

INSIGHTS INTO HUMAN ADAPTATION TO CLIMATE CHANGE: ANNUAL CLIMATE FLUCTUATIONS AND TECHNOLOGICAL RESPONSES IN THE HUDSON BAY LOWLANDS OF ONTARIO, CANADA

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Abstract

The record of human adaptation to the exigencies of the environment of the Hudson Bay Lowlands of northern Ontario extends back several thousand years. Over this time, the hemispherical climate has undergone many long-term changes not unlike those described today as being induced by the effects of global warming, albeit over longer time frames. It can be argued that seasonal variations which range from intense winter conditions not unlike those experienced in the Arctic, to sometimes crushingly hot summers were a greater challenge than modifications of annual mean temperatures that could only be measured over the course of generations. Indeed, archaeology indicates that seasonal variations in climate left an indelible imprint on the material record of the region rather than any measurable change in mean annual temperature.

Resumen

Perspicacias en la adaptación humana al cambio de clima: fluctuaciones de clima anuales y respuestas tecnológicas en las Tierras Bajas de la Bahía de Hudson, Ontario, Canadá

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El expediente de la adaptación humana a las exigencias del ambiente de las Tierras Bajas de Hudson de Ontario septentrional se empezaron varios miles de años atrás. Durante este tiempo, el clima hemisférico ha experimentado muchos cambios a largo plazo, a diferencia de los descritos en la actualidad que son inducidos por los efectos del calentamiento del planeta, no obstante sobre marcos de un tiempo más largo. Puede ser discutido que las variaciones estacionales que van desde el invierno intenso no muy diferentes a las experimentadas en el ártico, a veces los veranos muy calientes eran un mayor desafío que las modificaciones de las temperaturas medio anuales, que solo se podían medir a lo largo de las generaciones. De hecho, la arqueología indica que las variaciones estacionales en el clima dejaron una huella indeleble en el registro material de la región en lugar de cualquier temperatura de cambio mensurable.

Résumé

Aperçu de l'adaptation humaine au changement climatique: variations annuelles et modifications technologiques dans les Basses terres de la baie d'Hudson de l'Ontario, Canada

L'histoire de l'adaptation humaine aux conditions environnementales des Basses-Terres de la baie d'Hudson s'échelonne sur plusieurs millénaires. Pendant ce temps, le climat de l'hémisphère a connu plusieurs changements à long terme sur une échelle qui s'apparentent aux changements climatiques que l'on connaît de nos jours et qui sont attribués à l'effet de serre. On peut proposer que des variations saisonnières allant d'hivers avec des froids intenses, semblables à ceux de l'Arctique, et aux étés de chaleurs écrasantes présentaient des défis plus importants que des variations de température annuelle mesurées sur plusieurs générations. En effet, l'archéologie nous indique que les variations saisonnières du climat ont marqué le registre matériel de la région beaucoup plus que les changements de température annuels.

Resumo

Reflexões sobre a adaptação humana às alterações climáticas: flutuações anuais do clima e respostas tecnológicas nas planícies da Baía de Hudson, Ontario, Canada

O registro da adaptação humana às exigências do ambiente das planícies do norte de Ontário de Baía de Hudson se estende por volta de milhares de anos. Ao longo deste tempo, o clima do hemisfério sofreu muitas mudanças, não muito diferentes das descritas hoje como sendo induzidas pelos efeitos

do aquecimento global, embora ao longo de períodos de tempo maiores. Pode-se argumentar que variações sazonais, não diferente daquelas experimentadas no Ártico, que vão desde condições de inverno intenso a alguns verões muito quentes, eram um desafio maior do que as modificações das temperaturas médios anuais, que só poderiam ser medidas ao longo das gerações. Com efeito, a arqueologia indica que as variações sazonais no clima deixaram uma marca indelével no registro material da região, ao contrario de qualquer medida de mudança na temperatura média anual.

Introduction

For many years now, climate change, induced at least in part by the excessive release by humans of CO² emissions into the atmosphere, along with other pollutants, has been greatly debated (Houghton *et al.* 1996). Initially, discussions centered on whether these emissions were actually having an effect on the global atmosphere and whether they were to blame for changes in planetary climate (United Nations 1992). Today this causality appears to have broad acceptance (IPCC 2007), even if reluctantly so, and consequently debate has now turned towards possible solutions to alarming environmental trends which have been documented with data accumulated over the course of decades and, in some instances, for more than a century (see Gore 2013).

While palaeoclimatic data occasionally find their way into the popular presentations of discussions of recent climate change, the more common timeframe straddles various portions of the twentieth century and the longer ones extend into the nineteenth century. As an archaeologist, I have often found myself complaining that the span of time being considered—expressions such as “weather data going back to the middle of the XIXth century”, for example, are sprinkled liberally throughout this discourse—was extremely limited. In terms of human history, a century is rather like the blink of an eye. I have yet—although I freely admit I might have missed it—to come across a satisfying integration of a longer perspective into the entire debate, at least not in the general public’s arena. Are there not lessons to be learned from the past about the ways by which humans accommodated long term climatic changes? Can we learn from the human experiences of the last few millennia in contemplating our own collective future? Are we so reluctant to address the issue of correlations between human culture and environment for fear of returning to the exhausted and exhausting debate of environmental determinism (see Freilich 1967 for example)?

In this article I would like to review some data relating to climate change from northern Canada and in particular information relating to the Hudson Bay Lowlands. In many respects, that region provides us with an opportunity of assessing or at least of addressing some of these issues. Being a climatically marginal or ecotonal region, past climatic changes may have been more noticeable there (Payette, Fortin and Gamache 2001:709) and successful coping mechanisms might have been more critical to human survival. At the very least, this region might offer some insights into the kinds of issues that were of significance to past human occupations of climatically challenging regions when faced with significant climate modifications as well as some of the possible responses to these.

The Essential Characteristics of the Hudson Bay Lowlands – A Brief Overview

Geology, Geomorphology and Weather

The Hudson Bay Lowlands are a broad band of flat, poorly-drained, low-lying land bordering the southern portion of Hudson Bay and the shores of James Bay, from roughly 51°N at the bottom of James Bay to 58°N in northern Manitoba (Bostock 1970). The Lowlands lie mostly within the Canadian provinces of Manitoba and especially Ontario. A very minor component occurs within the province of Québec, in the form of a relatively narrow strip along the eastern shore of James Bay (see Figure 1). Unlike the pre-Cambrian Shield which surrounds the Hudson Bay Lowlands, bedrock is a rare occurrence in the Lowlands being visible only at a few locations along certain rivers which have cut down to the much younger Palaeozoic formations, often causing rapids and falls.



Figure 1. The Hudson Bay Basin, including the location of the Hudson Bay Lowlands.

The distinctive surface geology of the Lowlands, where inland sea and pro-glacial lake deposits of sand, silt and clay predominate, varies according

to the local post-glacial history (Craig 1969; Lee 1960; Martini 1982; McDonald 1969). The poorly-sorted and poorly-drained nature of these surface deposits results in extensive wetlands, a characteristic which stands apart from the adjacent Precambrian Shield region. These unconsolidated sediments were deposited by the Tyrell Sea which once covered the entire extent of the Lowlands. That inland sea was formed during the very last stages of the disappearance of the once vast Laurentide Ice Sheet which divided into remnant centers on either side of Hudson Bay, between 7,000 and 8,000 years ago (Dyke 2005:235). However, prior to the fragmentation of the rapidly melting continental glacier and the flooding of the basin by marine waters, enormous post-glacial lakes had occupied the newly ice-freed landscapes in the southern reaches of the Lowlands, leaving behind lacustrine deposits.

Weather patterns across North America are greatly affected by the presence of the large body of cold water that is Hudson Bay. In the ice free season, it appears to pull down the frigid Arctic Air Mass. Significantly, although the southern shore of Hudson Bay lies at roughly the same latitude as Copenhagen, Denmark, Hudson Bay weather is much more severe (see Table 1). Additionally, while the Lowlands are far to the south of the Arctic Circle, weather patterns in parts of the Lowlands are distinctly Arctic-like (Chapman and Thomas 1968; Thompson 1968). In fact, the summer position of the southern edge of the Arctic Air Mass lies along the northern portion of the Hudson Bay Lowlands and seems in large part responsible for the maintenance of a strip of treeless tundra extending inland for several kilometers along the southern coast of Hudson Bay. Ecologically, this tundra strip is critically important in determining the types and numbers of faunal resources of the region (Kershaw and Rouse 1973; Larson and Kershaw 1974, 1975). The Lowlands are underlain by both permanent and semi-permanent permafrost.

Economic Species

A wide array of faunal species is found within the Hudson Bay Lowlands, yet their seasonal availability is quite restricted. A quick examination of the mean temperatures for the region shows that winter temperatures are very harsh with freezing conditions beginning in October and continuing through till April (see Table 1). Consequently, many of the species that are in the region during the brief warm weather season will migrate out of the area with the onset of colder weather, travelling hundreds and even thousands of kilometers, or, as in the case of fish, become difficult—but not impossible—to reach because of river and lake ice cover. The result is a short season of relative abundance followed by a longer period of greatly reduced diversity, numbers and accessibility.

Table 1
Northern Ontario Temperatures and Precipitation*

	<i>Month</i>	<i>Fort Severn</i>	<i>Southern Lowlands</i>	<i>Thunder Bay</i>	<i>Copenhagen**</i>
Mean Daily Temperature (°C)	Jan.	-25.6 to -24.5	-25.6 to -24.5	-14.4	1.1
	Apr.	-10 to -8.9	-7.8 to -6.7	2.2	6.1
	Jul.	11.1 to 12.2	13.3 to 14.4	16.7	20.6
	Oct.	1.1 to 2.2	0 to 1.1	5.6 to 6.7	9.4
Mean Annual Precipitation (cm)		45.7-50.9	50.9-55.9	71.1-76.2	55.9
Mean Annual Snowfall (cm)		162.6-203.2	162.6-203.2	203.2-243.8	

Sources: * Data taken from Chapman and Thomas 1968.

** <<http://www.weather.com/weather/wxclimatology/monthly/graph/DAXX0009>>

Some of the more significant faunal resources of the region include many species of freshwater fish (both spring and fall spawning species (Scott and Crossman 1973)) and both small and medium-sized land mammals, most of which also provide warm furs for use in the manufacture of clothing. Most spectacular are the massive flocks of migratory waterfowl, especially ducks (Ross 1982) and geese, which funnel through the Hudson Bay Lowlands on their way to and from their Arctic nesting grounds in the Central Arctic (Thomas and Prevet 1982). The area is part of the Mississippi Flyway, one of the major migratory routes for several very important species (Hanson and Currie 1957; Hanson and Smith 1950). These birds move through the area, stopping briefly in the coastal tundra zones on their way north in the spring and again as they return southward in the fall when they feed on the ripening berries found in abundance on the raised beach ridges of the coastal zone. These stops represent important moments which allow the birds to rest and feed. They are also important hunting opportunities for local populations.

The diversity of sea mammals is as great as most regions of the Arctic, with several species of seals, beluga whales and walrus being present (Mansfield 1963, 1968). To date, however, no archaeological evidence for the exploitation of sea mammals has been identified save for a single specimen within the context of the late xviith century Hudson's Bay Company Fort Churchill/New Severn Post (Balcom 1980, 1981). Currently, sea mammal use by local First Nations in the Hudson Bay Lowlands is limited to ethnographic accounts (Pilon 1987: Appendix B).

Large land mammals present in the region (MacPherson 1968) are few. These include black bear, moose (Peterson 1955) and, in the coastal area,

polar bear. In fact the greatest concentration of polar bears in northern Canada is found in southern Hudson Bay. However, the most economically significant large mammal in the region by far is caribou. While the caribou of this region are classified as woodland caribou (*Rangifer tanrandus caribou*), these animals behave in a manner similar to their migratory barren-ground cousins (*Rangifer tanrandus groenlandicus*) to the west (Kelsall 1968). Late winter/early spring witnesses the northward movement of pregnant females who travel to the coastal tundra zone to give birth to their calves. Bulls join them somewhat later. The winds coming off of Hudson Bay provide respite from the clouds of blood-seeking insects. In late fall, small herds are once again seen travelling southward to inland areas rich in lichens, areas which range studies (Ahti and Hepburn 1967) and ethnographic information (Honigmann 1956, 1981; Pilon 1987:Appendix B) locate within the southern reaches of the Hudson Bay Lowlands, adjacent to the Precambrian Shield. In addition to the high value of their meat, caribou provided bone and antler for the manufacture of a wide range of tools and skins for clothing, shelters, cordage, etc.

An Overview of the Human Occupation of the Hudson Bay Region

The vast majority of the Hudson Bay Lowlands is still only accessible by air or water. While rail links to Churchill, Manitoba and Moosonee, Ontario have existed since the early twentieth century, it is only with more recent resource development projects that roads have been slowly reaching northward, and even then only into the southern reaches of the physiographic region near James Bay. It is now possible to drive during all seasons to Chisasibi on the east coast of James Bay, a direct result of the 1970s construction of hydro dams on the La Grande River.

The history of archaeological research shows that investigations within the region have been sporadic and very limited. Moreover, these have usually been undertaken before major resource development projects as part of environmental assessments and mitigation programs—hydroelectric developments in both northern Manitoba and northern Québec, and more recently diamond mining in northern Ontario.

The database on which to construct regional culture historical frameworks is thus quite constrained and overall very unbalanced. Nonetheless, a number of broad episodes of human occupation have been identified and tentative chronologies can be advanced. When these are combined with data from neighboring areas, a rough outline emerges for the region as a whole.

Hudson Bay Lowlands - Severn River Cultural Chronology

The archaeological research that has been carried out in the Severn River basin within the Hudson Bay Lowlands consisted for the most part of regional site surveys complemented by limited test excavations at selected sites thought to be able to elucidate certain time periods or add details pertaining to former economic patterns (Pilon 1987). In fact, this is the case with the vast majority of the work that has been carried out in the Hudson Bay Lowlands (Dawson 1976; Julig 1988; Lister 1988; Pollock and Noble 1975; Tomenchuk and Irving 1974). Sustained problem-oriented research has yet to be undertaken in this vast area.

Contributing in no small measure to the paucity of research are a number of factors which greatly reduce site survival and the overall visibility of archaeological sites in the region. Spring ice scouring of sites located in low lying areas effectively wipes these from existence. Frequent spring flooding producing massive overbank deposition, effectively buries higher sites under considerable amounts of river-transported deposits. Continuous and semi-continuous permafrost can lock sites in impenetrable frozen deposits, out of reach of standard test pitting and excavation techniques.

While work along the Severn River was initially premised on the possibility of finding Palaeoeskimo occupations in the region (Pilon 1983), such evidence has yet to be identified. Rather, existing data point to the presence of cultural traditions whose roots can ultimately be traced to southern and western regions, *i.e.* from elsewhere in northern Ontario and northern Manitoba. Notwithstanding these clear sources of influence, a local pattern, predicated upon the range and characteristics of the particular resources of the Severn River drainage, seems to have emerged sometime on the order of 1500 to 2000 years ago.

The oldest site identified to date from the Severn River basin within the Hudson Bay Lowlands is located in the southern portion of the area, near the confluence of the Sachigo and Beaverstone Rivers. The *Kitché Ouessecote* site (GfJi-1) is located along a long bypassed channel of the Beaverstone River. Its collection of lithic implements includes a number of corner-notched projectile points (Figure 2) which suggest affiliation with the Pelican Lake Archaic phase found in northern Manitoba and further south in the northern Plains and northwestern Ontario (Pilon 1987:181-182). While no direct radiometric dating is currently available for the Severn River specimens, elsewhere these points are estimated to date from about 2000 years ago. Still, the relatively high number of formal lithic implements in the *Kitché Ouessecote* assemblage stands in marked contrast to all later assemblages from the region where stone implements are much more expedient in nature and bone and antler tools likely occupied a more prominent place in the local material culture.

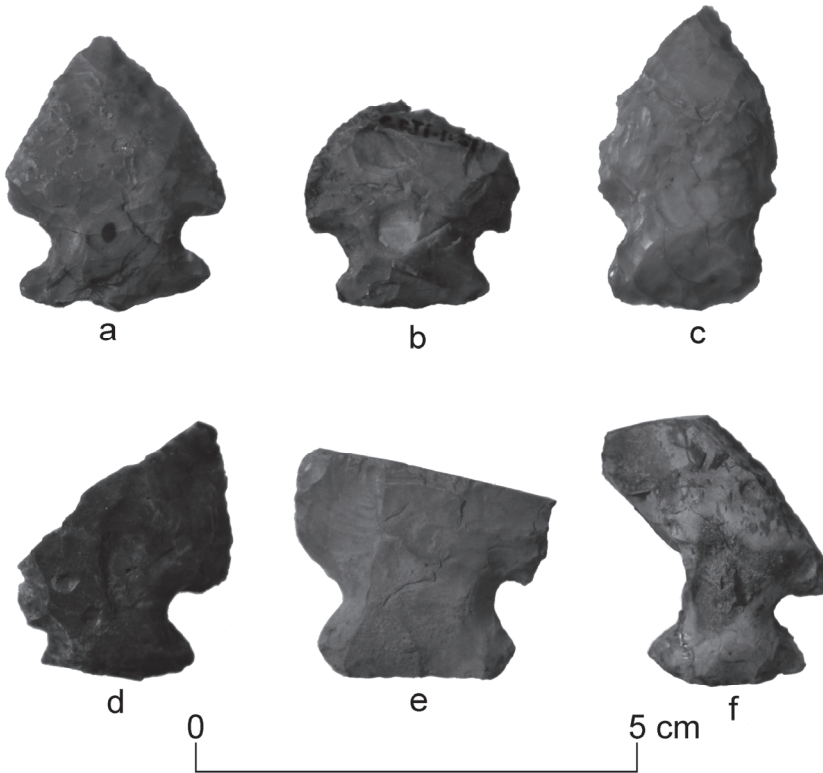


Figure 2. Side-notched points found at the Kitché Ouessecote site (GfJi-1) resembling Pelican Lake points identified in northern Manitoba and believed to be derived from the northern Plains (a-GfJi-1:54/111, b-GfJi-1:51, c-GfJi-1:25, d-GfJi-1:24, e-GfJi-1:79, f-GfJi-1:20).

Later occupations in the same vicinity suggest repeated use over the course of the following centuries up to and including the twentieth century. In at least two pre-contact layers of the *Ouissinaougouk* site (GfJi-2), ceramics were included among the material remains and these reflect both Initial Woodland and Late Woodland ceramic traditions (Figure 3). However, these ceramics were found in very small quantities. Additionally, trace element analyses demonstrate that these ceramic containers were not manufactured locally (Hancock, Stimmell and Pilon 1984). Considering the omnipresence of clay sources (the banks of the Severn River cut through massive beds of Tyrrell Sea clays), the disinterest in ceramics is believed to be indicative of a conscious decision by the Severn River people. Only very occasionally do they appear to have obtained fired clay pots through trade.

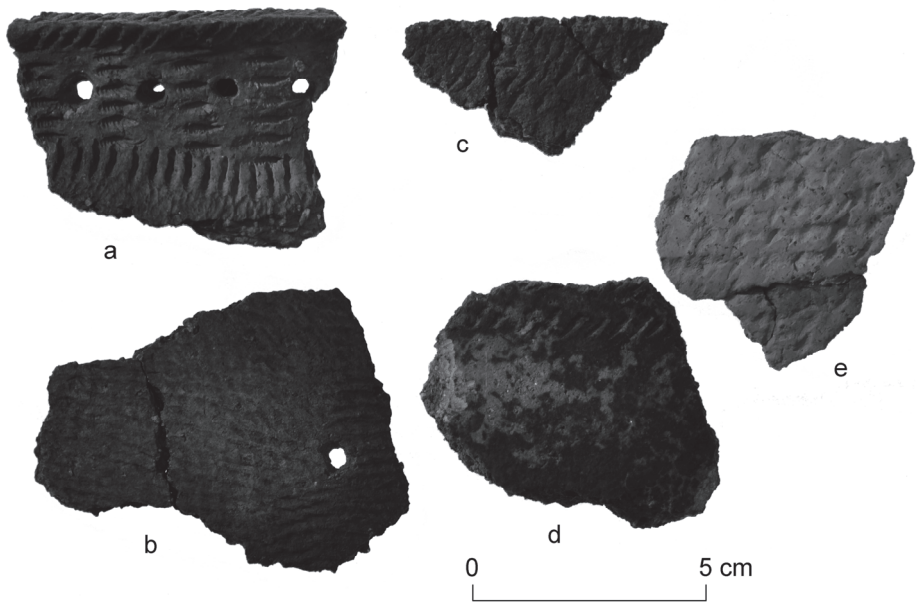


Figure 3. Some of the rare ceramic sherds found along the lower Severn River: a-Blackduck rimsherd (GfJi-2:64), b-Blackduck body sherd (GfJi-2:64/66), c-Laurel rimsherd (GfJi-2:39/41), d-Laurel body sherd (GfJi-2:43), e-Selkirk body sherds (Gllw-1:126/138).

Closer to the coastal reaches of the Severn River, a series of sites—several of them multi-component and stratified—attest to the continued use of the region over at least the last millennium. Ceramics only occur on one of these sites, the 1685-1690 fur trade post context site, Gllw-1, Feature B. With the exception of the late seventeenth century contact with Europeans and the attendant material culture changes brought on by these newcomers, no evident cultural transitions have been documented. Instead, as with the more southern Lowlands region, the distinctive lifestyle of the Severn River people persisted for centuries, being radically interrupted only in the mid to late twentieth century with the advent of greater external control by the government of Canada.

A hallmark of the Severn River seasonal pattern is that the entire annual cycle took place within the Lowlands and was focused around the exploitation of caribou as a focal resource, complemented during the warm season by fish, migratory waterfowl, and small and medium mammals. Additional information about this unique economic pattern is provided further in this article.

Culture Chronological Indicators from Elsewhere in Northern Ontario

Several hundred kilometers to the south, at Wapekeka located near Big Trout Lake, Scott Hamilton (1991:18) dated human burials found there to between 6600 and 7000 years ago. The site had been badly disturbed prior to an archaeologist arriving on the scene, and while associated artefacts were quite few, these were consistent with an early Archaic age. That site suggested that people had moved into the territory then bordering the Tyrrell Sea perhaps only 1000 years after the landscape had emerged from beneath the glacial melt waters that once covered the area.

Without doubt, groups of hunters and their families continued the pattern of exploiting the resources of the migrating southern Hudson Bay region. To the east of the Severn River, in the Sutton Hills area, occupations have been documented at Hawley Lake (Pollock and Noble 1975) and on the Shamatawa River whose occupations relate to late Archaic times. Radiocarbon dates of between 3000 and 4000 years ago (Lister 1988:76) attest to a range of hunting and fishing activities, including the construction and use of fish weirs.

Cultural Chronology of the Forests to the East of James and Hudson Bays

Before the 1975 signing of the James Bay Agreement (Anonymous 1976) and the beginning of the massive James Bay hydroelectric project on the east side of James Bay, archaeologists had rarely ventured into that area's forested regions. More recently, agreements have been reached that provide for new, much more community-based research relating to the damming of major rivers in the southeastern James Bay region (Denton 2004; Bibeau and Denton 2015).

Only slightly more studied was the Arctic coastline of eastern Hudson Bay (Harp 1976; Plumet 1976; Quimby 1940) but for the most part these were in archaeologically marginal and isolated regions.

Syntheses from the hydroelectric-related archaeological work have been slow to emerge, but it now appears that the earliest human occupations of the interior regions adjacent to the eastern shores of James Bay, the traditional territories of the James Bay Cree, did not begin until sometime on the order of 3500 years ago (Séguin 1985). This statement comes in spite of some recent, promising but so far undemonstrated, hints of an earlier coastal presence (CBC 2013).

In central Québec (Caniapiscau) and in the James Bay drainage proper, the presence of Ramah quartzite, which originates on the Labrador coast near its northern tip, is also characteristic of the more numerous assemblag-

es which date after 1600 B.P. (Denton 1988). Fine-grained cherts are also found along with some vein quartz. This pattern exhibits changes through time, with quartz being more frequent in the earlier stages than the later. In this respect, it is interesting to note the absence or under-representation of quartzite from Mistassini (Denton, personal communication, 1980), located to the south of Caniapiscou Lake. This suggests trade relations operated in an east-west direction across central Québec rather than between the south and the north.

An apparent hallmark of these assemblages throughout the prehistoric period was the reliance on simple or only slightly modified flakes for the great majority of the lithic implements required for adaptation to the spruce-lichen and forest-tundra of central Québec and the James Bay territory. Work in the Lac Abitibi area (Kritch-Armstrong 1982; Lee 1965; Noble 1982; Pollock 1975; 1976; Ridley 1954; 1956; 1958) suggests that such an adaptive scheme did not extend around the south end of James Bay. In the latter area, remains have been recovered, including ceramics, which are more easily related to more southern manifestations.

Cultural Chronology West of Hudson Bay

Information is available from three broadly defined areas on the west side of Hudson Bay, each of which appears to exhibit quite distinctive culture-histories and adaptations: the Barrenlands, the transitional forest and the boreal forest.

The human occupation of the Barrenlands spans at least seven millennia. Late Palaeo-Indian occupations are well attested to at sites such as Grant Lake (Wright 1976), Aberdeen (Wright 1972b) and Acasta Lake (Noble 1971). The presence of these groups is probably attributable to the presence of caribou as a principal subsistence resource, although no evidence in the form of bone has been preserved.

In the transitional forest, at least four Palaeo-Indian components have been identified on the basis of the very distinctive late point styles identified variously as Agate Basin, Angostura, Scottsbluff, Alberta and Sandia at the Little Duck Lake locality and on the Cochrane River (Nash 1975:163).

Following, and apparently stemming from these early occupants, in the Keewatin District at least, is the Amerindian Shield Archaic tradition whose distribution extended in a wide arc from the Keewatin in the west, down below Hudson Bay and into Québec and as far as the Atlantic shores of Labrador (Wright 1972a).

As a technological stage, the Shield Archaic persisted in a number of areas until contact with Europeans. Temporally meaningful trends within it have been proposed by Wright (1972a). These demonstrate a gradual change as

well as a stability of the adaptation initially developed. For example, projectile point styles initially exhibited close relations to their Palaeo-Indian lanceolate precursors, but soon evolved through stemmed varieties to initially large notched and later smaller notched points. The processes involved in these changes are not understood. Recoveries of materials related to this tradition are not found after approximately 3500 B.P.

In their place, carriers of the northern derived Arctic Small Tool tradition (pre-Dorset) expanded their range southward as far as the Churchill area (Giddings 1956; Irving 1968; Meyer 1977). Arctic Small Tool tradition evidence is well documented in the Keewatin by Gordon (1975, 1976, 1996) and Harp (1958, 1959, 1961, 1962) and at least one site was located within the transitional forest which appears to relate to this tradition. Once again, it must be remembered that at the time of occupation, the Gray site (Nash 1975:89) may not have been in the transitional forest but in the barren grounds.

Early into the first millennium A.D., cultural manifestations emanating from the District of Mackenzie, to the west, appeared in southern Keewatin and in the transitional forest. These various expressions of the Taltheilei Shale Tradition are documented in northern Manitoba/southern Keewatin until contact with Europeans, at which time they are identified as the Northern Indians or Chipewyan (Nash 1975). These assemblages, characterized by the use of lanceolate and stemmed point varieties among other more general traits, are distinctive in themselves and even more importantly, they stand in marked contrast to contemporaneous assemblages of the Manitoban boreal forest which have been identified as Cree by the direct historic method (Wright 1971).

The economic focus of these various Late Archaic complexes is inferred to have been oriented towards the exploitation of caribou, with important secondary contributions of fish and small and medium-sized mammals.

Cultural Chronology of the Northern Forest of Manitoba

Extensive research at Southern Indian Lake (Dickson 1980; Kroker 1990; Wright 1971), in northern Manitoba, has failed to locate any evidence of a Palaeo-Indian occupation. Further, the earliest occupation of the area appears to date to the third millennium B.C (Dickson 1980:147) and relates to a Shield Archaic occupation. This tradition appears to have exploited interior northern Manitoba until the first millennium B.C. At about this time, Arctic Small Tool tradition peoples (pre-Dorset) were extending their territory southward and evidence of their presence in the boreal forest is suggested by a limited number of finds which are tenuous at best (Nash 1969:139; 1976:153). Evidence from the transitional forest demonstrates that there was

a compression of the Shield Archaic range and a concomitant expansion of the Arctic Small Tool tradition territory.

Dickson (1980:149) has advanced evidence to suggest a Pelican Lake Phase presence at Southern Indian Lake which may strengthen Reeves' (1970:171) suggestion of a northward migration of the makers of the very distinctive corner-notched projectile points, from the northern Plains into the boreal forest as a result of competition from more southern Besant Phase peoples. If nothing else, the similarities in point styles and the chronological coincidence can certainly be taken as evidence of broad-scale information networks flowing along a north-south axis.

Following this brief manifestation, which does not appear to demonstrate any continuity with later cultural units at Southern Indian Lake, both southern and northern derived cultural traditions are documented.

To the north, it is clear that the bearers of the Talttheilei Shale Tradition included at least the northern portion of the boreal forest, the wintering grounds of the Barrenlands caribou, into their seasonal settlement/subsistence pattern. Although continuity of Talttheilei Shale Tradition occupation has been shown further north in the transitional forest and Barrenlands, in the boreal forest of northern Manitoba, there seems to be a hiatus of occupation between A.D. 1 and about A.D. 500 (Dickson 1980:149), but this absence could be the result of sampling bias. Whatever the case, however, material relating to the middle and late phases of this tradition are documented. The late phase persists to the north until historic times, and has been linked to the Chipewyan. Its contemporaneity with southern-derived, purportedly Cree remains poses questions about ethnic relations and cultural exchange. The preponderance of the southern derived complex in late prehistoric times, may explain the scarcity of evidence relating to the northern complex.

In northern Manitoba, Laurel (Initial Woodland) materials have been recovered from a few localities. The remains are relatively meagre and are radiocarbon dated at Southern Indian Lake to the 7th century A.D. (Dickson 1980:158).

By far the best represented and documented archaeological manifestation is the Late Woodland complex described as the Kame Hills Complex (Dickson 1980). This particular, northern Manitoba expression of the Selkirk Focus, originally defined in south-central Manitoba (MacNeish 1958), is characterized by a distinctive ceramic tradition along with a characteristic Late Woodland lithic technology.

The Late Woodland Kame Hills Complex can be equated with the historic groups who became collectively known by a number of names of which Cree was retained and is still in use (Honigmann 1981:227; Wright 1971:23, 24).

The last zone in northern Manitoba which constitutes an area with a fairly distinctive culture-history is the coastal area adjacent to Hudson Bay. Fairly

extensive work has been carried out in the vicinity of Churchill only, and so this information cannot yet be extended to the entire length of the coast.

The ecology of the coast stands in evidently marked contrast to the interior tundra, the transitional forest and the boreal forest and thus makes available different subsistence resources. However, the coastal tundra is relatively narrow and so access to the resources of adjacent areas allows a greater economic diversification by groups capable of exploiting both zones (Nash 1976:152-153).

This appears to have been the case. A number of Palaeo-Eskimo sites have been investigated which appear to be linked to the exploitation of coastal resources (Giddings 1956; Irving 1968; Meyer 1977; Nash 1969; 1972). Still, the southern expressions of the Arctic Small Tool tradition exhibit evidence which suggests adaptation to a forested environment by the presence of large implements interpreted as wood-working tools at these sites. The overwhelming proportion of the tool kits however, show strong technological bonds with northern ASTt groups.

Later Dorset culture sites are extremely rare in northern Manitoba (Meyer 1977). At the Seahorse Gully site, the artefact assemblage and faunal collections left no doubt that the exploitation of sea mammals was the principal economic activity. Inland Dorset sites are unknown, and it would appear reasonable to suggest that the coast of Manitoba was indeed peripheral to the territory regularly exploited by the Dorset culture. The date of 130 ± 95 B.C. (I-3973) (Nash 1972:15) allows a nine century hiatus between it and the previous Palaeo-Eskimo occupation of the area.

The brief Dorset occupation is followed by a lack of dated archaeological remains until the historic period when Inuit groups are documented as descending to the Churchill area to construct boats (Clark 1979:96). Historic Native sites have been recorded, but remain as yet poorly reported (Meyer and Linnaeae 1980) The presence of Thule or historic Inuit groups south of Eskimo Point never appears to have been important. However, this perception may be attributable in part to a lack of research in the area, as well as observer bias on the part of the early Europeans in the area.

Documenting Post-Glacial Climatic Change

North American Pleistocene remnant ice centers occurred on either side of the basin of today's Hudson Bay (Dyke, 2005:235). The incredible ice load of the glacier had of course depressed the earth's crust in the region to well below sea levels. In fact, modern isostatic rebound levels, basically the current adjustments of the earth's mantle to the removal of the ice loads thousands of years earlier are on the order of 0.7 m/century in northern Manitoba (Craig 1969:75) and 1.2m/century at Cape Henrietta Maria, where Hudson

Bay and James Bay meet (Webber, Richardson and Andrews 1970:325). It is worth pointing out that these rebound rates were initially much higher (Andrews 1970). When combined with the very flat-lying nature of the land, we can easily understand how this region is one of the few landscapes on earth that is currently expanding at a very significant rate. Using current rebound rates as well as the general slope of the region, it can be estimated that a strip of land in excess of 1.6 km wide is added to the Lowlands in the vicinity of Fort Severn every century. As a result, over the past several millennia there has been a constantly changing coastal region where newly emerged landscapes cycle through a number of states and ecological conditions from grassy coastal sand ridges to lichen covered strand lines to spruce-lichen forest-covered inland ridges.

The post-glacial history of the region indicates that over the past 8000 years or so, the region has experienced extremely radical environmental and ecological changes. While the landscape has been and continues to emerge from the marine waters of Hudson Bay, a number of environmental indicators in neighboring regions make it clear that the larger area has undergone numerous marked ecological adjustments and these have not been in a progressive nor linear fashion from the 8000 year old state to today.

Several proxy data sources relating to past climate trends exist. From northern Canada these include palynological studies, mostly in the Barrenlands of the former Northwest Territories (now the southern portion of Nunavut) and fire frequency studies such as those carried out in northern Québec. While there is no perfect correlation between the west and east sides of Hudson Bay, there is general agreement about the trends over the past several thousand years. These two data sets can then be compared with other more detailed climatic information sources such as ice core data from Greenland which are reputed to be much better and chronologically more accurate indicators of past climate trends.

Barrenlands - Palynology

The treeline west of Hudson Bay runs from the bottom of the bay diagonally towards the Mackenzie River Delta. In large part, the position of the treeline correlates with the mean summer position of the Arctic front (Barry 1967; Bryson 1966). As such, displacement of the treeline should be indicative of significant and long-term dislocation or adjustment of that mass of cold, dry air and thus of long-term climatic trends.

In the 1960s and 70s, a number of studies examined pollen cores and samples that were extracted from peat deposits and lake sediments in the Barrenlands west of Hudson Bay. Significant movements of the treeline throughout that vast region, by as much as 240 kilometers over the course of

several centuries, were documented (Nichols 1975). These data also suggest that there can be considerable lag time between the shift in the position of the Arctic front and the eventual “movement” of the treeline.

Trees growing on the northernmost edge of the forest-tundra ecotone do so under extreme conditions. Additional environmental stress does not necessarily result in the demise of the trees and thus the immediate adjustment of position of the treeline, but it can affect their ability to reproduce. While sexual regeneration may cease or be greatly impaired, the trees can continue to live for great lengths of time under certain protected conditions (*krummholtz*) with reproduction by cloning or layering (Nichols 1975:39). It is a complex relationship, but the movement of the treeline involves eventual destruction by forest fire; the ultimate, dramatic step in the treeline’s relocation (Payette 1980). Shifts in the treeline are indicated not only by changes in the presence of various arboreal species pollen grains, but also by the productivity of the palynological environment.

In the Barrenlands to the west of Hudson Bay, a major warm period which could have allowed the extension of the treeline up to 350 km north of its current position is suggested between 6900 and 5800 B.P. This was followed by a major cooling and retreat of the treeline between 5800 and 4500 years B.P. and another marked warming and readvance between 4500 and 3800 years B.P. (Payette, Eronen and Jasinski 2002:20). While other studies may propose slightly differing time ranges (Nichols 1976 proposes two warm periods at 5200-4800 years B.P. and 4000-3800 B.P.), these differences can be attributed to the location of the sampling sites and the effects of regionally specific conditions as well as the lag time between climate change and its manifestation in the pollen record (see the discussion in Payette, Eronen and Jasinski 2002:21).

Nichols (1976:34) suggested that in order for spruce to produce seedlings 250 km north of the current treeline of the southern Barrenlands, a 4° C warming is required based on limited existing data.

Northern Québec – Fire Frequency

Both palynology and plant macrofossil studies have been undertaken in northern Québec where the last remnants of the Laurentide Ice Sheet persisted much longer than elsewhere (Payette, Eronen and Jasinski 2002; Richard 1981). As a result, the initial establishment of vegetative communities and their evolution and changes through time were significantly different from the western side of Hudson Bay.

For the past 3200 years, the treeline has moved little; only short distance of less than 10 km have so far been documented, even during the significantly cooler Little Ice Age of A.D. 1550-1850 (Payette, Eronen and Jasinski

2002:21). Nonetheless, through a number of different forest fire frequency studies along the forest-tundra boundary, Payette has documented several distinct cool and dry periods since the last three millennia: viz. 2,800-2,500, 2,200-2,000, 1,600-1,400, 1,100-900, 700 ?, 500-100 years B.P. (Payette 1980:130).

Greenland Ice Cap Data

For several decades now, deep ice cores, some up to nearly 3000 meters in total length have been taken at various locations on the Greenland Ice Cap (Johnsen *et al.* 1995; Johnsen *et al.* 2001). Analyses of these have revealed variations in different elements trapped within the ice deposits which function as proxy data for environmental conditions at the time of the formation of the ice: “Changes in chemical flux values are believed to represent changes in the atmospheric composition over Summit” (O’Brien *et al.* 1995:1962). For example shifts in the deposition of calcium stemming from marine sources

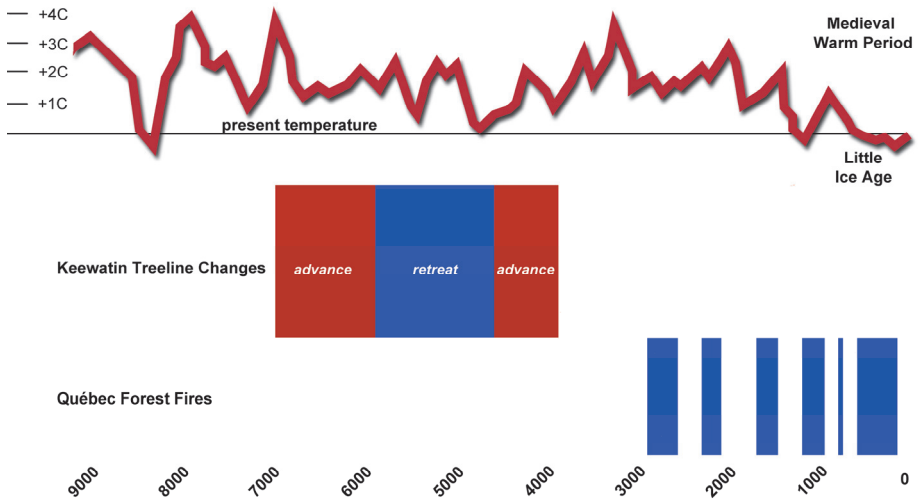


Figure 4. Palaeoclimatic data: top-Greenland Ice Core-derived temperatures (Cuffey and Clo 1997); middle-Barrenlands treeline movements (Payette *et al.* 2002); bottom-northern Québec forest fire episodes (Payette 1980; Payette *et al.* 2002).

versus calcium originating in terrestrial environments is believed to speak to relative rainfall levels (and thus of dust production) as well as regional atmospheric circulation patterns. Isotopic ratios correlate with palaeotemperatures and thus provide continuous and remarkably accurate temperature curves extending to the interstadial preceding the last ice age. Good correlations have been found with climatic patterns determined through other means (palynology for example) and thus the patterns detected in the Greenland Ice Cap have been extended to at least the last interstadial, more than 125,000 years ago (Johnsen *et al.* 2001).

For the Holocene, a number of clear warm periods have been identified: 610-960, 1500-2700, 6300-7900 and 9300-10,600 years B.P. (O'Brien *et al.* 1995:1962).

O'Brien *et al.* (1995:1963) conclude on a sobering note where they state that "...as the Holocene progressed, environmental change increasingly occurred on a regional basis. This complexity in Holocene climate makes distinguishing natural from anthropogenically altered climate a formidable task".

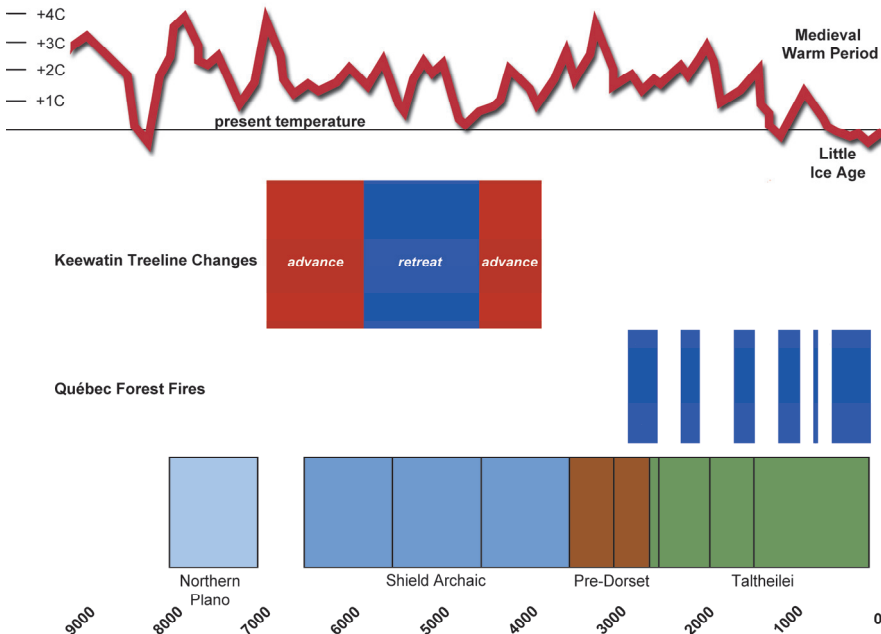


Figure 5. Juxtaposition of past climatic change indicators and major cultural episodes in the Barrenlands of the west side of Hudson Bay (Gordon 1996).

Summary

While there may be issues with the absolute chronology involved with the onset and ending of past climatic episodes, it is clear that weather patterns of the past 8000 in the Hudson Bay basin have changed markedly on several occasions (Figure 4). Movements of the treeline or major forest fire episodes have been tentatively correlated with warming or cooling episodes and when compared to temperature data obtained from Greenland Ice Cores, it is clear that climate has been constantly changing ever since the glaciers disappeared over the Barrenlands of Nunavut and Northern Québec. The resulting climatic episodes caused the treeline to move substantially, in some instances, by tens of kilometers.

There is no question that the trends noted in Barrenlands pollen cores and Ungava forest fire evidence are part of worldwide climatic episodes. The question becomes whether there was a concomitant impact on human populations inhabiting these northern ecotonal regions? Of course, such a discussion must be accompanied by a similarly pertinent question about whether these climatic trends impacted the animal species of these regions that the human populations depended on. Again, the answers to such fundamental questions do not appear simple. Current studies of the effects of climatic warming on certain Arctic species demonstrate a complex interplay between species and factors affecting their success in the changing environments (for examples see Obbard and Walton 2004; Smith, Gilchrist and Johnston). It is not simply a case of moving biotic zones northward or southward.

Correlating Climate Change and Culture Change in the Hudson Bay Basin

A superpositioning of climatic proxy data suggests some possible correlations but strongly hints at the necessity for much caution. At the very least there are apparent lag times between climatic episodes and possible implications for archaeological cultures. Moreover, Dyke (2005:213) warns that “plant colonization may have lagged climate warming by millennia and that maximum summer temperatures did not necessarily coincide with the most thermophilous vegetation development”.

Brian Gordon has conducted extensive survey and excavations throughout the Barrenlands and has divided the following broad cultural episodes, basically a succession of southern-derived Amerindian cultures beginning some 7000 to 8000 years ago. These were, however, interrupted between 3500 and 2600 years ago by northern-derived Palaeoeskimo occupations (see Gordon 1996:238).

A brief examination of the correspondence between climatic data and Barrenlands cultural episodes (Figure 5) suggests that these otherwise radical changes had little impact on the human groups occupying the region, or at least these have not yet been detected archaeologically. The single exception, at least superficially, appears to be the Palaeoeskimo incursion. Their replacement of Shield Archaic Amerindians appears to have taken place during a cooling episode. Similarly, the end of a Palaeoeskimo presence seems to coincide with a warming trend. In both instances, the turbulence of the climatic changes would have first had to have impacted caribou movements and numbers before affecting the human groups who depended on them. As well, we must also consider that the decision to hunt caribou inland during their migrations might have been affected not only by the availability of caribou but quite possibly also by changing conditions in coastal regions which could have presented either new opportunities or challenges there.

Obviously, more research is required to properly address such questions, but we do well to remind ourselves that climate change on the scale recorded by lake deposits in the Barrenlands to the west of Hudson Bay, forest fire records of the northern Québec forest-tundra ecotone or even finer registers such as the Greenland Ice Cap data nonetheless only provide data which greatly exceed the span of human lifetimes. While quite real, when centuries are charted together, the generations of people living through these changes might not have been conscious of these shifts but may have modified their land use patterns in such a gradual way as to be generally unaware of it. More significant to them, and definitely their immediate concern, was their ability to successfully predict the locations of resources over the course of the next annual cycle.

Human Responses to Annual Climate Extremes within the Hudson Bay Lowlands

In these latitudes seasonal climatic variations are tremendous, as shown earlier through mean monthly temperatures (Table 1). It was also shown earlier that these radical climatic variations completely rewrite the economic landscape where a wide range of food resources is replaced by a very narrow inventory of exploitable species. Under such conditions we might expect that human groups would need to modify or adjust their material culture to meet the changing requirements.

A Model of Hudson Bay Lowlands Land Use

When archaeological and ethnographic data from the Hudson Bay Lowlands (see Honigmann 1956, 1981; Lytwyn 2002:Chapter 5; Pilon 1987:Appendix B, 2013) are combined with general information from neighboring regions, some patterns emerge which suggest a seasonally dichotomized land use patterns for pre-contact and early historic times; a pattern that seems to extend to at least the last 1500 to 2000 years.

Since caribou is the single economically significant faunal species which can be found year-round within the Lowlands, the region's inhabitants organized their yearly cycle based on the availability of this focal resource. Of course, when additional resources became seasonally available, these were exploited: including possibly sea mammals but most assuredly migratory waterfowl, fish and an array of medium and small mammals. Summer time was very much a time of relative plenty and this was reflected in the gathering together of extended family groups during this period of the year. Yet, caribou were central in determining the seasonal movements of people; when caribou moved to the coastal areas, hunters and their families also moved northward, not only to exploit caribou, which had more or less abandoned the interior, but also to take advantage of fish runs and the great flocks of migrating waterfowl. Similarly, hunters capitalized once again on the southward migrations of waterfowl in the fall but eventually headed inland to seek out the wintering ranges of caribou.

Cold season occupations on the other hand presented people with a massive reduction in the variety and abundance of food species. At the outset of winter, fall fisheries were maintained as long as possible and small game was hunted when encountered. By far the most significant resource available to winter occupants of the Lowlands, or at least one that seems to have been central to locational strategies, was caribou. Wintering caribou sought out lichen-rich areas in the southern reaches of the Lowlands where they would spend much of the winter. Similarly, small groups of hunting families would locate themselves near to these caribou wintering grounds, exploiting not only the caribou, but also small game such as beaver, hare and porcupine located in the immediate site vicinity.

Over the course of an individual's lifetime, various animal species may experience cycles such as the well-known 10 year hare cycle (Krebs *et al.* 2001). Caribou also experience long-term population cycles which can see their numbers dwindle to bare survival levels from previous numbers that defied belief. These cycles have been documented within the lifetimes of hunters and so the knowledge of these can be expected to be passed on from one generation to the next (for example see Ferguson, Williamson and

Messier 1998; Zalatan, Gunn and Henry 2006). Groups exploiting these resources must be ever vigilant for the signs of the onset of such cycles.

For instance, a change in mean summer temperatures may have an adverse effect on the onset of insect breeding seasons which could increase distress among pregnant and birthing female caribou. Their reproductive success might be affected and their distributions might change. Being able to anticipate and react to such short term changes would clearly be key to both short and long-term success. Indeed, survival in these latitudes depends on having alternatives and having a good understanding of the choices available. But when examining long term climatic cycles, the situations seem to become more complex.

Ultimately, if we examine the differences between the inland/winter or cold season material culture assemblages and the coastal/summer or warm season assemblages, we note very dramatic changes. For example, housing in summer time involved the use of light, quickly constructed tent or brush shelters that had distinctly portable qualities. Winter habitations were usually much more considerable and involved a greater investment of labour and time in their construction (moss house or *askegan* for example). Once established, people tended to stay put.

Distinct sets of equipment were required for one season compared to the other: snowshoes, toboggans and dog sleds in winter time versus birch bark canoes when rivers and lakes were ice-free.

Archaeological Evidence of Seasonal Accommodation

Pre-contact Lowlands populations appear to have always been quite aware of the seasonal availability of raw materials suitable for the manufacture of all the lithic implements required for survival and daily life. Access to adequate supplies of suitable stone for the manufacture of tools is restricted by cold season snow cover since available local sources are secondary cobble deposits at or near the shores of rivers.

A tool cache was found at the *Ouissinaougouk* site (GfJi-2) located at the mouth of the Beaverstone River (*Ouissinaou Sibi*) in a portion of the Severn River basin used during the cold season (Pilon 2002). Most revealing was the composition of the cache. There was only one formal tool, a large side-notched projectile point. The rest of the collection was comprised of 249 large flakes suitable for transformation into whatever implement was required, 88 unifacial tools (mostly end scrapers, but also *pièces esquillées* or wedges, perforators, notches and the ubiquitous retouched flakes) and 3 bifaces (Figure 6). Stone on stone polish facets clearly indicated that the container of objects had actually been put together and transported for some time before being left behind at the site.

One conclusion that seems apparent from this unique find is the great flexibility that was required of the lithic resources that were gathered and set aside for the cold season. These resources had to meet all stone implement needs that this individual (or household?) would encounter over the course of the cold season when access to river cobbles was cut off due to snow accumulation. The majority of these resources were not committed until actual requirements were manifest and thus a large number of blanks were reserved. At the same time, the significant number of unifacial scrapers and other relatively expedient tools are likely good proxies for the kinds of stone implements that were commonly used in daily activities during this season. Remarkably, the owner of this cache did not feel it necessary to create a reserve of more formal tools, be they projectile points or knives. This may disappoint archaeologists but it served quite well the needs of the past.

Another inference that can be drawn from the pre-contact archaeological assemblages found along the Lower Severn River was the relative contributions of bone and antler implements to the tool kits of the Hudson Bay Lowlands people (Figures 7 and 8). Most often, at least ethnographically, bone and antler implements used in everyday life (fleshers, beamers, awls, netting needles, etc.) (see Skinner 1911 for example) are large compared to stone tools (projectile points, scrapers, perforators, etc.). It is assumed that objects found in archaeological sites are usually items that were discarded because they were no longer functional, or had simply been lost.

A number of additional factors must surely enter into the equation when discussing the survival rates of bone and antler tools as opposed to lithic implements. It may be that these organic items are more resilient to shock and stress resulting from their use than the more brittle stone tools. Many bone/antler implements are much larger than most stone tools and consequently may be less easily lost or misplaced. Also many of the common types of bone tools such as beamers and fleshers can be readily curated and thus their life expectancy greatly extended. They can be re-sharpened time and time again before they are finally discarded and incorporated into the archaeological record. The constant recovery of small numbers of bone and antler tool/fragments suggests there were a much greater number of these in and around a camp at the time of occupation.

The reverse might be the case with stone tools since these are harder to curate when broken, much easier to lose and harder to find given their much smaller size. Consequently, if only a few formal stone tools are found, it likely reflects the fact that such formal tools were not very numerous in the tool inventories. When proportionately more are found, they must have been much more significant.

It appears that bone and antler tools, found in small numbers, often as fragments, actually constituted a very significant proportion of the tool inventories of Lowlanders. As well, formal stone tools, found in relatively small

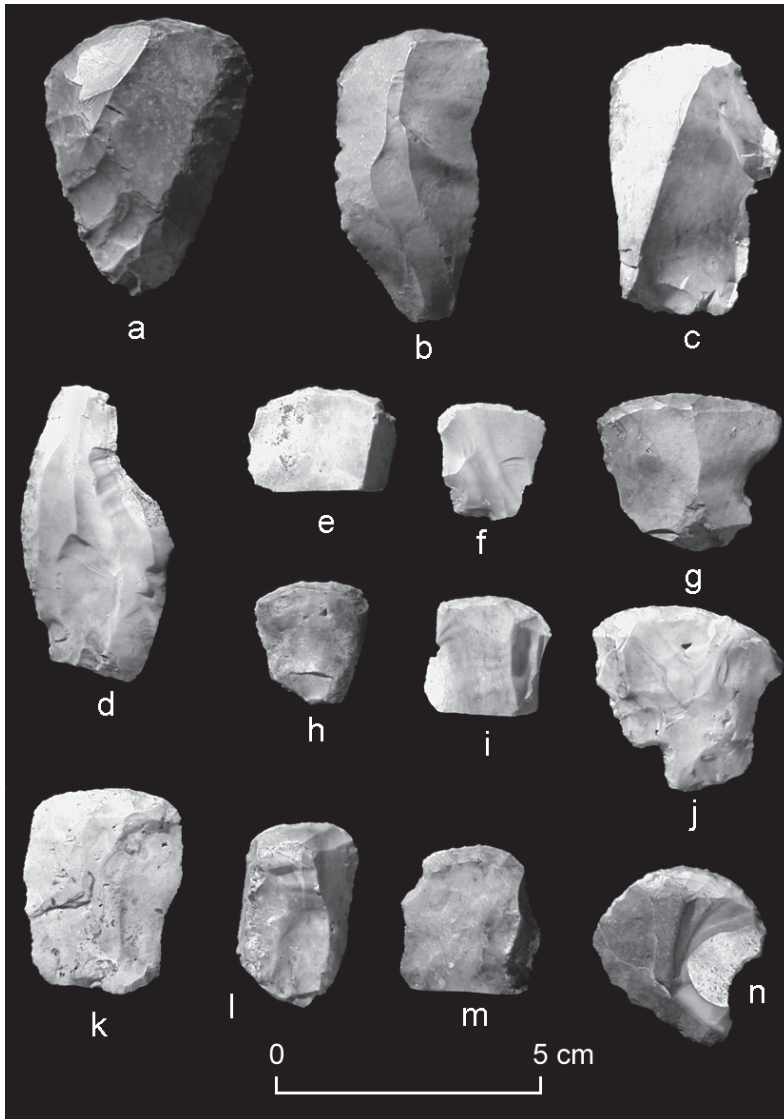


Figure 6. The Ouissinaougouk (GfJi-2) cache contained a single projectile point along with dozens of expedient tools including scrapers, notches, *pièces esquillées* as well as large flakes suitable for transformation as required (a-GfJi-2:106, b-GfJi-2:154, c-GfJi-2:169, d-GfJi-2:158, e-GfJi-2:179, f-GfJi-2:116, g-GfJi-2:175, h-GfJi-2:150, i-GfJi-2:171, j-GfJi-2:109, k-GfJi-2:117, l-GfJi-2:156, m-GfJi-2:157, n-GfJi-2:152).

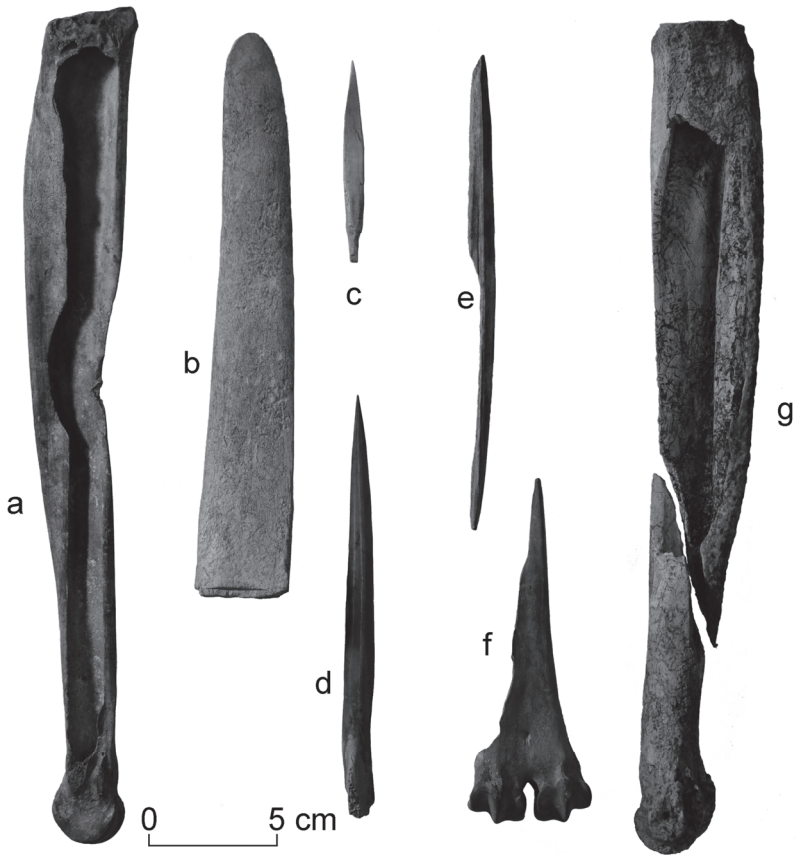


Figure 7. Examples of bone and antler tools found in both pre- and post-contact period lower Severn River archaeological sites: a, g-caribou metapodial beamers (Gllw-1:B1-1, GkJa-5:8), b-antler skinning tool (GkJa-6:49) c-bone point (Gllv-1:83), d-bird bone awl (Gllx-1:7), e-worked caribou metapodial fragment (GkJa-4:64), f-caribou metapodial awl (Gllv-1:84).

numbers on most sites, constituted a much less significant share of tool kits as compared to expedient tools or simply stone flakes which could be readily transformed, through minimal modification, into a variety of tools. The demonstrated focus on the exploitation of caribou would make bone and antler more common and accessible, on a year-round basis, than lithic resources. In fact, bone and antler articles constituted an important part of the material culture of prehistoric Lowlanders and may even have rivalled stone as a raw material used in the manufacture of tools.

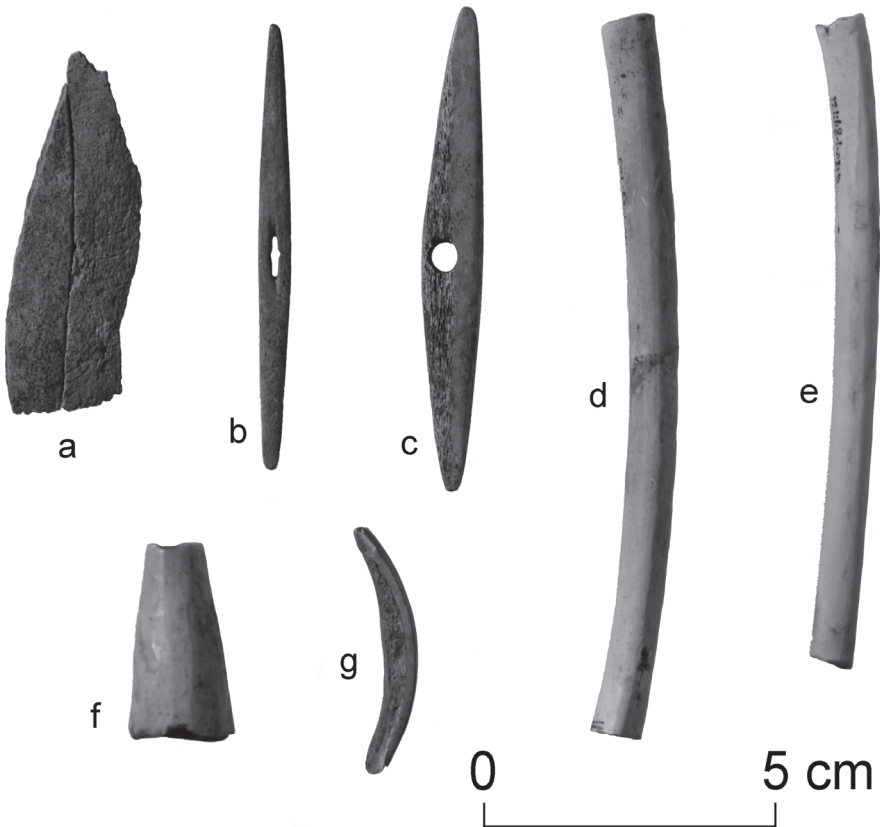


Figure 8. Examples of bone and antler tools found in both pre- and post-contact period lower Severn River archaeological sites: a-bit from a flesher (GkJa-3:44/87), b,c-snowshoe needles (GkJa-3:84, 83), d,e-bird bone tubes (Gllv-1:103, 121), f-modified caribou phalange (Gllv-1:105), g-modified beaver incisor (Gllw-1:106).

Discussion

The objectives of this article were manifold and perhaps overly ambitious. First, a number of proxy data sets were summarized that point to significant climate change since the end of the last glacial epoch. These data are well-known but are rarely evoked in public discussions which consider current

climate patterns. Rather, thinking quite often revolves around changes that occurred over the last few generations only. Without wishing to infer direct causality, it was important to review the extent of long-term past climate change given modern preoccupations.

A second purpose was to attempt to show that, at the Hudson Bay regional level, there has been significant culture change that occurred without any apparent correlation with long-term changes in climate. One exception does, however, loom prominently and that is the movement of Palaeoeskimo groups into and out of the Barrenlands of southern Nunavut (formerly the District of Keewatin). This territorial shift (the movement of Palaeoeskimo and the concomitant movement of Amerindian groups) has not been fully understood but likely finds some explanation with the effects that climate change had on caribou range changes and movements, and possibly the hunting methods used by these various groups.

The final goal of this article has been to underscore the very marked variation in seasonal weather patterns that groups occupying the Severn River basin experienced every single year. In very practical terms, these patterns presented monumental challenges for survival, possibly greater than any long term climate change documented by pollen or ice cores. They were apparently met by devising an economic strategy predicated on the exploitation of a central animal resource, caribou, which included long-distance seasonal relocation. As well significant flexibility was built in to their technological systems. Organic materials, many of them (bone and antler) provided by the focal resource, caribou, were used to manufacture a considerable proportion of the tools required over the course of a year. Similarly, inventories of chipped stone debitage, easily modified into whatever implement was required for a specific task, were stockpiled at the end of the warm weather season when access to tool stone was about to end.

How would long term climate change be experienced by Hudson Bay Lowlands hunter, gatherers, fishers? Shifts that occurred over the course of several lifetimes may or may not have been perceived. Oral traditions might have evoked slight changes in the onset of certain natural cycles or the distribution of certain animal species. Yet, few individuals would have had the opportunity of personally experiencing these changes since they would have spanned several generations. Instead, the change in climate taking place within the yearly cycle would have been more profoundly felt. The devised methods of dealing with these seasonal rhythms depended very much on having a flexible technological base and land use strategy. Therein lies the secret of the successful adaptation to one of the harshest regions of world.

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