Climate and Aboriginal Adaptation in the South Saskatchewan River Basin, A.D. 800-1700

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Abstract

Climatic variability was the principal cause of cultural changes in the SSRB and the Northern Great Plains during the late prehistoric period. During the benign conditions associated with the Neo-Atlantic Climatic Episode (A.D. 900-1200), the SSRB and surrounding grasslands were relatively stable with regard to human occupation. During the same period, populations in the adjacent woodlands, particularly to the east and southeast of the SSRB, underwent an extended period of cultural change and expansion as a consequence of longterm improvement in climactic conditions.

In regions surrounding the SSRB, the climatic deterioration associated with the Pacific Climatic Episode (A.D. 1200-1550) drove many woodland groups to the relative stability of the SSRB and northern Great Plains. Southeast of the SSRB, protracted desiccation prompted a region-wide abandonment of agriculture and a shift toward bison hunting. As conditions worsened during the Neo-Boreal Climatic Episode (A.D. 1550-1850), migrations to the SSRB from the woodlands to the east continued. Competition for resources, particularly bison, increased as groups originating south of the 49th parallel shifted their focus northward to the SSRB. Although long-term temperature decline and protracted drought undoubtedly reduced the biomass and available food supply in the SSRB, the impact of declining conditions in the regions surrounding it were much more severe.

For more than 500 years after A.D. 1200, the SSRB and vicinity served as a relative refuge for groups experiencing climatically-driven environmental stress. The dynamics of those migrations, undertaken during a period of protracted hardship is essential to the understanding of both climatic adaptation and tribal occupation of the SSRB and the northern Great Plains generally.

Introduction

Cultural change in the prehistoric societies of the SSRB and adjacent areas was directly related to the nature of long-term climatic trends. Until the arrival of Europeans, climactic stimuli were the primary factors shaping the development of pre-contact indigenous communities. Because of the primacy of climate as a force in the adaptation of tribal communities, the elements comprising the "Anatomy of Adaptation to Climate Change and Variability" (Smit et al 2000), are in many ways more obvious than in historic or contemporary societies, where external or human factors cloud the relationship between climatic stimuli and adaptation.

Measuring material and cultural changes in prehistoric indigenous peoples becomes possible owing to a careful consideration of the existing scientific literature on climactic variability patterns and archaeological records that reconstruct the patterns of habitation in the SSRB from approximately A.D. 900 to the beginning of the historic record at the end of the 17th century.

Prior to A.D. 1500, the consideration of climatic change is made at the level of global climate, the broadest of the temporal categories identified by Smit et al (2000:231). As such, central tendencies, or long term climatic trends are considered because variability at more precise intervals has yet to be identified in the scientific literature. However, this limitation does not prevent a cogent analysis of the changing pattern of human adaptation to climatic stimuli on a large-scale regional level. Although the archaeological data available for the SSRB before A.D. 1500 is limited, it still allows for the identification of major cultural changes, particularly the widespread trend of westward migration from woodlands toward grasslands. From this pattern a better understanding of adaptive human responses to climatic stimuli is possible.

After A.D. 1500, the use of proxy records (Case and MacDonald 1995; Sauchyn and Skinner 2001) and historical reconstructions (Quinn et al 1987) increase the precision of data regarding phenomena such as droughts and ENSOs to the "variability" level within long-term climatic trends identified by Smit and his colleagues (2000:231). The improved scientific data after A.D.1500 allows the reconstruction of climatic variability at the decadal level, and increases our understanding of the interaction of forcing mechanisms such as volcanic activity, ENSO wind occurrences, and solar irradiation on climatic phenomena such as drought periods in the SSRB. Evidence of cultural change in the SSRB and vicinity also improves after A.D. 1500. The integration of the scientific literature on climatic stimuli with that from anthropology provides a more detailed picture of the interaction of climate and human communities in the late prehistoric period.

Linking Archaeological Evidence to Historical Communities

Reconstructions of climatic stimuli answer one of the fundamental questions raised by Smit et al. (2000:229) in their anatomy of adaptation, namely "adaptation to what?" The second factor identified in the anatomy of adaptation, "who or what is adapting?" is not immediately self-evident in the prehistoric period. Although human communities have

inhabited the SSRB and the northern Great Plains for more than 11,000 years, the connection between prehistoric societies, identified through the analysis of archaeological remains, and historic and contemporary First Nations is neither readily apparent nor free from dispute.

Uncovering the link between prehistoric and contemporary societies in the SSRB is critical to understanding the impact of climatic change on the development of aboriginal communities. The prehistoric population of the SSRB did not simply react to climatic stimuli.

Practices that developed in prehistory and continued into the historic period, namely the non-exploitation of beaver and the employment of non-disruptive bison hunting practices, served as anticipatory adaptations to climatic variability, particularly to drought (Morgan 1979, 1991). These practices and prohibitions allowed pre-equestrian aboriginal communities in the SSRB to withstand protracted droughts as their residence pattern centered on the tributaries of large waterways for long periods of the year (Morgan 1979; 1991). Because their forays into the open grasslands were limited to brief hunting expeditions during periods when the herds were congregated in large numbers, they were without access to dependable water and wood supplies for long periods.

During severe drought episodes, when the productivity of forage in the grasslands was undermined by the lack of moisture, bison herds tended to remain near available water sources. Thus, pedestrian communities were able to reduce their summer travel requirements as their food source came to them. Groups that functioned within sustainable thresholds of adaptation to climatic variability on the SSRB endured; others, particularly groups on the eastern margins of the plains who depended on territorial animals such as deer, whose populations declined in relation to habitat degradation brought on by negative climate stimuli, were not able to overcome their vulnerability to climatically induced stress. The result was a region-wide abandonment of woodland areas and migration to the grasslands and the adoption of bison as a staple food.

Beginning in the 13th century, the SSRB and adjacent areas became a desirable destination for populations from other areas seeking refuge from climatically-driven habitat decline. The descendents of those who undertook that migration were important participants in the historical development of the SSRB. Many of them remain in the region to the present.

The importance of bridging the gap between prehistoric, historic and contemporary indigenous populations is also critical to the understanding of long-term adaptations to climatic change in the SSRB. The linking of archaeological and contemporary populations illustrates the methods by which communities adapted to shifting climatic regimes. The connection between prehistoric and existing populations however, remains a subject of debate.

J.R. Vickers attributed the difficulty of relating prehistoric and contemporary populations to both limited data and the inconsistency of its interpretation in the field of archaeology.

He added, "none of the current models [of cultural change in the prehistoric] can be demonstrated to be other than guesses" (1994:33). In the SSRB and in the Canadian plains generally, one thing was a certainty however; the yearly cycle of humans following bison herds from the plains in summer to sheltered areas in the parklands or wooded areas from the fall to the spring was essentially an unchanging and unchangeable phenomenon:

> This then must serve to approximate the human-land relationships for the past two thousand years. No matter what the coming and going of archaeological phases or historic tribes, all must have constructed their adaptation to the seasonal availability of resources. Deviation from the seasonal round outlined here would seem impossible for a hunting people on the Northwestern Plains. Climatic change may have advanced or retarded the schedule of resource exploitation slightly, but the basic adaptation must have remained constant (Vickers 1994:6).

Vicker's assertion reveals several truths about human adaptation to the climate and environment of the SSRB. First, human communities relied primarily on bison herds for their subsistence. Other resources were undoubtedly used as a supplement but bison remained the staple food of the plains for millennia. Second, archaeological groups who participated in the seemingly endless cycle of bison predation changed over time.

Although changes in material cultures did not always signal changes in the in the ethnic identity of their makers, it is certain that different ethnic groups occupied different regions of the plains over time. Third, climatic change over thousands of years would have modified the annual movement of the herds and the human populations that hunted them, though as Vicker's stressed, "the basic adaptation must have remained constant" (1994:6).

Climatic change was a significant, if not the dominant, force in determining which prehistoric and historic communities maintained the chain of predation of bison in the SSRB. The cycle was ultimately broken only in the last half of the 19th century, when wild herds became extinct. The ensuing malnutrition coupled with poor living conditions led to a devastating outbreak of tuberculosis among First Nations people in western Canada. Coming as it did in the wake of the extermination of the bison, the catastrophic health consequences suffered by the indigenous population stands as a grim testament to the impact of the severing of the millennia old relationship between humanity and the bison on the plains (Daschuk 2002).

Although climate has been the central factor governing human occupation patterns in the SSRB since the arrival of people at the end of the last glacial period, a survey of paleoclimate and ancient populations prior to A.D. 900 is beyond the scope of this discussion (for a discussion of Holocene paleoclimatology in the SSRB, see Velez 2004). The consideration of the interrelationship of climate and human adaptation in the late prehistoric period illustrates the primacy of climate stimuli to human adaptation on a regional scale in the SSRB and the Northern Great Plains before the arrival of Europeans.

Because human adaptations were made in response to, and in anticipation of, the exigencies of climatic variability rather than external forces such as markets, the adaptations practices of prehistoric communities in the SSRB may have been reliable and efficient than those of groups who occupied the region in later times.

The Neo-Atlantic Climatic Episode and Archaeological Change in the SSRB, A.D. 900-1200

In the 1960s, two pioneers of climatic history, Reid Bryson and Wayne Wendland designated the period from A.D. 900 to 1200 as the "Neo-Atlantic Climatic Episode" (Bryson and Wendland 1967). During this time, global climatic patterns, the central tendencies of weather conditions or "mean" temperatures (Smit et al. 2000: 231), underwent a long term period of warm temperatures and adequate precipitation.

This period has also been variously described as the "Climatic Optimum" and in Europe as the "Medieval Warm Period," and coincided with Norse expansion into Iceland and Greenland (Fagan 2000; Beaudoin 2003:10). Bryson and Wendland described the general effect of the Neo-Atlantic Climate Episode on North America:

> (O)pen water appeared in the Canadian Arctic Archipelago, the tree-line re-advanced into the tundra, summer rains extended farther into the southwest and corn-farming became practical across the Great Plains. Glaciers disappeared from the U.S. Rockies. These evidences suggest weaker westerlies and more meridonal [southerly] circulation. The boreal forest probably expanded both south and north, while prairies shifted west at the expense of the steppe (1967:294)

If climatic conditions of the Neo-Atlantic for western North America were summarized in a single word, it would be "benign" (Meyer and Hamilton 1994:112). Temperatures were warm, and moisture levels increased from the arid Scandic Climatic Episode that preceded it (Gregg 1994:78).

Michael Gregg noted that the Neo-Atlantic was marked by an increase in both biomass[1] and human populations across western North America. Warm temperatures and ample precipitation abetted plant growth. The augmented volume of vegetation led to an increase in the herbivore populations. This in turn allowed a larger human population to prey on the expanded supply of animals. The expanded resource base coupled with a larger human population exploiting it, resulted in major changes to prehistoric cultures in western North America.

The abundance of food and other resources, created an extended period of innovation and expansion, particularly in the woodland areas east of the SSRB. In the SSRB itself, the Neo-Atlantic brought centuries of resource and cultural stability. Although the region remained, as ever, subject to drought (Beaudoin 2003:28) the inhabitants of the SSRB could rely on the cyclical nature of the bison hunt. Archeological evidence indicates that cultural change during the period, was gradual and without intrusion from other regions

(Peck and Hudecek-Cuffe 2003:90). In contrast to later periods, this period marked a time of cultural stability and relative climatic predictability in the SSRB.

At the beginning of the Neo-Atlantic, the inhabitants of the southern plains of Saskatchewan and Alberta, the core region of the SSRB, were represented by only two distinct populations, the Besant archaeological phase and the Avonlea phase.[2] A third phase, Old Woman's, may have developed from Besant, Avonlea, or both between A.D. 500 and A.D. 800 in southern Alberta (Peck and Hudecek-Cuffe 2003: 90). They all relied on the bison for their subsistence, although Avonlea sites on the northern margins of the plains indicate a diverse food base, including fish, waterfowl, moose, elk and beaver as a supplement to bison (Peck and Hudecek-Cuffe 2003: 81).

The Besant people were spread across the western plains and parklands. They primarily used atlatls (spear throwing sticks), pounds and jumps in their bison hunting strategies (Vickers 1994:13; Peck and Hudecek-Cuffe 2003: 74). They were well-adapted to dry conditions. Their origins are unclear, they may have developed within the SSRB or they may have migrated north from the in the arid country of Wyoming (Frison 1978 in Vickers 1994: 3).

In his environmental history of the northwestern Great Plains, Ted Binnema noted that the atlatl technology used by the Besant people was well suited to the undulating country of the western plains, including the upper SSRB. The bow and arrow technique, introduced to the Canadian plains by the Avonlea people was better adapted to the flatter and drier central prairies. (2001:63-64). On the open plains, hunters required the ability to take down prey from greater distances than the inhabitants of the hilly country in the western SSRB. The Besant people were probably more numerous than Avonlea. Besant sites are three times more numerous than those producing Avonlea materials (Vickers 1994). The distribution of both Besant and Avonlea sites was equally extensive, though not identical, through the SSRB (Peck and Hudecek-Cuffe 2003:78).

As the Neo-Atlantic brought more mesic (humid) conditions to the plains, a new phase, the Old Woman's phase, expanded in the SSRB and persisted until well into the 18th century. Rather than the replacement of one population with another, the shift from Besant to Old Woman's was probably the result of the adoption of new technologies. According to Vickers, the "most parsimonious explanation" of the shift is that Old Woman's is "Besant with bows" (1994:22).

The gradual nature of its rise in the SSRB, led Peck and Hudecek-Cuffe to conclude that Old Woman's represented an in situ development from Besant, Avonlea or both, rather than the intrusion of a culture from another region (2003: 90). While archaeological evidence indicates relative stability with regard to human occupation of the SSRB, the period between A.D. 900 and A.D. 1350-1450 was marked by greater drought severity than the period that followed it (Sauchyn and Beaudoin 1998:343). Climate in the SSBR may have been more prone to drought at this time but human communities in the region were well adapted to dry conditions, living within their means in an arid environment.

Although the territory occupied by the Old Woman's tradition shrank as new groups poured in after the end of the Neo-Atlantic, their culture persisted into the historic period. Old Woman's is widely acknowledged to be the prehistoric manifestation of the historic Blackfoot culture (Vickers 1994: 28). After A.D. 1300, Old Woman's sites were most frequent between the branches of the Saskatchewan River west of the present location of Saskatoon. In fact, the Old Woman's-Blackfoot occupation of the SSRB represents the longest continuous occupation of the SSRB of the past thousand years.

The Avonlea phase coexisted with the Old Woman's phase in the SSRB for as long as 500 years (Peck and Hudecek-Cuffe 2003:83). Avonlea first appeared in Alberta and southern western Saskatchewan between A.D.150 and 250. Avonlea people expanded their territory southward into Montana, westward into the Rockies and northeast to the margins of the boreal forest. (Vickers 1994).

About A.D.1150, Avonlea occupation of the western SSRB began to decline and was eventually replaced by the Old Woman's phase (Peck and Hudecek-Cuffe 2003: 83). By A.D. 1400, the Avonlea occupation of the SSRB terminated (Schlesier 1994:313). Their disappearance coincided with the long-term deterioration of climate during the Pacific Climatic Episode between A.D. 1200 and 1450 (Bryson and Wentland 1967) and may have been the consequence of in migration by other groups into the SSRB during the period, particularly that of the Mortlach phase from the east (Peck and Hudecek-Cuffe 2003:85).

Developments in the woodlands east of the plains during the Neo-Atlantic had profound implications for the eventual cultural makeup of the SSRB. A new ceramic tradition, known as Blackduck, emerged in central Minnesota about A.D. 800. Within two hundred years, the Blackduck complex[3] had spread from the St. Lawrence-Great Lakes forest region east of Lake of the Woods northwest to the Interlakes of Manitoba and eventually to the Assiniboine River (Gregg 1994; Meyer and Hamilton 1994).

David Meyer and Scott Hamilton attributed the northward expansion of the Blackduck and Laurel complexes to the improved environmental conditions experienced during "this benign climatic episode" (Meyer and Hamilton 1994:112). By the end of the Neo-Atlantic in the mid 13th century, Blackduck sites were common throughout western Manitoba and extended east to Lake Superior. In northern Ontario, Blackduck persisted until the mid 15th century (Meyer and Hamilton 1994:117).

Woodland groups southeast of the SSRB in the American mid-west who practiced a mixture of horticulture, hunting and gathering also expanded their territory during the Neo-Atlantic episode. There was a clear connection between the improved climate of the Neo-Atlantic and the fluorescence of mixed economies based on hunting, gathering and agriculture.

According to Gregg, "(m)esic conditions enabled the spread of corn gardening and promoted the increase in the overall biomass which enhanced the productivity of hunter-gatherers." (1994:83). In South Dakota and Iowa, the Great Oasis Complex produced a

number of horticultural villages including those known as the Mill Creeks sites (Gregg 1994:85; Bryson and Murray 1977). The archaeological assemblages of these communities bore strong affinities to the highly urbanized Cahokia Culture at the confluence of the Missouri and the Mississippi, near the present City of St. Louis, Missouri (Gregg 1994:85; Emerson 1997).

By A.D. 1000, the Hidatsa and the Mandan established "a semi-sedentary, horticultural way of life in the Middle Missouri Region" (Winham and Lueck 1994:159). The doyen of Middle Missouri archaeology, W.R. Wood, stressed the connection between the favourable climate and the establishment corn horticulture in the region, "(i)t is surely no accident that the initial variant makes its appearance on the Prairie-Plains border and High Plains at the time it does...This was a warm period when more moisture was available than previously on the High Plains" (2001:190).

Agriculture probably spread to the Missouri basin rather than being developed there. The origins of the farming communities of the Middle Missouri remain disputed. Winham and Lueck stated that the Middle Missouri people migrated from the woodlands to the south or east (1994:175). An opposing view was that the practice spread northward from New Mexico (Schlesier 1994: 338).

Whatever the source, the success of the Mandan and Hidatsa adaptation to their new territory of the banks of the Missouri River is underscored by their continuous occupation of the region until their destruction near the middle of the 19th century, the result of epidemic disease and Dakota invasion. Archaeological studies indicate that the villages of the Middle Missouri underwent periodic episodes of surplus and hardship from climatic variability (Lehmer 1977: 59-71) but the maintenance of a farming economy in the Missouri basin for a period of at least 800 years indicates that the villagers were able to maintain a highly successful coping range with regard to climatic stimuli.

The expansion of horticulture in response to the improved climatic conditions of the Neo-Atlantic continued northward into Manitoba. During this period, agriculture was practiced only a few hundred kilometers east of the SSRB. Archaeological sites with evidence of corn cultivation have been found in at several locations in the province; including the Lockport Site, north of Winnipeg, the Lovstrom Site, south of Brandon, and the Johnas Site, north of the Assiniboine River near Oak Lake (Nicholson 1990:35). Investigations from southwestern Manitoba indicate that the practice of agriculture was brought to the area from the Missouri villages around A.D. 1100 (Nicholson and Hamilton 2001:54).

Indirect evidence points to other potential northern horticultural occupations during the Neo-Atlantic. A packet of squash seeds *(Curcurbita pepo,* variety *ovifera*) was found in a pouch associated with a burial near the Sheyenne River in North Dakota -dated to approximately A.D. 800 (Good 1975 cited in Gregg 1994:81). In the Qu'Appelle Valley, the Moose Bay burial mound (near Crooked Lake) contained a bone tool identified as a squash knife (Hannah 1976:55). The date of the site (A.D. 1040 ±70 yrs.) falls within the climatic optimum of the Neo-Atlantic. Because the mound is nearly 160 km. away from

the nearest site exhibiting crop growing (on the Souris River), the author of the monograph was wary of characterizing the occupants of the mound as being horticulturalists (Hannah 1976:55).

The presence of an agricultural tool in the Moose Bay mound indicates that if the inhabitants of the Qu'Appelle Valley were not planting crops themselves, they were connected to people who did. There is no prehistoric evidence for the production of food crops within the SSRB itself.

The long period of warm temperatures, regular precipitation and successful integration of crops into their diet was not the only advantage provided to the inhabitants of the eastern plains during the Neo-Atlantic. Gregg noted:

> (p)erhaps even more important than the expansion of gardening practices was the overall buildup of the regional biomass. Grasslands and bison flourished. Availability of bison seems to have been the persistent limiting factor for human population growth and stability throughout the entire prehistory in the area (1994:95).

The variability of available vegetation and the number of bison who grazed on it, largely a function of climate, had profound consequences for the inhabitants of the SSRB and surrounding regions when the climate deteriorated in the 13th century. Communities that had grown accustomed to ample supplies of food were forced to radically alter their economies and, in many cases, change their subsistence practices completely to survive the effects of the new climatic regime of the Pacific Climatic Episode.

The Neo-Atlantic optimum also brought changes to the archaeological traditions of the boreal forest to the north and east of the SSRB. Although the direct implications of these changes would not be felt on the plains for several centuries, they were profound and continue to the present. As the weather improved after A.D. 900, the longstanding inhabitants of the forest in northwestern Ontario and northern Minnesota, the Laurel complex expanded northward as far as the Hudson Bay Lowland, the Grass River in northern Manitoba, the Saskatchewan River Delta and possibly into the eastern woodlands of the present province of Saskatchewan (Meyer and Hamilton 1994:102-104).

As the Laurel people moved northward, so too did their environment. During the Neo-Atlantic, the boreal forest advanced 280 km. north of the present location of the tree line west of Hudson Bay (Meyer and Hamilton 1994:100; Bryson, Irving and Larson 1965). Forested areas also expanded west of the SSRB. In the Rocky Mountains for example, the tree line was higher before A.D. 1200 than it is at present, an indication of improved climatic conditions (Beaudoin 1999:28). The retreat of the Laurel people from the northern boreal forest after the 13th century has been linked, in part, to the rise of the population now identified as the Cree.

The halcyon years of the Neo-Atlantic, when climatic conditions were analogous to those

of the 1960s (Bryson and Wendland 1967; Crowley 2000), did not last. Although climate varied from the end of the Neo-Atlantic to the modern period, conditions marked by drought or cold or both continued in the northern Great Plains until at least the mid 19th century. The resulting decline in biomass on the SSRB and adjacent areas over such an extended period forced the existing human populations to make drastic changes in their food procurement strategies in order to survive.

The Pacific Climatic Episode and Archaeological Change on the Plains A.D. 1200-1550

The change in climate following the end of the Neo-Atlantic was swift, brutal and unforgiving. The deterioration of conditions after A.D. 1200 was a global phenomenon. The precipitous decline in temperatures may have been triggered by a massive volcanic eruption dated to A.D. 1259 (Crowley 2000). The concentration of sulfates in ice cores corresponding to that event were eight times higher than those of the Krakatoa eruption of 1883 and three times higher than those associated with the eruption of Mount Tambora in 1816 which produced the global phenomena known as "the year with no summer" (Crowley 2000).

The severity of temperature decline and the expansion of glaciers in the northern hemisphere led Stephen Porter to conclude that the cold climatic period known as the "Little Ice Age" began circa A.D. 1300 (1986:36). In the Rocky Mountains, glaciers began a two hundred year period of advance beginning in the mid 12th century (Beaudoin 2003:27). In the Rockies, intervals of particular cold were dated to A.D. 1190-1250 and A.D. 1280-1340 (Beaudoin 1999:33).

Brian Fagan's recent popular book, *The Little Ice Age: How Climate Shaped History, 1300-1850*, centered on the effect of plummeting temperature on the population of medieval Europe. By 1309, Christmas feasts were taking place on the ice of the Thames River in London (Fagan 2000:29). In the spring of 1315, unceasing rains brought chaos to Europe, thousands died in floods and from subsequent crop failures (Fagan 2000:31).

As Europe underwent an unprecedented period of extreme wet conditions, the opposite was true in the SSRB and the North American Great Plains generally. The entire region was subjected to a long and intense period of water shortage. The climate of the SSRB and surrounding areas was not only drier but also colder. A detailed analysis of the shift from the Neo-Atlantic to the Pacific Climatic episodes has not been undertaken for the SSRB, though studies from the American Midwest for the period serve to illustrate the severity of the impact of the transition from the Neo-Atlantic to the Pacific Climatic Episodes.

The most lucid account of the global climatic change and its consequences on human populations during this critical time was presented by Bryson and Murray in "Climates of Hunger: Mankind and the World's Changing Weather" (1977). Although a pioneering work in its integration of climatic forces and human adaptation, the highly theoretical discussion of the climatic shift in the 13th century presented by Bryson and Murray

(1977) has been criticized for its failure to account for regional differences in climatic variability (Hall 1988; Bamforth 1990). Douglas Bamforth noted their discussion was based on the "theoretical analysis of circulation patterns … with relatively little supporting local data" (Bamforth 1990:360). Bamforth warned that caution must be used in considering atmospheric circulation models because of their focus on global phenomena rather than accounting for specific changes in specific areas but acknowledged that "such a theoretical emphasis is essential to achieving a causal understanding of how and why climates change…" (1990:360).

While the Bryson and Murray hypothesis of climatic change is flawed, it remains the clearest discussion of climatic variability as a causal or forcing mechanism in the large-scale population dislocations beginning in the 13th century. The severity of drought in the American plains during the 1200s was such that it was designated only one of two "megadroughts" on the American Great plains during the last 1000 years (Woodhouse and Overpeck 1998:2698-2699).

According to Bryson and Murray, the worsening climate which characterized the Pacific Episode was probably experienced most profoundly across transitional zones between grasslands and woodlands of North America. They wrote, "(w)hile western Europe grew damp and gloomy, the farmers of the plains 800 years ago must have seen their corn wither and turn white with drought, their game die or move away" (1977:29). The climatic downturn at the beginning of the Pacific Climatic Episode, "appear[s] to be directly reflected" in the sudden constriction and partial abandonment of Middle Missouri Villages (Lehmer 1977:121).

The Bryson-Murray hypothesis of extended drought on the eastern margins of the Great Plains was based on a number of factors. First, the presence of more Arctic air over North America caused temperatures to plummet. They noted that the retreat of the northern margins of the boreal forest began about 1200 (Bryson and Murray 1977:25). Other studies have shown that the tundra continued to grow at the expense of the forest until the end of the 18th century (Rupert's Land Research Centre 1992:31) At its southern margin, the boreal forest moved as far as five degrees south in the Great Lakes region (Bryson and Wendland 1967).

The effect of the drop in mean temperatures was an expansion of the circumpolar vortex and a reduction of tropical air entering North America during the summer (Bryson and Wendland 1967:296). Bryson and Murray explained, "the expansion of the westerlies [was]-in effect the expansion of the Arctic" (1977:47). Because Arctic air was further south, it increased the prevalence of westerlies coming over the Rockies producing a dry "shadow" over the plains, particularly the vulnerable area encompassing most of the SSRB.

At times when temperatures are warmer, (when the westerlies are further north) moist air from the Gulf of Mexico is able to reach the plains. During cold periods, such as those experienced after A.D.1200, the increasing importance of westerlies as the prevailing winds would have blocked moist air from entering the plains, "enlarging and intensifying

the dry shadow of the Rockies" (Bryson and Murray 1977:29).

The prevalence of drought on the plains was identified as the cause of the disappearance of the Mill Creek villages, the sedentary horticulturalist hunter-gatherers of northwestern Iowa, southeast of the SSRB (Bryson and Murray 1977). Because the Mill Creek people occupied the Iowa ecotone[4], the transitional area between the arid short grass prairie to the west and the wetter tall grass prairie to the east, they were particularly vulnerable to climatic fluctuation.

Bryson and Murray used several types of material evidence to illustrate the effects of the drought on the demise of the Mill Creek farmers. They documented a general decline in faunal remains. The drop in available game led to a shift from deer, which browse on trees, to an increased reliance on bison, consumers of grass and more resilient to dry conditions (Bryson and Murray 1977:35). The increasing orientation of woodland communities toward the bison, a species which grew in importance as climate conditions worsened, is a critical factor in the understanding of human adaptations to climatic stimuli from the 13th century on.

To consider the effect of drought on corn production, Bryson and Murray traced the presence through time of potsherds, which were used to store, cook and serve agricultural produce. Most of the sites showed a decline ceramics as the drought period progressed. As pottery was required for the storage and preparation of corn, the decline in ceramics was an indication that less corn was being consumed. The authors noted that evidence of ceramics remained high for a time even after bone counts dropped, "while the drought must have hurt the corn farming, it hurt hunting even more" (Bryson and Murray 1977:39). A dramatic exception to the general decline in ceramics occurred at approximately A.D. 1300, when sherds were so numerous the authors posited that their makers were using pots to water crops (Bryson and Murray 1977:40).

Pollen analysis also indicated a change in the environment surrounding the Mill Creek sites over this period. Between A.D. 900-1200 when the climate worsened, oaks were the prevalent tree species in the study area. Later, willows became the dominant species. As for other plant communities, "(t)hey moved from a higher percentages of composites-which include sunflowers and asters-to a large percentage of grasses, which have smaller leaf surfaces and require less moisture; they are favored by a drier climate" (Bryson and Murray 1977: 41). Although the factors surrounding the abandonment of farming in Iowa are specific to the area, they illustrate the general pattern of climatically-driven human adaptations at the beginning of the Pacific Climatic Episode on the eastern margins of the Great Plains.

In the Missouri Basin, climatic change sparked a major relocation of its inhabitants, according to Lehmer:

> [I]n South Dakota the relatively unfavorable Pacific I climate seems to be directly affected by the abandonment of most of the Missouri valley and the concentration of the remaining villages in a few small areas (1977:63).

While this pattern of abandonment took place hundreds of kilometers from the SSRB

itself, the demographic ripple resulting from the climatic changes that came after A.D. 1200 had direct consequences for the region. Many of these prehistoric "environmental refugees" from the eastern woodlands came to occupy portions of the SSRB as they adopted the bison hunt as their primary means of subsistence. For some, the shift toward hunting may have been an incremental rather than a qualitative change in subsistence. Even during optimal conditions, the horticultural villages of the Middle Missouri may have relied on hunted meat for as much as half of their food requirements (Lehmer 1977: 60)

As global conditions worsened, populations along the forest-grassland transitional zones were increasingly drawn westward into the grasslands in their pursuit of bison. Although still susceptible to drought, the SSRB and surrounding areas provided a relatively stable food supply, especially in comparison to woodland regions that surrounded them.

Beginning in the 13th century, the plains were increasingly important as a refuge from habitat decline in the boreal forest and woodland areas. In the northern United States, a major shift occurred during this period from woodlands to the plains owing to the presence of bison as a dependable food source (Gregg 1994:88). The large-scale regional migrations of people who inhabited the prairie-woodland border of the central U.S. indicates that climatic change during the Pacific Episode was severe enough to trigger the abandonment of farming over a large area and prompt the adoption of migratory bison hunting in the western plains. Climatic deterioration itself, particularly with regard to drought, may have been less drastic in the SSRB than in the eastern plains (Velez 2004).

Tree ring reconstructions of the North Saskatchewan River indicate an increase in stream flow in the late 13th century which, "may reflect a climate regime shift associated with a change in dominant atmospheric circulation patterns possibly initiated by changes in North Atlantic and North Pacific sea surface temperatures" (Case and MacDonald 2003: 711). South of the 49th parallel, other studies support the Bryson and Reid hypothesis of increasing post A.D. 1200 desiccation. In North Dakota, analysis of core sediments indicates that the Devil's Lake Basin in North Dakota dried up three times between A.D. 1300 and 1535. According to Gregg, they provide "solid evidence of negative environmental effects of Pacific climatic episode droughts" (1994:88).

Although conditions were not uniformly adverse during the Pacific episode, the increasing frequency of drought coupled with reduced temperatures contributed to numerous complications for the inhabitants of the plains and surrounding regions. For farmers in the Missouri River Basin, they included the decline of crops production food shortages, malnutrition, and warfare (Gregg 1994).

Portions of the region were abandoned altogether (Lehmer 1977:63). Elsewhere, horticultural villages responded to the increased tension by fortifying their communities with palisades and defensive ditches (Gregg 1994:88-89). Some village groups went on the offensive during this difficult period. Douglas Bamford attributed the large scale killings of malnourished villagers at the Crow Creek site in South Dakota to an attack by

either the Mandan or their allies, the Hidatsa, during the 14th century (1994:105-108).

The circumstances of the battle at Crow Creek indicate that the northern horticulturalists were exerting military force on their southern rivals. The attack, which coincided with an ever deepening climatic crisis on the eastern Great Plains, was predicated to a significant degree to climatic forces. In their attempt to cope with food shortages resulting from protracted drought, the agriculturalists of the Middle Missouri may have shifted their focus toward land further downstream, into the country of the people killed at Crow Creek. Skeletal evidence of tuberculosis found in excavations of village populations is also indicative of malnutrition.

One outcome of the increasing violence in the eastern woodlands was a short-lived migration of horticulturalists northward into Canada, along the Red River and into the Souris River Basin southwestern Manitoba (Nicholson and Hamilton 2001:68). According to Nicholson and Hamilton, climatically-induced warfare In the Missouri Basin, "caused a demographic ripple throughout the northeastern Plains, with some groups drifting northwards following stream valleys, including the Pembina and Souris Rivers" (2001:69). Attempts at growing corn were marginally successful at best:

> It may be that an initial, limited horticultural success in the region ended in a series of cold summers that prevented the harvesting and drying of corn, with the last crops being consumed as "green corn" or simply lost due to unseasonal [sic], late killing frosts (Nicholson and Hamilton 2001:69).

The final blow came between A.D. 1453 and 1454 when a "cataclysmic volcanic explosion in the South Pacific resulted in severe worldwide climatic deterioration" (Nicholson and Hamilton 2001: 69). The effect of the Kuwae eruption (Volcanic Explosivity Index[5] hereafter VEI 6) on the global climate may have been worsened by a major eruption (VEI 5) at Aniakchak, Alaska in approximately1450 (Briffa et al 1998: 453).

Evidence from just beyond the SSRB supports the hypothesis of a sudden drop in temperatures. The eruption period coincides with a sharp decline in stream flow in the North Saskatchewan River (Case and MacDonald 2003: 710), possibly as a result of cold conditions limiting glacial melt. The immediate post eruption period coincides with the abandonment of horticulture in southwestern Manitoba and the arrival of the Awaxawis [6] Hidatsa to the Knife River (in the Missouri Basin) from the north "after having lost their corn" (Nicholson and Hamilton 2001: 69). Improved conditions in the Middle Missouri after A.D. 1450 are indicated by the resettlement of southern portions of the region which had been abandoned earlier (Lehmer 1977:67).

By A.D. 1500, there simply was no agricultural activity north of the Missouri River (Binnema 2001). On the southern margins of the SSRB, groups associated with the Middle Missouri people, particularly the Hidatsa, continued to hunt to provide meat for the villages but were increasingly forced to share the herds with other groups who shifted their subsistence practices toward the relative security of the plains. In addition to the

Hidatsa, other groups that migrated toward the SSRB area traded meat procured north of the Missouri settlements for corn and other crops grown in the villages. Bamforth noted that colder winters and increased year to year variability in temperatures associated with the Little Ice Age heightened the interdependency of nomadic hunters and village horticulturalists as both groups increasingly required supplements of stored food to ensure survival through unpredictable winters (1990:364)

While increasingly cold and unpredictable weather conditions after A.D. 1500 heightened the interdependency of village dwellers and nomadic bison hunters, the continued reliance on bison hunting in the grasslands would have served to mitigate the effects of dry conditions on human populations in the grasslands of the SSRB and vicinity during the Pacific Climatic Episode.

Prior to their constriction and eventual extermination in the wild, bison herds ranged from southern Texas to the subarctic of northwestern Canada, a testimony to the ability of the species to adapt to a wide array of conditions (Roe 1972:72-73). Although investigations of bison migrations, and the occasional lack of them, have shown that their movements were complex, their ability to travel in large herds over great distances made them both more numerous and less susceptible to climatic changes such as drought than territorial ungulates such as moose, deer and elk in the plains and parklands (Epp 1988:313-314).

As conditions deteriorated in areas inhabited by territorial species, animal populations declined as a consequence of the increasing degradation of their habitat. Climatically-driven habitat decline in the boreal forest and woodland areas to the south may have continued for as long as 600 years. Human communities in the woodlands, which depended on the ever-dwindling supply of game, would have been forced to look elsewhere for food.

The increased reliance on bison herds by human populations both in and around the plains may well be the key but, as yet, unrecognized factor in understanding the migration of aboriginal groups to the prairies in both the prehistoric and historic periods. Woodland groups such as the Cree and the Saulteaux continued their movement westward until well into the 19th century. While habitat degradation has been recognized as a factor in the shift to the plains during the Pacific Climatic Episode, the decline of food supplies in the woodlands would probably have been exacerbated during the colder Neo-Boreal climatic episode (A.D. 1550-1850). This factor has been overlooked by historians who have interpreted their shift toward the plains as an expansion resulting from human forces such as the expansion of the fur trade and depopulation from disease as catalysts for westward migration (Ray 1993:118-122).

Numerous tribal groups migrated westward from the woodlands to hunt bison during the Pacific Climate Episode. Among them were the Atsina, also known as Fall Indians or Gros Ventres. While their origins are not fully understood, the most credible interpretation is that the Atsina and their kin, the Arapaho, originated in the Interlakes region of Manitoba (Binnema 2001:75) Their ancestors were probably the makers of the Duck Bay pottery phase which emerged from the Blackduck style at the beginning of the

Pacific Climatic Episode (Binnema 2001:76; Bryson and Wendland 1967:280).

The split of Duck Bay from Blackduck may have been a sign of a partial collapse of the latter, as interaction between the parent group (Blackduck) and the outlying group (Duck Bay) may have diminished during this stressful time. Although climatic decline and the emergence of Duck Bay pottery took place at roughly the same time, the paucity of archaeological research in western Manitoba limits the connection between the two events to that of a hypothesis. As was the case with so many other groups during the period after A.D.1250, they shifted their focus toward the plains and the bison.

Over time, the Atsina moved westward to the parklands and plains. The predominance of Duck Bay pottery north of the Assiniboine River indicates that they migrated west through the parklands of western Manitoba (Walde et al 1995: 40). By A.D. 1550, the occupied the area around the forks of the Saskatchewan Rivers (Binnema 2001:76) Their identification as the Rapid Indians, Fall Indians, or even Waterfall Indians in early historical accounts has been attributed to their occupation of the country surrounding the swift moving water of the lower SSRB (Binnema 2001).

As the Atsina moved west out of the woodlands of Manitoba, their relatives, the Arapaho, moved southwest into the United States. Although both the Atsina and Arapaho were Algonkian language speakers, they maintained strong cultural and economic ties to the Siouan-speaking Middle Missouri villages (Malainey 1995). Their ties to the villages of the Missouri Basin may have been based on the increasing interdependence of hunting and farming groups for a secure food supply (Bamforth 1990:364).

Although they initially occupied the plains and parklands in the eastern portions of the SSRB, the Atsina shifted west under pressure from other eastern groups shifting their focus to the grasslands. By the mid-1700s, they were allied to the Blackfoot and shared the country between the North and South Saskatchewan Rivers (Fowler and Flannery 2001:677). When they were finally forced from what would become Canadian territory at the turn of the 19th century, many Atsina took up agriculture among Mandan and Hidatsa villages on the Missouri River (Malainey 1995).

The inhabitants of the SSRB, the Old Woman's phase (representing the historic Blackfoot), the Hidatsa (the northern allies of the Mandan who hunted in the southern portions of the SSRB), and the Atsina found themselves faced with increased competition from other groups who migrated from the woodlands to the east during the Pacific Climate Episode. The most important group of immigrants was identified as the Mortlach phase or "aggregate"[7] which appeared on the eastern margins of the SSRB about A.D. 1300 (Walde et al 1995:32). Mortlach material culture likely developed from a pottery style known as Sandy Lake, which in turn was part of the larger Psinomani culture.

The Psinomani were Siouan speakers who replaced the Algonkian speaking Blackduck phase in Minnesota about A.D. 1000 (Walde 1994:140-146; Walde et al 1995: 38). Dale Walde identified the makers of Mortlach pottery as the ancestors of the historic Assiniboine. During their initial occupation of the plains, Mortlach sites are found

almost exclusively along the south and east portions of the SSRB, in the grasslands south of present day Saskatoon (Walde 1994:17). By the 1650s, they extended southwestward into Montana, on northern tributaries of the Missouri River (Joyes, et.al. 1999:16-17). During the early historical period, they were reported to be as far west as the Rocky Mountains and beyond the northern margins of the plains along the North Saskatchewan River. The westward expansion of the Assiniboine, the most northerly of Dakota-Siouan speaking groups during the period of climatic decline again fits the wider trend of westward migration from the forest to the plains during the late prehistoric and early historic periods.

Walde's analysis of the Morthlach-Assiniboine occupation of southern Saskatchewan showed that there were two distinct subphases within Mortlach. The southern group, identified as the Lake Midden subphase, centered their hunting on valley areas such as the Qu'Appelle and the Missouri (the adjacent watersheds to the SSRB) from the fall through the spring (Walde 1994:119,124). In summer, they followed the herds onto the open plains.

A clustering of Mortlach sites around the Big Muddy area indicates that it was used as a corridor between the SSRB and the villages of the Missouri Basin, supporting Bamforth's view of the interdependence between nomadic hunters and village dwellers (1990:364). During the Neo-Boreal, the dependence of the Middle Missouri villages on hunted meat increased. Settlement patterns in the area reflect a reduction in both the size and length of village occupation, evidence of a diminished carrying capacity of their cultivated land (Lehmer 1977:69). The connection between the Assiniboine and the Middle Missouri Villages continued into the historic period. It was the Assiniboine who guided the La Vérendryes to the Mandan villages in the 1741 and the explorer noted that the two groups knew each other's languages (Walde 1994:139).

The northern Mortlach suphase, known as the Lozinsky, were likely almost year round inhabitants of the parklands of the SSRB (Walde 1994:118). A major feature of Lozinsky sites is the presence of Selkirk ceramics (Meyer and Epp 1990). Because the Lozinsky Mortlach people occupied the parklands year round, they had ample opportunity to interact with, and be influenced by, Selkirk people, who undertook seasonal forays into the parklands from the boreal forest to hunt bison (Walde 1994:118). Full time residence in the parklands would have been possible because, as Epp asserted, some of the bison did not migrate onto the plains (1988). The question of dual strategies for bison foraging (migratory and non-migratory) remains unsettled (Epp 1988:317; Vickers and Peck 2003:95). The distinction between the two groups of Assiniboine people, those of the plains and those of the woodlands, continued into the historic period.

During the Pacific Climate Episode, the availability of bison in the SSRB drew not only immigrants from the eastern woodlands but also from the boreal forest. Selkirk, the archaeological tradition associated with the historic Cree, developed from the Laurel type in northern Manitoba about A.D. 1100 (Meyer and Hamilton 1994:118). Within a hundred years, Selkirk sites extended from the Churchill River in Northern Manitoba east to the headwaters of the Severn River in Ontario (Meyer and Hamilton 1994:118).

Between A.D.1250 and 1500, as climatic conditions deteriorated, the Selkirk people greatly expanded their territory in the boreal forest to the south, west, and east. By the late 14th century, they occupied a site at Nipawin, Saskatchewan, just below the SSRB. By A.D. 1500, they were well ensconced on the Churchill River in Saskatchewan and the boreal forest of northern Ontario (Meyer and Hamilton 1994:123). Although Meyer and Hamilton considered the expansion of Selkirk during a period of climatic deterioration "remarkable" (1994:123), the notion that northern groups should retreat southward into other regions during a time of worsening climate should be almost expected. Renée Fossett, for example, has shown that prehistoric Inuit groups also shifted southward during the Pacific Episode (2001:24).

By 1500, territorial boundaries were fairly well defined in the Canadian plains. The Hidatsa, the northern members of the Middle Missouri Village society, occupied the plains of southwestern Saskatchewan and southeastern Alberta, the southern portions of the SSRB. The Assiniboine (Mortlach) were in the central plains to the east of the South Saskatchewan River and possibly in the parklands near the forks of the Saskatchewan. Atsina occupied the country between the branches of the Saskatchewan River and the eastern borders of the SSRB. The Blackfoot (Old Woman's) occupied the plains along the North Saskatchewan and the country to the south. The Cree (Selkirk) were in the boreal forest and may have been in the parklands of the Lower Saskatchewan River, just east of the SSRB.

Although human populations had undergone three centuries of climatic decline since the end of the Neo-Atlantic phase, the 300 years after A.D. 1500 were harsher still. A consequence of the worsening conditions was an increase in competition, often violent, over the increasingly valued bison herds of the SSRB and western Canadian plains.

The Neo-Boreal Climatic Episode and Human Adaptations A.D. 1550-1700

By the mid 16th century, global temperatures began a three hundred year slide into what has become known as the "Little Ice Age." The temporal parameters for what is considered the true Little Ice Age have been disputed. H.H. Lamb, the leading historical climatologist of his generation, used the term to designate only the years of severest global cooling, from about A.D. 1550 to 1800 (1977:104).

The term Little Ice Age, as a global and temporal phenomenon, has come under criticism from some scientists who view it as too simplistic a concept in the scientific literature because it does not encompass regional variability in climate fluctuations (Luckman 1996:105; Bamforth 1990:359). Evidence for variability within the period known as the Little Ice Age includes the presence of tree remains in the Rocky Mountains dating from the 14th to the 17th centuries that are higher than the present tree line, a possible indication of warmer rather than cooler temperatures west of the SSRB (Beaudoin 1999:28). Other climatic histories have acknowledged the deepening cold with the Pacific Climatic Episode but equate the Little Ice Age with the Neo-Boreal climatic episode, between A.D.1550 and 1850 (Bryson and Wendland 1967: 280; Fossett 2001:29).

While the term may have its scientific limitations, the designation Little Ice Age is useful in the consideration of human adaptations to the increasing cold especially after A.D. 1500. Alwynne Beaudoin noted that the glacial advances that roughly correspond to the wider time parameters for the Little Ice Age, beginning in A.D. 1142 to 1850 were probably the greatest in the Canadian Rockies for the past 4000 years (1999:27-28). One estimate of the mean annual temperatures for the Little Ice Age was that they may have been 1? C lower than those of the present, and that the mid 19th century was the coldest interval of the last 400 years (Beaudoin 1999:34)

Another influence which must be considered when discussing climactic temperature variability during this Episode is the level of solar irradiation during the period under discussion. Although the influence of solar activity as a direct forcing mechanism on climate on a yearly scale as been questioned (Robock 1979), the effect of solar irradiation as a partial determinant of decadal-scale temperature variability seems all but certain (Crowley 2000). The period of diminished solar activity during the second half of the 15th century, the Spörer minimum, corresponds with the decline in temperatures at the beginning of the 1500s (Lean 1996). Perhaps the greatest effect on decadal climatic variability was that of volcanic activity.

Thomas Crowley noted that during the period A.D.1400-1850, between 41 and 49% of decadal-scale cooling could be explained by these events, "thereby indicating a very important role for volcanism during the Little Ice Age" (Crowley 2000). As noted above, the eruption of the Kewae volcano sparked a rapid decline in global temperatures, and probably drove the remnant population of horticulturalists from Canadian territory (Nicholson and Hamilton 2001:69).

In the Rockies, a cold interval was reported for the years A.D. 1440-1500 (Beaudoin 1999:33) Both branches of the Saskatchewan experienced long periods of low stream flow during the second half of the 1400s, which would result from diminished temperatures and a lowering of glacial melt (Case and MacDonald 2003: 710). According to Bradley and Jones (1993), cold periods at the beginning and end of the 1500s were among the most severe in centuries. The consequence of declining temperatures may have been an increase in the frequency and severity of drought in the Great Plains.

The entire continent of North America underwent what has been called a "megadrought" through the 16th century. (Stahle et al 2000; Woodhouse and Overpeck 1998: 2698). Dendroclimatic reconstructions from the Alberta foothills indicate drought periods in the 1520s and 1570s (Case and MacDonald 1995). Other studies show that Alberta, Montana and Wyoming suffered through severe drought conditions from the 1570s to 1600 (Stahle et al 2000). The year 1597 was reported to be the worst single drought year on the southwestern prairies until 1937 (Sauchyn and Skinner 2001). Because the 16th century was marked by a significant decline in temperatures, the "rain shadow" effect of worsening cold followed by increased westerlies and subsequent desiccation as postulated by Bryson and Murray (1977:47) may well have been in operation.

The combination of drought and severe cold would have diminished the biomass of the plains and strained food procurement strategies for many of the aboriginal communities who subsisted upon it. Warfare and territorial dislocation were common on the plains during this period of declining temperatures. It is significant that violence and dislocation increased before the influence of European germs, goods and guns was felt. An early discussion of the period in North America hinted at the consequences of the climatic decline in the 16th century, "(w)as this climatic deterioration (from the farmer's viewpoint) in the northeastern United States, more important in its impact on the life ways of the Indians than the contact with the whiteman which occurred at the same time?" (Bryson and Wendland 1967:296).

In the historical literature the arrival of Europeans and their ecological baggage has often been considered the spark for the widespread turmoil in the west. While the impact of Europeans is undeniable, the fact that these changes predate the introduction of new ecological forces indicated that other factors, particularly climate, were driving decisions of human populations, their institutional adaptations, before the onslaught of the new economic and ecological regime that came in the wake of European contact. In his discussion of the interaction between climatic variability and occupation of the Missouri basin, Lehmer stressed the primacy of climatic forces on human adaptations until as late as A.D. 1675 (1977:70).

The key adaptation during the end of the Pacific and the beginning of the Neo-Boreal episodes appears to have been an even greater reliance on bison hunting from groups outside of the plains. David Meyer noted that both the size and density of bison hunting archaeological sites in Saskatchewan increased to an unprecedented level after A.D. 1500 (1993). The excavation of Mortlach sites indicate that bison were exploited to their fullest:

> In particular, bison bones were intensively processed by being broken into tiny pieces and then boiled, the vats of water being heating heated with red hot rocks. Apparently, the bone fragments where then drained and dried, following which they were used as fuel. As a result, these sites contain massive deposits of small pieces of burned bone (Meyer 1993:64).

The exploitation of bison by the Mortlach-Assiniboine was efficient indeed.

Although Shepard Krech's controversial discussion of the relative meaning of the term "conservationists" when applied to Native Americans included the spectrum from the efficient butchering of meat to the use only of tongues, humps or fetuses, the choicest cuts, his discussion of bison processing did not include the use of carcasses to the extent exhibited by the Mortlach-Assiniboine (1999). The maximization of benefit from each animal killed may have been a key feature of Mortlach-Assiniboine success during this harsh climatic period.

The expansion of the Mortlach-Assiniboine onto the plains was not an isolated event. Sally Greiser noted that by A.D. 1450, other Siouan speakers had moved west from the woodlands as far as the Yellowstone River and into Wyoming (1994:54). She proposed that such "waves" of woodland peoples moving west was an ongoing phenomenon

throughout prehistory. Other woodland groups, such as the Algonquian speaking Cheyenne shifted their focus to the plains along the Sheyenne River of North Dakota by about A.D. 1500 (Gregg 1994:93).

During the 16th century, territorial shifts in Montana were marked by violence, "(t)hat warfare existed in those pre-horse days is documented through rock art of the region. We know that, as competition increased for the bison, intergroup warfare was common, but we have yet to document the extent"(Greiser 1994:55). The wave of violence which spread to the SSRB at the time may have been the outcome of the "megadrought" identified by Stahle and his colleagues (2000) which drove people northward from the desiccated America Great Plains.

During the 16th century, the Shoshone people expanded northward from their home territory in Wyoming and invaded the SSRB in Southern Alberta. Their advance forced the Blackfoot to retreat to the relative sanctuary of the North Saskatchewan River basin (Schlesier 1994:315). The occupation of the southern Canadian plains by the Shoshone lasted until the 18th century, when they were ousted from the region by groups associated with the fur trade who had gained the tactical advantage provided by European weaponry (Binnema 2001).

Binnema has noted that the environment northwestern plains supported a more numerous and dependable supply of bison that other parts of the prairies at this time (2001), so the Shoshone "expansion" northward may well have been caused by game depletion in their drought-stricken homeland. The Shoshone were not the only group to focus on the on the herds of the SSRB and the northern plains. Other Siouan speaking groups, the Crow and their relatives, the Hidatsa later pressured the Blackfoot from the south (Schlesier 1994:323). The Crow and the Hidatsa were probably the same group prior to the equestrian era which began in the early 18th century. The Hidatsa hunted in the southern SSRB to provide meat for the increasingly resource-depleted villages of the Middle Missouri (Binnema 2001:79).

To the north and east of the SSRB, the Selkirk-Cree continued their westward expansion to the margins of the boreal forest and beyond. By A.D. 1400, Selkirk people were in the valley of the Lower Saskatchewan River as far west as the original site of Cumberland House (Meyer and Thistle1995:411). They occupied no less than six aggregation centres between Grand Rapids (Manitoba) and Fort a La Corne (at the forks of the Saskatchewan River) in the late pre-contact period. These sites were chosen because fish could be seasonally exploited in large numbers (Meyer and Thistle 1995:413-414). The reliability of the food supply at the aggregation sites is underscored by their antiquity. Some sites have been used for as long as 6000 years (Meyer and Thistle 1995:414).

The dependability of fish stocks over such a long period would have made them especially prized during the centuries of environmental degradation in the boreal forest which must have accompanied the Pacific and Neo-Boreal climatic episodes. The migration of the Selkirk-Cree was probably driven by climatic decline associated with the Pacific episode. There is no evidence of Selkirk occupations in the Nipawin area of

eastern Saskatchewan before A.D. 1300 (Meyer and Russell 1987:17). Selkirk ceramics from the lower Saskatchewan differ from those in northern Manitoba in that they exhibit an influence of other groups from the parklands and grasslands (Meyer and Hamilton 1994:123). This indicates the interaction of the Selkirk-Cree with groups who already inhabited the Lower Saskatchewan River (particularly the Mortlach-Assiniboine) and by extension, an increased orientation toward bison hunting in the parklands just below the SSRB. By the end of the 16th century, the bison herds of the SSRB were under increased pressure from additional groups seeking refuge from climatically-induced stress, the Cree from the northeast, and the Shoshone from the south.

Although harsh climatic conditions drove many to the grasslands of the SSRB by the end of the 16th Century, conditions worsened after 1600. The 1600s were marked by a dramatic increase in volcanic activity from the previous century, prompting Briffa and his colleagues to conclude:

> The apparent cluster of possible eruptions in the seventeenth century, suggested by our data, perhaps in combination with lower solar irradiance, may have been a contributing factor in the extended hemispheric cooling that occurred at that time (1998:454).

The frequency and severity of volcanic eruptions undoubtedly exacerbated the already harsh climatic conditions of the Neo-Boreal. The 17th century began with a severe decline in temperatures resulting from the volcanic eruption of Mount Huaynaputina in Peru (VEI 6+). The eruption equaled or surpassed the later and better documented Indonesian volcanic explosions at Tambora and Krakatoa in the 19th century (Sigurdson 2000). One discussion of the eruption noted:

> The most severe short-term Northern Hemisphere cooling event of the past 600 years occurred in 1601, suggesting that either the effect on climate of the eruption of Huaynaputina, Peru, in 1600 has been previously greatly underestimated, or another, as yet unidentified, eruption occurred at the same time (Briffa et al 1998:450-451).

In the aftermath of Huaynaputina (and possibly a contemporaneous unknown eruption), Europe experienced its coldest summer since A.D. 1400-and the coldest for the next 400 years (Fagan 2000). The Northern Hemisphere underwent an estimated summer temperature drop of 0.8° C in 1601 (Briffa et al 1998:452). In what may have been a common pattern during the historic period, drought in the SSRB followed in the wake of the eruption. Although further research on this issue is required, a connection is postulated between the decline in temperatures resulting from volcanic activity and the temporary reestablishment of increased westerlies and drought on the plains.

Tree ring data indicates a drought in the SSRB from 1606 to 1609 (Sauchyn and Skinner 2001:266). Interestingly, the stream flow reconstruction of the South Saskatchewan River indicates only a slight drop in water levels (Case and MacDonald 2003:710). Droughts were also indicated from 1664-1668 and 1688-1691 (Sauchyn and Skinner 2001:266).

Significant volcanic eruptions may have been contributing factors in the onset of those droughts. Major eruptions occurred in 1641 (Mount Parker on Mindanao, Philippines VEI 5), 1663 (Hokkaido VEI 5), 1673 (Hammahera VEI 5) and 1680 (Sulawesi VEI 5) (Sigurdson 2000; Fagan 2000). At least seven other VEI 4 level eruptions occurred during the 1600s (Sigurdson 2000). In addition to the event at the beginning of the century, strong cooling events in the Northern Hemisphere were noted for 1641-1642, 1666, 1695 and 1698 (Briffa et al 1998: 451).

Again, just as in the 1500's, solar activity may be seen as a key forcing mechanism of climate of the late 17th and early 18th centuries. The unprecedented absence of solar activity between the years 1645 and 1715 has become known as the Maunder Minimum (Eddy 1976). Studies have shown a close correlation between solar activity and temperature, even that solar influence is the "predominant" forcing mechanism of climate (Lean, Beer and Bradley 1995:3195).

The dearth of solar activity during the Maunder Minimum and the Second Maunder Minimum at the beginning of the 19th century correspond closely to severe cold periods throughout the northern hemisphere. The period between 1680 and 1730 was marked by such a severe plummeting of temperatures that the growing seasons in England were reported to be five weeks shorter than it was during the warmest decades of the 20th century (Fagan 2000). Evidence derived from both tree rings and glaciers in the Rockies indicates that the 1690s were particularly cold (Beaudoin 1999:33).

Although the climatic variables indicate that the 1600s were particularly harsh, new and complex factors determining human adaptation made their appearance in the second half of the 17th century. It is during those decades that diseases probably spread from the Spanish in the south to the southern margins of the study area, the Middle Missouri Basin (Ramenofsky 1987). European goods were being traded to the plains well before the end of the 1600s. The ascendancy of groups controlling the trade with Europeans, the Cree and Assiniboine, and the Athapaskan speaking Chipewyan Dene in the far north, led to the first wave of market-driven population dislocations in the interior during the historic period (Ray 1993:122).

Goods came not only from English posts, established on Hudson's Bay after 1670 but also from the trade originating in New France. Trade networks to the south also brought goods from Spanish settlements. The most important item originating from the Spanish was the horse. Horses first made their appearance in the southwestern plains at the end of the 17th century. They were brought by the Numic speaking Shoshone who had earlier invaded the southern plains. The Shoshone acquired horses from their southern relatives, the Commanches (Binnema 2001:84). Their early access to horses, probably by the early decades of the 18th century, provided the Shoshone and other southern groups with a temporary military advantage in the SSRB.

The advantage of horses, however, was seasonal. A recent discussion of shift from dogs to horses in southern Alberta noted that the new species greatly improved mobility during summer, though dogs remained a more reliable beast of burden in winter (Landals

2004:246-247) By the second half of the 18th century, the northern rivals of the Shoshone, the Blackfoot and especially the Cree and Assiniboine, armed with guns turned the tables on the southern peoples and forced their retreat from the SSRB to the high country of the northwestern United States.

Although journeys to the suppliers of goods would have been both difficult and lengthy, some groups were willing to undertake the risk of long distance trade. The Assiniboine, for example, were reported to be trading as far east as Lake Nipigon in the mid 17th century (Russell 1993:178). Some middleman groups such as the Cree and Assiniboine undertook journeys as long as 3600 km. to reach their European suppliers (Ray 1993).

Long distance trade was not an innovation that came with the arrival of Europeans. In the prehistoric period, trade networks for such luxury items as dentalium extended from the Pacific Ocean to the Gulf of Mexico (Gregg 1994:89). In becoming partners in the fur trade, middleman groups were increasingly exposed to hazards brought on by climatic variability. In 1716, when the HBC supply ship could not reach York factory due to thick ice resulting from extreme cold, hundreds of middleman Indians who had traveled to the bay to meet the ship underwent severe hardship from both hunger and disease (Newman 1986; Ekert 1987).

The experience of the middleman traders at York Factory indicates that those who undertook the journey to the coast submitted themselves to an increased risk from climatic factors as their journeys forced them to travel long distances for the purpose of trade rather than focus on their more pressing needs such as the quest for food. As indigenous groups increased their orientation toward trade with Europeans, they often increased their vulnerability to climatic stimuli.

Although the middleman trade had almost certainly extended to the margins of the SSRB by the end of the 17th century, the extent of the trade may well be under represented in the archaeological record. According to A.J. Ray, aboriginal middlemen who undertook the journey to Hudson Bay did not purchase goods specifically for the purpose of trade, rather "the Indian middleman who arrived at Hudson's Bay Company Posts bought goods largely to satisfy his own demand" (1978:30).

Although company traders encouraged middlemen to take more than they could use themselves, most groups brought only what they could use on their return trips inland where the by now second hand goods were traded to those actually procuring furs (Ray 1978). The effect was to keep the value of the few goods coming from the bay very high, with the surplus profit expended while middlemen were at the posts. For archaeologists, it meant that few items of European origin ended up as artifacts in sites dating to the protohistoric period.

One study of the early fur trade in the interior, described the middleman period as an almost entirely Indian creation (Rupert's Land Research Centre 1992:95). Groups with access to Europeans goods certainly had an advantage over those who did not. The expansion of the Cree into central Alberta in the late 17th century acted as a "wedge"

between the Athapaskan speaking groups, the Beaver and their southern kin, the Sarcee (Dempsey 2001: 629). Although the Sarcee were separated from the Beaver by the incursion of the Cree, the former had already taken up seasonal forays into the plains to exploit the bison (Dempsey 2001: 629). The shift of the Sarcee people toward the relative security of the bison hunt and their close, though not exclusively harmonious, relationship with other members of the Blackfoot Confederacy may well have been underway before they were "pushed" onto the plains at the beginning of the 18th century.

The first European to actually see the plains, Henry Kelsey traveled as far west as the Forks of the Saskatchewan at the beginning of the 1690s. He was guided from Hudson Bay by a group of Assiniboine who had gone to the bay to trade. They ventured as far south as the grasslands of eastern Saskatchewan (east of the SSRB) where they encountered an enigmatic group called the Naywatame Poets. Their identity is uncertain, they "have been identified with nearly every group on the northern Plains: Mandan, Sioux, Blackfoot, Snake, and Gros Ventres (Russell 1993:74). The best guess is that they were probably the Siouan speaking Hidatsas (Russell 1993: 84-85).

Alwynne Beaudoin remarked that Kelsey "wasn't very impressed by what he saw and quoted the explorer's description of the plains as "nothing but short Round sticky grass and Buffilos [sic]" (1999:35). While Kelsey may not have been overwhelmed by the splendor of the grasslands, his journey represents the beginning of historical documentation from the plains. For students of climate change and its impact on human populations, it marks the start of a new and largely untapped source of information for the both climatic variability and its impact on the human communities who experienced it. Historic sources, from the time of Kelsey's journey provide first hand accounts of events on the ground in the prairie west.

Although tree ring data indicates that the western plains underwent a severe drought during the period of Kelsey's journey (Sauchyn and Skinner 2001:266), a discussion of the environment that Kelsey encountered on the eastern margins of the plains interpreted the climate to be undergoing a wet cycle (McConnell 1993:8). In addition to the references to wet conditions contained in the Kelsey journal, tree ring evidence of heavy precipitation is cited from the Kananaskis area and the Swan Hills to support the notion that Kelsey passed through while the country was in times ofample moisture (McConnell 1993:9; Jozsa et al 1984). This probably indicates the variability of conditions across the region, and the complexity of climatic phenomena as a whole, rather than a potential problem with the reliability of the dendroclimatic data as a proxy record of drought. It also underscores the value of historical sources in providing eye witness accounts of what was transpiring on the plains.

Kelsey's journal provided the first documentary account of both the natural environment and human activity in the region. Kelsey's report to his superiors at the Hudson's Bay Company was but the first direct account of the west produced for, and preserved by, the Hudson's Bay Company. The unparalleled collection of documents pertaining to the corporate history of the HBC, now at the provincial Archives of Manitoba, represent a gold mine of information dealing with both climatic change in the west and the changes

made by both Europeans and aboriginal groups to meet the needs imposed by it. Accounts from the HBC archives allow a new level of sophistication in the interpretation of changes in both the environment and human activity on the plains that have been sketched out through proxy records derived from scientific sources and from the limited archaeological record.

Changes in human adaptation became increasingly complex in the 18th and 19th centuries, the result of introduced diseases and the effects of increasing European influence in economic and military matters. Investigations of HBC materials have provided researchers with the historical data to develop an increasingly sophisticated understanding of those changes. Although Winnipeg-based historical geographers such as Alan Catchpole, Tim Ball, Bill Rannie and Danny Blair have used the HBC materials for studies of historic climate in Manitoba and Hudson Bay itself, the potential of the HBC archives in relation to climatic change for the central prairies, and the SSRB has gone largely unexploited.

The parkland belt that Kelsey traveled through is widely accepted to have been much narrower than it is at present, the growth of trees was controlled by seasonal migration of bison herds and fires (Epp 1993; Rannie 2001; Meyer and Russell 2004). Recent studies have also shown that the extirpation of the bison led to a widening of the aspen parklands (Campbell et al 1994). David Meyer noted that at the end of the 17th Century, the Cree occupied the boreal forest, the Atsina, the grass lands of west-central and southwestern Saskatchewan and the Hidatsas in the southern grasslands (1993). The Assiniboine, according to the same study, occupied only the eastern half of the Saskatchewan grasslands at this time.

The apparent contradiction between Meyer's view that the Assiniboine occupied only the eastern margins of the Saskatchewan plains and the assertion by DeMallie and Miller (2001) that the prehistoric Mortlach phase was actually Assiniboine is a sign that there is no consensus regarding aboriginal territoriality in the late17th Century. One thing is certain, Binnema's migration theory is correct. Although Binnema did not assign a cause, other than the availability of bison in Alberta, the SSRB and neighbouring regions of the western plains were, by 1700, drawing people to the country like a magnet:

> By 1700 the northwestern plains were home to a great diversity of human communities that included Algonkians, Siouans, Athapaskans, Numas, Salishans, and Kutenais. Linguistic evidence suggests that these groups entered the Great Plains from every direction. Some of them battled their way onto the northwestern plains, while others arrived with little resistance. The behavior of each of these groups during the equestrian era was influenced by its history and relationships cultivated during the pedestrian era. Some recent migrants were heavily influenced by ties to communities far beyond the northwestern plains. All of these communities were prepared to defend their position there militarily even as they cultivated and maintained cooperative relations with other groups. Each had a unique history and connections and faced different challenges and opportunities when the horse arrived among the Numic bands of the Missouri

basin near the turn of the eighteenth century (2001:85).

Conclusion

During the relatively mild conditions associated with the Neo-Atlantic Climatic Episode (A.D.900-1200), human occupation of the SSRB was relatively stable. Although societies undoubtedly changed during that time, there is no evidence of from the archaeological record of new groups entering the region. With the climatic changes of the Pacific Climatic Episode, the stability of occupation in the SSRB was altered dramatically. For as long as 600 years, the grasslands served as a destination of choice for numerous groups who were forced by climatic variability from unsustainable regions.

The key to understanding the pull of the northwestern plains to so many groups by the end of the 17th century was the relative security of the bison hunting on the plains in relation to habitat degradation of the areas that surrounded it. The decline in temperatures would have resulted in a reduction in regional biomass for the grasslands and a probable drop in bison population available to human populations.

The constriction of the resources in the SSRB and the Northern Great Plains that accompanied the six centuries of climatic deterioration during the Pacific and Neo-Boreal Climatic Episodes undoubtedly paled in comparison to the habitat decline in the boreal forest and woodlands east of the plains. The ability of the herds to survive the environmental pressures that came in the wake of the Little Ice Age would surely have made bison an increasingly sought after resource for the inhabitants of western North America. The bison hunt, particularly as it was practiced in the pedestrian period without the use of firearms, was a sustainable and resilient subsistence base for the tribal peoples of the northern Great Plains.

Until at least A.D. 1650, climatic variability was the key factor in human adaptation in the SSRB and surrounding regions. Although the SSRB underwent a long period of harsh conditions including drought, cold, or both after A.D. 1200, human communities were drawn to the region because of its relative stability with regard to its primary food supply, the bison. Although certain groups undoubtedly underwent hardships in the SSRB due to periodic climatic variability, the region-wide adoption of bison as a staple mitigated what was in other regions, an untenable ecological situation.

What is notable from a survey of the existing scientific, archaeological, and historical literature is that there is no evidence to support the notion that indigenous occupants of the SSRB in the pre-contact era ever attempted an agrarian mode of production. While such pursuits were certainly undertaken on the periphery of the region, it was never attempted within the SSRB. Seemingly, in the estimation of the inhabitants of the SSRB the region was deemed, either too unsuitable to agriculture pursuits, or too rich in other resources (bison and eventually furs) for such adaptation to be worthwhile. Only in the wake of European domination on the heels of the virtual extinction of the bison would such an adaptation ever be attempted.

The vulnerability of indigenous peoples to climatic stimuli increased with their integration into European based economies. By the turn of the 18th century, the increasing influence of Europeans brought new forces that modified the longstanding relationship between First Nations and their environment. The ongoing and increasing reorientation of aboriginal societies toward the relative security of the bison hunt continued as it had for the previous two centuries or more. The climate continued its protracted deterioration as it had since the beginning of the Pacific climatic episode in the 13th century.

The Little Ice Age would continue its relentless grip on the people of the northern plains and beyond for another one hundred and fifty years. As biomass declined, pressure on the herds increased from human predation, disease, economic and military factors as well as the introduction of an entirely new species, the horse, to the plains. These new elements changed the millennia old relationship between people and the land and its key determinant, the climate.

The already complex relationship between communities and their environment in the prehistoric period was further complicated from the expansion of Europeans and their ecological baggage to the interior of the New World. A key factor for researchers trying to unravel the increasingly difficult puzzle of the interrelationship between climate change and human adaptation after 1700 was that Europeans were there to document it.

Notes

[1]The *Oxford English Dictionary* defines biomass as "the total weight of living organisms in a given area or of a given species."

[2] A "phase" in archaeology is defined as "an archaeological unit possessing traits sufficiently characteristic to distinguish it from all other units similarly conceived, whether of the same or other cultures or civilizations, spatially limited to the order of magnitude of a locality or region and chronologically limited to a relatively brief interval of time." Gordon R. Willey and Philip Philips, *Method and Theory in American Archaeology* (1963), 23.

[3] Archaeological Complexes "are groups of distinctive material remains that have been found at multiple sites in a given area...The material remains that typify a particular cultural complex include technologically and stylistically similar artifacts such as ceramic wares, points of particular types, and unique grave offerings. The distinctive material remains of a complex sometimes also include settlement traits such as certain kinds of residential lodges and mortuary features." Because archaeological nomenclature is not uniform, phases can also be identified as complexes. Michael Gregg, "Archaeological Complexes of the Northeastern Plains and prairie-Woodland Border, A.D., 500-1500." In *Plains Indians, A.D. 500-1500: The Archaeological Past of Historic Groups*, ed. Karl Schlesier (Norman: University of Oklahoma Press, 1994), 72.

[4]The term ecotone is a controversial one in the biological literature. It either describes the transitional zone between two distinct environments, or biomes, or it defines a distinct unit separate from the discrete biomes that it falls between. Robert E. Rhoades, "Archaeological Use and Abuse of Ecological Concepts and Studies: The Ecotone Example." *American Antiquity* 43(1978): 608-614.

[5]Volcanic explosivity is used as a measure of the magnitude of the force of eruptions.

[6] The Awaxawi are one of three village groups that comprise the Hidatsa people. Only one of the Hidatsa

village groups, the Awatixa, is though to have been present in the Middle Missouri before A.D.1200, the other two groups came later during the Pacific Climatic Episode. Frank H. Stewart, "Hidatsa." In *Handbook of North American Indians.* Volume 12, Part 1. Plains., ed. Raymond J. DeMallie, 329. Washington: Smithsonian Institution Press, 2001.

[7] An aggregate is "a collection of cultural manifestations in a given spatial context, or as the sum total of materials occurring in a site. This term is used in discussing finds from sites when there is no real assurance that the remains are actually associated." Wood 1961:5 cited in Dale Walde, "The Mortlach Phase." Ph.D Thesis, University of Calgary, 1994, 97.

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