a large volume of tool stone would seem impractical (Ellis 1989). When placed in the broader context of Paleoindian



raw material transport throughout northeastern North America (e.g. Ellis 1989; Meltzer 1984), 180 km seems rather pedestrian and the occurrence of multiple sites at 170-180 km provides compelling data that suggests redundant, annual population movements at this scale.

A second, more critical assumption is that movements of peoples to the east of the Fossil Hill source area are contemporaneous with movements to the southwest. Ellis and Deller (2000) argue that a reduction in basal width suggests the Fisher site actually dates later than Parkhill and Thedford II. This raises the possibility that the movement of Fossil Hill chert to the east represents a territory shift over time. However, Fossil Hill chert was regularly transported to the east during the previous Gainey Phase, appearing in assemblages at Udora, Sandy Ridge, and Halstead (Jackson 1998; Stork and Spiess 1994). Unless this area was abandoned and then reoccupied toward the end of the Parkhill phase, it may be more reasonable to argue that movements to the east of the Fossil Hill source area occurred contemporaneously with the better documented movements to the southwest. Nevertheless, the most conservative estimate of territory size would only include the maximum observed distance transported to one site, in this case the 180 km to Thedford II. This conservative estimate suggests a minimum territory size of  $22,500 \text{ km}^2$ , which is still quite large (Table 6.13). However, the size of this territory does not differ in any appreciable way from the predicted territory size using the ethnographic data discussed above.

Table 6.13. Territory Size Estimates

Phase	Raw Material	Minimum one way transport (km)	Maximum distance (km)	Estimated territory width (km)	Territory Size Estimate (km <sup>2</sup> )	
					Conservative	Known distribution
Gainey	Fossil Hill	250	340	150	37,500	51,000
Parkhill	Fossil Hill	180	225	125 - 150	22,500	28,125 - 33,750
Parkhill	Bayport	125	175†	125(175†)	15,625	21,875 (30,625†)
C/H	Bayport	165*	175	165	27,225	28,875
C/H	Onondaga	160	230	160	25,600	36,800
Territory size predicted from ethnographic record					23,500	

\* Caradoc is located 175 km from the nearest source, but the obvious ceremonial nature of the site calls into question its applicability as an estimate for the normal range of population movement.

†Shott (1997:3) notes a Parkhill component from the Four Mile Lake Site approximately 175 km from the nearest source, although the component at this site has not been confirmed and no other information is available. It is included here since this potentially represents the maximal known distribution of a Parkhill phase site (i.e. non-isolated find) from the Bayport source.

While data on the transport of Fossil Hill formation chert during the Parkhill phase provides a reasonably accurate measure of territory size, the more limited sample of sites makes it difficult to infer territory size from the distribution of Bayport and Onondaga chert. Transport of material from these sources is presumed to reflect adjacent regional bands. Unfortunately without a larger sample of sites it is difficult to infer the overall shape of the territory making size estimates prone to large errors. In southern Michigan, Bayport chert was being transported minimally 125 km to the southwest during the Parkhill phase and 180 km to the south during the Crowfield/Holcombe phase. Assuming that the width of this territory did not exceed its length, then this would result in territory size estimates for the Parkhill phase that are smaller in size than those observed in southern Ontario, while the Crowfield/Holcombe phase data would be comparable. Transport of Onondaga chert in southern Ontario appears to correspond primarily with the Crowfield/Holcombe phase and delimiting the area where sites dominated by this material are located also results in similar estimate of territory size to the Parkhill phase in southern Ontario.

On the other hand, data from the earlier Gainey phase seems to indicate that raw materials were regularly being transported across much larger distances. In southern Ontario this results in a much greater distance that Fossil Hill formation chert was being transported, approximately 340 km from its easternmost (Halstead) to southwestern most (Snary) extent. This would seem exceptional, except that Upper Mercer chert was transported 380 km northward to the Gainey site. Estimates of territory size based on data from southern Ontario range from a conservative estimate of 37,500 km<sup>2</sup> to upwards of 51,000 km<sup>2</sup>. Although very large, these

territory estimates are not outside the range of known territories inhabited by sub-arctic and arctic hunter-gatherers (Binford 2001; Burch 1972:Table 1; Ellis 1984).

#### 6.4.2 SEASONALITY OF MOVEMENTS

The final regional scale dimension to be examined involves evaluating the principal direction that lithic raw materials are being transported. Direction of transport has the potential to provide information regarding the orientation of mobility systems employed by lower Great Lakes Paleoindians. In particular, the RMCH model suggests that the direction and magnitude of mobility systems would be similar to that of caribou herds groups were preying upon. The expectation of this model is that human populations would primarily undertake seasonal movements northward during the summer months and return back southward for the winter months. This expectation is an important element to the RMCH model because this pattern of mobility is thought to have been necessary to ensure that populations maintain contact with caribou herds year round. Northward migration would ensure groups were in the vicinity of calving grounds during the summer months, while subsequent southward movements during the fall would have been necessary to ensure groups relocated toward the wintering ranges of caribou.

The archaeological expectations of this model would be for the consistent movement of lithic raw materials either northward (from winter to summer ranges) or southward (summer to winter ranges) (Krist 2001:285-287, Figure 7.27). Given the possible influence of snow cover on the procurement of lithic raw materials an argument could be made to suggest that the southward movement of raw materials is most likely. That is the procurement of tool stone would be more likely to occur in the summer months and subsequently transported south into a groups winter

ranges. However, two factors complicate this idealized prediction of raw material movements. First, the primary determinant of mobility within the RMCH model are the caribou herds themselves and secondly the distribution of primary source areas for high quality lithic raw materials is limited in the Great Lakes region. The implication of these two factors is that the scheduling of lithic acquisition may have been influenced more by the timing of overlap between caribou ranges and primary raw material sources rather concerns such as snow cover. In other words, if this overlap occurred within the winter ranges of the caribou herds, then the scheduling of lithic acquisition could have occurred during the winter despite the increased costs resulting from snow cover.

Table 6.14 presents the available data on the primary lithic raw material source being utilized on Great Lakes Paleoindian sites and the direction from source of that primary raw material. As discussed above, Paleoindian sites in the region are almost exclusively dominated by a single lithic raw material that helps provide a more clear understanding of the direction of transport. The most direct overland route to the nearest known outcrop was used to calculate direction of transport from source to site and estimated in increments of five degrees. However, some variability in these bearings from the actual quarry to site direction is expected, but unavoidable given our inability to more accurately identify specific quarry localities within these primary source areas. For comparative purposes a sample of random bearings was also calculated to help assess the degree to which the observed bearings deviate from random.

Table 6.14. Summary data for the direction lithic raw material are being transported

Site	Phase	Material	Direction	
			from source	Random Bearing
Butler	Gainey	Bayport	165	248
Gainey	Gainey	Upper Mercer	330	249
Halstead	Gainey	Fossil Hill	100	38
Murphy	Gainey	Fossil Hill	210	90
Sandy Ridge	Gainey	Fossil Hill	100	44
Snary	Gainey	Fossil Hill	210	276
Udora A-east	Gainey	Fossil Hill	105	257
Barnes	Parkhill	Bayport	230	190
Dixon	Parkhill	Fossil Hill	220	341
Fisher	Parkhill	Fossil Hill	90	145
Leavitt	Parkhill	Bayport	200	212
McLeod	Parkhill	Fossil Hill	220	87
Parkhill	Parkhill	Fossil Hill	220	11
Thedford II	Parkhill	Fossil Hill	220	280
Alder Creek	C/H	Fossil Hill	180	175
Bolton	C/H	Onondaga	270	251
Caradoc	C/H	Bayport	125	145
Crowfield	C/H	Onondaga	270	43
Fowler	C/H	Onondaga	10	48
Holcombe Beach	C/H	Bayport	150	87
Zander	C/H	Onondaga	15	198

To examine the hypothesis that raw materials were being transported in primarily a north to south direction the observed and random bearings are grouped together within four directional categories (Table 6.15). Each of these directional categories encompasses 90 degree increments centered on the four cardinal directions. For example, the northerly category includes raw material movements from NW (326 degree bearing) to NE (45 degree bearing), while the easterly category consists of raw material movements from NE (46 degree bearing) to SE (135 degree bearing). For the purposes of comparison the randomly assigned bearings represent the expected distribution of raw material movements if no cultural influence were imposed on the directionality of raw material movements and the independence of the two distributions is evaluated using a chi-square test. Although there is a greater than expected movement of raw materials in the southerly direction (n = 10), as is expected with the RMCH model, results of the chi-square ( $\chi^2 = 5.217$ ; df = 3; p = .157) test indicate the observed distribution does not differ significantly from a random selection of bearings.

Table 6.15. Comparison of observed raw material movements against a random sample

Direction Bearings	Northerly 326-045	Easterly 046-135	Southerly 136-225	Westerly 226-325
Observed	3	5	10	3
Random	5	4	6	6
$\chi^2 = 5.217$ , df = 3, p = .157				

Results of the chi-square test should not be seen as suggesting Paleoindian groups in the lower Great Lakes region were transporting lithic raw materials randomly across the landscape. The two major limitations of these data include sample size and the inability to link raw materials recovered in stone tool assemblages with specific quarry localities. Similarly the method employed here to calculate directionality does not account for all movements, instead the method only links the location of discard to primary geological source of the raw material. Regrettably a great deal of complexity in past mobility strategies is eliminated through this method and does not account for the fact that a curated assemblage of tools may have been transported to the south, then west, then back north prior to being discarded; that assemblage would only be counted in the westerly in this sample. Nevertheless, these data do provide a very general view of the overall spatial orientation of mobility systems and provides evidence to reject the hypothesis that there is a strong north-south pattern to the mobility strategies practiced by lower Great Lakes Paleoindians.



## **CHAPTER 7:**

### **ANALYSIS AND DISCUSSION**

#### **7.1 SUMMARY OF ANALYSIS AND INTERPRETATIONS**

The lower Great Lakes Paleoindian archaeological record was examined in the previous chapter and compared against a residually mobile caribou hunter (RMCH) model developed using ethnographic and comparative archaeological data. The purpose of this analysis is to specifically examine the hypothesis that caribou hunting was the primary subsistence focus of lower Great Lakes Paleoindians. To accomplish this goal the preceding chapter evaluated the archaeological record across three scales of analysis; assemblage level, site level; and regional level analysis. This multi-scalar approach enables several key dimensions of the RMCH model to be evaluated including the degree to which populations were residually mobile and the influence of the fall caribou hunt on the overall economic organization. Additional dimensions to the analysis also include evaluating the prevalence of risk pooling as the primary risk minimizing strategy along with providing estimates of group size and population density.

##### **7.1.1 INTERPRETATION OF ASSEMBLAGE LEVEL ANALYSIS**

Analysis of assemblage level data focused on measures of standardization and two measures of assemblage composition; richness and evenness. Standardization data are important as it provides one line of evidence to evaluate the possibility that Paleoindian groups in the region geared up in advance of the fall caribou hunt. Along with standardization data, measures of assemblage evenness were also examined to evaluate the role of gearing up in the overall

organization of the economic system. Data on assemblage richness were examined with the primary goal of determining if the organization of lithic toolkits reflects the provisioning of people or the provisioning of places (e.g. Kuhn 1994). Understanding the organization of toolkits along these dimensions is understood to shed light on the specific mobility strategies employed by lower Great Lakes Paleoindians.

#### 7.1.1.1 STANDARDIZATION

The standardization of extractive tools were examined in the previous chapter and focused specifically on the basal widths of hafted bifaces. Several generalizable patterns emerged from the evaluation of this standardization data, although statistical differences between individual assemblages were limited by sample sizes. Temporally there appears to be a marked difference in standardization between the earlier Gainey and Parkhill phases and the later Crowfield/Holcombe phase. This temporal trend is exemplified by the fact that CV for the sample of Crowfield/Holcombe phase sites were in excess of 11.0 percent and the Crowfield site itself was statistically more variable than both the sample of Gainey isolates and bifaces from the Parkhill site. In contrast several Parkhill phase assemblages and the Gainey sample had CV of less than 10.0 percent suggesting a greater emphasis on standardization during those two phases.

Examining standardization across space was possible only for the Parkhill phase, which had enough assemblages in the database to permit comparison. Overall the Parkhill phase is distinguished by sites located along the Lake Algonquian shoreline (Fisher, Parkhill, Thedford II) exhibiting notably low CV with respect to extractive implements. In contrast, Leavitt and Barnes are located more interior, away from the shoreline and exhibit consistently higher CV's.

In fact, the greater variability in the Leavitt and Barnes assemblages are statistically significant when compared to the sample of Gainey Isolates, which represent the most standard assemblage in the database. This general pattern of interior/coastal difference in standardization is further supported by the observation that the sample of Barnes isolates is also more variable than the three coastal sites. This observation is important because the Barnes isolates sample reflect points from several interior localities in southern Ontario and Michigan.

Increased standardization is a response to increased risk and results from an increased desire to manufacture more reliable tools (Fisher 2000; Kuhn 1994). For specialized caribou hunting societies the production of more reliable extractive implements is most directly associated with the fall caribou hunt. This is because the fall caribou hunt represents a critical juncture in the seasonal round when fat stores and hides are most optimal. Because of this importance there is also increased risk accrued in the event of shortfalls in the expected numbers of caribou, or worse, their failure to appear at all. The expectation for greater standardization is supported by ethnographic data that indicate the importance of the fall caribou hunt and comparative archaeological data from the Taltheleti and Magdalenian of central Europe that provide evidence for an increase in standardization that is linked to preparation of the fall caribou hunt (Fisher 2000; Gordon 1996).

Does the available data from the lower Great Lakes support a seasonal difference in standardization, and can this difference be reasonably attributed to intercept hunting of migratory caribou? The available data do not indicate there is a general north-south difference in standardized assemblages. For instance, assemblages from Parkhill and Fisher both exhibit a high level of standardization even though both date to the Barnes period and Fisher lies some

100 km to the north of Parkhill. This would not support the classic ideal of specialized caribou hunters undertaking northward migrations in the summer and a southward movement in the winter.

To be fair, the absence of large expanses of tundra in the lower Great Lakes region at this period of time makes it uncertain if caribou themselves undertook this classic migratory pattern. Nevertheless, there are observed differences in standardization between interior and coastal sites during the Parkhill phase. Several researchers have previously hypothesized that the concentration of sites near the Lake Algonquian shoreline is attributed to this coastal zone remaining more open than interior areas (Ellis and Deller 2000; Stewart 2004:104-109; Storck 1982). As a result the open coastal zone is thought to have channeled the movements of migrating caribou and the large sites clustered at different coastal locations resulted from the targeting of caribou herds (Ellis and Deller 1997; Ellis et al. 2011). The increased standardization of extractive implements does support this view.

The general picture that emerges from the standardization data are that differences in coastal and interior areas during the Parkhill phase are related to the interception of migrating caribou herds. From this perspective, the data are more similar to the Magdalenian of central Europe as opposed to the ideal of the classic barren ground caribou hunters exemplified by the Ethen-eldeli. Among the Madgalenian archaeological record reviewed in chapter four, differences in standardization occur between lowland and upland areas with lowland areas exhibiting considerably more standardized assemblages than upland areas. This increased standardization is attributed to the targeting of the fall migration of caribou that are concentrated within major alluvial valleys, an interpretation supported by faunal data. Like the Magdalenian

data, standardization data from the lower Great Lakes region lend support to arguments that the coastal zone attracted migratory caribou, which were targeted by groups during the Parkhill phase.

#### 7.1.1.2 RICHNESS

Richness data presented in the previous chapter exhibit a strong linear correlation between richness and log assemblage size. Because there is a much weaker correlation between richness and area excavated it is argued that these data most closely reflect differences in the archaeological record themselves rather than archaeological sampling. This lack of correlation between richness and area excavated also supports the interpretation that group size and duration of occupation are two underlying behavioral factors contributing to assemblage size and by extension also the two variables influencing assemblage richness. The greater the number of people occupying a site and the greater duration a site is occupied results in increased chances that different classes of stone tools present in toolkits will have become exhausted and subsequently discarded at a given site.

The observed link between assemblage size and richness data also support the idea that the primary organizational emphasis on lithic toolkits was for the provisioning of people. This observation is supported by the fact that similar types of tools were being discarded uniformly on virtually every assemblage included in the sample and the strong correlation between richness and assemblage size. In contrast, if richness data did deviate from assemblage size then the argument could be made that assemblages were more or less rich than expected because they represent a restricted range of activities undertaken by specialized task groups practicing

logistical mobility or large base camps in a logistically organized system (Binford 1980).

However, this assumption is not met for any of the assemblages included in the analysis. Instead the data suggests that a system of residential mobility and an emphasis on the provisioning of people was in place among lower Great Lakes Paleoindians.

#### 7.1.1.3 EVENNESS

Evenness data was examined to assess the influence of the fall caribou hunt on the scheduling of extractive tool production. It was hypothesized that the fall caribou hunt would result in the gearing up or the increased production of extractive tools (Fisher 2000; Kuhn 1994). However, CV from the sample of excavated assemblages containing channel flakes does not indicate any association between the frequency of channel flakes (i.e. fluted point production) and assemblage evenness. Several explanations could account for this lack of association. First, there is the possibility that fluted bifaces manufactured during such episodes of gearing up were subsequently transported away from the site, meaning this particular category of tools are artificially lowered and thus resulting in a more even assemblage. A second explanation is that other factors are influencing the evenness of assemblages so that the relationship between any one behavioral phenomena (i.e. gearing up) is obscured by these other factors. For instance, the increased use and discard of unifaces after a successful fall caribou hunt where meat and hide are processed could similarly result in a more uneven assemblage, although it should be noted that there is only a very weak negative correlation between end scrapers and CV on excavated Parkhill phase sites ( $n = 21$ ;  $r = -0.13$ ).

Evenness data from excavated Parkhill phase sites provides the largest, temporally controlled sample with which to evaluate these alternatives. The overall distribution of CV scores indicates a unimodal distribution with a long tail to the right (Figure 7.1). This would suggest that most evenness scores are the result of multiple factors and distribute normally around 9.0 percent. This observation is suggestive of the possibility that there may be no regular influence on the scheduling of tool production such as gearing up, or at the very least assemblage evenness is not sensitive to such scheduling influences. Nevertheless there are three Parkhill phase assemblages with CV greater than 15 percent that represent the most variable assemblages in the sample; Area B at Parkhill, Area C at Fisher, and Area b at Fisher.

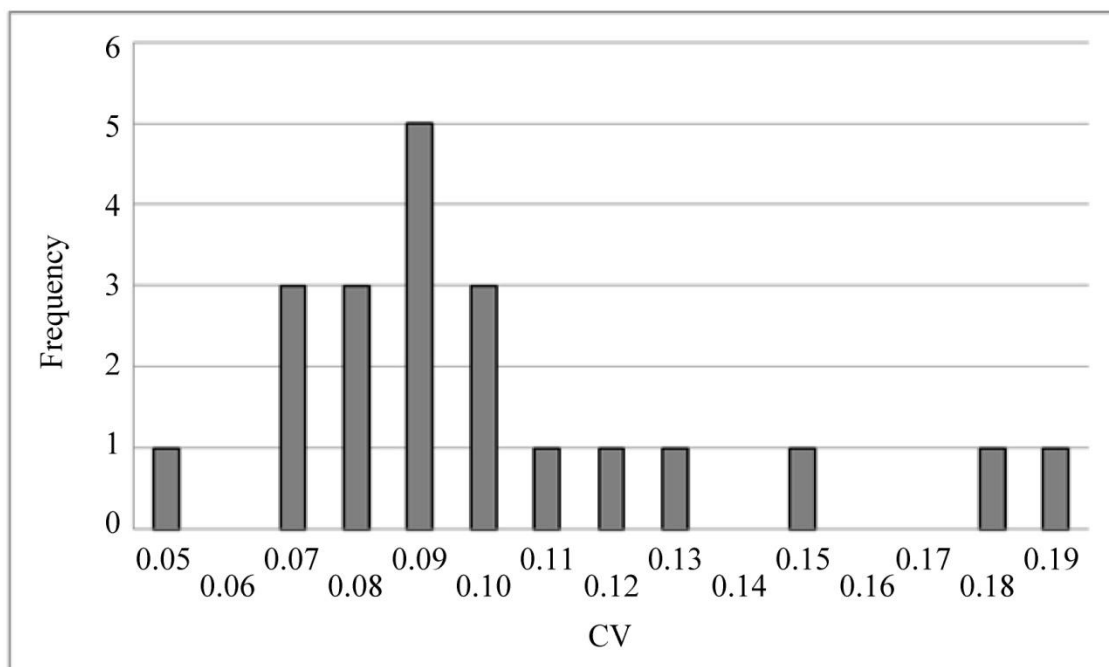


Figure 7.1. Frequency of CV among excavated Parkhill phase sites

Examining the composition of the two Fisher site assemblages (area C and area b) indicate that both are affected by unusually large counts of utilized flakes. In both instances utilized flakes account for about 55 percent of the site assemblage. In fact, the Fisher site as a whole and Areas C and b in particular exhibit a considerably higher frequency of utilized flakes than any other Paleoindian assemblage included in this analysis except for Banting. Removing this class of tools from consideration results in CV that fall within the range observed for the other assemblages. Several alternative explanations for the high frequency of utilized flakes can be offered. On one hand the large numbers of utilized flakes may reflect the increased use of expedient implements at the Fisher site or, similarly, because the site is by far the closest to a raw material source (25 km east of the Fossil Hill source) there may have been a decreased incentive to curate flake tools in the first place leading to an increased rate of discard. Yet, this increase in these classes of tools could also be the product of archaeological systematics considering both Banting and Fisher were excavated by the same principal investigator (Stork 1979, 1997).

In contrast to the other two areas, Area B at Parkhill is dominated by fluted biface manufacture. The unusually high frequency of bifaces ( $n = 78$  or 76 percent of the assemblage) and channel flakes ( $n = 142$ ) is notable. In fact, the principal investigators emphasize the unusual nature of Area B and contrast the high frequency of fluted biface production with other loci throughout northeastern North America (Ellis and Deller 2000:217-219). In this instance the high CV does correspond to the expected archaeological signature of gearing up for an episode of intensive activity, a viewpoint supported by the highly standardized nature of the biface assemblage at Area B (see Table 6.3). Interestingly the fourth most variable assemblage at 13



percent is Area C from Parkhill that is also described by the principal investigators as a loci dominated by fluted biface manufacture (Ellis and Deller 2000:217-219).

#### 7.1.2 INTERPRETATION OF SITE LEVEL ANALYSIS

The analysis of archaeological data at the site level was undertaken to evaluate patterning both within and between individual assemblages present on Paleoindian sites from the region. The first part of the analysis focuses on intra-assemblage patterns and explores the possibility that assemblages represent spheres of domestic activities or households. These domestic activity areas were examined for archaeological signatures indicative of female labor and serves as an additional line of evidence to evaluate the organization of mobility strategies. Examination of inter-assemblage patterning was undertaken to evaluate group size and the role of social aggregation as a risk minimizing strategy.

##### 7.1.2.1 HOUSEHOLD PATTERNING

Excavated archaeological assemblages were examined to provide a second line of evidence to evaluate the role of residential mobility among Paleoindian groups. To evaluate the role of residential mobility it was hypothesized that residentially organized caribou hunters should produce a consistent archaeological signature of entire domestic groups, including female labor. Although stereotyping specific classes of stone tools with specific genders is not without its shortfalls, the available ethnographic data for sub-arctic and arctic large game hunting societies does affirm the consistent role that females play in processing tasks such as the preparation of hides. The perspective adopted here relates hide-working as an exclusively female

activity and follows the observation that as the contribution of large game hunting to the diet increases so does a gendered division of labor (Waugespeck 2005).

Despite limiting the available data to excavated archaeological assemblages, it is clear that unifaces in general and end scrapers in particular are present at virtually every lower Great Lakes Paleoindian archaeological site. When viewed from the perspective outlined above, end scrapers are interpreted as a positive indicator of female labor and thus the presence of whole domestic groups at Paleoindian sites rather than task and gender specific sites in a logistically organized system.

Thus the end scraper data presented here also provides a second line of evidence supporting the earlier interpretation that assemblage richness values reflect residential mobility. Using these two lines of evidence it can be argued that Paleoindian sites within the lower Great Lakes region consistently reflect the movement of residential units rather than specialized, logistically organized, task groups. In other words, the available assemblage and site level data support the interpretation that lithic toolkits were designed to provision people and that male and female activities are reflected in equal frequencies.

#### 7.1.2.2 INTER-ASSEMBLAGE PATTERNING AND AGGREGATION

Data on the number of spatially separate concentrations of artifacts indicate that occurrences of multiple loci at Paleoindian sites appear to be a regular occurrence. Moreover, these areas do not appear to be the result of Paleoindians spatially segregating different tasks except in a few rare instances (e.g. the unusually large signature of biface manufacture at Parkhill Area B; Ellis and Deller 2000). This observation is supported above through the

observed presence of artifacts reflecting a range of domestic activities rather than task specific activities. From this perspective the typically small size of sites, two to three loci, is consistent with the ethnographic data discussed in chapter five for RMCH during the dispersed phases of the year. The expectation of this model is for minimal hunting bands of 20 individuals or approximately three households.

Ethnographic data also suggests that group size among RMCH peoples will fluctuate during the year and group size may be upwards of 50 individuals during the aggregated portion of the year. The archaeological signature of this annual aggregation of the regional band should be as many as eight or nine households present at these sites. Among specialized caribou hunting peoples, this annual increase in group size is generally thought to have occurred in conjunction with the fall caribou hunt. However, archaeological data reflecting the predicted annual increase in group size are equivocal. On one hand there is not a lot of evidence from the larger multi-locus sites to provide a convincing argument to suggest that size of the occupation at these sites reflect aggregations of up to nine households. In fact, if viewed conservatively the data only suggests that two or three areas at these large sites may have been occupied contemporaneously (Ellis and Deller 2000; Stewart 1997), with the exception being Thedford II where four to five contemporary domestic loci is a reasonable interpretation (Deller and Ellis 1992).

Yet other data, although circumstantial, is suggestive that group size may have increased in conjunction with the fall caribou hunt. For instance, during the Gainey phase the multiple assemblages from both the Gainey and Butler sites are suggestive of larger group sizes and are located in an area thought to have channeled caribou movements, an interpretation confirmed by GIS modeling (Krist 2001:229; Simons 1997). Likewise, during the subsequent Parkhill phase it

has been suggested that the areas near the Lake Algonquian shoreline remained more open and thus channeled caribou migrations within the coastal zone (Deller 1988; Ellis et al. 2010). Not surprisingly the large multi-locus sites during this period are all concentrated within this coastal zone. Lending further support is the fact that these larger sites (Parkhill, Thedford II, and Fisher) within the coastal zone are also the most standardized in respect to extractive implements, which also would be expected to occur in conjunction with the fall caribou hunt. In contrast, the smaller two or three locus Barnes and Leavitt sites are located in the interior, reflect a dispersed phase of settlement based on group size estimates, and provide evidence for decreased emphasis on standardized extractive implements.

Group size may also increase as a result of social considerations more distantly removed from immediate economic goals. Whallon (2006) highlights the important role of visiting between members of regional bands that serves the purpose of reinforcing reciprocal ties and maintaining the flow of environmental information. Visiting is also a likely cause of increased group size and one that does not necessarily need to occur alongside the fall hunt. Thedford II provides the most convincing evidence of a site resulting from visiting. Among the six activity loci, four or perhaps five can be reasonably suggested to represent households and when considering the internal spacing, spatial proximity, and presence of refits strongly suggest these loci were occupied contemporaneously (Deller and Ellis 1992). More importantly, the presence of both Bayport chert tools and debitage is suggestive that residents in at least one of those households recently relocated to the site from outside the immediate region as would be expected within Whallon's (2006) model for visiting.

What is lacking from the regional archaeological record is evidence for the periodic large aggregations between regional bands that is suggested by Binford's (2001) data. This is not a new observation and echoes a similar statement by Ellis and Deller (2000:245). Ethnographic data suggest that periodic aggregations between regional bands may number around 175 individuals or 29 households (Binford 2001; Whallon 2006). Obviously no sites known from the region fit this expectation. The largest, Fisher, has 19 loci, but the available data make a strong case that most of these are the product of multiple occupations. The only comparable sites to the expected patterning lie outside the immediate Great Lakes regional and include Bull Brook in eastern Massachusetts, which contains roughly 30 loci exhibiting patterned internal organization (Robinson et al. 2009).

### 7.1.3 REGIONAL LEVEL ANALYSIS

The final scale of analysis examined regional level data related to the spatial distribution of lithic raw materials across the lower Great Lakes region. This analysis is aided by the fact that lower Great Lakes Paleoindians apparently made preferential use of visually distinctive and geographically limited lithic raw material sources. The primary data include the distance and direction from source for these assemblages that are dominated by a single raw material. In addition, data concerning the presence of minor amounts of exotic lithic raw materials at individual sites were also evaluated. These lithic raw material data are used to assess three dimensions of the RMCH model and include territory size, risk pooling behavior between regional bands, and seasonality of movement.

### 7.1.3.1 TERRITORY SIZE

The available distance to source data indicate that Paleoindian groups within the region were routinely transporting tool stone on average between 135 and 205 km. The actual distance from source does depend on the phase being examined, with the Gainey phase exhibiting both the largest distances between source and the largest estimates of territory size. Overall each of the five territory estimates in Table 6.21 resulted in large territories (15,000 – 38,000 km<sup>2</sup>) with an overall average of 25,690 km<sup>2</sup> that is not appreciably different than the expectation of 23,500 km<sup>2</sup> derived from the RMCH model. Performing a chi-squared test to evaluate differences between the observed and expected territory sizes indicate that there is a statistically significant difference (Table 7.1). However, when the residuals are examined it is clear that this difference is driven by the higher than expected territory size during the Gainey phase. When the Gainey phase is removed from the analysis, territory sizes for the Parkhill and Crowfield/Holcombe phases are not statistically different than expected. Interestingly the territory size estimate for the Parkhill phase in southern Ontario (Fossil Hill), considered here to be the most reliable of the estimates because it is based on the largest sample of sites, is the one that most closely matches the expected territory size.

Table 7.1. Comparison of territory size estimates against the expected territory size

	Gainey	Parkhill	Parkhill	C/H	C/H
Raw Material	Fossil Hill	Fossil Hill	Bayport	Bayport	Onondaga
Observed (100 km <sup>2</sup> )	37.5	22.5	15.6	27.2	25.6
Expected (100 km <sup>2</sup> )	23.5	23.5	23.5	23.5	23.5
With Gainey	$\chi^2 = 11.809$ ; df = 4; p = 0.019				
Excluding Gainey	$\chi^2 = 3.469$ ; df = 3; p = 0.325				

These data indicate that territory size estimates of the Parkhill and Crowfield/Holcombe phases correspond to the expected size of a 172 person regional band within the RMCH model. Within these territories Paleoindian sites are dominated by a single lithic raw material source and show consistent transport of this material upwards of 160–170 km. This observation builds upon Wiessner's (1982) suggestion that risk pooling behavior will result in material cultural signatures that emphasize a homogenous group identity. This observation supports the idea that the preferential use of a single lithic raw material source by lower Great Lakes Paleoindians serves as a signature of membership within a risk pooling group (Carr 2005; Ellis 1989; Ruggles 2001). The importance of this observation in regard to the present analysis is that it provides an additional line of evidence that suggests risk pooling was the primary risk minimizing strategy practiced by lower Great Lakes Paleoindians and this risk pooling behavior occurred within the context of a one-tiered regional band (Whallon 2006).

The exclusive use of a single lithic raw material source also occurred during the Gainey phase, but this phase differs on the basis that raw materials were transported across extremely large distances, on average 205 km. As a result a conservative territory size estimate for the transport of Fossil Hill chert during the Gainey phase is 37,500 km<sup>2</sup> and could be upwards of 50,000 km<sup>2</sup> if the known distribution of sites dominated by Fossil Hill chert during this period is considered. Several alternative explanations can be offered to account for this larger than expected estimate of territory size. One explanation would be to suggest that Gainey risk pooling groups includes a much larger population, perhaps a two-tiered regional band, and by extension would need a larger territory in order to maintain sustainable population densities. However, since Gainey represents the earliest phase of human occupation of the region the opposite, an

increase in population size after Gainey, would be expected. A second explanation would be to suggest that the observations of unusually large distances from source reflect colonization movements and as a result artificially inflate territory size estimates. This explanation also is flawed since the observed movement of Fossil Hill to the Snary site in southern Ontario is 250 km to the southwest and opposite the expected direction of colonization. A third explanation advanced by Ellis et al. (2011) is that Gainey movements were less constrained by both population density (i.e. the earliest occupation in the region) and environment (i.e. dates prior to Younger Dryas and resulting closing of the spruce-sedge parkland). As a consequence groups were more able to target productive, but widely distributed resource patches resulting in larger than expected movements of lithic raw materials.

#### 7.1.3.2 SEASONALITY OF MOVEMENTS

Data concerning the direction of lithic raw material movements constitutes the final line of evidence evaluated in this study. Although southerly movements were the most common directional category, the direction of movements did not differ statistically from a random sample of bearings. The major implication resulting from the analysis is that the directionality data does not support the hypothesis that strong seasonal north-south movements characterize Paleoindian mobility systems in the lower Great Lakes region.

In order to provide alternative explanations for these data we need to revisit the effect of the two complicating factors discussed in chapter six; the influence of caribou herd movements on mobility systems and the limited distribution of high quality sources of lithic raw materials in the region. These factors mean that episodes of lithic acquisition are likely to have been



restricted in both time and space and require lithic procurement strategies to account of these restrictions. Alternative explanations to account for the observed data include two distinctly different procurement strategies; embedded and disembedded procurement.

On one hand if there is a spatial overlap between the ranges of caribou herds and primary lithic sources, then it is possible lithic procurement could still have been embedded in the normal course of following herds with acquisition scheduled during the period of overlap. This is similar to the earlier expectation; however, the critical difference is that caribou herds may not have been undertaking north-south seasonal migrations. If we take into account the possibility that favored caribou habitat was heterogeneously distributed throughout the region and the potential for east-west oriented moraine systems and coastlines to channel caribou movements, then we might argue that caribou movements themselves deviated from this idealized north to south seasonal pattern. As a result Paleoindian groups could still embed the acquisition of tool stone within the normal course of following caribou herds, but that the overall direction of movement was not in the north to south pattern envisioned in the model.

The second strategy would be to argue that the acquisition of tool stone was disembedded from the normal course of population movements. Episodes of lithic acquisition could have occurred via specialized task groups, perhaps during the summer months when the costs of acquisition may be at their lowest. Although the earlier analysis of Paleoindian assemblages suggests sites are the result of residential movements, it is fair to note that no immediate quarry sites are included in the analysis; Fisher being the closest but is clearly a residential site (Storck 1997). If lithic acquisition was disembedded from the seasonal round then the expectation would

be for logistically oriented sites to be located in the immediate vicinity of quarry areas, thus their absence from the present analysis being the product of archaeological sampling bias.

A third, and obvious, explanation is that Paleoindians did not organize their mobility systems to engage in the following of caribou herds year round.

## 7.2 EVALUATION OF THE CARIBOU HUNTING MODEL

Research undertaken here employed a multi-scalar approach to evaluate the hypothesis that the lower Great Lakes Paleoindian economy was organized around the specialized predation of caribou hunters. The advantage of a multi-scalar approach is its potential to provide a measure of independence in archaeological data to address specific research hypothesis. For instance, residential mobility is a key dimension to the RMCH model being tested and both assemblage level and site level data can be used to evaluate the degree to which Paleoindian groups were residentially mobile. Because these use different lines of evidence and operate at different scales of analysis, they offer a measure of independence to provide a more reliable assessment of the role residential mobility played among Paleoindian groups.

The multi-scalar approach employed here specifically examined archaeological data at the assemblage, site, and regional scales of analysis and compared the available archaeological data against a model for specialized caribou hunting societies developed in chapter five. Data from each of these scales of analysis were used to investigate several related aspects of Paleoindian economies including the organization of mobility and labor strategies, organization of chipped stone tool technology, territory and group size, and risk management strategies (Table 7.2). The central question that remains is; does the available archaeological data support the

Table 7.2. Summary of model expectations and observations from the archaeological data set

	RMCH Expectations	Observations	Comments
Standardization	<ul style="list-style-type: none"> <li>• Increased standardization at gearing up sites in advance of fall caribou hunt</li> <li>• Decreased standardization during other periods of the year</li> </ul>	<ul style="list-style-type: none"> <li>• Declining standardization over time</li> <li>• High standardization at coastal localities</li> <li>• Less standardization at interior localities</li> </ul>	<p>Some difference in standardization is observed, but does not fit the hypothesized north-south geographical distribution</p> <p>Coastal/interior oriented instead</p>
Richness	<ul style="list-style-type: none"> <li>• Richness corresponds to assemblage size</li> <li>• Reflects the provisioning of people with a mobile toolkit and residential mobility</li> </ul>	<ul style="list-style-type: none"> <li>• Richness corresponds to log assemblage size</li> <li>• Provisioning of people with a mobile toolkit and residential mobility</li> </ul>	<p>Good correspondence between the RMCH model and observed data.</p> <p>Data suggests an organizational emphasis on residential mobility and the provisioning of people rather than places</p>
Evenness	<ul style="list-style-type: none"> <li>• Gearing up in advance of fall caribou hunt will produce less even assemblages (i.e. dominated by biface production)</li> </ul>	<ul style="list-style-type: none"> <li>• No correspondence between frequency of channel flakes (gearing up) and assemblage evenness</li> </ul>	<p>Does not support the expectation that the fall caribou hunt would influence scheduling of extractive tool manufacture</p> <p>Area B at Parkhill may be an exception</p>
Inter-assemblage patterning	<ul style="list-style-type: none"> <li>• Consistent signature of female labor at all site loci</li> <li>• Reflects residential movement of domestic units rather than logistical task groups</li> </ul>	<ul style="list-style-type: none"> <li>• High frequencies of end scrapers and unifaces suggest the consistent presence of females at sites.</li> <li>• This signature may be declining after the Parkhill phase</li> </ul>	<p>Similar to richness data, there is good correspondence between the RMCH model and observed data.</p> <p>Suggests reliability because both test the same behavioral dimension (Residential mobility)</p>

Table 7.2. (Cont'd)

Intra-assemblage patterning	<ul style="list-style-type: none"> <li>• Sites with 2-3 loci represent dispersed phase of year</li> <li>• Sites with 8-9 loci represent aggregated phase of year; associated with fall caribou hunt</li> <li>• Sites with approx. 29 loci represent periodic regional aggregation</li> </ul>	<ul style="list-style-type: none"> <li>• Most sites contain 2-3 contemporaneous loci</li> <li>• Only Thedford II (4-5 loci) can link more than 3 loci with any certainty</li> <li>• No evidence for periodic regional aggregation sizes</li> </ul>	<p>Consistent occurrence of 2-3 loci corresponds to RMCH expectation for small dispersed populations</p> <p>Larger aggregations associated with fall caribou hunt are equifinal, although the largest multi locus sites also exhibit the greatest standardization</p>
Territory Size	<ul style="list-style-type: none"> <li>• Territory sizes of approx. 23,500 km<sup>2</sup> at a population density of 0.0073 people/km<sup>2</sup> for a 1-tier regional band</li> <li>• 68,000 km<sup>2</sup> for a 2-tier regional band</li> </ul>	<ul style="list-style-type: none"> <li>• Territory size estimates range between 15,650 – 37,500 km<sup>2</sup></li> <li>• Most reliable estimate for southern Ontario (22,500 km<sup>2</sup>) corresponds closely to expected territory size</li> </ul>	<p>Declining territory size after the Gainey phase</p> <p>Data do correspond with estimates for a 1-tier regional band during Parkhill and C/H phases</p>
Seasonality of movement	<ul style="list-style-type: none"> <li>• Directionality will exhibit a north-south pattern of raw material movements that reflect herd following</li> </ul>	<ul style="list-style-type: none"> <li>• No observed directionality for raw material movements</li> </ul>	<p>Data does not support suggestion for herd following in the classic north (summer ranges) to south (winter ranges) pattern of movement</p>

hypothesis that lower Great Lakes Paleoindians were specialized caribou hunters that engaged in a residentially mobile herd following strategy? In order to address this question several key elements of the RMCH model will be explored and include the role of herd following, residential mobility, the impact of the fall caribou hunt, and social structures including risk management.

### 7.2.1 HERD FOLLOWING

Seasonal movements alongside migratory caribou herds are an idealized element to specialized caribou hunting societies, but one that has achieved a prominent role among archaeological interpretations of caribou hunters (e.g. Deller 1988; Jackson 1997; Krist 2001:285-287; Simons 1997). Assemblage level data provide mixed results for answering the question of whether or not groups engaged in herd following. For instance, there is clear evidence for the standardized production of extractive tools that is reflected by low CV from some assemblages. However, linking standardization to herd following is much more difficult. In fact, there is no evidence for a north to south difference in standardization that would be expected if groups were relocating between summer and winter ranges of caribou; an observation that is seen among the archaeological record of the late Pre-contact Taltheilei herd followers (Gordon 1996, see also chapter four) and documented within the ethnographic record (Burch 1991; Smith 1981).

Instead the available data indicate that there may be a coastal/interior difference relating to standardized tool production. A second, independent line of evidence that can be used to confirm this observation is the direction of raw material movements. A chi-square test does not support the idea that Paleoindian populations were undertaking regular seasonal north to south

movements, although there is the possibility that a system of disembedded procurement would affect these data. Nevertheless, assuming Late Glacial caribou herds were migrating north to south, two different lines of evidence contradict the expected north to south movements of a herd following strategy.

### 7.2.2 RESIDENTIAL MOBILITY

Archaeological data used to assess the role of residential mobility include the assemblage richness and site level data for household composition. Both of these lines of evidence do correspond strongly with the expectations outlined in the RMCH model. Richness data correlate most strongly with assemblage size and would indicate that size and duration of occupation rather than spatial segregation of activities are the primary determinant of richness. The link between richness and assemblage size also supports the idea that toolkits were organized around residential mobility and the provisioning of people rather than logistical mobility and the provisioning of places (Kuhn 1994). A second line of evidence used to confirm this observation is the consistent presence of end scrapers and other unifacial tool forms that are argued here to represent female labor. This observation is important because it corroborates the richness data by suggesting entire domestic groups were moving from site to site, rather than specialized task groups working from residential base camps.

### 7.2.3 INFLUENCE OF THE FALL CARIBOU HUNT

The importance of the fall caribou hunt has been discussed previously and centers on the observation that caribou aggregate in large numbers during this period and that both hides and fat

stores are at their most optimal condition. It was also observed in chapter four that one distinguishing characteristic of specialized caribou hunting societies is that the fall caribou hunt represents the economic basis for social aggregation. Archaeological data used to assess the potential role of the fall caribou hunt include assemblage evenness, standardization, and the role of social aggregation. All three lines of evidence are equivocal in their support of the role of the fall caribou hunt, but together provide a framework for future investigation to explore this issue.

As mentioned above the standardization data does suggest an increased emphasis on the production of reliable extractive implements, but that differences in standardization are linked to a coastal/interior dichotomy rather than north to south seasonal movements. Likewise, assemblage evenness was also thought to provide a means of examining if groups attempted to “gear up” in advance of the fall caribou hunt. However, there was little correlation between channel flakes and assemblage evenness, although Area B (and possibly Area C) at the Parkhill site are notable for their comparatively high evenness measures associated with a clear emphasis on fluted biface production. Unfortunately, without any additional sites to confirm this observation the evenness data remains equivocal. Likewise, data pertaining to social aggregation also did not provide confirming evidence to suggest that fall caribou hunt represented the economic basis of aggregation. In fact, only one site (Thedford II) can be linked with any certainty to social aggregation and that instance may reflect visiting between regional bands rather than periodic aggregation of a regional band for caribou hunting.

Despite this lack of strong evidence, overall the data may circumstantially support the idea that the fall caribou hunt represented the economic basis for social aggregation and warrants further research in this direction. For instance, the sites that exhibit the highest amount of

standardization are the large, multi-locus sites that are concentrated on the coastal zone. Further research is needed to specifically attempt to identify the number of loci that are contemporaneous with one another. Likewise, the Gainey site is thought to be positioned in an interior location that afforded access to caribou migration routes (Krist 2001; Simons 1997). However, data linking these loci together are also needed in order to better evaluate the link between social aggregation and probable locations related to intercepting migrating caribou herds.

Finally, although the available data does not support the north to south pattern of movement, it does suggest there is some structure to the idea that the economy may have been oriented between coastal and interior settings; at least during the Parkhill phase. While data on standardization do not correspond to the Taltheilei archaeological data, the coastal/interior dichotomy corresponds well with the lowland/upland shift in standardization observed during the Magdalenian period in central Europe. In light of these similarities, the extent to which the Magdalenian and lower Great Lakes Paleoindian archaeological records correspond needs further investigation. However, assuming any further relationship between the two archaeological traditions is problematic, in much the same way that relying on simple relational analogies from the ethnographic record is problematic.

#### 7.2.4 SOCIAL STRUCTURES AND RISK MANAGEMENT

The final element of the RMCH model evaluated through this research is the social structure of lower Great Lakes Paleoindians and observation regarding the role of social storage or sharing as the primary risk minimizing mechanism. One notable aspect of all specialized caribou hunting societies is the need for large territories and low population densities in order to



maintain a sustainable economic reliance on caribou. An assessment of the number of loci present at archaeological sites suggest that most are small and include two to three contemporaneous loci, which corresponds well with the ethnographic expectations for small dispersed groups of about 20 individuals. Corroborating this observation are the data on territory size, that indicate lower Great Lakes Paleoindian groups inhabited territories between 15,000-37,500 km<sup>2</sup> with most estimates clustering between 20,000-30,000 km<sup>2</sup>. Assuming the focal use of specific lithic raw material sources reflects the presence of a one-tiered regional band, these territory size estimates correspond very well with the expected size and population density needed to ensure a specialized caribou hunting adaptation was sustainable.

The other dimension to social structure involves the role of social storage as a risk minimizing strategy. As discussed in chapter three specialized caribou hunting group include Inuit and non-Inuit adaptations, with the non-Inuit adaptation favoring residential mobility, herd following, and sharing as the primary risk minimizing strategy and forms the basis of the RMCH model evaluated here. Unfortunately the available data on social aggregation is equivocal, however the emphasis on residential mobility and absence of probable meat caches in the archaeological record does support the notion that groups did not heavily invest in risk assuming behaviors such as practical storage. This suggestion is also supported by lithic raw material data that indicate the homogenous use of a single lithic source within the territories defined above, which is a material cultural signature of groups engaged in risk pooling as opposed to risk assuming (Wiessner 1982, 1983).

### 7.3 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

Evaluation of the RMCH model using a multi-scalar approach indicates that parts of the model may be accepted, but that other areas do need revision. Archaeological data do support the observation that Paleoindian groups in the lower Great Lakes region were residentially mobile and inhabited large territories in excess of 20,000 km<sup>2</sup>. As a consequence of both high residential mobility and low population density an argument for risk sharing as the primary risk minimizing strategy can also be supported. However, the model does not provide convincing evidence for a herd following economic strategy. Instead the data appears to support a coastal/interior organized economy (Jackson 1997; Jackson and McKillop 1991). If caribou did in fact play a role in this economy, then it may be suggested that lower Great Lakes Paleoindian groups practiced a herd intercept strategy that targeted herds along the coastal zone, rather than a herd following strategy that required regular seasonal movements between the summer and winter ranges of individual caribou herds.

This interpretation is similar to that observed among the Magdalenian caribou hunters of central Europe who intercepted caribou in lowland areas and supplemented caribou hunting with horse predation in the uplands during other parts of the year (Audouze and Enloe 1991; Fisher 2000). Interestingly, Krist's (2001) analysis of site catchments around interior Paleoindian sites in southern Michigan found a correspondence between site location and moose habitat. If we hypothesize that moose rather than horse supplemented the intercept hunting of caribou, then the data reviewed here would seem to support the results of Krist's (2001) study with respect to the interior portion of Paleoindian subsistence systems. A more detailed analysis exploring the relationship between the lower Great Lakes Paleoindian and the central European Magdalenian

economies constitutes one direction of future research. Specifically, how close a relationship is there between the Magdalenian system of intercepting migratory caribou in lowland river valleys and upland encounter based predation of horse and a potential Great Lakes economic system involving the interception of migratory caribou along the Lake Algonquian coastline, and the interior encounter based predation of other species such as stag moose, elk, musk ox, and/or mammoth and mastodon?

Identifying a positive archaeological signature of high residential mobility and a revision to the north to south orientation of caribou hunting to include a coastal/interior adaptation provides a better understanding of the organization of Paleoindian subsistence economies in the lower Great Lakes. Building upon these observations a number of important economic dimensions still need to be evaluated. These dimensions include estimating the size of the foraging radius surrounding individual sites, duration of occupation at individual sites, and the overall frequency of residential movements. Additionally, seasonal differences in each of these dimensions are also very likely. Given the changing Late Glacial landscape experienced by the Paleoindian inhabitants of the lower Great Lakes several predictions of these dimensions may be offered. When the environment in general becomes less predictable foraging radius may decrease while residential frequency may increase. This perhaps is the situation that faced Gainey populations migrating into the region. Greater mobility frequency and magnitude may have been needed to focus on a few, widely distributed, but highly productive resource patches. In contrast, during the subsequent Parkhill phase, there may have been a decrease in mobility frequency and an associated increase in foraging radius. As the environment began to close, the coastal zone of Lake Algonquian became a more attractive zone. More importantly, predictability in the resource

patches increased measurably. As a result a decrease in the frequency of residential mobility and increase in foraging radius may be expected. In southern Ontario at least, there appears to be some structure to this general pattern.

A second avenue of future research concerns the nature of interaction between southern Michigan and southern Ontario. During the Gainey phase both regions exhibit the notable use of Ohio lithic raw materials, namely Upper Mercer chert. However, during the Gainey phase the pattern appears to switch to the preferential use of Bayport, Fossil Hill, and Onondaga cherts. In particular, there appears to be consistent movement of small quantities of Bayport into southern Ontario and Fossil Hill into southern Michigan. As argued here this consistent movement of raw materials reflects social interaction, including visiting, between regional bands. However, an important research question that arises out of this analysis concerns just how frequent and how long of duration were these episodes of interaction?

## APPENDIX

Table A.1. Assemblage Information

ID	Assemblage Name	Phase	Collection Type	Area (m <sup>2</sup> ) Excavated	Debitage	Channel Flakes	References
1	Ferguson	Gainey	Excavation	13	12	0	Deller 1988
2	Gainey	Gainey	Excavation			126	Shott 1997; Simons et al. 1984; Simons 1997
3	Halstead	Gainey	Excavation	495	805	5	Jackson 1998
4	Murphy	Gainey	Excavation	75	156	9	Jackson 1996
5	Plottner	Gainey	Surface Only			0	Lovis, personal communication
6	Sandy Ridge	Gainey	Excavation	270	2033	0	Jackson 1998
7	Snary	Gainey	Surface Only			0	Wortner and Ellis 1993
8	Udora A-east	Gainey	Excavation	105	5586		Storck and Spiess 1994; Storck and Tomenchuk 1990
9	Weed	Gainey	Excavation	13	10		Deller 1988
10	Banting - A	Parkhill	Excavation	351	436	0	Storck 1979
11	Banting - B	Parkhill	Excavation	206	859	1	Storck 1979
12	Barnes	Parkhill	Excavation	216	2541	111	Wright and Roosa 1966; Voss 1977
13	Dixon	Parkhill	Surface Only			1	Deller 1988
14	Fisher B	Parkhill	Excavation	310	7312	408	Storck 1997
15	Fisher b	Parkhill	Excavation	35	2479	24	Storck 1997
16	Fisher c	Parkhill	Excavation	52	763	10	Storck 1997
17	Fisher C	Parkhill	Excavation	93	7447	6	Storck 1997
18	Fisher C-east	Parkhill	Excavation	109	2539	124	Storck 1997
19	Fisher D	Parkhill	Excavation	216	5867	396	Storck 1997
20	Hussey	Parkhill	Excavation	128	101	0	Storck 1979
21	Leavitt	Parkhill	Excavation	206	4416	10	Shott 1993

Table A.1 (Cont'd)

22	Mawson	Parkhill	Surface Only		2	0	Deller 1988
23	McLeod	Parkhill	Excavation			5	Deller 1988; Muller 1999
24	Mullin	Parkhill	Surface Only		2	0	Deller 1988
25	Parkhill A/J	Parkhill	Excavation	9		7	Ellis and Deller 2000
26	Parkhill B	Parkhill	Excavation	202	3174	142	Ellis and Deller 2000
27	Parkhill C	Parkhill	Excavation	112	1446	42	Ellis and Deller 2000
28	Parkhill D	Parkhill	Excavation	58	1444	21	Ellis and Deller 2000
29	Parkhill E	Parkhill	Excavation	7		0	Ellis and Deller 2000
30	Parkhill G	Parkhill	Surface Only			0	Ellis and Deller 2000
31	Parkhill H	Parkhill	Surface Only			0	Ellis and Deller 2000
32	Parkhill I	Parkhill	Surface Only			2	Ellis and Deller 2000
33	Parkhill K	Parkhill	Surface Only			0	Ellis and Deller 2000
34	Schofield	Parkhill	Surface Only		5	0	Deller 1988
35	Scott Glen	Parkhill	Surface Only		0	0	Deller 1988
36	Thedford II A-center	Parkhill	Excavation	164	276	9	Deller and Ellis 1992
37	Thedford II A-E	Parkhill	Excavation	80	75	0	Deller and Ellis 1992
38	Thedford II A-NE	Parkhill	Excavation	116	266	17	Deller and Ellis 1992
39	Thedford II A-SE	Parkhill	Surface Only			0	Deller and Ellis 1992
40	Thedford II A-W	Parkhill	Excavation	88	354	13	Deller and Ellis 1992
41	Thedford II Grid B	Parkhill	Surface Only			0	Deller and Ellis 1992
42	Wight	Parkhill	Surface Only		2	0	Deller 1988
43	Alder Creek	Crowfield	Excavation	88	183	9	Timmins 1996
44	Bolton	Crowfield	Excavation	184	320	31	Deller and Ellis 1996
45	Crowfield (Feature 1)	Crowfield	Excavation		35	5	Deller and Ellis 1984
46	Crowfield (Feature 2)	Crowfield	Excavation		7	2	Deller and Ellis 1984

Table A.1. (Cont'd)

47	Crowfield (Unheated)	Crowfield	Excavation			0	Deller and Ellis 1984
48	Zander - 1	Crowfield	Excavation	42	558	13	Stewart 1984
49	Zander - 2	Crowfield	Excavation	54	1419	36	Stewart 1984
50	Caradoc	Holcombe	Excavation			0	Ellis and Deller 2002
51	Fowler	Holcombe	Excavation		2113	3	Woodley 2004
52	Holcombe Beach - Main	Holcombe	Excavation	275	11078		Fitting et al. 1966
53	Holcombe – Paleo II	Holcombe	Surface Only		3096		Fitting et al. 1966
54	Holcombe – Paleo II-W	Holcombe	Surface Only		1998		Fitting et al. 1966
55	Strathroy	Holcombe	Surface Only			0	Deller 1988
56	Tedball	Holcombe	Surface Only			0	Deller 1988



Table A.2. Summary of tool richness and evenness data

Assemblage Info			Long List Summary				Short List Summary			
ID	Assemblage Name	Phase	Tool Classes	Total Tools	Menhiniks Index	C.V.	Total Classes	Total Tools	Menhiniks Index	C.V.
1	Ferguson	G	3	5	1.34	0.69	2	5	0.89	2.09
2	Gainey	G					7	942	0.23	0.84
3	Halstead	G	10	71	1.19	0.78	7	71	0.83	0.90
4	Murphy	G	7	20	1.57	0.59	5	20	1.12	1.27
5	Plottner	G	2	23			2	23	0.42	
6	Sandy Ridge	G	8	59	1.04	1.19	5	59	0.65	1.22
7	Snary	G	3	10		1.21	3	10	0.95	2.06
8	Udora A-east	G	9	138	0.77	1.11	7	138	0.60	0.96
9	Weed	G	3	5	1.34	0.35	3	5	1.34	1.33
10	Banting Area A	P	11	80	1.23	0.88	7	78	0.79	0.89
11	Banting Area B	P	11	55	1.48	0.92	5	54	0.68	1.24
12	Barnes	P	8	56	1.07	0.74	6	56	0.80	1.20
13	Dixon	P	6	15	1.55	0.90	5	15	1.29	1.09
14	Fisher B	P	15	442	0.71	1.24	7	438	0.33	1.07
15	Fisher b	P	14	120	1.28	1.92	6	118	0.55	1.67
16	Fisher c	P	8	29	1.49	1.20	7	274	0.42	1.77
17	Fisher C	P	12	283	0.71	1.85	6	29	1.11	1.21
18	Fisher C-east	P	12	102	1.19	0.97	6	102	0.59	0.95
19	Fisher D	P	14	170	1.07	0.97	7	167	0.54	0.90
20	Hussey	P	13	43	1.98	1.01	6	41	0.94	0.90
21	Leavitt	P	12	82	1.33	0.97	6	68	0.73	0.84
22	Mawson	P	1	1	1.00		1	1	1.00	2.65

Table A.2. (Cont'd)

23	McLeod	P	11	32	1.94	0.85	7	32	1.24	0.81
24	Mullin	P	4	4	2.00	0.00	3	4	1.50	1.38
25	Parkhill A/J	P	5	14	1.34	1.05	3	14	0.80	1.85
26	Parkhill B	P	9	103	0.89	1.59	5	99	0.50	1.74
27	Parkhill C	P	11	45	1.64	1.33	6	45	0.89	1.19
28	Parkhill D	P	13	87	1.39	1.03	6	85	0.65	0.83
29	Parkhill E	P	6	9	2.00	0.56	4	9	1.33	1.16
30	Parkhill G	P	5	6	2.04	0.37	3	6	1.22	1.42
31	Parkhill H	P	5	7	1.89	0.64	3	7	1.13	1.53
32	Parkhill I	P	5	6	2.04	0.37	5	6	2.04	0.81
33	Parkhill K	P	7	10	2.21	0.55	5	10	1.58	1.20
34	Schofield	P	2	2	1.41	0.00	2	2	1.41	1.71
35	Scott Glen	P	2	3	1.15	0.47	2	3	1.15	1.84
36	Thedford II A-center	P	10	45	1.49	0.88	5	45	0.75	0.80
37	Thedford II A-E	P	10	21	2.18	0.76	7	21	1.53	0.75
38	Thedford II A-NE	P	11	38	1.78	0.98	6	37	0.99	1.24
39	Thedford II A-SE	P	4	9	1.33	1.11	3	9	1.00	1.72
40	Thedford II A-W	P	10	25	2.00	0.71	5	25	1.00	0.90
41	Thedford II Grid B	P	4	6	1.63	0.38	3	6	1.22	1.42
42	Wight	P	2	3	1.15	0.47	2	3	1.15	1.84
43	Alder Creek	C/H	5	10	1.58	0.50	4	10	1.26	1.33
44	Bolton	C/H	8	24	1.63	0.59	5	24	1.02	1.01
45	Crowfield (Feature 1)	C/H	13	145	1.08	1.29	6	145	0.50	1.21
46	Crowfield (Feature 2)	C/H	6	16	1.50	0.61	5	16	1.25	1.00
47	Crowfield (Unheated)	C/H	8	26	1.57	0.90	6	26	1.18	1.02
48	Zander Area 1	C/H	11	79	1.24	1.04	7	79	0.79	1.22

Table A.2. (Cont'd)

49	Zander Area 2	C/H	10	130	0.88	1.02	6	130	0.53	0.95
50	Caradoc	C/H	6	62	0.76	1.29	4	62	0.51	1.50
51	Fowler	C/H	10	42	1.54	0.73	7	42	1.08	0.61
52	Holcombe Beach - Main	C/H	13	381	0.67	1.67	7	377	0.36	1.77
53	Holcombe – Paleo II	C/H	10	52	1.39	1.12	6	52	0.83	1.04
54	Holcombe – Paleo II-W	C/H	7	36	1.17	0.91	6	36	1.00	0.94
55	Strathroy	C/H	4	9	1.33	0.43	3	9	1.00	1.54
56	Tedball	C/H	4	7	1.51	0.55	4	7	1.51	1.15

Table A.3. Tool Classes and Counts for the Long List

Assemblage ID	Preforms	Fluted points	Backed bifaces	Alternatively beveled bifaces	Other bifaces/biface fragment	Channel flake	Points/mini scrapers	End Srapers	Narrowed/offset end scrapers	Side scrapers	Concave side scrapers	Gravers/micro-piercers	drills	Becs/burins/hafted perforators	Denticulates/Notches/Borers	Other unifaces/Uniface fragments	Utilized/Retouched Flakes	Pièces esquillée	Cores
1	1	3						1											
2																			
3		1			4			15		5		18		2	7	9	7	3	
4		1						5		3					2	5	3	1	
5	23																1		
6								24		4		7		2	1	18	1	2	
7								8				1					1		
8	4	14			15			48		7		4		4		40		2	
9		2						2									1		
10		2			9			7		15	3	10			3	5	22	2	2
11	1			1	7					10	1	7	2	2		9	14		1
12	14	14			7			9		2		1		2			7		
13		2	1	1				7		2						2			
14	50	28		2	65	1		12		44	5	31		20	3	38	139	1	3
15	7	3		1	10	1		4		6	1	6		3	5	7	65		1
16	3				2			1		3	1	4		1			14		
17	2				44			3		15	10	7		5	16	14	157	1	9
18	27	9		1	16			3		7	2	7		1	1	9	19		
19	36	15		1	31			5		9	5	11		9	2	12	30	1	3

Table A.3 (Cont'd)

20	1	1	1	2	8		6		12	2	1		2	2		3		2
21	8	3	2		10		19	3	17		1		1	1		3		14
22		1																
23	1	2		1			6	1	8		2		1		4	5	1	
24		1					1							1		1		
25	2	8									1			2		1		
26	10	58		1	9	4	1		2				2			16		
27	3	20		2	4		5	2	3	1	3		1			1		
28	4	13	1	2	5	2	27	4	8		6		2	5	8			
29	1	3					1	1			2			1				
30								1	2	1				1	1			
31							3	1		1			1		1			
32		1	1				2				1					1		
33		1			1		2	3			1			1		1		
34		1							1									
35		2									1							
36				2	2		9	1	7	1	13			4	4	2		
37	1				1		1	2	4		4			1	5	1	1	
38	10	9		1	4	1	6	1			1			2	2		1	
39							6		1	1						1		
40	2	3	1	1	5		6	2	3						1	1		
41	2						1	2						1				
42		2	1															
43	3	2								1	1					3		
44	2	6	1		3				1		3			5	3			
45	6	24	13	3	54			1	7	11	1	4	2		6	13		

Table A.3 (Cont'd)

46	2	3	1		1		5		4										
47	1		1	10	2	2	4		3				3						
48	1	5	4	18	6	2	4		1			16	21	1					
49	8	12		1	34	11	10	5				8	40	1					
50	1	1		1	32		5						22						
51		9		8	3	5	2	2		2	1	8		2					
52	107	160		45	8	18	5	4	1	1	4		23	1	4				
53	3	21		7	3	3	2	6	2	1			4						
54		15		4	3	2		6		1			5						
55	2	3			3										1				
56		1			1			2					3						

Table A.4. Tool Classes and Counts for the Short List

Assemblage ID	Fluted biface	Other biface	End scraper	Side scraper	Graver	Pièces esquillée	Other unifaces/retouched Flake
1	4	0	1	0	0	0	0
2	106	175	174	112	31	2	342
3	1	4	15	5	18	3	25
4	1	0	5	3	0	1	10
5	0	23	0	0	0	0	1
6	0	0	24	4	7	2	22
7	0	0	8	0	1	0	1
8	18	15	48	7	4	2	44
9	2	0	2	0	0	0	1
10	2	9	7	18	10	2	30
11	1	8	0	11	7	0	27
12	28	7	9	2	1	0	9
13	2	2	7	2	0	0	2
14	78	67	12	49	31	1	200
15	10	11	4	7	6	0	80
16	2	44	3	25	7	1	192
17	3	2	1	4	4	0	15
18	36	17	3	9	7	0	30
19	51	32	5	14	11	1	53
20	2	11	6	14	1	0	7
21	11	12	22	17	1	0	5
22	1	0	0	0	0	0	0
23	3	1	7	8	2	1	10

Table A.4. (Cont'd)

24	1	0	1	0	0	0	2
25	10	0	0	0	1	0	3
26	68	10	1	2	0	0	18
27	23	6	7	4	3	0	2
28	17	8	31	8	6	0	15
29	4	0	2	0	2	0	1
30	0	0	1	3	0	0	2
31	0	0	4	1	0	0	2
32	1	1	2	0	1	0	1
33	1	1	5	0	1	0	2
34	1	0	0	1	0	0	0
35	2	0	0	0	1	0	0
36	0	4	10	8	13	0	10
37	1	1	3	4	4	1	7
38	19	5	7	0	1	1	4
39	0	0	6	2	0	0	1
40	5	7	8	3	0	0	2
41	2	0	3	0	0	0	1
42	2	1	0	0	0	0	0
43	5	0	0	1	1	0	3
44	8	4	0	1	3	0	8
45	30	70	1	18	1	0	25
46	5	1	1	0	5	0	4
47	1	11	2	2	4	0	6
48	6	22	6	2	4	1	38



Table A.4. (Cont'd)

49	20	35	11	15	0	1	48
50	2	33	0	5	0	0	22
51	9	8	3	7	2	2	11
52	267	45	8	23	4	1	29
53	24	7	3	5	6	0	7
54	15	4	3	2	6	0	6
55	5	0	3	0	0	1	0
56	1	0	1	0	2	0	3

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