

PALEOINDIAN RANGES IN NORTHEASTERN NORTH AMERICA BASED ON LITHIC RAW MATERIALS SOURCING

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Abstract. Archaeologists working in northeastern North America continue to rely heavily on stone tool technology and the sourcing of raw materials for their interpretations of mobility and territoriality among Paleoindians during the late Pleistocene and early Holocene. Hunter-gatherer band ranges reflected in the lithic raw material use on Early Paleoindian sites are presented for the region of eastern New York, southeastern Quebec and New England. While there has been a greater focus on the accurate geological sourcing of stone tool raw materials using petrography and chemical characterization within the last fifteen years, substantial basic research remains to be done. These studies, combined with a greater attention to the organization of stone tool technology (*e.g.*, chaîne opératoire), should permit archaeologists to revisit and in some cases reinterpret the question of Paleoindian mobility and territoriality.

Résumé. Les archéologues qui travaillent dans le Nord-est de l'Amérique du Nord continuent à dépendre en grande partie sur l'étude de la technologie lithique et les sources de matières premières pour aborder la question de territoire et mobilité chez les groupes paléindiens de la fin du pléistocène et le début de l'holocène. Nous présentons ici des données pour la région de l'est de l'état de New York, la Nouvelle Angleterre, et le sud-est du Québec, sur les territoires de bandes de chasseurs-cueilleurs basés sur les matières premières qui dominent sur les sites. Même s'il y a eu une augmentation dans les recherches géologiques ciblées sur les matières premières et leur caractérisation physicochimique, nous constatons qu'il reste beaucoup de recherche à faire si on veut faire avancer nos interprétations. Ces études géoarchéologiques devront être combinées avec une attention accrue à l'organisation de la technologie lithique (par. ex. approche de chaîne opératoire) afin de permettre aux archéologues de mieux aborder les questions de territoire et mobilité chez les paléindiens.

Introduction

It was a great pleasure to present in this session which brought together archaeological datasets from the European Palaeolithic and North American Prehistoric periods in order to look at issues of group territories and mobility. I have been thinking about these issues lately and how to address them by using my own research focus, the sourcing of lithic raw materials, as part of a project with Dr. Brian Robinson of the University of Maine re-analyzing the Bull Brook Paleoindian site (Byers 1954, 1955, 1959; Grimes 1979). While I am not a Paleoindian specialist, the Paleoindian case often comes up as the exception to the rule in lithic sourcing studies. How to explain the fact that stone tool assemblages at Paleoindian sites are often dominated by raw materials that come from hundreds of kilometres away? My interest was further piqued by the recent discovery of the first ever fluted point Paleoindian site in Quebec (Chapdelaine 2004). The tools and debitage at this site in Mégantic, Quebec, are overwhelmingly made from materials that are non-local. In fact, most of the tools are made from two raw materials that are also common at the Bull Brook site 300 km to the south. How do we explain these long distances from the source and the systematic concentration on a limited number of raw materials over huge geographic areas? I will try to answer

these questions by using the lithic sourcing data for several Early Paleoindian sites in northeastern North America.

The issues related to eastern North American Paleoindian economies, lithic raw material use and territories have been thoroughly and thoughtfully treated by several authors (see papers in Ellis & Lothrop 1989; Tankersley & Isaac 1990). Rather than summarize this work, I will define some initial parameters for this study and provide some definitions that are largely inspired by the research presented in these two volumes. First is the issue of territory. I take the term territory here to refer to the geographic area exploited on a regular (seasonal, annual and multi-year) basis by a hunter-gatherer group. I prefer to use the term range for the rest of this paper to refer to the territory or geographic area covered by a band. This range can be seen as the equivalent of a series of superimposed collective annual and lifetime ranges for all individuals in a band (*sensu* Sampson 1988:17-28). I am therefore defining here only the maximum dimensions of territory for a Paleoindian band over several generations since this is the level of resolution available for the Paleoindian period. I also will assume that Paleoindian groups were not highly territorial in the sense of not having well defined boundaries to their territories and not defending or restricting access to these territories and the resources

within them (Cashdan 1983; Dyson-Hudson & Smith 1978). Meltzer (1989) has suggested that Paleoindian bands would not have been territorial because it was too risky. Hunter-gatherer groups tend to have considerable fluidity in terms of individuals changing band membership (*e.g.*, Mailhot 1993) and it is actually rare for a hunter-gatherer band to refuse access to a resource within their traditional territory to another band. This lack of territoriality reduces risk for the individuals and bands involved (Wiessner 1977, 1984). Kelly & Todd (1988) also point out that given the low demographic density of eastern North America there would have been no packing of hunter-gatherer groups which is usually a prerequisite to territoriality. Finally, the stylistic similarity of Paleoindian tool kits, in particular fluted points, across vast geographic areas of North America suggests that there was considerable intergroup communication and fluidity of members changing bands (Ellis 1989). We should keep in mind, however, that there are no close modern or historic ethnographic analogues for Paleoindian hunter-gatherer bands.

Mobility can be seen as the other side of the territory question. Several researchers have tried to tease apart hunter-gatherer mobility, demonstrating that it is not a simple construct (Binford 1980, 1990; Kelly 1983, 1992; Shott 1986; Wiessner 1982). I do not deal in detail with the issue of mobility in this paper because I do not believe the Paleoindian lithic sourcing data lends itself to answering the question directly, but it is certainly part of the answer. Mobility of Paleoindian bands in eastern North America can best be addressed with reconstructions of the environment and subsistence adaptations. Curran and Grimes (1989) propose a useful model for the adaptation of Paleoindian hunter-gatherers to the ecology of northeastern North America at the end of the Pleistocene. They see small hunter-gatherer bands with a high residential mobility covering large annual territories moving along a north-south, interior-coastal axis depending on the seasonal abundance of resources including migratory caribou herds. Unfortunately, the preservation of faunal remains on Paleoindian sites in the Northeast is very poor but some caribou remains have been recovered (Spiess *et al.* 1984/5). Once again we must be cautious with our interpretations since there is no close modern or historic analogue for the environment encountered by Paleoindians in the region. Recent data on the Younger Dryas cooling period at the end of the Pleistocene also demonstrates that the climate and the environment were extremely dynamic and changing rapidly at the very moment that the first humans arrived in northeastern North America (Alley 2000; Hughen 2000). As an anthropologist raised on the ethnographies of Subarctic Canadian hunter-gatherers (*e.g.*, Leacock 1954; Mailhot 1993; Rogers 1963; Speck 1915; Speck 1977), I am inclined to see the Paleoindian groups of the northeastern North America as highly mobile and being able to cover large territories as part of an annual round. I also tend to see these Paleoindian groups as being closer to the forager end of the forager-collector spectrum (*sensu* Binford 1980). I would therefore suggest that Paleoindians obtained most of their raw materials using an embedded strategy (Binford 1979), but I do not discount the possibility of logistical trips to quarries or a combination of both procurement strategies.

Lithic Sources and Proportions of Tools and Debitage at Sites

My goal in this paper is to study the range of various Paleoindian bands in northeastern North America as evidenced by the distribution of raw materials from their bedrock quarry origin or source to the archaeological sites where they were abandoned. My study area is shown in figure 1. It covers most of New England and part of southeastern Quebec and eastern New York. I look at the data available in light of various models previously proposed by researchers for Paleoindian economy and adaptation. I propose a series of hypotheses which can be tested with further detailed lithic sourcing studies of the collections from Paleoindian sites in northeastern North America. First I present some definitions of the measures used in this analysis.

Chronology

In this paper I use the chronology proposed by Spiess (1998) for the Early Paleoindian sites of northeastern North America. A conservative estimate for the time span from the Bull Brook phase to the Michaud-Neponset phase is 10,800 to 10,200 radiocarbon years BP (Spiess *et al.* 1998:236-238). These 600 radiocarbon years are probably equivalent to 1000 calendar years once calibrated. This serves as a reminder of the resolution we may have in terms of group movements over the landscape; in no way are we approaching an annual round territory. The ranges reconstructed are more like a palimpsest or a conflation of various group movements (residential and task specific) over time that in the archaeological record produce a series of overlapping areas that if stippled can produce the image of a maximum territory or range used repeatedly by a group with a smaller darker core area and a larger lighter peripheral range (*cf.* Sampson 1988:17-28).

Distances

Distances from site to source have been calculated as linear distances ("as the crow flies"). I believe this is the most objective measure of distance. A GIS application was used to calculate distances precisely from the Munsungun quarry source taking into account the curvature of the earth but not the topography (*fig. 1*). Topography is obviously important and we would hope that the data presented here might eventually be used to assess topographic variables. Curran and Grimes have proposed certain corridors of Paleoindian movement in the Northeast (Curran & Grimes 1989). In some cases the data is compelling as in the east-west corridor along the upper Androscoggin River through the Israel River complex of sites near Jefferson, New Hampshire (Boisvert 1992, 1999). It may be problematic, however, to focus on modern river valleys as travel corridors given the fact that river geomorphology and drainages were probably quite different from the present. In addition, without dense forest cover, Paleoindians may have moved easily across the landscape using the upland plateaus in areas like central and northern Maine for example (*cf.* Gramly 1980).

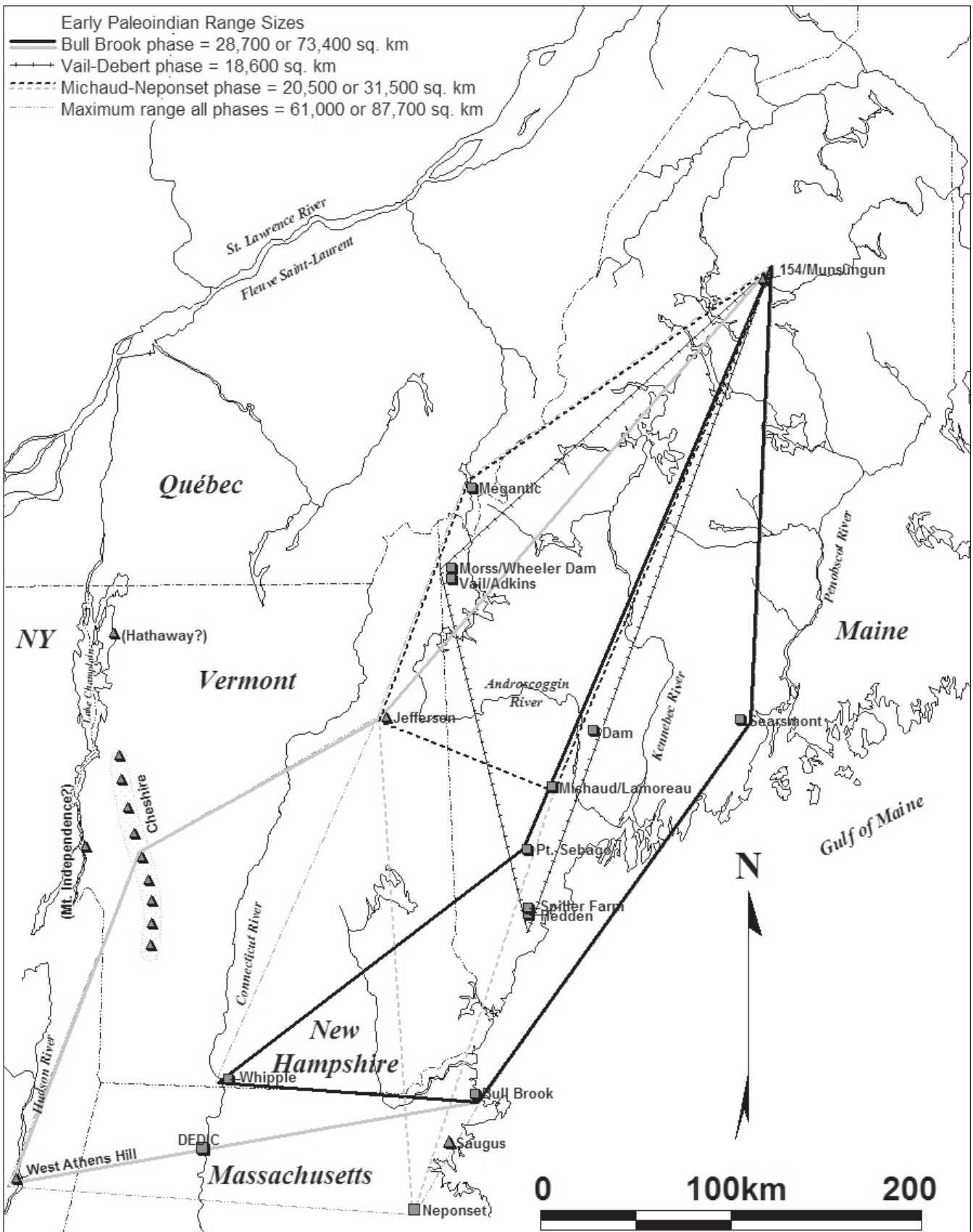


Figure 1. Early Paleoindian sites of northeastern North America used in this study. Squares are occupation sites for which we have raw material use data. Triangles are quarry source areas. Polygons represent the different Paleoindian band ranges or territories discussed in the text.

Sourcing

The data presented here are based on macroscopic or low power (10x-20x) microscopic identifications of tool and debitage raw materials as compared to geologic hand samples from known prehistoric quarries in the study region. These visual identifications are also based on detailed petrographic and field geologic analyses of the raw material source areas in question, namely Munsungun and Jefferson/Mt. Jasper, by geologist Stephen Pollock (Pollock 1987, 1987; Pollock *et al.* 1996, 1999, 1995). The author has also visited all of the quarries pictured in figure 1, collected hand samples from those prehistoric quarries, and done chemical and petrographic analyses on these samples (except the Saugus quarry which has been destroyed by development, Grimes *et al.* 1984). Considerable work still needs to be done on the petrographic and chemical characterization of the raw materials used by Paleoindians in northeastern North America (but see Eley & von Bitter 1989; Hatch & Miller 1985; Janusas 1984; Kuhn & Lanford 1987; LaPorta 1996; Luedtke 1992; Prothero & Lavin 1990; Tankersley 1991; von Bitter 2002). Problems persist for example in the identification by archaeologists of "Lake Champlain" and Ledge Ridge chert (Gramly 1982, 1988; Spiess & Wilson 1989, 1987). The current project on the Bull Brook site undertaken by the author will try to resolve some of these grey areas.

Raw material choices

We agree with Goodyear (1989) that Early Paleoindians focused on high quality cryptocrystalline rocks for the manufacture of their chipped stone tools: bifaces, scrapers, graters and pièces esquillées. They also privileged massive bedrock sources (beds, lenses, large nodules) over secondary deposits. This seems to be particularly true in the case of the glaciated regions of eastern North America (Meltzer 1989). The discovery near Jefferson, New Hampshire, of three Paleoindian sites that use both local bedrock and secondary glacial deposits of rhyolite for tool manufacture is the necessary exception that demonstrates Paleoindian flexibility and adaptability (Boisvert 1999). In addition, local, coarse grained igneous rocks were also used on a systematic basis for larger tools with few flake removals (*e.g.*, scrapers, planes, choppers, core tools). The focus of this study is Munsungun chert, a high quality, lustrous, cryptocrystalline rock. Large blocks can be extracted from the massive bedded chert at the source around Munsungun Lake, Maine, and while it is not always free of imperfections (microveins of quartz, joint sets, less siliceous units), it can regularly produce large bifacial blanks on the order of several decimetres (Bonnichsen [dir.] 1981; Bonnichsen *et al.* 1980; Pollock *et al.* 1999).

Economic models

Paleoindians seem be the exception to the rule in terms of typical fall off or distance decay models used in archaeology (*cf.* Renfrew 1975, 1977). The stone tool assemblages of Paleoindian sites in northeastern North America are regularly dominated by raw materials that come from hundreds of kilometres away (Curran & Grimes 1989; Custer & Stewart

1990; Deller & Ellis 1988; Gramly 1988; Janusas 1984; Meltzer 1989; Storck & von Bitter 1989). Unfortunately this means that the distance decay models probably cannot be applied to look at prehistoric group territories and define boundaries in the same way as we would for later periods (*e.g.*, Ericson 1981; Hodder & Orton 1989; Sampson 1988). This being said, I will assume a somewhat direct and perhaps overly simplistic correlation between areas of high densities of use of a raw material and regional ranges of specific Paleoindian groups. This general approximation approach has been used elsewhere in northeastern North America by various researchers (*e.g.*, Custer & Stewart 1990; Deller & Ellis 1988; Gramly 1988; Smith 1990; Storck & Tomenchuk 1990; Stothers 1996). In order to resolve some of the complexity hidden in the Paleoindian procurement of raw materials I focus below on specific dimensions of the problem in order to break it down into components that might be easier to explain.

Dimension 1: Percentages of raw materials - one bedrock source or more than one source?

First I look at the extent to which a group may be "tethered" to a single source. This is presented in the form of alternate models. I assume that procurement is primarily embedded in subsistence activities and direct, with little or no exchange of raw materials or finished tools.

1a. Tethered to one source

Looking at those sites where Munsungun chert dominates the tool assemblage (>50%) we can see an enormous range in terms of the distances covered by Paleoindian groups from source to site (tabl. 1, fig. 1). At the Bull Brook site, which is 440 km from the Munsungun chert source, 58% of those tools identified to a raw material type come from the Munsungun source. At Spiller Farm, which is 340 km from Munsungun in a straight line, 96% of the tools and 99% of the debitage is made from Munsungun chert! This is noteworthy not just because of the exceptional distance of raw material transport but also because one raw material dominates an assemblage at such an enormous distance from the source. This points rather strongly to direct procurement by a Paleoindian group and not procurement via exchange with other groups. Reliance on exchange for such a large proportion of raw materials and tools would be much too risky for a hunter-gatherer group (Meltzer 1989:17). Furthermore, the long distance exchange of bulk commodities is extremely rare in the ethnographic record. Exchange may in fact be taking place between Paleoindian bands as evidenced by some Munsungun chert at sites like Neponset 505 km away (see also Tankersley 1990). This would reflect Sampson's "gift recycling zone" that corresponds to an area even larger than the maximum lifetime range of a band (Sampson 1988). I do not reject outright the possibility of exchange, but following Meltzer's (1989) detailed analysis of exchange of stone tools and raw materials among eastern Paleoindians, I feel that the data points to direct procurement of the raw materials.

We can expand our sample of sites to include those sites that have at least 25% of the tools made of Munsungun chert (to

<i>In order of distance from the Munsungun source</i>			<i>In order of percentage of Munsungun chert</i>		
Site	Distance km	Percent Munsungun chert	Site	Distance km	Percent Munsungun chert
154-14 Munsungun	7	100	154-14 Munsungun	7	100
154-16 Munsungun	7	100	154-16 Munsungun	7	100
154-17a Munsungun	7	97	154-17b Munsungun	7	100
154-17b Munsungun	7	100	Morss	215	100
Mégantic (QC) a	180	45	Vail Kill	220	100
Mégantic (QC) b	180	23	Pt. Sebago b	310	100
Wheeler Dam	215	81	Spiller Farm b	340	99
Morss	215	100	154-17a Munsungun	7	97
Adkins a	220	36	Spiller Farm a	340	96
Adkins b	220	14	Pt. Sebago a	310	93
Vail Kill	220	100	Wheeler Dam	215	81
Vail	220	77	Vail	220	77
Searsmont	220	28	Whipple (NH)	490	77
Dam a	275	52	Michaud	275	62
Dam b	275	40	Bull Brook I (MA)	440	58
Michaud	275	62	Lamoreau a	275	53
Lamoreau a	275	53	Dam a	275	52
Lamoreau b	275	29	Hedden	340	43
Jefferson I (NH)	295	<1	Dam b	275	40
Jefferson II (NH) a	295	3	Mégantic (QC) a	180	45
Jefferson II (NH) b	295	<1	Adkins a	220	36
Pt. Sebago a	310	93	Lamoreau b	275	29
Pt. Sebago b	310	100	Searsmont	220	28
Hedden	340	43	Mégantic (QC) b	180	23
Spiller Farm a	340	96	Adkins b	220	14
Spiller Farm b	340	99	Jefferson II (NH) a	295	3
Bull Brook I (MA)	440	58	Jefferson II (NH) b	295	<1
Whipple (NH)	490	77	Jefferson I (NH)	295	<1
Neponset	505	1	Neponset	505	1
DEDIC	525	0?	DEDIC	525	0?

Table 1. Early Paleoindian sites and the percentage of Munsungun chert in the stone tool assemblage versus distance from the Munsungun source. Percentages are based on data published in Pollock *et al.* 1999. Pollock's identifications are based on detailed macroscopic analysis supported by extensive comparative geological reference collections from the Munsungun quarries. The values for Munsungun chert include all seven categories of Munsungun chert identified by Pollock. Values for DEDIC and Neponset are from Spiess *et al.* 1998, values for Jefferson I and II are from Boisvert 1999 and personal communication with R. Boisvert. I have calculated the percentages using only those tools and debitage that had a raw material identification, including general categories such as chert or rhyolite. Site names followed by a letter "a" or "b" have both tool and debitage data available, otherwise percentages represent only the tool assemblage: a = chipped stone tools, b = debitage. Values for Mégantic, Québec, refer to table 2. Refer to figure 1 for site locations.

Searsmont with 28% of tools made from Munsungun at 220 km, tabl. 1). At 25% of tools, which one could argue is still a considerable proportion, we have an even larger range covered. While it is unusual for prehistoric groups to rely exclusively or even heavily on one single raw material source, it is possible that Paleoindians did so. After all, the Paleoindian groups of northeastern North America regularly demonstrate no distance decay or fall off in proportions of a raw material from the source. This contradicts the usual economic arguments plotting transport costs versus benefits. If we consider that Paleoindian groups were colonizing the landscape then it is possible that their knowledge of high quality bedrock raw material sources was limited and this could lead to a band concentrating on one high quality bedrock source for its formal chipped stone tools with some local materials being used mostly out of necessity but also for specific functional tasks. At Bull Brook, where a majority of tools were made of Munsungun according to Pollock *et al.* (1999), it does seem as if locally available igneous rocks were used for larger tools such as large scrapers and 'informal' tools (see also Michaud site use of local Christian Hill diabase, Spiess & Wilson 1987).

1b. Two or more sources

Paleoindian groups in our study area of northern New England and southeastern Quebec did not use only one source of high quality bedrock raw material (fig. 1). Despite being dominated by Munsungun cherts, in some cases to the exclusion of other raw materials (>90%), virtually all of the sites in our sample have at least two known bedrock sources represented in the tool assemblage. In fact, during the earliest phase of human occupation of northeastern North America, assumed here to be the Bull Brook-Gainey phase (Spiess 1998), we can see the use of several sources of high quality siliceous rocks from Ohio and Pennsylvania, to New York and Ontario, to Vermont, New Hampshire and Maine. Moreover, these are not limited to cherts. Paleoindian groups regularly used bedrock sources of igneous rocks early on in their adaptation to the Northeast (Saugus, Jefferson/Mt. Jasper rhyolite, and Kineo-Traveller rhyolites), along with crystal quartz and quartzite (Cheshire) (fig. 1).

I think it unlikely that a Paleoindian band would have been "tethered" to one source in particular. The data from sites like

Cliche-Rancourt in Mégantic, southeastern Quebec (tabl. 2), suggest that it might be just as parsimonious to think of a band moving over a large range and using more than one lithic source in an embedded procurement strategy as residential groups moved to the source during an annual round, or as part of logistic task groups sent out from residential sites at short (<50 km?) distances from the source (sensu Binford 1979, 1980). Curran & Grimes (1989) have suggested that we look at the different proportions of the raw materials from known sources as representing seasonal movements away from and back towards the bedrock sources, primarily in a north-south axis. A band that is largely dependent on large herbivores like Caribou would tend to move north in the summer to follow and hunt these animals, and then take refuge further south in the winter. Munsungun would be part of the summer range while Bull Brook would represent the winter habitation site. As a band using the Munsungun source moves away from the source and uses up its materials, these will diminish in proportion, but will still dominate the assemblage. Other materials like Jefferson/Mt. Jasper rhyolite will replace the Munsungun chert as the band moves through the region of northern New Hampshire for example. Curran and Grimes see chert procurement as an "embedded activity or as a task logistically organized from a nearby subsistence station" (Curran & Grimes 1989:62) and I tend to agree with this model.

The Curran and Grimes model is elegant and provides a way of explaining the high proportions of Munsungun chert or Jefferson/Mt. Jasper rhyolite at great distances to the south of these sources. They explain this economically and ethnographically counterintuitive pattern in the data by suggesting that it may be advantageous for a group of hunter-gatherers to focus on one or two high quality sources

because this can actually reduce risk. By redefining costs in terms of risk we can assume that it would in fact be safer for Paleoindians to make most of their tools, especially those for which performance is particularly critical like projectile points, out of the highest quality raw material possible. Local, lower quality materials often from secondary deposits would be used when away from the high quality sources, but only to replace large informal tools where failure in performance may be less catastrophic (e.g., Bull Brook and Michaud sites, Bleed 1986; Ellis 1997; Goodyear 1989). "Groups in transit should, therefore, make only highly selective use of raw materials encountered enroute" (Curran & Grimes 1989:63). It would certainly be simpler in terms of explaining the distribution of raw materials on sites with respect to group territories or ranges if we assumed that one band used one source and that any other minority materials were obtained locally or by exchange (1a). The problem with this model is that we have sites at enormous distances that are dominated by a source and that essentially overshoot other sources known to have been used. Supposed ranges that would be delineated would overlap considerably as the "Munsungun" group would be larger than the "Jefferson/Mt. Jasper" group, at least until we found the next Early Paleoindian site. If we use a 50% cut-off for tool percentages of Munsungun for example we simply narrow the range of our band by removing Searsmont in the east and Mégantic and Adkins in the west. But we might just as easily interpret the lower proportions of Munsungun chert on these sites as related to a specialized logistical site function.

I tend to favour a two or more source model but it also suffers from a lack of resolution in the data. I find it unlikely that prehistoric groups that covered large ranges and who had a highly organized and formalized chipped stone tool

Units G to K from west to east, and 70 to 75 from north to south = 24.5 square meters, materials below 15 cm only						
	Munsungun chert	other chert?	NH rhyolite	quartz	TOTAL	(other, no id.)
Debitage	133	428	9	19	589	(679)
%	22,6	72,7	1,5	3,2	100,0	
channel flakes	4		5			
Tools and tool fragments	Munsungun chert	other chert	NH rhyolite	quartz	other - no id	
	1 fluted point tip	4 bifacial tool frag.	3 fluted point tips	1 bipolar piece	4 bifacial tool frag.	
	1 fluted point base	1 scraper	1 fluted point base	1 used flake	1 sidescraper	
	1 biface preform tip	3 used flakes	1 biface preform	1 chipped tool frag.	1 used flake	
	1 scraper	(1 core - not incl.)	2 bifacial tool frag.			
	15 used flakes		3 scrapers			
	2 used flake/gravers		3 sidescrapers			
	1 graver		3 gravers			
	1 sidescraper/graver		1 used flake			TOTAL
TOTAL	23	8	17	3	6	57
percentage	40,4	14,0	29,8	5,3	10,5	100,0
% without other - no id.	45,1	15,7	33,3	5,9		100,0

Table 2. Raw materials used at the Early Paleoindian Cliche-Rancourt (BiEr-14) site, Mégantic, Quebec. Percentages were calculated using the site catalogue (Chapdelaine 2004, Chapdelaine & Corbeil 2004), personal observation and from personal communication with the site excavators Claude Chapdelaine and Pierre Corbeil. The data used here come from the site area most directly associated with the Early Paleoindian occupation (units G to K from W to E, and 70 to 75 from N to S = 24.5 square metres). I have only included the materials found below 15 cm so as to not include any later materials. There is at least one other occupation at the site which may be Late Paleoindian.

technology would bypass a source of high quality raw material if they knew of its existence. It seems more likely that a group would want to reduce risk by trying to include whenever possible into its north-south range a residential move to a high quality raw material source, or at least a short distance logistical trip to such a source. Paleoindian groups in eastern North America do indeed focus on one high quality source but they also regularly include one or two other high quality sources in their tool kit (papers in Ellis & Lothrop 1989; Tankersley & Isaac 1990). Looking again to Curran and Grimes (1989) we can try to fit the newer sites in our study area into their model of north-south seasonal band movement. This model reconciles the dominant use of one or two high quality sources by a group, even at great distances from these sources, with the complementary use of local lesser quality raw materials. Curran and Grimes (1989) find that the Adkins site does not fit well into their model due to a low percentage of Munsungun chert. From this perspective we could say the same for the Mégantic and Searsmont sites. No model is going to be able to fit all the data perfectly, and we must assume that the organization of Early Paleoindian technology is a complex system affected by several factors not the least of which is the access to high quality raw materials.

Ingbar (1994) has suggested that archaeologists often make simplistic equations between the proportions of a raw material on sites in a region of study and group territories (e.g., "the people of source A & B"). Using three different simulations, he demonstrates how easily the proportions of raw materials can vary from one site to another within a region - and therefore the group territories inferred from these data - simply by changing the number of sources visited, the number of tool use and discard events in between visits to a source, or the degree of logistical or residential mobility of a group (Ingbar 1994). Ingbar's analysis is sobering and clearly invites caution when reconstructing territories or ranges of prehistoric groups based on lithic raw material proportions. To resolve this issue and the problems encountered in our discussion of Dimension 1 (one bedrock source or more?), we need a greater number of detailed and holistic analyses of the organization of Northeast Paleoindian stone tool technology, paying specific attention to the type of raw material in use. Since Goodyear (1989), and even earlier (e.g., Wilmsen 1970), archaeologists have paid particular attention to the portable and flexible nature of Paleoindian toolkits in combination with the use of high quality cryptocrystalline siliceous rocks. This has produced an important body of theory and method that forms the foundation of this paper (cf. Ellis & Lothrop 1989; Tankersley & Isaac 1990).

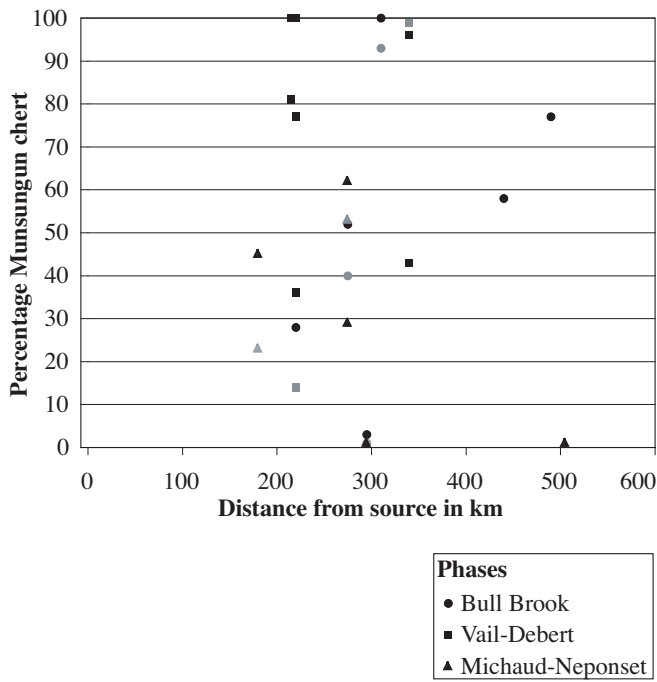
We now need to move towards a rigorous analysis of specific reduction sequences that are linked to specific raw materials. This is analogous to the French chaîne opératoire approach which looks at the complete reduction sequence from the raw material quarry source and workshop to the final product including use, curation and recycling of tools (e.g., Boëda 1994, Pelegrin 1995). More importantly, these reduction sequences are usually defined according to each specific raw material used. Spiess & Wilson (1989) attempted to separate out the different "life histories" of tools made of

different raw materials found at the Michaud site in order to address questions of group territories and logistical versus residential mobility. Unfortunately this is only one site and the analysis needs to be done in a similar manner on several sites at the regional level in order to reconstruct the complete organization of Northeast Paleoindian stone tool technology. A recent article by Jones *et al.* (2003) also provides a useful example of this regional approach to hunter-gatherer territories which is based on understanding the complete life history of tools used by Paleoarchaic groups in combination with the accurate chemical sourcing of the raw materials used. There is another dimension which we have not mentioned yet and which is probably critical to the resolution of many of the problems raised above: the dimension of time, or the differences through time of the various raw materials used on sites in the region.

Dimension 2: Time - separating out phases or groups?

As is often the case in archaeology, the ability to control for time, or temporal resolution, has a lot to do with how successful our interpretations of the data are. Conflating sites into a period centuries long hides diachronic patterns. This is especially true of the patterns that operate at the generational and even annual scale such as group territory and mobility. In the case of the Early Paleoindian period described here (approx. 10.800 to 10.200 radiocarbon years BP) we can actually subdivide the time span into three subperiods or phases: Bull Brook, Vail-Debert, and Michaud-Neponset (following Spiess *et al.* 1998). This allows us to look at the dimension of time and how it may affect our interpretations of raw material use and group ranges, and ultimately, we hope, group territories and mobility. Taking the raw material proportion data and dividing it into the three phases, we can now look at changes that might take place over time. More importantly it allows us to evaluate the stability, visibility and ethnographic reality of the ranges that are apparent from the archaeological data.

Table 3 and figures 1 and 2 show the site raw material proportions and ranges for the three different phases. A couple of patterns are worth pointing out. In terms of continuity or stability of the ranges as defined by raw material use, we can see that the large geographic scale persists. There is a definite north-south tendency to the ranges as well, and they are all centered on western Maine, southeastern Quebec, New Hampshire and northeastern Massachusetts. Coastal use is not necessarily consistent from one phase to another. The continuity in use of the bedrock quarry sources is very real, however. This is worth noting because the bedrock sources of high quality lithic raw material are fixed resources and therefore did not change throughout the Early Paleoindian period as opposed to the exceedingly dynamic nature of the climate and faunal/floral resources at the end of the Pleistocene and the beginning of the Holocene. We should keep in mind that some important bedrock sources may have been more or less available depending on fluctuating lake levels such as Hathaway on Lake Champlain (see also Kettle Point on Lake Huron, Janusas 1984). It is intriguing to point out that the



Site	Distance km	Percent Munsungun chert	Phase
Searsmont	220	28	Bull Brook?
Dam a	275	52	Bull Brook?
Dam b	275	40	Bull Brook?
Jefferson II (NH)	295	3	Bull Brook
Jefferson II (NH)	295	1	Bull Brook
Pt. Sebago a	310	93	Bull Brook
Pt. Sebago b	310	100	Bull Brook
Bull Brook I (MA)	440	58	Bull Brook
Whipple (NH)	490	77	Bull Brook
DEDIC	525	0?	Bull Brook
Morss	215	100	Vail-Debert?
Wheeler Dam	215	81	Vail-Debert?
Vail Kill	220	100	Vail-Debert
Vail	220	77	Vail-Debert
Adkins a	220	36	Vail-Debert
Adkins b	220	14	Vail-Debert
Spiller Farm a	340	96	Vail-Debert
Spiller Farm b	340	99	Vail-Debert
Hedden	340	43	Vail-Debert
Debert NS	450	0	Vail-Debert
Mégantic (QC) a	180	45	Michaud-Neponset
Mégantic (QC) b	180	23	Michaud-Neponset
Michaud	275	62	Michaud-Neponset
Lamoreau a	275	53	Michaud-Neponset
Lamoreau b	275	29	Michaud-Neponset
Jefferson I (NH)	295	1	Michaud-Neponset
Neponset	505	1	Michaud-Neponset

Figure 2 and Table 3. Percentage of Munsungun chert in the stone tool assemblage versus distance and separated by Early Paleoindian phase. Percentages are as in table 1. Symbols in grey are the debitage values ("b" values in table 1)

fixity of the quarries allows us to think of inter-generational knowledge of a resource and a technology, a temporal scale not easily seen in Paleoindian studies.

What are the patterns of change that might be visible if we look at the three phases separately and how do these compare to the data presented in Dimension 1? Assuming a temporal sequence from Bull Brook (oldest) to Vail-Debert (intermediate) to Michaud-Neponset (youngest) we can see that there seems to be a reduction in the maximum distance covered from source to site over time (490 km to 340 km to 275 km). This does not include those sites that have less than 2% Munsungun (dashed lines). There may be a narrowing of the ranges in the east-west dimension over time, but this depends largely on one site, Searsmont. Group movements seem to go further to the northwest and the interior over time which may reflect an improving environment in northwestern Maine and southeastern Quebec following deglaciation. This shift to the west is possibly reflected in a shift in raw material use as Paleoindians use less Munsungun and progressively use more Jefferson/Mt. Jasper rhyolite. Overall it is safe to say that there is a trend towards a smaller range. The ranges defined by the closed polygons can be interpreted as the maximum geographic area used over several generations (200-300 years?) by a band. The ranges shown in figure 1 (28,700 km², 18,600 km² and 20,500 km²) are all within the norm of Boreal forest hunter-gatherers, particularly if we consider that they represent several generations of land use (Custer & Stewart 1990; Kelly 1983, 1992). Interestingly, these ranges are close to the ranges proposed by Storck and Tomenchuk (Storck & Tomenchuk 1990: 82-85) for Paleoindian bands in southern Ontario and Jones *et al.* (2003) in their study of contemporary Paleoarchaic groups in the Great Basin.

It is possible to look at the reconstructed ranges according to Early Paleoindian phase in a different way. What if we assume

that there are in fact two bands that were adjoining and which probably overlapped on a regular basis? This overlap could take the form of individuals changing band membership or simply bands having access to resources in another band's typical or repeated exploitation range, both of which are common occurrences among hunter-gatherers. This assumes contemporaneity between Vail-Debert and Bull Brook phase sites. It is important to note that Vail-Debert points remain in an uncertain temporal position within the Northeast Early Paleoindian sequence (Spiess *et al.* 1998:235-236). When looking at the distributions of sites in Figure 1 and the ranges, a separation between east and west polygons or groups is apparent. One has to ask the obvious question: is this a temporal change in projectile point style or a subtle difference in contemporaneous fluted point styles among neighbouring bands? This alternate interpretation implies that we should eventually find more recent sites of the Michaud-Neponset phase in the eastern Bull Brook range. In principle it should be possible to test these alternate hypotheses as our database improves in terms of sites and radiometric dates.

Looking to the southern extent of our study area (Massachusetts), we can assume that sites like DEDIC and Neponset are outside of the range of a band using Munsungun chert due to the very low proportion of Munsungun chert. How do we then interpret this data in terms of the temporal distinctions (phases)? The Neponset site, with its high proportions of Jefferson/Mt. Jasper rhyolite (95%) and low proportions of Munsungun chert (1%) (Spiess & Wilson 1987:131), could represent the development over time (Vail-Debert to Michaud-Neponset phase) in the western group of two distinct bands: a northern band focused on Munsungun (Mégantic, Michaud, Lamoreau), and a southern band focused on Jefferson/Mt. Jasper (Neponset). These bands would obviously overlap and the Jefferson/Mt. Jasper source would

probably be used regularly by the northern group as well as the southern group. This could be an interesting hypothesis to test but the number of sites for the Michaud-Neponset phase is slim especially as compared to the geographic area covered.

Earlier sites and phases like Bull Brook are harder to interpret and we have to consider the factors related to being the first colonizing populations or "pioneers" in the study area (Dincauze 1996). Bull Brook has a high proportion of Munsungun chert based on Pollock's visual identification of the raw materials. Tankersley has demonstrated a clear pattern for the mid-continental US that shows older Paleoindian sites with sources to the west at huge distances, and later Paleoindian sites with sources to the west and east that are closer indicating that the earlier "pioneer" groups can be distinguished based on the distance and direction of non-local lithic materials (Tankersley 1990). This does not seem to be the case for the Bull Brook phase sites if we consider them to be representative of first arrivals in New England. Some of the grey and black cherts at Bull Brook may in fact be from the West Athens Hill Early Paleoindian quarry in eastern New York (fig. 1, Funk 1973). Recent macroscopic and lower power (25x) microscopic analyses by the author of the West Athens Hill Paleoindian quarry materials at the New York State Museum indicate that several tools and debitage at the Bull Brook site originate from the West Athens Hill quarry. Therefore, Bull Brook may have significant amounts of raw material from areas to the west (West Athens Hill), but it also has a significant proportion of materials from the north (Jefferson/Mt. Jasper & Munsungun) which does not match Tankersley's model for expanding colonizing groups.

Analyses of the Bull Brook collections are ongoing but they point once again to the unique character of the site (Dincauze 1996; Grimes 1979). Its large size and numerous concentrations, and now the mix of raw materials from several directions and covering a massive territory much bigger than the other ranges we have seen (dashed line, up to 73.400 sq. km), may point to the fact that Bull Brook was in fact a large aggregation site for two or more bands and that these bands overlapped in eastern Massachusetts. One band would have a west-east axis from the West Athens Hill chert source in eastern New York to DEDIC, Whipple and Bull Brook. This group would also use the Saugus source and possibly Cheshire quartzite in Vermont (Cheshire is present at the Whipple site and the bedrock source is less than 70km away, Curran 1984). The sites in Massachusetts also regularly have raw materials from further south and west such as Pennsylvania jasper. We assume here based on my initial analyses that some of the chert identified at Bull Brook as Munsungun is in fact chert from eastern New York. This will have to be tested more precisely in the next phase of our research on Bull Brook. The second band would have a north-south axis from the Munsungun chert source in northern Maine to Searsmont, Dam, Point Sebago and Bull Brook. This band would also use the Jefferson/Mt. Jasper rhyolite source on occasion.

Eventually these hypothetical band territories or ranges should be defined in terms of other neighbouring band ranges.

To the west, in the Champlain Valley of New York, Vermont and southern Quebec, there are a few Paleoindian sites and at least three sources of bedrock lithic raw materials: Cheshire quartzite, Mt. Independence and other Clarendon Springs chert outcrops, and Hathaway chert (fig. 1). Unfortunately there is little evidence of Paleoindian use of these raw materials at the sources themselves and the Hathaway source may have been underwater at the time of Early Paleoindian occupation. To the east, east of Searsmont, Munsungun, and the Penobscot River, there are no Early Paleoindian sites other than those around Debert, Nova Scotia, more than 400 km away, and some isolated surface fluted point finds (Bonnichsen *et al.* 1991; MacDonald 1968). If 400 km is near the limit of the ranges we have been looking at, then the Debert band is the easternmost band of Early Paleoindians in the Northeast. A recent macroscopic analysis of the tools from the Debert site by the author indicates that the tools are overwhelmingly made from cherts that originate in the local Mesozoic formations of the Minas Basin approximately 70 to 110 km distant. Unfortunately, most of these outcrops are underwater today (Greenough 1995).

Problems with the data, or future research areas?

Some problems are evident in our data but they are also intriguing. For example, we have almost no data for sites within a 200 km radius of Munsungun. The discovery in the summer of 2003 of the Cliche-Rancourt site in the Mégantic Lake region of southeastern Quebec (fig. 1, Chapdelaine 2004) was a welcome surprise. Not only is this the first fluted point site to be found in Quebec but it is also relatively close and intermediate to our two major northern sources of high quality raw material: Munsungun, Maine, 180 km to the northeast and Jefferson/Mt. Jasper, New Hampshire, 125 km to the southwest. It is not coincidental then that the site contains tools and debitage made of both sources (tabl. 2, based on the author's personal macroscopic observation of the assemblage and confirmation by C. Chapdelaine, R. Boisvert and P. Corbeil). This being said, it is a handicap for us not to have sites within 180 km of the Munsungun source other than the quarry related workshop sites immediately surrounding Munsungun Lake. This problem may not be resolved soon either since the area encompassed within the 180 km radius of the Munsungun quarries which includes Maine, Quebec and New Brunswick, is largely forested, has few roads and is undeveloped. The author's field experience in this region demonstrates that site visibility is generally low with the exception of quarry related sites like those at Munsungun, Témiscouata (Quebec), Tobique (New Brunswick), and Mt. Kineo (Maine) (Bonnichsen [dir.] 1981; Bonnichsen *et al.* 1980; Burke 2000; Burke & Chalifoux 1998; Hamilton *et al.* 1984; McGuire 1908).

Most of the major quarry source areas in the Northeast like Munsungun, Jefferson/Mt. Jasper and West Athens Hill still require further excavation to better understand the process of extraction and initial reduction-manufacture. In addition, while it is generally true that "exotic" or non-local materials are rare on quarry sites, they do exist. In fact, my experience on later prehistoric quarries such as La Martre and Témiscouata

in Quebec, Flint Mine Hill in New York, Tobique in New Brunswick, and Munsungun in Maine shows that it is not unusual to find tools made of non-local materials, especially on the nearby workshop or production sites (Gramly 1980). The sheer volume of local material will always eclipse any non-local material when calculating percentages of raw materials at a quarry site, but we need to look more closely at nearby Early Paleoindian workshop sites, like the King's Road site near West Athens Hill (Funk *et al.* 1969). I believe this will demonstrate that the quarries are part of a more complex organization of stone tool technology based on the use of several raw material sources. This data can then be used to address the issue of embedded versus logistical procurement (cf. Spiess & Wilson 1989). Unfortunately, I have had to deliberately minimize some of these key aspects of the settlement-subsistence system, such as differing site functions, which must have affected stone tool use and lithic economies. Even if we assume that Paleoindians were primarily foragers, we must assume that they had sites with special functions other than the quarry workshop sites (e.g., meat, raw material and tool caches [Gramly 1988; Storck & Tomenchuk 1990; Tankersley 1991] and hunting stands and kill sites [Gramly 1982]).

Summary and Conclusions

The Paleoindian period of North America remains fascinating in terms of its chipped stone tool technology and use of raw materials. While the site data presented here seems sparse in terms of the huge geographic area and time span being considered, regular patterns do emerge that suggest that the meagre data available do indeed reflect behaviours that took place over enormous distances within a period of several generations. I have looked at the spatial and temporal aspects of Early Paleoindian raw material use and band ranges along two different dimensions: the use of one or several sources, and the diachronic aspects of changing or shifting ranges. Both dimensions are hard to resolve in a satisfactory fashion but some hypotheses that I hope will be useful to researchers have been put forward. Dimension 1 will have to be resolved by using a holistic approach to the organization of stone tool technology, one that starts at the quarry source, proceeds to define the reduction-production sequence(s) for a specific raw material, and follows this toolstone through its life from use to curation to recycling to final discard at a site. For this we find our inspiration in the chaîne opératoire approach that has proven so useful in Palaeolithic studies of lithic technology and territory. Dimension 2 is a more typical and universal archaeological problem of taxonomy and chronology. We will probably have to wait until we have more sites with radiocarbon dated features in order to see if the ranges we have reconstructed represent a change through time or synchronous ranges of groups with different styles of fluted points. Only time will tell!

The success of any future research into Paleoindian territory and mobility based on raw material economies will rely on the continued accurate sourcing of the raw materials. The macroscopic identifications used for this analysis and the interpretations made based on these identifications feel at times like a house of cards, even when they are based on extensive comparative geologic reference collections and thin section petrographic analyses. It is imperative therefore that we expand research into both destructive and non-destructive methods of chemical and physical characterization of raw materials. This will have to involve the destructive analysis of some portion of the archaeological materials if we are to find a way out of the interpretative traffic circle we are currently in. I am just one of the latest to jump into the traffic, and I expect to stay here for a while until I find my way out. A detailed analysis of the Bull Brook lithic raw materials in collaboration with geologist Stephen Pollock using chemical characterization and thin section petrography is currently underway. This will provide part of the answer but one site is not sufficient and the hypotheses proposed will require a regional approach. If we combine this sourcing data with improved temporal control and with careful analyses of the separate reduction sequences from site to site for the different raw materials using a chaîne opératoire methodology we can gain greater insight into what was going on during this unique and fascinating time of North America's human history. Paleoindians continue to be the exception to the rule in many cases. They have no close modern or historic analogue for the environment they lived in, the territorial organization of their hunter-gatherer bands, and they do not follow the economic rules of distance decay. Rather than being a handicap, this may in fact provide the impetus for archaeologists to develop archaeological models *sui generis* (i.e., internally-inductively, based primarily on archaeological data), just as the lack of modern analogues for Neanderthals has not hampered research on territories and adaptation but rather has posed an interesting challenge to archaeologists.

Acknowledgements. Thank you to Pierre Chalard, Hélène Martin and Ariane Burke for inviting me to participate in their session at the annual meeting of the European Association of Archaeologists in Lyon, France, September 2004. Thank you to Brian Robinson for asking me to collaborate on the Bull Brook project, which is supported by a grant from the National Science Foundation (BCS 0352918). I was also fortunate to receive a travel grant from the Faculté des arts et des sciences of the Université de Montréal to attend the EAA conference in Lyon. I would also like to thank archaeologists Claude Chapdelaine, Pierre Corbeil, Arthur Spiess, and Richard Boisvert for sharing their thoughts and opinions on the sites presented, and geologist Stephen Pollock for laying the solid "bedrock" foundation for this and future studies. I take full responsibility for any manipulations of the data produced by these researchers.

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