An Examination of Species Diversity and Bison Processing Intensity Contextualized within an Aboriginal Seasonality Framework for Late Precontact Sites on the Canadian Northeastern Plains

By

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A Thesis Submitted to the Faculty of Graduate Studies of
The Univeristy of Manitoba
in Partial Fulfillment of the requirements for the Degree of

Doctor of Philosophy

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ABSTRACT

This dissertation considers faunal recoveries from a selection of archaeological sites located in the Canadian Northeastern Plains that date between AD 1000 and 1600. These faunal assemblages derive from three different archaeological cultures that are thought to reflect different subsistence orientations. The analysis quantifies this variability by assessing the taxonomic abundance and intensity of bone processing evident in the recoveries.

At issue is determination whether variability in the faunal assemblage reflects differences in subsistence economy deriving from the diverse origins of these societies. This requires control over other potential contributors to variability. This includes ecological comparability of the site localities, consistency of excavation, sampling and analytic methods, and similarities in site function. Particularly important is determination that the selected sites reflect comparable seasons of site occupation.

This latter consideration is important since the established archaeological and ethnological literature suggests that both available resources and the economic orientation of resident populations varied significantly with season. To this end, a major research component focused on the development of more refined means of determining the season of site occupation by measuring the degree of osteological development of recovered foetal bison bones. The creation of linear regression equations based on these measurements will allow applied archaeologists to establish season of site occupation without the need for a large, difficult to obtain foetal bison comparative collection.

The analysis suggests the variability in the faunal assemblages occurs independently of site cultural affiliation, and might reflect economic activities conditioned by more finely divided seasonal divisions than is apparent with the conventional four-season model deriving from agrarian European societies. Aboriginal language markers, specifically moon-names, were used to identify significant biophysical and bison reproductive events. By placing the six sites within Aboriginal concepts of seasonality, animal food subsistence choices are better understood. These results have implications for the classification scheme archaeologists have used to define subsistence strategies.

ACKNOWLEDGMENTS

I would like to acknowledge my dissertation committee for their commitment to my program of study and ensuring that this dissertation was successfully completed. Dr. Bev Nicholson has been much more than an advisor. He provided me with the opportunity as an undergraduate student to be directly involved in archaeological research and has maintained a presence in my academic career, Dr. Scott Hamilton was also instrumental in helping me clarify my research objectives and provided numerous suggestions for improving my arguments. Drs. Micheline Manseau and Emdad Haque helped me understand the contributions that academic research can have in resource management. I would particularity like to thank Dr. Jack Ives who served as my external examiner and provided thoughtful insights and valuable suggestions.

The faculty and staff at the Natural Resources Institute must be commended for their dedication to their students and I would like to recognize the work of the departmental assistants Tammy Keedwell, Dalia Naguib and Shannon Wiebe. I would especially like to thank Dalia who went above and beyond her duties. I would also like to thank Thomas Henley for getting me back on track more than once and motivating me when I needed it most. I would also like to acknowledge the support of Dr. Michael Campbell.

I received fellowships from the Social Sciences Humanities Research Council and the University of Manitoba as well as scholarships from the Faculty of Graduate Studies and the Natural Resources Institute, in addition to a Saskatchewan Association of Professional Archaeologists grant. I was also grateful for the travel grants provided by the Faculty of Graduate Studies, the Graduate Student Association and the Alumni Association which helped offset the cost of several conferences.

Dr. Nicholson and Sylvia Nicholson graciously enabled access to the Lovstrom, Jackson and Vera faunal assemblages while Dr. Hamilton supplied both the Hokanson and Twin Fawn materials. Dr. Evelyn Siegfried of the Royal Saskatchewan Museum facilitated access to the Sanderson site material and kindly helped sort through boxes of bones. I would also like to thank Marc

Bellon of Prairie Rose Meats for providing the modern foetal bison specimens and putting me in touch with the Gomph family who provided the young bison specimens. Dr. Ernie Walker in the Archaeology and Anthropology Department at the University of Saskatchewan permitted the inclusion of his foetal bison specimens to be used. Thank you.

I simply cannot thank Jill Taylor-Hollings and Dr. Hamilton enough for the support and words of encouragement when needed most. Jill also helped me understand the complexities of archaeological taxonomies and pottery chronologies. I feel nothing but gratitude towards my fellow Manitoba archaeolgists: Kevin Brownlee, Matt Singer, Myra Sitchon, Suyoko Tsukamoto and Amber Zimmerman-Flett. I would also like to thank my Saskatchewan Archaeological Society collegues, Ms. Belinda Riehl-Fitzsimmons and Ms. Karin Steuber.

I would not have accomplished this without the support of my wonderful family. To my sisters Nell and Heather, thank you so much for being my sisters! Your reassurance that I could do this, even during the really tough times is what kept me going. Thank you to all my parents, mom, dad, Sherry, Pat and Brent. To Heath, how do I start to express my gratitude for your patience, understanding and support? What else can I say but thank you.

Finally, I would like to dedicate this dissertation to Dr. Nicholson. I would not be where I am today if it was not for Bev. Bev took a chance on me when I had little archaeology experience and just wanted to 'dig in the dirt'. He not only taught me that the cool stuff' we found represented past peoples, he also provided me, and many of my peers with the opportunity to experience field archaeology in one of the most beautiful places on earth - southern Manitoba. His quest for life-long learning has inspired me to do the same and the impact of his mentorship on a generation of archaeolgists will benefit everyone. Thank you Bev.

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ACRONYMS

A	Anterior
A/I	Axial or Indeterminate
AMS	Accelerated Mass Spectrometry
BP	Before Present
BUI	Bone Utility Index
CAA	Canadian Archaeological Association
Cal	Calibrated
FODS	Foetal Osteological Development Sequence
GI	Grease Index
HRB	Historic Resources Branch (Manitoba)
HRIA	Heritage Resource Impact Assessment
ILU	Indeterminate Large Ungulate
KRF	Knife River Flint
L	Lateral
M	Medial
MAU	Minimum Animal Units
MAX	Maximum
MIN	Minimum
MGUI	Modified General Utility Index
MNE	Minimum Number of Elements
MNI	Minimum Number of Individuals
MTS	Midwestern Taxonomic System
NEPV	Northeastern Plains Village Complex
NISP	Number of Identified Specimens
Nspecies	Species Richness
NTS	National Topographic System
%CN	Percent Complete
P	Posterior
RC	Radiocarbon
SC	Size Class
(S)MAVGGRE	Standard Modified Average Grease Index
(S)MAVGMAR	Standard Modified Average Marrow Index
(S)MAVGTP	Standard Modified Average Data Total Products Index
SVC	Scattered Village Complex
TI	Tool Impressions
UTM	Universal Transverse Mercator
YA	Years Ago

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CHAPTER 01: INTRODUCTION

Introduction

On the Canadian Northeastern Plains, reconstructed subsistence strategies employed by three different archaeological cultures suggest variability in resource utilization. This dissertation explores zooarchaeological recoveries to determine the magnitude of this variability, and whether it reflects diverse cultural origins, or subsistence differences related to the season of site occupation. The conventional distinctions between these archaeological cultures are briefly summarized before addressing the key research objectives.

Blackduck complex sites date between circa AD 800 until the protocontact time period, and are primarily located in the boreal forest of northwestern Ontario and Manitoba as well as northern Minnesota, where sites indicate a generalized foraging strategy (Hamilton et al. 2007; Nicholson 1987a, 1987b; Snortland-Coles 1979). Sites with Blackduck pottery have also been identified in southwestern Manitoba and exhibit subsistence variability. Several communal bison kills are reported that include the Hokanson and Stott sites (Badertscher et al. 1987; Hamilton et al. 2007, 2011; Walde et al. 1995) while others are small ephemeral campsites such as Gosselin or Heron. These small campsites also contain bison remains, but in much smaller numbers, suggesting they were not procured using communal kill methods. The Bell and Oak Lake Island sites suggest a more generalized foraging strategy based on more diverse faunal recoveries, and are tentatively identified as warm season occupations (Hamilton et al. 2007, 2011).

The makers of Vickers focus pottery are believed to be an amalgamation of horticultural/forager groups deriving from the Eastern Woodlands and Middle Missouri subarea who settled into the Tigers Hills region about AD 1300 (Nicholson 1990, 1991, 1993, 1994, 1996a, 1996b; Nicholson et al. 2006a, 2011). Here, it is postulated they followed their traditional lifeways, practicing horticulture mixed with generalized foraging, for about 100 years before abandoning the area and reappearing in the *Makotchi-Ded Dontip*i (Dakota phrase meaning “place where we live”) locale of the Lauder Sandhills of southwestern Manitoba. A small bison kill at the north end of the Jackson site, the general lack of horticultural paraphernalia, and the proposed interaction with the Mortlach complex is presented as evidence that the Vickers focus adopted a focal bison hunting subsistence system (Hamilton and Nicholson 1999; Mokelki 2007; Nicholson and Hamilton 1997a, 2001; Nicholson et al. 2002, 2006a, 2006b, 2006c, 2008, 2011; Playford 2001a, 2010).

Mortlach complex sites are concentrated in south and central Saskatchewan, date between circa AD 1300-1750 and are always classified in the literature as being occupied by ‘specialized bison hunters’ (Magee 1997; Meyer 1993; Nicholson et al. 2011; Walde 2003). The spatial and temporal proximity of the Vickers focus and Mortlach complex sites in the Lauder Sandhills as well as pottery trait similarities and the adoption of bison hunting by the Vickers focus is thought to indicate a possible relationship between these two groups (Nicholson and Hamilton 1999, 2001). Mokelki (2007) examined the pottery from Vickers focus and Mortlach sites in the *Makotchi-Ded Dontipi* locale and concludes that the Mortlach complex and the Vickers focus were part of a larger Eastern Woodland migration, and these groups maintained separate identities until interacting, and eventually amalgamating in the Lauder Sandhills.

Research Problem

Subsistence variability has been a widely studied phenomena in northeastern Plains archaeological research. Seasonal availability has long been suggested as a factor influencing subsistence resource utilization (Hamilton et al. 2007; Nicholson 1987a, 1987b, 1987c; Ray 1998; Syms 1977). This derives from interpretation of historic text that suggests that bison herd migration was cyclical, with movement into the open Plains in summer, with a return to the shelter of the Aspen Parkland in winter (Arthur 1975, Moodie and Ray 1976; Morgan 1980; Ray 1998; Syms 1977). However, this has been challenged in favour of interpretations that bison were available in some parts of the Plains year-round (Epp 1988; Hamilton et al. 2006; Hart 2001; Malainey and Sherriff 1996). Thus, depending upon which interpretation of bison behaviour is accepted, archaeological recoveries might be expected to reflect considerable subsistence variability.

In order to further archaeological interpretation, Nicholson (1987a, 1987b, 1987c) modelled ethnohistoric observations of Cree, Assiniboine and Ojibwa movements and subsistence in western Manitoba for the protocontact and contact time periods. He found that while the ethnohistorical records attest to the importance of plants, fish, migratory waterfowl and other small game for survival, bison and other large mammals played an important subsistence role (Bowers 1965; Denig 1961; Ewers 1958; Mandelbaum 1979; Skinner 1914; Wilson 1917, 1924). Hamilton and Nicholson (2007) have also documented subsistence variability in the historical records. They advocate that Aboriginal subsistence is marked by adaptive flexibility and included three different orientations: specialized bison hunting, generalized woodland foraging, and mixed foraging with horticulture. This has been validated by the identification of micro-botanical evidence of maize and bean phytoliths and/or starches in residue collected from Avonlea, Laurel, Blackduck and Vickers pottery vessels (Boyd and Surette 2010; Boyd et al. 2006b, 2008; Lints 2012; Surette 2005). This early, and widespread distribution of domesticated plant foods, and the possible year-round availability of bison has ramifications for the proposed subsistence strategies of the Blackduck complex, the Vickers focus and the Mortlach complex.

Past archaeological interpretations of subsistence strategy have relied on faunal recoveries because bone usually preserves well in the archaeological record due to its partial inorganic chemical composition. Also, animal food procurement sites such as large mammal communal kills are highly visible and have been the focus of archaeological research since the beginning of Plains archaeology. Past diet can be inferred from the animal bones recovered at a site by performing a qualitative and quantitative analysis of the faunal assemblage (Campana 1995; Lyman 1994a). Research findings of studies on modern hunting and gathering groups has provided a foundation from which archaeologists can explain food procurement, processing, preparation and discard behaviours (Binford 1978, 1981; Dahlberg 1981; Lee and Devore 1968; Smith 1983).

The subsistence strategies of the Blackduck complex, Vickers focus and Mortlach complex located on the Canadian Northeastern Plains have been inferred from only a few key comprehensive faunal analyses or from qualitative faunal descriptions, as well as from non-food aspects such as material culture or site location (Badertscher et al. 1987; Graham 2005; Hamilton and Nicholson 1999, 2006; Hamilton et al. 2007; Magee 1997; Playford 2001a, 2010; Playford and Nicholson 2006; Snortland-Coles 1979; Syms 1977). According to Graham (2005:59), there are almost 50 identified Blackduck sites in southwestern Manitoba, but quantitative faunal analyses have been undertaken and reported for only two, the Stott and Heron sites (Badertscher et al. 1987; Hamilton 1982; Hamilton et al. 1981; Tisdale 1978; Walker 1996). Of the eight identified Vickers focus sites, the Jackson and Vera site faunal assemblages have been analyzed and published, although early qualitative results were presented for some of the Lovstrom site material (Nicholson 1986, 1990; Nicholson and Gibson 1990; Nicholson and Kuijt 1990; Nicholson and Malainey 1991, 1995; Playford 2010; Playford and Nicholson 2006). Walde (2003:99-154) presents a comprehensive summary of the Mortlach sites identified up until the mid-1990s. Of the 23 sites he lists, he only describes the Lake Midden site as having had any type of extensive faunal analysis completed although several of the sites are proposed communal bison kills. Malainey (1995) had undertaken a faunal study as part of her report on the Mortlach complex Lozinsky site in central Saskatchewan. Subsequent to these publications, Magee (1997) undertook an extensive examination of a faunal sample from the Sanderson site as part of his Master’s thesis at the University of Saskatchewan.

Because seasonality is suggested to be an influencing factor in the subsistence decision-making processes of Blackduck, Vickers and Mortlach peoples, it is imperative that sites with good indicators of seasonality be examined. Archaeofaunas containing seasonally restricted resources such as migratory waterfowl, fish or foetal bison elements have the potential of providing reliable seasonality estimates (Monks 1981). Site seasonality estimates are often provided either as general categories such as cold or warm, winter or summer or by simply compounding seasons as in late fall/early winter or late winter/early spring. Explicit definition of what these seasons constitute is rarely provided, and when they are defined, it is within the westernized four season paradigm of spring, summer, fall and winter (i.e. Nicholson 1987a; Syms 1977).

Problem Statement

Any subsistence strategy is comprised of a series of subsistence choices, and to properly reconstruct the subsistence strategy of a group, it is necessary to understand their subsistence choices throughout an entire seasonal year. The Blackduck complex, Vickers focus and Mortlach complex sites identified on the Canadian Northeastern Plains exhibit apparent subsistence variability, especially in terms of animal food subsistence choices. The recent identification of domesticated plant foods like beans and maize from pottery vessels associated with all three groups suggests additional subsistence choices in terms of plant food resources (Boyd and Surette 2010; Boyd et al. 2006b, 2008; Lints 2012; Surette 2005). It is not clear whether this apparent variability noted between cultural entities reflects true intergroup variability in subsistence choice (due to one or a series of factors such as seasonality, socio-political organization, culture contact and/or change, and environmental parameters) or whether such distinctions reflect an incomplete or non-representative archaeological record. Almost no sites with a known season of site occupation have quantified food subsistence choice interpretations.

Purpose Statement and Objectives

This dissertation addresses variability in subsistence practices at six archaeological sites representing three different Late Precontact cultural entities found on the Canadian Northeastern Plains. While all three groups were reliant upon bison, variation in the detail of prey choice and degree of bison processing may reflect culturally mediated differences indicative of differing socio-economic orientations of these populations. Alternatively, the apparent inter-assemblage variability might reflect differences deriving primarily from the season of site occupation.

To answer these questions, the following objectives were established.

Objective 1

Compare animal food subsistence choices that have been inferred to exhibit variability from Plains Blackduck complex, Vickers focus and Mortlach complex sites located on the Canadian Northeastern Plains.

Objective 2

Develop a new measure of establishing site seasonality involving consideration of foetal bison osteological development and apply it to the foetal bison assemblages from each site to determine site seasonality.

Objective 3

Explore Aboriginal concepts of seasonality and identify significant seasonal socio-economic activities important to Plains and Woodland adapted people to better understand subsistence variability.

Resource Management Implications and Applications

Although no current figures exist, based on previous studies in Ontario, it is safe to conclude that the majority of Canadian archaeological studies are now being undertaken in fulfillment of heritage resource impact assessments and mitigations required by provincial and federal legislation (Ferris 1998:235). The Canadian Constitution identifies property rights as a matter of provincial or territorial jurisdiction. Because of this, archaeological (or the more all-encompassing heritage) resources are managed by the individual provinces or territories, whereas resources located on Crown lands are managed by federal agencies such as Parks Canada. To review the history and scope of federal and provincial heritage legislation and its implications is far beyond the scope of this dissertation. However, there are two key important issues to note.

One is the distinction made between academic archaeology and that of heritage/cultural/archaeological resource management, or what is commonly referred to as consulting archaeology. Academic archaeologists strive for scholarly excellence as determined by peer-reviewed publications or presentations and awarding of successful research funding.   Consulting archaeologists instead must implement resource management policies that meet the criteria of licensing agencies (Nicholson 2000:184).

The second issue is the use of established criteria to determine archaeological potential. Projects potentially impacting archaeological resources require an archaeological impact assessment to be undertaken to determine the nature and extent of the potential impact. Different jurisdictions have created their own policies and guidelines for consulting archaeologists to assess archaeological resource potential. Ontario has recently released comprehensive guidelines for consulting archaeologists that were developed over a five year period and included consultation from a variety of stakeholders (Ontario Ministry of Tourism and Culture 2011). In Manitoba, the following criteria were established in the early 1990s to assess archaeological potential (Badertscher 1990):

1. proximity to known heritage resource site,
2. proximity to areas previously investigated/or heritage concerns,
3. size of project,
4. prior use and/or land disturbance,
5. archival data available,
6. proximity to watercourses and bodies of water; and
7. landform features to be affected.

"If there are no conflicts between the project and known or potential heritage resources, the project is approved and the development proceeds.. . . If, however, it appears that *significant* heritage resources will be adversely impacted by the project, the project will be advised by the Historic Resources Branch that a heritage resource impact assessment will be necessary." (Badertscher 1990:07, emphasis added). These criteria are essentially a basic inductive predictive model based on the location of already known resources and their associated landforms to predict where future resources may be located (Hamilton 2000:44-45). This is problematic for two main reasons. It runs the risk of perpetuating conventional wisdom (Hamilton 2000:45) and it relies heavily on the existing archaeological record to predict future recoveries.

While not disregarding the usefulness of inductive predictive models, deductive models that could potentially synthesize land use, settlement pattern and economic orientations, might better address heritage resource prediction (Hamilton 2000:45). Such models would be an essential tool for heritage resource managers to identify areas of increased resource potential. Also of concern is the decision-making process to undertake impact assessments only when *significant* heritage resources are encountered. An examination of Manitoba's heritage legislation and implementation is in and of itself a dissertation topic, but it is suffice to note here that the archaeological regulatory body in Manitoba identifies seven inductive criteria to determine if a project will potentially impact archaeological resources. When significant resources are encountered, an impact assessment and potential mitigation will be undertaken.

Although the main purpose of this dissertation is not the development of a deductive predictive model, the results can be incorporated into the creation of such a model. Furthermore, academic archaeology should contribute to the development of consultation practices. The gap between academic and applied archaeologists stems from perceived (and real) differences in obligation, and quality of work. Academic archaeologists rarely consider cultural resource management, and applied archaeologists have little engagement with current theoretical developments (Birch 2006:41-44). In an attempt to bridge this gap, the following supplementary objective of this dissertation was established

Objective 4

To provide consulting archaeologists with an accessible, easily applied tool to establish season of site occupation. Furthermore, a better understanding of site subsistence variability can be incorporated into the criteria for assessing archaeological potential currently being employed.

Methodology Overview

To determine if subsistence variability is a factor of seasonality, the season of site occupation must be a constant rather than a variable. This was accomplished by selecting sites with foetal bison remains and devising a method of estimating site seasonality based on these recoveries. Once seasonality becomes a constant, quantified subsistence choices executed by different site inhabitants can be compared. To achieve this, faunal assemblages from two Blackduck, two Vickers and two Mortlach sites were analyzed to interpret and compare the animal food resource subsistence choices of species diversity and intensity of bison processing within each group and between groups. A better understanding of how the site inhabitants may have conceptualized seasonality enabled intra- and inter-site subsistence choice comparisons. To accomplish the three main and one supplementary objective, it was necessary to:

1. review previous interpretations of the subsistence strategies interpretations employed by Blackduck, Vickers and Mortlach groups;
2. select Blackduck, Vickers and Mortlach sites using established criteria to enable valid intra- and inter-site comparison;
3. analyze the faunal assemblages from the selected sites following a standardized analysis procedure;
4. select observable animal food subsistence choices which could be quantified for each of the selected faunal assemblages;
5. create a method of estimating site seasonality based on the presence of foetal bison remains and apply that method to the selected faunal assemblages;
6. explore Aboriginal concepts of seasonality;
7. compare intra- and inter-site animal food subsistences choises of the selected sites;
8. re-evaluate intercultural subsistence choices using measures of species diversity and bison processing intensity for the selected Blackduck, Vickers and Mortlach sites by placing them within a framework of Aboriginal seasonality; and
9. examine the resource management implications of these results.

Theoretical Perspective

Until the 1960s, North American archaeology was concerned primarily with developing cultural chronologies and archaeological taxonomies. This cultural-historical approach defined distinct, geographically-bound archaeological cultures based on material culture traits and was essentially a descriptive endeavour (Trigger 1989). Although Taylor (1948) was the first to argue for an integrated approach to archaeology, aligning it with anthropology and using scientific methods to understand the archaeological record, it was not until the publications of Binford (1962, 1964, 1965) that these ideas were accepted.

The “New Archaeology” saw itself as part of anthropology and attempted to reveal the universal processes of culture change. The belief that these cultural processes could be completely reconstructed gave rise to the term processual archaeology (Trigger 1989:295). Processual archaeologists studied the archaeological record using a scientific approach based in logical positivism. They undertook quantitative data analysis on, and applied the scientific method to, the archaeological record. Whitley (1998:04) pointed out that processual archaeology relies on behaviourism, which holds that people and the things they create can best be understood in terms of stimulus and response relationships. In such a scenario, the environment plays a pivotal role in determining human behaviour. Systems theory became an important interpretative component of processual archaeology. By treating the archaeological record like a natural system, elemental components could be studied separately to determine cause and effect (Flannery 1968).

The idea that archeological study could be wholly objective if adhering to the scientific method was criticized by postprocessual archaeologists (Hodder 1985, 1986, 1991; Shanks and Tilley 1992). This reflects the growing influence of postmodern thought in the social sciences (VanPool and VanPool 1999:35). Postmodernism argues that science, including archaeology, is subjective and that universal laws do not exist. It is also argued that processual archaeologists focused too heavily on materialist interpretations which left no possibility of understanding non-material aspects of culture (Hodder 1985). Postprocessual archaeologists challenged behaviourism by recognizing that the human mind and cognition were key factors in the creation of the archaeological record (Whitley 1998:05).

Postprocessualism does not encompass a single prevailing theoretical approach. Schiffer (1988:479) described it as shattering archaeology into a thousand pieces. VanPool and VanPool (1999:36) instead classified two types of postprocessualists: hyperrelativists and moderates. Hyperrelativism rejects all truth and knowledge and argues that no aspect of the archaeological record can be understood through archaeological research. They saw archaeological interpretations as being created by individual bias, which is partly a result of group ideology, so archaeology in inherently political. Any archaeological research then is a means of accomplishing specific political goals. Alternatively, moderate postprocessualists recognized that the archaeological record exists and can be studied. Truth and knowledge are not rejected, but there is a recognition of uncritically accepted, and often subconscious, assumptions (Conkey and Spector 1984; Shanks and Tilley 1992). "Their interpretations are intended to empower aboriginal and other disenfranchised groups, show inequalities or inconsistencies within the current social structures, and challenge the dominant views of archaeological knowledge"(VanPool and VanPool 1999:36).

Watson (2008:35) suggested that archaeologists endeavour to incorporate the most useful portions of individual theories, and this dissertation incorporates aspects of all three major theoretical archaeological perspectives. Webster (2008:20) stated that much of archaeology today is still studied within the cultural historical organization framework of archaeological cultures, culture areas and types, etc. This study continues that practice. Furthermore, assuming a processual or moderate postprocessual viewpoint, archaeological research should continue to contribute to the development and refinement of cultural histories. By undertaking site level analysis of faunal assemblages from three different archaeological cultures, the results of this dissertation directly contribute to the culture history of the Canadian Northeastern Plains. Methods of processual archaeology, and their underlying theoretical implications, are used to quantify the subsistence strategy choices of species utilization and intensity of bison processing. Optimal foraging theory, which attempts to explain human subsistence in terms of energy expenditure and gain, will be further explored in Chapter Four. Recognizing that precontact site inhabitants likely did not perceive seasonality in the same way the author does, the attempt to reconcile that difference is very much a postprocessual theoretical application.

Organization of the Study

This dissertation is composed of three separate components which are integrated to gain a better understanding of the subsistence decision-making processes exhibited at two Blackduck, two Vickers and two Mortlach archaeological sites on the Canadian Northeastern Plains. Chapter One introduces the subject matter of subsistence strategy interpretations on the Canadian Northeastern Plains and how subsistence variability and seasonality are potentially connected.

Chapter Two presents an extended review of human occupation of the Canadian Northeastern Plains from initial population until European contact. A brief explanation of archaeological taxonomies and cultural chronologies is presented to show how archaeologists conceptualize and organize the archaeological record. Archaeological cultures of the Early and Middle Precontact time period are briefly reviewed, and a more in-depth discussion of the Late Precontact time period sets the stage for the Blackduck complex, Vickers focus and Mortlach complex summaries. The material culture, site selection variables, inferred settlement patterns and a comprehensive examination of the interpreted subsistence strategies for these three groups are presented.

Chapter Three outlines the site selection criteria used to choose the Blackduck (Hokanson and Lovstrom), Vickers (Jackson and Vera) and Mortlach (Sanderson and Twin Fawns) sites which will enable intra- and inter-site subsistence choice comparisons. Site descriptions are presented for each site and include site location, environmental setting, environmental reconstruction, excavation history and procedures, cultural assemblage and affiliation, as well as the sample used in the dissertation. The assessed ecological diversity of each site is presented to determine if they have similar levels of ecological diversity which is necessary to enable inter-site comparisons.

The fourth chapter presents the analyzed faunal data for each selected site. The faunal analysis methodology is presented prior to the data presentation. A discussion of subsistence strategy reconstruction results in the quantification of two animal food subsistence choices, species diversity and bison processing intensity. Species diversity is examined using richness, evenness and the Shannon Index of Diversity. Fragmentation rates and economic bison utility indices were selected to assess the intensity of bison processing.

The creation of a bison foetal osteological development sequence (FODS) is outlined in Chapter Five. A review of the methods used to estimate site seasonality from recovered bison bones indicates that foetal bison elements have the potential to provide more precise estimates of site seasonality. Prior to creating the FODS, an extensive review of the historical documents, coupled with modern herd studies, indicates that bison do have a seasonally restricted parturition and that foetal element size can be used as a proxy for gestational age. Measurements were taken of modern foetal bison appendicular elements of known age and linear regression equations were calculated by plotting these measurements against gestational age. The foetal assemblages from each site are described, and seasonality was estimated based on application of the linear regression equations. When the archaeological foetal assemblages did not contain measurable elements, comparisons were made to the modern samples to estimate seasonality.

Chapter Six explores the different concepts of seasonality. A review of the westernized four season paradigm is contrasted with Aboriginal seasonality concepts, which can include up to six seasons. Traditionally, Aboriginal societies recognize and measure seasonal change through consideration of socio-economically important changes in the biophysical environment. The use of language markers such as moon-names are used to identify significant seasonal events for Woodland and Plains adapted groups.

Chapter Seven is the discussion section which incorporates the quantified animal food subsistence choices for sites with known season of site occupation and places them within a framework of Aboriginal seasonality. By doing this, it can be determined whether the differences in species diversity and bison processing intensity observed at the six sites are a factor of seasonally significant events. The final chapters present a brief summary of each chapter, highlight the main conclusions and propose recommendations for further work.

CHAPTER 02: SUBSISTENCE AND SEASONALITY ON THE CANADIAN NORTHEASTERN PLAINS DURING THE LATE PRECONTACT TIME PERIOD

Introduction

Prior to presenting a detailed culture history of the Canadian Northeastern Plains, *how* the Canadian Northeastern Plains study area came to be defined is examined. An overview of evidence of human occupation of this area is presented in chronological order from the earliest dated sites up to the historic time period after a brief explanation of archaeological taxonomies and cultural chronologies. Inferred subsistence and seasonality indicators are emphasized for each archaeological culture to provide a basis for understanding the complex nature of Late Precontact subsistence models. An expanded review of the Blackduck, Vickers and Mortlach cultural affiliations is provided and their inferred subsistence strategies are examined.

Culture Area Concept

The organization and classification of museum collections according to natural geographical areas was likely the antecedent of the culture area concept employed by American anthropologists and archaeologists. Wissler (1917) was one of the first anthropologists to organize and classify indigenous Native Americans based on the presence of grouped traits (Figure 2-1). By grouping similar traits such as subsistence, mode of transportation, textiles, artwork and religious rites, Wissler (1917) delineated nine culture areas including the Plains. Typical cultures of each area exhibited many of the defining traits for that region, while marginal cultures exhibited fewer of the defining traits.

Wissler (1923, 1928) later argued that the culture area concept had a theoretical application and hence could be applied to contemporary groups. He emphasized the cultural center, and believed that the environment offered a limited number of possibilities for cultural growth. This idea was countered almost immediately with criticism as it was thought that modern societies were

Figure 2-1: Wissler's culture map of North America.

simply too heterogeneous to be usefully classified using such a scheme (Willey 1931). Others (Wood 1934) dismissed the culture area concept outright, stating that Wissler had drawn generalizations too broadly and that in some areas there were far more marginal tribes than typical ones. Indigenous cultures were also too heterogeneous to be understood in such a simplistic manner. When non-material cultural traits were included in the analysis, these did not coincide with the material traits, suggesting that the theory was applicable only to material culture and not cultural groups.

Other anthropologists soon expanded upon Wissler’s culture area concept. Kroeber (1939) examined the Native cultures of North and South America using not only cultural traits, but also tribal distribution and natural vegetation. Lowie

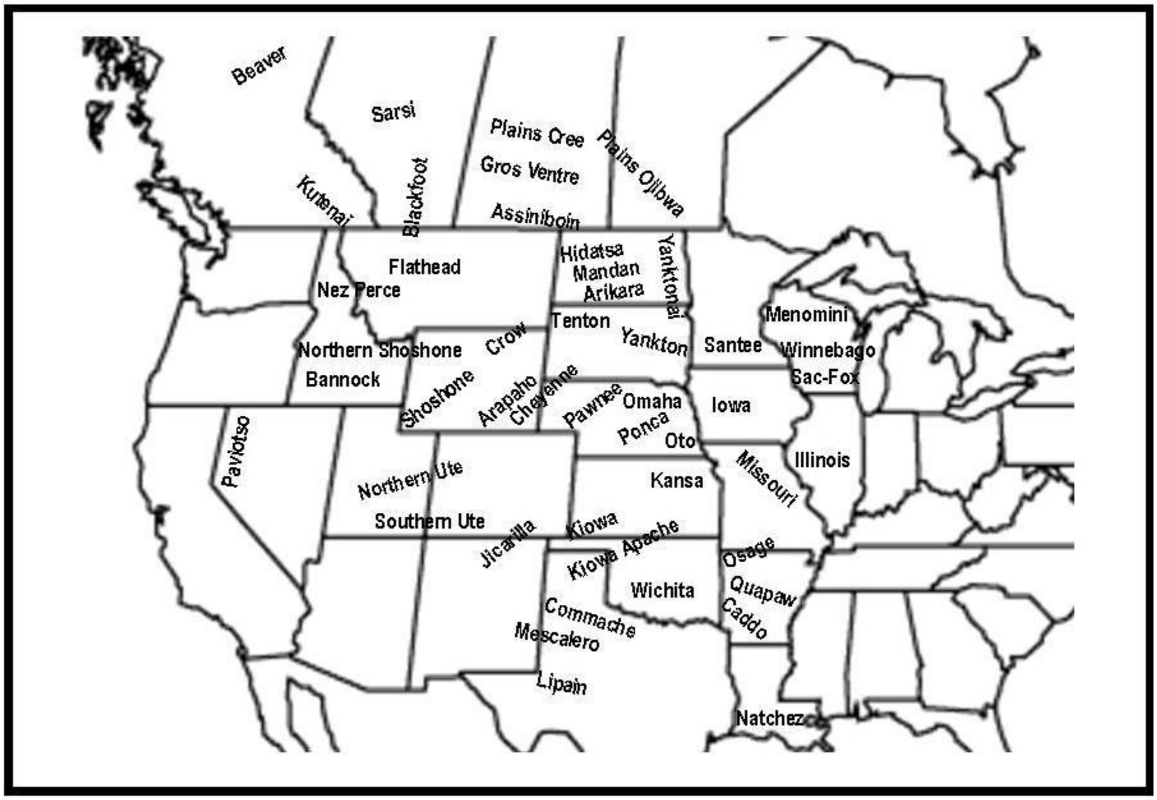
(1955) disagreed with Wissler's ideas about a cultural centre but adamantly defended the culture area concept. Wissler had essentially established the basis for cross-cultural studies. While the application of the culture area as a theoretical concept has since been eclipsed, its use as a descriptive and classification device has become an essential heuristic device for anthropologists and archaeologists. The term culture area is used here in this descriptive manner, not as the theoretical concept Wissler originally intended.

The North American Great Plains

The North American Great Plains was the area in which Wissler had undertaken his own brief field work between 1902 and 1905, and his 'Hunters of the Plains' culture area extended from eastern Washington to western North Dakota southward to include all of Texas (Freed and Freed 1992). Lowie (1954:01-02) explained that classifying the Plains using geographical criteria is problematic, as vegetation gradually changes across the Plains, precipitation varies year to year, and elevation can vary dramatically within localized areas. He even went as far as to not show boundaries on his culture areas map (Lowie 1954:03) (Figure 2-2).

A study by Rossum and Lavin (2000) showed that while most people do recognize the North American Great Plains as a distinct geographical region characterized by relatively flat, semi-arid grassland, a comparison of 50 published maps indicated that the boundaries varied considerably. This variation was a result of the criteria used to define the Plains and whether or not the researchers chose to include Canada. On some maps, only physical criteria were employed; in others, only cultural, and on other maps, both physical and cultural traits were used to delineate boundaries (Rossum and Lavin 2000:544). Recognition that the Great Plains are not, nor were they ever homogenous, and that variation exists (and existed) especially in terms of vegetation cover, fauna, precipitation, etc. is a principle well understood by archaeologists (Kornfeld and Osborn 2003). Attempts to delineate some of this variation (both cultural and natural) has resulted in the identification of five regional subareas. It is imperative to remember that the boundary lines marked on maps are arbitrary,

Figure 2-2: Lowie's culture map.



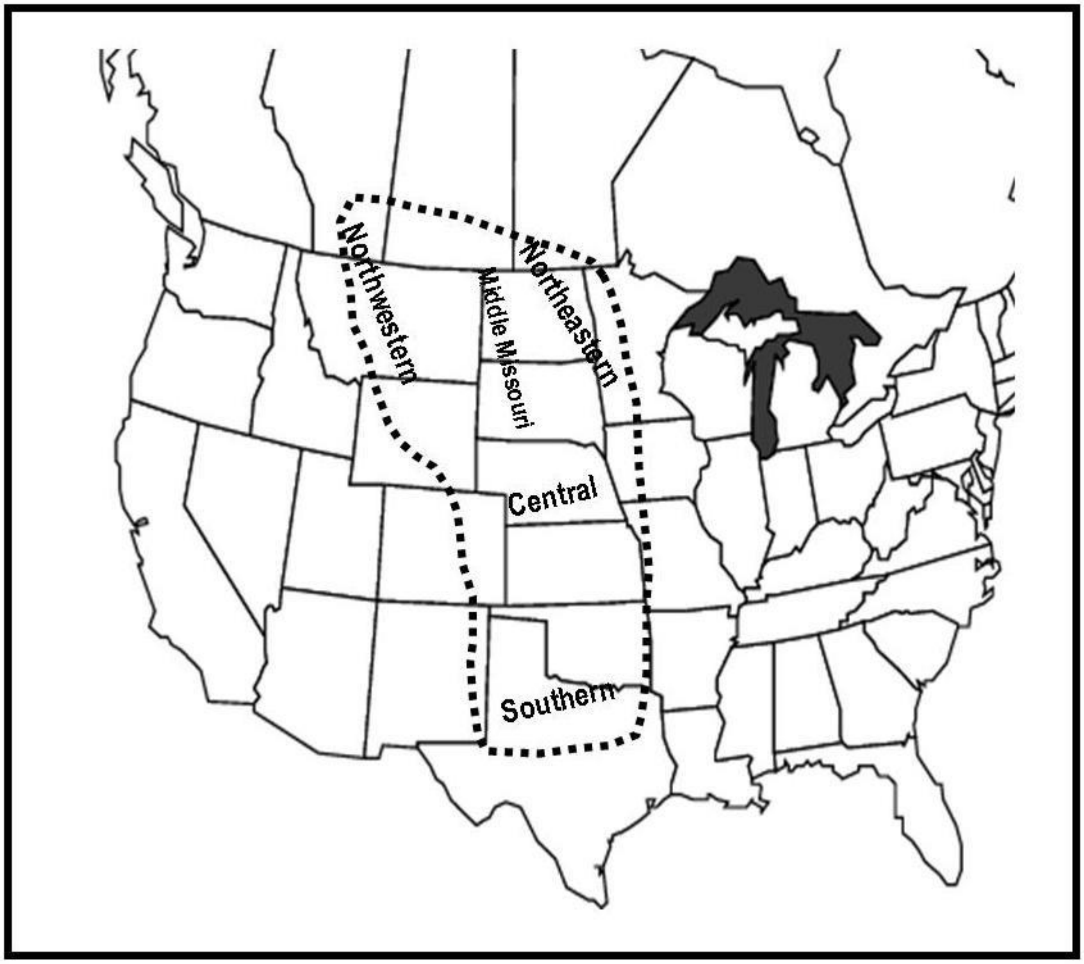
and that interaction along and between these ‘boundaries’ occurred (Wood 1998:10).

Wedel’s (1961) examination of Plains prehistory presented the subarea classification scheme still in general use today. It should be clarified that Wedel (1961:24) did not conceptualize the Plains in terms of a distinctive culture area. Instead, “. . . the native cultures and ways of life have varied greatly from section to section, as well as from time to time within each section. Nonetheless, there are certain broad uniformities of environment in the region encompassed.” (Wedel 1961:24). His five subareas included the Central Plains, Southern Plains, Middle Missouri, Northeastern Periphery and Northwestern Plains (Figure 2-3).

The Northeastern Plains

Wedel (1961:210) perceived the Northeastern portion of the Plains as a periphery. He contended that the roots of the historic and archaeological cultures located there were found to the east in Minnesota and Iowa. Geographically, he classified the Northeastern subarea as being marginal to the

Figure 2-3: Five sub-areas of the Great Plains.



Plains, and considered the designation as a periphery as appropriate. This has since been challenged by other researchers who have identified discrete groups distinctive to the area. The idea that a region several hundred kilometers across be deemed a periphery has been dismissed (Anfinson 1997:02) and the subarea has since been renamed the Northeastern Plains (Gregg 1985a:67).

The Northeastern Plains subarea extends from the extreme northwest corner of Iowa along the western boundary between Minnesota and the Dakotas, through the centre of the Dakotas north along the southwestern corner of Manitoba and into the southeastern corner of Saskatchewan. The subarea is bounded on the west by the Missouri Escarpment, and on the east by the Eastern Woodlands. The northern edge of the subarea corresponds to the northern margin of the grasslands and the southern boundary is delineated by the presence of the Dissected Till Plains in Iowa and Minnesota. Fifteen archaeological regions have been designated within the Northeastern Plains according to Gregg et al. (1996:77), but the designations reflect a preoccupation with American archaeological research. Only four regions extend into Canada, and none are exclusive to Canada. Furthermore, the largest region, the Souris River Basin region actually includes the southern Assiniboine River Basin (Gregg et al. 1996:77). While the recognition of archaeological research areas could be a useful descriptive scheme, none adequately describe the Canadian portion of the Northeastern Plains which is considered here as its own archaeological region.

There is an obvious understanding that while the Plains reflect a distinct area identified by specific physical, biological and cultural traits, none of these have remained constant through time. Climate is a primary influencing factor of biological traits, and changes in climate are often reflected in vegetation. Wedel (1986) developed a chronology of episodes summarized in Table 2-1. This model offers coarse scale resolution (Hamilton et al. 2011:100) but does provide context for the socio-cultural environment.

Social-Cultural Context

Understanding Archaeological Taxonomies and Chronologies

Taxonomy is simply a hierarchical classification system. Several different archaeological taxonomic schemes have evolved over time, and these different schemes, or variations of a single scheme have been used to classify the archaeological record on the Canadian Northeastern Plains. Taxonomies are the foundation for chronologies which attempt to conceptually organize the archaeological record into sequential order. Artifact types provide the basic classification unit for devising taxonomies and chronologies. A type has been defined as a distinguishing cluster or pattern of attributes. Some archaeologists regard types as being artificial constructs of the researcher to categorize artifacts, while others believe they represent reality and are manifestations of the society who created them. Others fall somewhere between these two opposing ideas.

Table 2-1: Macro-scale climatic episodes for the Plains.

Episode	Date Ranges in ya (approx.)	Events
Recent	Post 100	stronger westerlies starting 1883, drier, warmer on the Plains, end of the Little Ice Age, beginning of present day climate
Neo-Boreal	400-100	Little Ice Age, colder, moister, cool summers, cold autumns, glaciers reform in Rockies
Pacific	800-400	stronger westerlies, increased Pacific airflow, return to drier conditions, cooler and drier in central and Northern Plains, steppe conditions move eastward, prairie retreats
Neo-Atlantic	1225-800	Increased moisture, warming trend peaks, more Gulf airflow, increases summer rain in central and Northern Plains, prairies move westward
Scandic	1600-1225	transition period, warming trend, return to Atlantic conditions, warmer and drier in Northern Plains
Sub-Atlantic	2900-1600	general deterioration, wetter summers, stormier winters
Sub-Boreal	5000-2900	cooler, more precipitation in Northern Plains, increased Arctic airflow
Atlantic	7900-5000	Altithermal, stronger westerlies, more Pacific air, climate warmer and drier, extensive desiccation of the Plains, maximum expansion of grasslands
Boreal	9530-7900	atmospheric circulation patterns change, rapid wasting of continental ice sheet, climate increasingly continental, warmer summers, colder winters, grassland predominate by 9500
Pre-Boreal	10,800-9530	warming trend, continued grassland expansion, beginning of Holocene at 10,870
Late Glacial	13,000-10,800	cooler summers, warmer less severe winters, Boreal Forest retreats northeast, grassland expand, mean temperature a few °C cooler than present
Full Glacial	To 13,000	cooler summers, milder winters, widespread Boreal Forest in Northern Plains

and think that types have a reality as folk taxonomies, but the knowledge of the true taxonomy is uncertain (Syms 1977:69). Apart from what a type actually represents, they have consistently been used by archaeologists to classify and organize the archaeological record and are used here for that purpose.

On the Canadian Northeastern Plains, three main taxonomic schemes have been employed (Table 2-2). In the 1940s, Chris Vickers combined the Midwestern Taxonomic System (MTS) as used by Minnesota researchers with the direct historical approach to develop a chronological framework for southern Manitoba. A new taxonomy was introduced by Willey and Phillips (1958) in the late 1950s, and in the late 1970s, Syms (1977) created a third taxonomy when he introduced his Co-Influence Sphere Model. This model shifted from the individualistic regional approaches to one that was more integrative, recognizing that complexes (or other alternative conceptual classifications) cut across biomes

Table 2-2: Archaeological taxonomic terminology.

MTS (McKern 1939)		Willey and Phillips (1958)		Syms (1977)	
Term	Description	Term	Description	Term	Description
Base	most fundamental trait of subsistence category (i.e. horticulture-pottery base; seed-gathering-basketry)	Climax			
Pattern	series of traits reflecting primary adjustments to the environment (i.e. Mississippian vs. Woodland)	Civilization Culture	later developmental stage early developmental stage	Pattern	primary adjustment to subsistence base
Phase	similarity in ceramics technology, house type or burial pattern	Horizon Tradition	spatial restriction temporal continuity represented by persistent configuration in technologies or other systems (i.e. settlement or ceramic traditions)	Configuration	distant genetic ancestry or cultural convergence
Aspect	similar pottery decoration with variety of expressions			Composite	complexes with shared traits indicating common ancestry
Focus	local tribe level with identical decorative motif	Phase	Units with characteristic traits sufficient to distinguish from other similarly conceived units (some culture or not) short temporal distribution; spatially restricted	Complex	group who shared lifestyle and tool kit in short time span
Component	site level expression of focus	Component	site level expression of phase	Assemblage	site level expression of complex

and research areas. According to Syms (1977:70), “In Manitoba, terms such as phase, focus, complex, and culture have been used without methodological definition, consistency of use, or theoretical implication”. To further complicate matters, artifact type names are commonly used as a cultural identifier. For example, Besant can refer to a projectile point type, a type of pottery, or as the entire material culture of a particular precontact hunter-gatherer adaptation (Cloutier 2004:05). Ideally, artifact types and the higher taxonomic categories would have separate names, but this has not been the practice.

There have been several different archaeological chronologies created for the Canadian Northeastern Plains (Dyck 1983; Gregg 1994; Gregg et al. 1996; Nicholson 1987a, 1987b; Syms 1977; Syms et al. 2010). Figure 2-4 illustrates that while most of the chronologies use a similar division of time, none use the same terminology to describe time periods. Of course, archaeological chronologies are consistently in need of updating as new information can sometimes drastically alter current interpretations of the archaeological record. Another factor influencing the development of these different chronologies is the research area of the individuals. The chronologies developed specifically for southern Manitoba (i.e. Nicholson 1987a, 1987b; Syms 1977) tend to be influenced by developments and research taking place in the Boreal Forest as well as the Middle Missouri culture area and the Eastern Woodlands, while Saskatchewan chronologies (i.e. Dyck 1983) tend to be more heavily reliant on developments in the Northwestern and High Plains culture areas. This reflects the geographic reality that adjacent culture areas influenced Saskatchewan and Manitoba peoples in profoundly different ways.

The purpose of the above discussion is to recognize that there are competing Canadian Northeastern Plains taxonomies and chronologies in the archaeological literature and that the terminology and inferred implications of the terminology used in each can be quite different. To discuss the merits and limitations of each taxonomy and chronology is far beyond the scope of this dissertation. A generalized chronology is presented below without adherence to one specific taxonomic or chronological scheme. Instead, an attempt has been made to incorporate the most current thinking with theories that have been well established in the published literature. This generalized chronology is then used to set the stage for a more in-depth examination of the Blackduck, Vickers focus

Figure 2-4: Northeastern Plains archaeological taxonomies.

Years BP	Syms 1977		Nicholson 1987a	Dyck 1983	Gregg et al. 1996			Syms et al. 2010
200	Late Woodland	Late/Early Historic			Plains Woodland			
500		Middle	Neo-Indian	Late Plains Indian			Plains Village	Late Side-Notched Tradition
		Early				Late		
1000	Middle Woodland							
1500								
1000						Middle		
1500								
2000	Early Woodland		Meso-Indian			Early		Plains Early Ceramic
2500				Middle Plains Indian	Plains Archaic	Late		Plains Intensive Diversification
3000						Middle		
3500								
4000								
4500								
5000								Early Side-Notched
5500						Early		
6000								Plano
6500								
7000								
7500								
8000				Early Plains Indian	Paleoindian			
8500			Paleo-Indian					
9000								
9500								Folsom
10,000								
10,500				Pleistocene Hunters				
11,000								Clovis
11,500								
12,000								Glacial Lake Agassiz
12,500								
13,000								
13,500								
14,000+								

and Mortlach archaeological cultures.

The Early Precontact Period (Paleoindian): 12,000 – 8000 ya

This early period is commonly called the Paleoindian period in North America and coincides with the end of the last glacial episode. The term Paleoindian is still prevalent in the literature although Aboriginal people today find the term derogatory, feeling that it relegates them to fossils, so the term is not used here.

Meyer et al. (2011:06) described the Early Precontact period as the transition from the Pleistocene to the Holocene and stated that it is marked by substantial climatic and landscape changes associated with the deglaciation of North America. The Turtle Mountains were the first part of Manitoba to be exposed from the receding ice sheets about 11,500 ya, and the rest of the Western Uplands were freed of ice within the next 500 years (Pettipas 2011:07-09). With the receding of the glacial lakes and the colonization of a mosaic shrub tundra and white spruce parkland, the southwestern corner of the province became inhabitable (Pettipas 2011:32).

Two traditions are identified for the Early Precontact period. The Llano tradition existed roughly around 11,200 to 10,200 ya and is comprised of the Clovis and Folsom complexes. The subsequent Plano tradition dates between 10,500 and 7,800 ya and is comprised of the Agate Basin, Hell Gap, Alberta, Cody and Late Plano complexes (Meyer et al. 2011:06). It had long been thought that the distinctive fluted Clovis points sometimes found in association with extinct megafauna represented the earliest occupation of the New World by bands of big game hunters entering via the Bering Land Bridge (Haynes 1987). Compelling evidence in the form of contemporaneous or earlier dated sites without a Clovis toolkit has challenged this “Clovis First” model (Walters and Stafford 2007:1125). The debate regarding the origin and fate of the pre-Clovis population is essentially extraneous here as no definitive pre-Clovis materials have been recovered from the Canadian Northeastern Plains. It is generally accepted that Clovis materials represent the first evidence of human occupation on the Canadian Northeastern Plains (Meyer et al. 2011; Peck 2011; Pettipas 2011).

The Clovis complex is dated between 11,300 and 10,900 years ago and is well represented across the American Great Plains (Holliday 2000). In addition to a lithic technology utilizing high quality material, it appears that Clovis people also produced bone and ivory tools. Recovered bone and ivory rods are thought to represent spear foreshafts or atlatl darts (Meyer et al. 2011:10). The perceived predominance of Clovis materials at large game kill sites has led to the identification of Clovis as being specialized big-game hunters (Frison 1998; Hill 2007:417) who took part in organized communal mass kills (Robertson 2006). Stanford (1999:326) argued that Clovis people were not focused on large game and instead, “had a generalized foraging economy that utilized a wide range of resources”.

No excavated sites have been recorded on the Canadian portion of the Northeastern Plains although projectile points have been identified in surface collections. Water levels of Glacial Lake Agassiz made much of Manitoba uninhabitable until around 10,500 ya, which corresponds to the appearance of Folsom projectile points.

Folsom points are much like Clovis, but tend to be smaller and have a much larger flute. Like Clovis, Folsom projectile points are not well represented in Manitoba’s archaeological record. Unlike during Clovis times, there were no physical barriers such as glaciers or glacial lakes to explain the lack of Folsom recoveries in southern Manitoba (Pettipas 2011). Instead, it is postulated by Boyd (2007) that the area was marked by a low plant biomass/carrying capacity and could not support large game although Pettipas (2011:38) states, “All things considered, the Folsom economy can be described as ’broad based’ with a very strong preference for bison”.

Later Paleoindian projectile point types of the Plano tradition are more numerous in southern Manitoba and adjacent Saskatchewan. These later Paleoindian points represent a non-fluted stemmed point tradition starting about 10,000 ya and are recovered across the entire Plains culture area. Plano projectile points recovered from southern Manitoba include Agate Basin, Hell Gap, Alberta and Scottsbluff. Makers of these point types continued to focus on hunting extinct species of bison, and large-scale bison kills date to this time period on the High Plains (Meyer et al. 2011:20-24).

The end of the Paleoindian period came about 8000 years ago with the complete disappearance of Lake Agassiz and the development of Lakes Winnipeg, Winnipegosis, Manitoba and Dauphin in Manitoba. The Canadian Shield became covered in Boreal Forest while the grasslands expanded up to the western shores of Lake Winnipeg (Pettipas 1996). This also coincides with the onset of a warmer, drier climate most commonly referred to as either the Altithermal (Meltzer 1999) or the Hypsithermal (Deevey and Flint 1957). This change corresponded with a northward shift of more temperate ecological communities, coupled with the extinction of the megafauna (Table 2-1). This is associated with the diversification of archaeological cultures throughout the Middle Precontact period.

The Middle Precontact Period (Intensive Diversification): 8000 – 2000 ya

As stated, the end of the Early Precontact and the beginning of the Middle Precontact period coincided with a warmer, drier climate which was believed to have resulted in a reduction of moisture, surface water and declining resource abundance throughout much of the Plains (Meltzer 1999:405-406). The term Archaic has been used as a designation for this time period but has fallen out of favour for two reasons. First, the term Archaic, like Paleoindian, is not preferred by today’s First Nations, given that the word can also mean primitive. The initial archaeological use of the term was meant to designate a lifeway reliant on plants and small game that was followed by people who lived in the Great Basin region of the United States. This may not be reflective of lifeways throught the entire Plains culture area.

At the beginning of the Middle Precontact period, there is a complete shift from the spear to use of the atlatl or spear thrower. This change in hunting technology resulted in changing styles of projectile points from the stemmed or lanceolate spear points to large side-notched darts (Peck 2011). Robertson (2006) correlated this change in hunting technology with a shift from communal large game hunting in the Early Precontact to a focus on more individualistic hunting. There is a general consensus that that people living during the Altithermal were thought to have responded to the changed environment by adopting a broader range subsistence base with a greater reliance on plants and smaller animals (Frison 1992; Robertson 2006).

Sites dating to the beginning of the Middle Precontact period are relatively rare in the archaeological record and at one point it was believed that the Plains was completely abandoned during this time (Mulloy 1958; Wedel 1961). In contrast, Reeves (1973) argued that this was simply a function of sample error, but a study by Sheehan (1995) seems to confirm the refugia concept, whereby people moved into areas of greater moisture such as river basins, higher elevations and peripheral zones. Dyck's (1983) consideration of southern Saskatchewan sites supports this contention. He interpreted (Dyck 1983:109) that the Middle period was one of the richest periods in Saskatchewan's record, likely due to the presence of human and bison populations which had survived around the fringes of the warm, dry Plains.

The Mummy Cave series, consisting of several different side-notched point styles, represents the first Middle Precontact presence across the Northern Plains and existed between about 7500 to roughly 5000 ya. Bison hunting continued, but it has been questioned whether large communal kills were still being utilized (Walker 1992:129). The species of bison being hunted at the later Mummy Cave sites may not have been an extinct form of bison, as the modern species evolved around 5000 ya (McDonald 1981). Speciating bison recoveries from these sites can be difficult if no cranial or complete elements are recovered, as was the case from the Atkinson site, a Mummy Cave site from southwestern Manitoba (Nicholson and Playford 2004). Evidence of communal hunts comes from the foothills of Alberta (Reeves 1973) and the Black Hills in Wyoming (Frison el al. 1976). Walker (1992:130) suggested that while those sites represent communal kills, the low number of bison from Saskatchewan sites indicate that bison were still an important resource but the procurement strategy revolved around hunting smaller groups of animals. Whether or not Mummy

Cave people shifted to foraging of smaller animals and plants, varied from region to region (Walker 1992:130).

Subsequent Oxbow points, dating between 4700 and 4000 ya are much better represented in the archaeological record and flourish at the end of the Altithermal (Green 2005:101). Classic Oxbow points are side-notched dart points with an indented or concave base, and the shape of the notching produces distinctive “ears”. Citing similarities in lithic technology, most researchers believe that the Oxbow technology developed out of the Mummy Cave Series (Green 2005; Walker 1992). This time period is marked by increased trade as evidenced by native copper and marine shell artifacts (Green 2005:100). Bison bones dominate Oxbow faunal assemblage, indicating the focus of the economy, and an increased presence of stone boiling pits and hearths suggests that bone grease manufacture became an important subsistence element (Peck 2011:191). Interestingly though, no Oxbow bison kill sites have yet been identified, possibly suggesting that large scale kills were not utilized (Nicholson and Webster 2011:84). Instead, “subsistence practices may have been geared toward a wider range of food species. Furthermore, this emphasis on individual procurement of plants and animals may not have been restricted to species other than bison. Instead, the exploitation of bison also may have become an individual pursuit” (Robertson 2006:219). This pattern is consistent with the following McKean complex subsistence (Nicholson and Webster 2011:85).

The McKean complex is comprised of three point types: McKean Lanceolate, Duncan and Hanna. Based on subsistence similarities, these technologies were originally thought to have developed out of the Desert Culture in the Great Basin (Mulloy 1958: Wedel 1961). After re-examining McKean sites, Webster (2004:95-96) concluded that the earliest sites date to about 4900 ya and are located in and around the Wyoming Big Horn Basin. McKean sites first appear in the archaeological record on the Canadian Plains about 500 years later. He also contended that like Oxbow, they too may have evolved from Mummy Cave related traditions (Webster 2004:95-99).

There has been a lot of debate about the nature of McKean subsistence strategies interpreted from Northern Plains sites compared to those interpreted from sites in Wyoming and along the Plains periphery. When taken as a whole, a wide range of subsistence strategies seems to have been practiced by McKean complex people. Large amounts of plant remains, grinding stones and evidence of roasted insects were recovered at a cave site in Wyoming (Frison and Huseas 1968). Other faunal assemblages in this location suggest that small-scale hunting of various mammals was practiced. Based on excavations at an Alberta site, Brumley (1975) suggested that northern McKean groups continued to rely extensively on bison. Webster's (2004) analysis of McKean subsistence suggested that the sites with a broader spectrum of animal species were ones located outside of, or on the grassland fringe such as in the Boreal Forest, Aspen Parkland or tributary systems. Bison-dominated assemblages tend to be found on the open grassland and in the foothills of the Northern Plains. It seems that McKean populations were able to adapt to different environmental areas and maximize local resources (Webster 2004:73-75) and this later led Webster (2009) to classify them as hunter-foragers.

Following the McKean complex is the Pelican Lake complex, with the distinct "Christmas tree" looking projectile point distinguished by sharp shoulder barbs formed with deep corner-notching. These are generally believed to have been dart points, but smaller versions may have been used with the bow and arrow (Nicholson and Webster 2011:91). Pelican Lake points generally date between 3400 and 1800 ya (Peck 2011:225). There is a widespread appearance of the points across the entire Northern Plains and there is evidence that these people had adapted to a bison hunting lifeway right from their initial appearance in the archaeological record. This has some researchers suggesting an in situ development on the Plains and others suggesting that based on point typology, an origin in the Powder River Basin of Montana and Wyoming is more likely. There is also evidence that Pelican Lake people may have interacted or traded with groups in the Eastern Woodlands based on the recovery of shell and copper from a Pelican Lake burial in Saskatchewan (Nicholson and Webster 2011:92-93).

In southwestern Alberta, Pelican Lake faunal assemblages contain heavily utilized bison bone as well as other ungulates, small animals, fish and plants. This is interpreted as representing a subsistence strategy ranging from wide spectrum hunting, fishing and gathering in the west to communal bison hunting on the Plains (Nicholson and Webster 2011:94). There is definitely a greater focus on communal mass kill technology than was seen with the earlier McKean hunter-foragers. These communal kills seem to be restricted to the foothills of Alberta where bison jumps were repeatedly utilized for mass kills and associated bison processing. Most Pelican Lake sites are campsites with only a few bison being represented. Peck (2011:236) proposed that bison kills consisted mostly of solitary hunts away from camp and bison were supplemented with deer, dog or wolf, beaver, mallard duck and trout. Pelican Lake points seem to disappear rather quickly from the archaeological record after a short co-existence with Besant (Nicholson and Webster 2011:95).

The Late Precontact Period (Plains Woodland): 2000 – 500 ya

The transition from the Middle to the Late Precontact period is marked by increased cultural diversity as seen in the assortment of pottery wares, subsistence strategies and social organizations. These changes are believed to be heavily influenced by social developments occurring in the Eastern Woodlands culture area. The Eastern Woodlands culture area evidently had earlier experimentation with pottery production, and may date as early as about 3000 ya. The Middle Woodland tradition (2500 – 1000 ya), showing up initially in the Eastern Woodlands, appears to have had profound technological and social influence upon resident populations in the adjacent eastern Plains and eastern Boreal Forest biomes. In the mixed wood forest zones, it is generally associated with increased levels of social complexity, population growth and sedentism originally based on intensive hunting and gathering but eventually included horticulture and permanent occupied villages with increased complex political hierarchies. The construction and use of large earthen mounds is a key component of Woodland traditions, and this lifeway culminated about 800 ya with the Hopewellian tradition (Brose and Greber 1979). Exotic art objects and elaborate burial rituals linked autonomous groups across the Eastern Woodland and beyond into adjacent culture areas such as the Northern Plains. Exotic materials from the Plains, the Subarctic and the Great Lakes basin have been found within Hopewellian sites. The movement and trade of these raw materials as well as the production and trade of finished goods are known as the Hopewellian Interaction Sphere (Brose 1994). After about 800 years ago, these socially complex large communities began to break down and their populations dispersed into smaller foraging or farming groups (Braun 1986; Hall 1980).

The manifestation of pottery and burial mounds on the Plains, reflecting Eastern Woodland influences, is referred to as the Plains Woodland tradition, to be discussed in more detail below (Gregg 1985a:117; Johnson 2001). The appearance of a Plains Woodland tradition along with the widespread adoption of the bow and arrow signalled the onset of the Late Precontact period on the Canadian Northeastern Plains (Dyck 1983; Hamilton et al. 2011; Syms et al. 2010).

These developments did not appear suddenly in the archaeological record and have created taxonomic dilemmas (Gillespie 2003:310). Traditionally, the Besant complex has been placed at the end of the Middle Precontact and this scheme has been continued by some researchers (Reeves 1990:182). The recognition that pottery and arrow points are part of the Besant complex, and its proposed relationship with Eastern Woodland societies, has others placing it at the beginning of the Late Precontact period (Dyck 1983:110; Hamilton et al. 2011:107; Walde et al.1995:11).

Vickers (1994:09) made the observation that Besant represented a culture in technological transition, an idea echoed by both Peck (2011) and Syms et al. (2010). They recognized this period of conversion and define the Middle to Late Prehistoric period transition and the Plains Early Ceramic periods respectively. Peck (2011:309) included only the Sonota complex (often considered a variant of Besant as discussed below) in his transitional period and relegated Besant to the end of the Middle Precontact, whereas Syms et al. (2010) identified both Besant and Avonlea groups as somewhat transitional. For the purpose at hand, Sonota/Besant and Avonlea have been included in the Late Precontact period.

Sonota, Besant and Avonlea are the final archaeological complexes that are primarily identifiable on the basis of projectile point typology after which, pottery becomes more widespread and technologically diversified, and therefore the most useful diagnostic artifact. Many different pottery manufacturing, surface finish and decorative techniques were used, resulting in a great number of different possible styles. When certain pottery attributes in vessels (composition, firing, and surface treatment) occur together over time and/or space, they are identified as a ware (Rice 1987) and then typically subdivided into types and varieties. Wares are often regionally and temporally distinct, but can be grouped together within a component, focus, phase or complex, depending on the archaeological taxonomic system being used. These are then grouped into higher categories and encompass different wares as well as other aspects of a society such as other material culture, subsistence, social organization, and so on.

The Besant complex dates from 2200 to about 1500 ya and is distributed across the Northern Plains (Hamilton et al. 2011:107). Besant projectile points can vary from being quickly manufactured to very well made, lanceolate-shaped points with low side notches twice as wide as deep. These notches sometimes remove the lateral edge, giving the point a corner notch, and bases are often ground (Vickers 1994:09). Up to five different point types have been defined in the literature, but the Samantha point is simply a smaller version of the classic Besant side-notch (Cloutier 2004:21-23). Gregg (1994:76) suggested that these small points might represent use of a light-weight javelin launched with an atlatl but it is generally accepted that they were arrow points (Hamilton et al. 2011:107).

Pottery appears infrequently in Alberta Besant assemblages but is more common from sites in Saskatchewan and southwestern Manitoba (Hamilton et al. 2011:110). Walde et al. (1995:18) described Besant vessels as being elongated, shoulder-less, conical forms manufactured using the paddle and anvil technique with a grit or sand temper. Most exhibit a cord-roughened surface treatment although smooth vessels have been recovered. Decoration usually consists of punctates or bosses confined to the lip and rim although dentate impressions, single cord, cord wrapped-object or sharp tool impressions have also been observed.

Besant cultural origins remain a debatable topic with no apparent consensus. Reeves (1983:191-192) speculated that Besant people originated in the Eastern Woodlands and expanded west up the Missouri River basin. There, they undertook communal bison hunting and may have participated in the Hopewellian Interaction Sphere by controlling access to Knife River Flint (KRF), which is a brown chalcedony quarried from North Dakota. Dyck (1983:113) correlated the prominence of Besant on the Northern Plains with the onset of the Scandic period that might have enabled increased bison population levels. Byrne (1973:465) presented another scenario where an aceramic Besant emerged from the Boreal Forest and onto the Plains in Manitoba, where they adopted burial mound ceremonialism and the use of pottery, likely under the influence from Eastern Woodland Middle Woodland societies.

Ascertaining Besant origins is complicated by the presence of Sonota sites in the Dakotas and southwestern Manitoba, which have an identical toolkit but include the use of low domed burial mounds containing projectile points similar to Besant points, a high incidence of KRF, pottery, copper and entire bison skeletons (Neuman 1975:40). The nature of the relationship between Sonota and Besant cultures is highly disputed. Those who maintain that Sonota and Besant represent parts of a single entity, usually with Sonota being identified as a regional variant (Cloutier 2004; Dyck 1983; Reeves 1983), include the use of burial mounds and the presence of exotic trade goods as features of the Besant complex. Those who advocate a separation between the Sonota and Besant complexes (Peck 2011) do not include these features with Besant. A third scenario is that Sonota and Besant are distinct entities but are somehow linked (Hamilton et al. 2011; Syms 1977). Hamilton et al. (2011:116) reiterated Sym's

(1977) idea that the Sonota burial mound sites are evidence of limited participation in the Hopewellian Interaction Sphere, but clarify that the non-local traits were selectively incorporated using local frames of reference, especially bison hunting.

The Besant people's repeated use of jumps, pounds and corrals as well as their implied use of pemmican, indicated by large midden deposits of butchered and smashed bison bone, led Frison (1992) and others (Dyck 1983; Novecosky 1999) to identify them as the quintessential bison hunters. The faunal recoveries from non-kill sites corroborate an almost entire reliance on bison (Peck 2011:305). This type of communal hunting suggests a higher degree of political integration, labour coordination, and larger group size (Hamilton et al. 2011:110). Some have argued that this type of communal bison hunting had social implications for tribal organization not previously seen on the Plains (Walde 2006a).

Cloutier (2004:34-36) questioned whether the Besant complex merged with the succeeding Avonlea complex, developed into a new archaeological complex, or was displaced. He contended that there is little evidence of Besant and Avonlea intermixing, and that although the radiocarbon dates for these two complexes do overlap, sites with good stratigraphic control indicate separate components. The late Besant dates from the Dakotas and Montana, where few Avonlea sites have been recorded, suggest displacement of Besant by Avonlea. Morphological similarities between Besant points and those of the later Prairie side notch type may suggest cultural continuity between those two groups. Regardless, the distinctive Besant projectile point disappeared from the archaeological record around 1500 ya on the Northern Plains and slightly later in the Dakotas and Montana.

The Avonlea complex existed from 1750 to about 1150 ya across a large geographical area spanning the Northern Plains, Aspen Parkland and Boreal Forest edge from British Columbia to Ontario, through Montana and the Dakotas (Hamilton et al. 2011:118). Given the large geographical distribution of Avonlea with regional variations, Meyer and Walde (2009:50) reasoned that the term horizon is more applicable than complex, a sentiment echoed by Hamilton et al. (2011). Although the validity of this terminology is recognized, the term complex is retained here for simplicity's sake. More than one type of Avonlea point has been defined in the literature but all appear to be arrow points. They are all quite similar across the Avonlea range and are finely made, extremely thin triangular points, usually with side notches and a slightly concave base (Peck 2011:336).

In contrast to the projectile points, pottery associated with Avonlea sites exhibits regional variation in form and decoration. Meyer and Walde (2009) identified three main wares and a fourth that occurs sporadically (Table 2-3).

Table 2-3: Avonlea ware characteristics.

Ware	Geographical Location	Description	Characteristics
Rock Lake Net/Fabric Impressed	very large area from Eastern Woodlands through central MB to southern AB	conoidal; net/fabric impressed surface treatment; undecorated or singe row of punctates (parkland sites); horizontal rows of incisions and tool impressions(grassland sites)	similar pottery in called Brainerd ware
Truman Parallel Grooved	southern AB, south-central SK, MB, MT	conoidal; parallel grooved surface treatment; tall, thin near the rim but thickens towards the base; straight rim; slight neck constriction on some vessels	overlap with other wares; found with or without Avonlea point types; also found in Brainerd assemblages in
Ethridge Cord Roughened	northern MT and southern AB	globular or ovoid; cord wrapped paddle surface treatment; usually undecorated or simple decorations (incised lines, punctates, finger indentations, thumbnail) on rim and shoulder	characteristic of assemblages in west-central part of range
Avonlea Plain ware	southern AB, SK, MB, MT	plain surface treatment but sometimes decorated like other Avonlea wares; sometimes bowl shaped	difficult to distinguish from Plain Laurel in northeastern range

Norris (2007) noted the stylistic similarities between Avonlea assemblage pottery and that identified as Brainerd ware of the Elk Lake Culture from north-central Minnesota. He contended that the Manitoba assemblages lacking the distinctive Avonlea projectile points should be considered an eastern expression of the Elk Lake Culture, and that the affiliation between the two signified a potential Minnesota origin for the Avonlea wares. This expansion from the

Eastern Woodlands may have followed the prairie border up into the Canadian Northeastern Plains by way of the Pembina Trench in southern Manitoba, which would have been ecologically similar to prairie-woodlands of the Mississippi River headwaters. Once out of the Eastern Woodlands, makers of Brainerd ware pottery may have come into contact with the people making the Avonlea style projectile points (Hamilton et al. 2011:128).

The early appearance of the Avonlea style arrow tip in southern Saskatchewan and Alberta suggest an indigenous development in this area. Walde (2006b:300) summarized the nature of the relationship between the makers of the Avonlea projectile point and Avonlea pottery wares. The point style spread eastward either through migration or along established trade networks, then met or merged with the Rock Lake Net/Fabric Impressed ware of the Elk Lake Culture then spread onto the Northern Plains about 1600 ya via the Parkland, where it has been found in Avonlea and non-Avonlea components. Likewise, the Truman Parallel Grooved ware also originated in Minnesota and spread out onto the Northern Plains and has been found in Avonlea sites.

Hamilton et al. (2011:128) identified Avonlea as “clearly Plains-oriented” but noted the evidence of maize and, “while largely reflecting a bison-focused migratory lifestyle, a number of sites located along the north and northeastern margins of its range illustrate seasonally-based subsistence flexibly and continued contact or exchange with Middle Woodland Boreal Forest foragers”. Avonlea sites exhibit a very wide range of subsistence practices. Ongoing research has identified evidence of maize and wild rice from Avonlea pottery vessels and grinding stones in Saskatchewan as well as from one site in Manitoba (Lints 2012). In the parkland and forest edge sites of Saskatchewan and Manitoba, fish, migratory waterfowl and small mammals have been recovered, although bison are still present in the assemblages (Landals et al. 2004:153; Smith and Walker 1988:85). Similarly, a pronghorn kill site in north-central Montana contained the remains of at least one bison (Davis and Fisher 1988:107). Other sites in Alberta (Peck 2011:338) and Montana (Tratebas and Johnson 1988; Wilson 1988) are bison kill sites, sometimes pounds or jumps, associated processing areas, and/or campsites. Other notable features of Avonlea are basin, surface or rock-lined hearths, roasting pits and stone circles (Peck 2011:357).

Given the widespread distribution of Avonlea-identified pottery and projectile points, the demise of the Avonlea archaeological culture is geographically diverse. In southern Alberta, southwestern Saskatchewan and north-central Montana, a co-occurrence of Avonlea and Old Women's Phase material culture took place about 1100 ya, signalling the transition to Old Women's Phase on the Northwestern Plains (Peck 2011:372-375). On the Northeastern Plains, Avonlea people appear to have coincided with Middle Woodland groups before their technology disappeared from the archaeological record.

Although recoveries are fairly rare on the Plains, the Middle Woodland Laurel complex is well represented in the Boreal Forest of northwestern Ontario, central Manitoba and east-central Saskatchewan and temporally overlaps with the Avonlea complex (Reid and Rajnovich 1991). The Laurel complex is thought to have originated in the mixed woods of northern Minnesota where sites contain medium sized, coil-made conoidal pots decorated with elaborate stamp designs. In the Rainy Lake/Rainy River area, Laurel pottery is associated with small burial mounds. Stoltman (1973) interpreted this use of burial mound ceremonialism, along with some pottery style similarities, as the most northern expression of the Hopewellian Interaction Sphere. Alternatively, Vehik (1983:227) suggested that Laurel mounds are smaller, exhibit different internment styles, and lack characteristic Hopewellian artifacts. Although these mounds are smaller than those of the Eastern Woodlands, they represent a significant labour investment (Hamilton et al. 2003:41-43).

Laurel subsistence, as described by Syms (1977:81-83), focused on hunting of available medium to small mammals and birds, as well as fishing. Meyer and Hamilton (1994:104-105) outlined three geographically constrained subsistence economies thought to have been followed by Laurel peoples. In the vicinity of the Great Lakes, summer aggregation sites were supported by the exploitation of concentrated fish resources, while winter sites were likely occupied by small groups hunting diffuse land mammal resources. In Minnesota, Laurel peoples seem to be following a seasonal round between the mixed conifer-hardwood and parkland biomes. Numerous scattered sites located in northwestern Ontario and north and eastern Manitoba suggest a reliance on diffuse resources. More recently, Boyd and Surette (2010:119) described Laurel as having a broad-based foraging economy although they note that Laurel sites located in the Aspen Parklands of Manitoba and Saskatchewan indicate a shift towards bison exploitation. Their examination of residue from Laurel pots has revealed maize and wild rice phytoliths and/or starches. This is interpreted as evidence that Laurel people participated in long-distance food exchange networks and maize likely represented an occasional, minor supplement to their diet (Boyd and Surette 2010:129).

Based on the presence of mixed assemblages as well as mixed Laurel and Avonlea vessel traits, it was previously thought that Avonlea and Laurel peoples may have interacted in the Aspen Parklands of Saskatchewan (Meyer and Epp 1990:331-332) but a reconsideration of the pottery wares (Meyer et al. 2006) from this area no longer supports interaction but has confirmed the presence of Laurel sites. It is commonly thought that Laurel co-existed and eventually evolved into the Late Woodland manifestation named Blackduck (Reid and Rajnovich 1992:228), although the temporal overlap may be a factor of radiocarbon dating complications (Hamilton 2006:75).

The Blackduck Complex

The Late Woodland period, differentiated by pottery form and decoration, begins about 1200 ya and extends into the contact period (Hamilton et al. 2003:46-47). One of the best-represented Late Woodland archaeological manifestations on the Northeastern Plains is the Blackduck complex, but summarizing Blackduck is complicated by several factors. Pottery attribute and resource utilization variations are associated with major temporal and spatial distributions, and this has resulted in a number of modified definitions for Blackduck, identifying it as a ware, focus, phase, horizon, complex, tradition, culture or composite as part of a larger configuration (Carmichael 1977; Dawson

1974; Evans 1961; Hlady 1970; Lenius and Olinyk 1990; Lugenbeal 1978; MacNeish 1958; Meyer and Russell 1987; Syms 1977). Arzigian (2008) presented a synthesis of the relevant literature and stated that there had been little cross-referencing between researchers and almost no consensus on typology. To further complicate matters, most seriation or typology schemes had been based on pottery decorative motifs and techniques from assemblages with compromised contexts such as burial-mound fill, multiple site collections, or from mixed deposits.

Blackduck complex sites have been divided into two categories by some researchers, based on pottery attributes and dates (Table 2-4). One, often called Early Blackduck or the Blackduck configuration (or horizon) dates from as early as 1400 ya but more often from 1200 ya to about 900 ya and includes Blackduck, Kathio and Clam River pottery. The second category of sites date from roughly 1100 ya to about 700 ya, with a few dates extending into the early contact period (AD 1600s). Pottery wares in this category include those identified as Late Blackduck or part of the Rainy River composite (Arzigian 2008:106, 109) and Lenius and Olinyk (1990) divided these into Duck Bay, Bird Lake and Winnipeg River complexes (with the same names for wares). Arzigian (2008) incorrectly lumped Selkirk composite assemblages with Late Blackduck assemblages, since there is overwhelming evidence to indicate that Selkirk represents a completely different cultural composite, particularly in Canadian sites where the majority of these assemblages have been found (e.g. Meyer and Hamilton 1994).

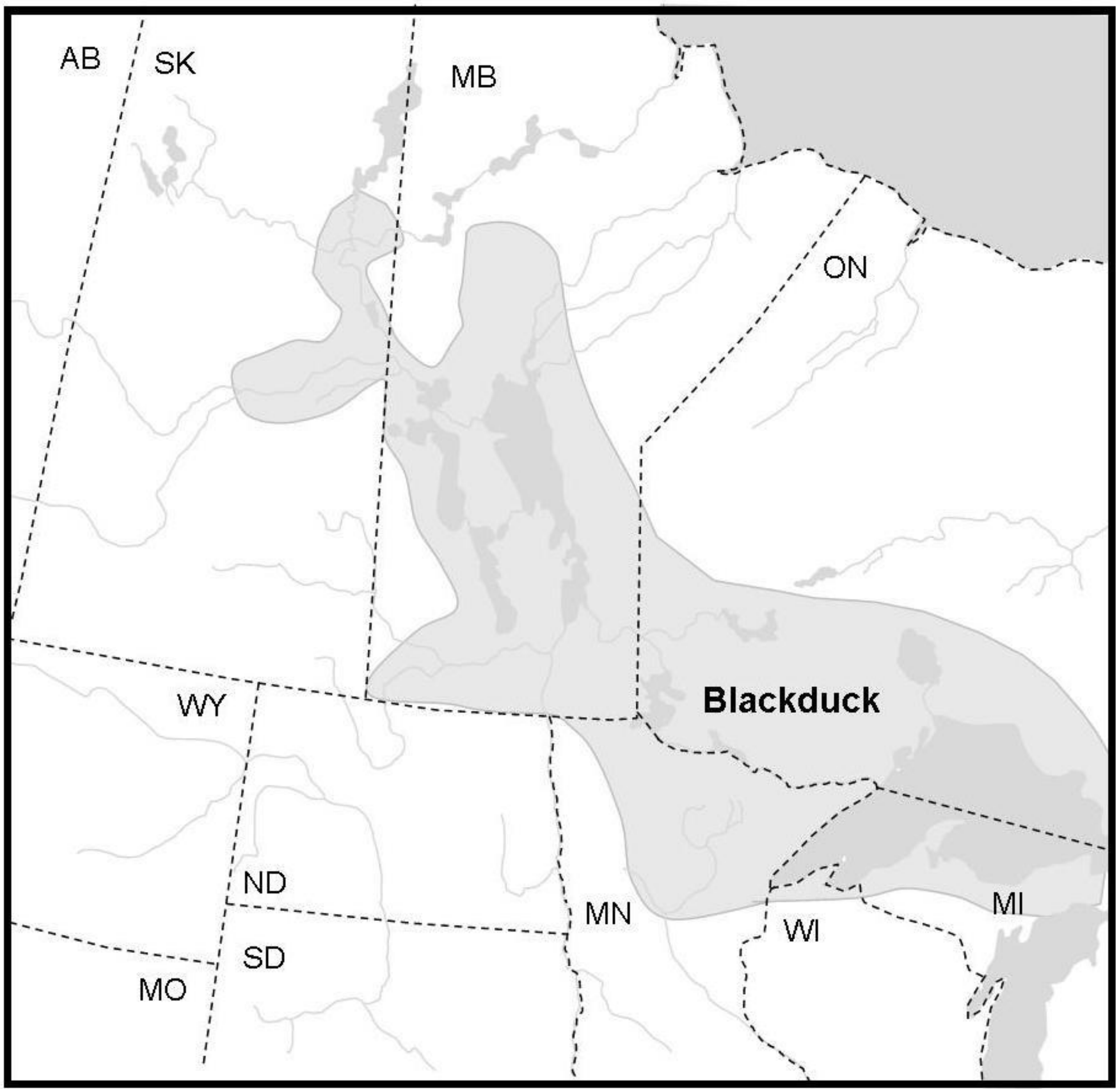
Alternatively, Hamilton et al. (2007:95) concurred with Pettipas (1983), who stated that the Blackduck complex derived from generalized Late Woodland roots in the upper American Midwest and southern Ontario as early as 1500 ya. There, Blackduck pottery has been associated with relatively small earthen burial mounds and people followed a generalized hunting and gathering subsistence strategy. There was a gradual divergence into regional entities with subtle distinct pottery variations and subsistence strategy differences. Rather than identify separate complexes for each regional and temporal distinction, Hamilton et al. (2007:96) used Blackduck in a more generic fashion to describe textile

Table 2-4: Proposed dates, terminology, geographical range and distinctive characteristics of the Blackduck manifestation.

	Early Blackduck		Late Blackduck	
Dates	1200 – 900 ya		1100 – 700 ya	
Terminology	Blackduck-Kathio (Anfinson 2006) includes Blackduck, Kathio, Clam River pottery		Rainy River Late Woodland (Anfinson 2006) includes Late Blackduck, Selkirk, Duck Bay pottery	
	Early Blackduck (Lugenbeal 1976)		Late Blackduck (Lugenbeal 1976)	
	Blackduck Configuration (Thomas and Mather 1996)		Rainy River Composite (Lenius and Olinyk 1990) includes Duck Bay, Bird Lake Winnipeg River pottery	
Geographical Range	northern MN; northwest MI; northwest ON, southern MB		central MN, northwestern ON, parklands and boreal forests of MB	
	Early	Middle	Early	Late
Pottery Attributes	cord wrapped tool (CWT) or dentate stamp obliqueover horizontal motif	CWT oblique over-horizontal motif	CWT oblique over circular punctates but no horizontal CWT	oblique CWT only
	circular punctates with interior bosses	circular punctates with interior bosses	circular punctates with interior bosses	
	CWT or dentate interior oblique motif	various interior decorations a) interior CWT b) interior combing c) none	no interior decorations	no interior decorations
	may or may not have flared lip	flared lip	flared lip	flared lip
	corded surface treatment (ST)		corded ST	corded or fabric impressed ST
	no exterior or interior combing	exterior or interior combing		
	high rim			low rim height
	occasional exterior bossing			
	no smoothed undecorated neck bands		combed band below circular punctates	smooth band below CWTSCT
			linear stamp (fingernail-like) in columns on combed band and at base of band	slash or knot linear stamping

impressed globular shaped vessels with constricted necks, outflaring rims, and elaborate decorations recovered from sites across a wide geographical range (Figure 2-5). The only distinction was that of Plains Blackduck, which was first proposed by Walde et al. (1995:24) to identify Blackduck sites on the Plains in

Figure 2-5: Approximate distribution of Blackduck sites.



Manitoba that contained large amounts of bison bone and were thought to represent a bison hunting adaptation. This more generic characterization of Blackduck is offered here, although reference is made to the regional variations when appropriate.

Blackduck pottery has been recovered from numerous sites throughout northern Minnesota, northwestern Ontario as well as southern and central Manitoba. It is less well represented from sites in Saskatchewan (Meyer et al. 1999) and generally considered absent from North Dakota (Hamilton et al. 2011:131) although Toom (2004:282) listed Blackduck as one of the Late Woodland groups displaced from eastern North Dakota by the Northeastern

Plains Village complex. As outlined in Table 2-4, Blackduck pottery attributes are diverse, but general characteristics include globular shape, constricted necks, outflaring rims, cord roughened or textile impressed bodies with cord wrapped object and punctate impressions on the necks and rims (Hamilton et al. 2007:95). Vessels were most likely manufactured using the paddle and anvil or fabric mold technique (Lenius and Olinyk 1990:79). Three different types of vessels have been identified: large storage vessels with conoidal or sub-conoidal bases, medium globular cooking vessels and small mortuary vessels (Arzigian 2008:112).

Non-pottery Blackduck complex artifacts are less diagnostic. Projectile points recovered at sites with Blackduck pottery consist of unnotched and notched small triangular points such as the Prairie or Plains Side Notch (Hamilton et al. 1981:132). These point types, especially the Prairie and Plains Side Notch versions have also been recovered from sites with Old Women's, Highwood, Selkirk, and Mortlach pottery wares from Alberta, Saskatchewan, Manitoba, Montana and North Dakota (Peck and Ives 2001:164). Worked bone implements such as awls, needles, unilaterally barbed harpoons, flakers and spatulas as well as cut beaver incisors and bear canine ornaments have been recorded, as have clay or steatite pipes, native copper fishhooks, gorges and beads and birch bark containers (Arzigian 2008:113-114).

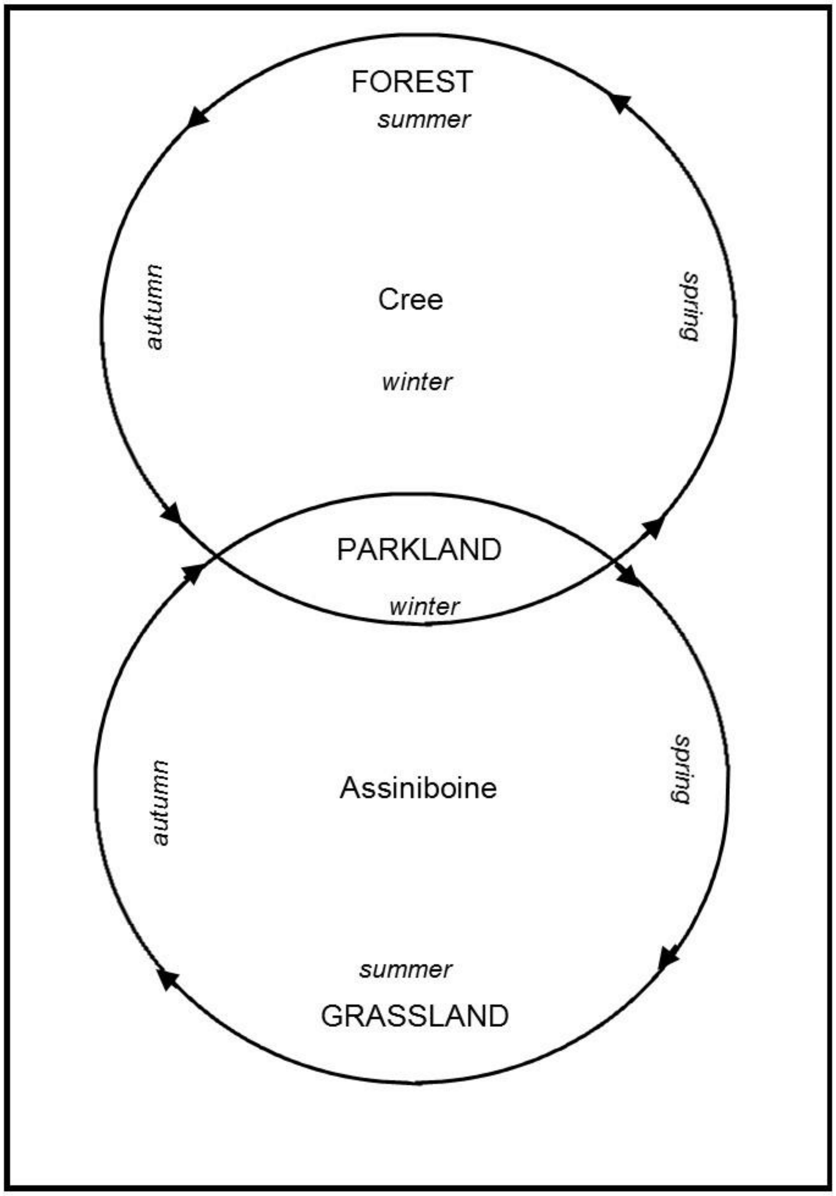
Early Models of Blackduck Subsistence

Given the large spatial and temporal span of sites with Blackduck pottery, it is not surprising that there are a diversity of site types, inferred site activities, and reconstructed subsistence strategies. Blackduck complex sites located in the boundary waters region of northwestern Ontario and northern Minnesota as well as the Mississippi River headwaters region, or the core of “Early Blackduck”, reflect a lifeway centered on the seasonal utilization of forest resources (Arzigian 2008:114-117; Dyck and Morlan 2001:128; Hamilton et al. 2007:101). Fish and riverine mammal remains dominate the faunal assemblages of Minnesota Blackduck complex sites (Arzigian 2008:114). Dyck and Morlan (2001:128) listed sturgeon, moose, beaver, black bear, birds, martin, turtle, muskrat, snowshoe hare, wolf and clams as utilized animal food resources. A similar situation occurs in northwestern Ontario where Hamilton et al. (2007) classified the Blackduck complex subsistence strategy as generalized Boreal Forest foragers. There, they argue, the sparse, transitory and diffuse resources would become seasonally rich and predictable and enabled periodic large communal gatherings to procure warm season resources such as wild rice and fish. This was followed by scarcity during the cold season so the large groups dispersed (Hamilton et al. 2007:101). Blackduck complex sites located in the Boreal Forest of Manitoba follow a very similar site location and subsistence pattern (Carmichael 1977; Graham 2005; Nicholson 1987a, 1987b; Snortland-Coles 1979; Syms 1977).

When Blackduck pottery is recovered from sites outside the Boreal Forest, notably within the Plains and Aspen Parkland, sites are not always located along waterways, and bison remains dominate the faunal assemblages (Badertscher et al. 1987; Graham 2005; Hamilton et al. 1981; Hamilton et al. 2007; Nicholson 1987a, 1987b; Pettipas 1980; Ray 1998; Syms 1977). This apparent subsistence shift had early researchers postulating a seasonal round for the makers of Blackduck pottery. Several of these models (i.e. Syms 1977; Pettipas 1980; Nicholson 1987a) were influenced, at least in part, by Ray's (1998) Parkland Exploitation Cycles Model (Figure 2-6).

Ray (1998) examined historical evidence regarding the movements and activities of the Assiniboine, Cree and Ojibway to model Aboriginal population movements throughout the fur trade time period. For the period from 1690 to 1765, he identified two cycles of resource exploitation characteristic of groups living in southern Manitoba and southern Saskatchewan. In this model, he suggested that the Cree followed a seasonal round based on the resources of the Boreal Forest and Aspen Parkland. The warmer months were spent in the forest when the men could trade with the Hudson's Bay Company and the families fished and hunted along the lakes and rivers. At the beginning of fall, the hunting of moose and trapping of beaver took place along the prairie margins. From November until March, the Cree moved into the parkland proper and lived with the Assiniboine, where they hunted bison and trapped canids. In contrast,

Figure 2-6: Ray's Parkland Exploitation Cycles Model as presented in Graham (2005:96).



the Assiniboine followed a grassland-parkland strategy and had only indirect contact with the Hudson's Bay Company. In the winter, they too resided in the parkland to seek shelter, hunt bison and trap wolves. At the coming of spring, they would set up fishing weirs along principal rivers such as the Assiniboine and capture sturgeon. Populations shifted into the open grasslands over the middle and late summer to prey on large bison herds. Trading trips to the Mandan villages to obtain corn took place toward the end of summer, into fall, and even into early winter (Ray 1998:46).

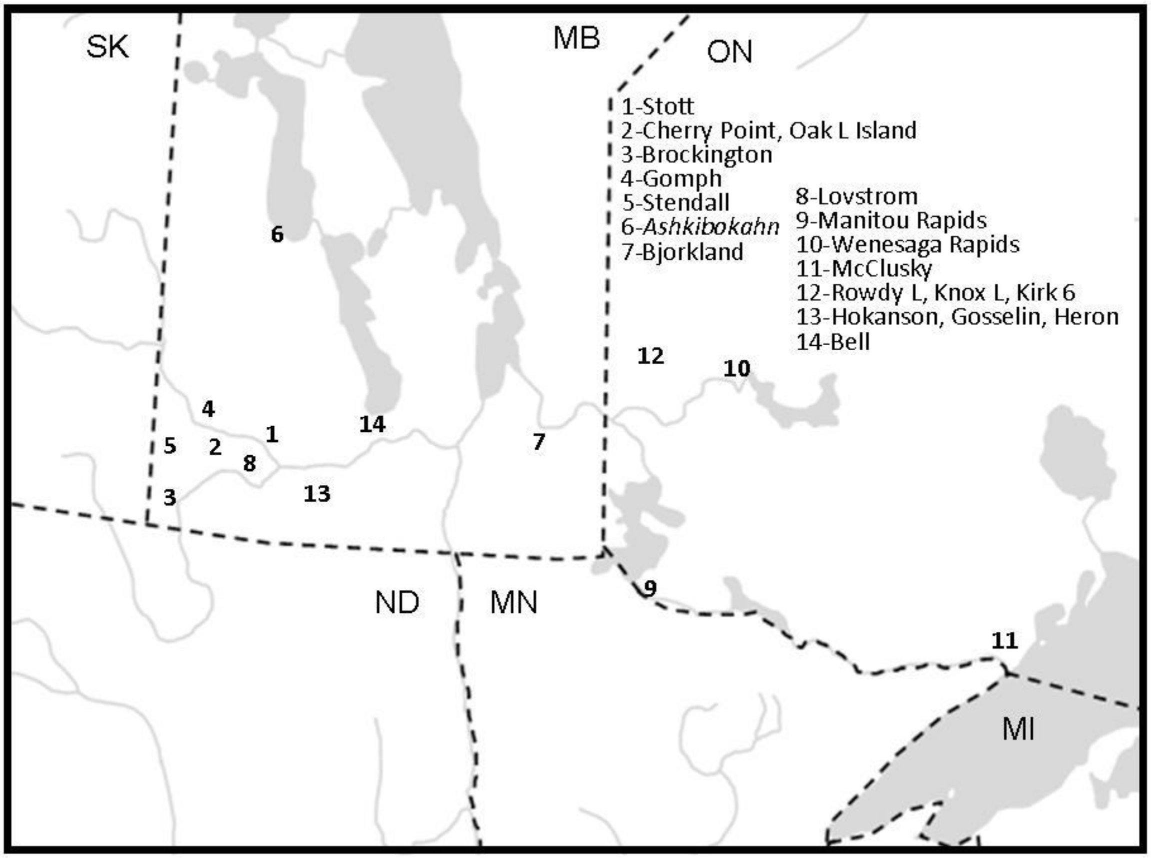
> It was through these overlapping economic systems . . .that tribes of the grasslands, forest and parklands came into contact with each other. These economic contacts encouraged an inter-regional exchange of ideas. Through these exchanges, the various bands learned to cope with the different habitat zones that characterized the regional landscape. The Cree, for example, learned the technique of construction and using the buffalo pound from the Assiniboine. The ability to exploit all of these zones gave these groups a great deal of ecological flexibility. This flexibility permitted them to make rapid adjustment to changing economic conditions . . .(Ray 1998:46-48).

To develop his model, Ray assessed the resource potential of the woodland (Boreal Forest), parkland (Aspen Parkland) and grassland (Plains) habitats. Woodland resources included caribou, moose, many small game species, fish, waterfowl and wild rice. Alternatively, grassland resources included pronghorn, mule deer, elk, bison and fewer small mammals. The parkland offered resources of both minus the caribou. Ray (1998:30) observed that the seasonal availability of food resources for these habitats did not parallel each other but instead were complementary, resulting in seasonal use of each as described above.

Syms (1977:136) believed that as the Blackduck complex people shifted from the Boreal Forest to the Plains, they also underwent a gradual shift from a diffuse Woodland economy to a transitional Woodland-Plains economy and then to an intensive utilization of bison. He listed the species recovered from Ontario and northern Minnesota sites (birds, fish, deer, bear, beaver, moose and possibly elk) and compared the list to faunal recoveries from the Stott site (Figure 2-7) located in the Aspen Parkland along the Assiniboine River valley. He identified the Stott site as a Blackduck fall bison kill containing animals normally found along wooded valleys, suggesting that the faunal remains represented a transitional Woodland-Plains economy. The Blackduck components from two southwestern Manitoba sites, Cherry Point and Brockington, were presented as spring or autumn and autumn, winter or spring bison kills respectively and reflected specialized bison procurement and intensive bison processing.

Pettipas (1980) reasoned that there were two Blackduck groups inhabiting Manitoba who followed similar cycles as the Cree and Assiniboine in Ray's Parkland Exploitation Cycles Model. The northern Blackduck group inhabited the

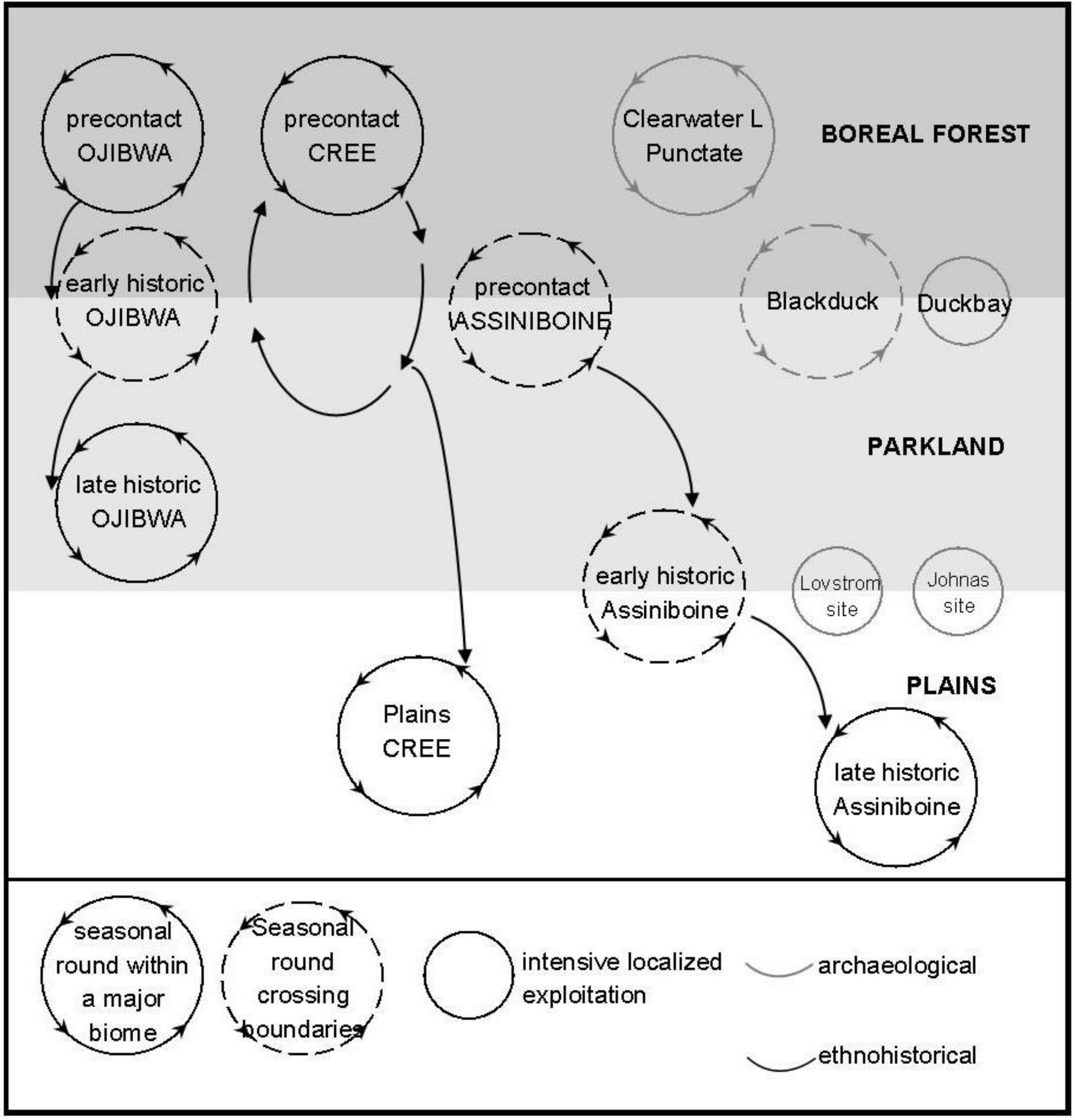
Figure 2-7: Blackduck sites discussed in Chapter Two.



Boreal Forest in summer and the Aspen Parkland in winter, while the southern division were also in the Aspen Parkland for winter and then moved out onto the grasslands in the summer to hunt bison. Pettipas (1980:154) took into consideration the grassland-parkland border fluctuation, showing that some sites (i.e. the Stott site) currently considered Aspen Parkland sites would have been located within the grasslands at time of occupation. One problem Pettipas identified with his Parkland Convergence Model was “the virtual absence of Blackduck pottery south of the Parkland boundary” (Pettipas 1980:152). He suggested that because women were generally the makers and users of pottery, perhaps only the men went on hunting expeditions to the Plains, or other containers such as birch bark baskets were used (Pettipas 1980:152-153). Pettipas (1980:155) found this idea implausible and further suggested that the southern Blackduck group followed major river courses such as the Assiniboine, Souris and Pembina, which offered water as well as wood in addition to the proper landscape necessary for driving bison. Here, the people settled into base or habitation camps and this could explain the lack of Blackduck pottery from Plains sites.

Nicholson (1987a, 1987b, 1987c) reviewed past human population dynamics in southwestern Manitoba, and devised a comprehensive analysis of human adaptation for the late precontact and early historical time periods (Figure 2-8). By placing the archaeological and ethnographic data within an ecological framework of biomes and ecotones, Nicholson (1987a:142-144) identified the following four basic adaptive strategies:

Figure 2-8: Nicholson's Environmental Adaptation Model for the forest/grassland transition zone of western Manitoba AD 700-1700 (Nicholson 1987a:148).



Strategy A = seasonal round utilizing resources of a single biome,
Strategy B = seasonal round utilizing resources of two or more biomes,
Strategy C = seasonal round utilizing resources of a single biome together with seasonal exploitation of one or more ecotones; and
Strategy D = intensive exploitation of one or more ecotones.

The ethnographic data was used to ‘test’ the models and found that the Assiniboine were first following strategy B, using the resources of the Boreal Forest and Parkland, but quickly moved to strategy C with the acquisition of horses. When the Cree began their role as middlemen in the fur trade, their strategy shifted from A to C. The Ojibwa were also following a type A strategy within the Boreal Forest but as their participation in the fur trade increased, some retreated to the forest and established a type B strategy, while others moved onto the Aspen Parklands to exploit bison. These changing subsistence strategies were largely due to European intervention (i.e. the fur trade) and it is unlikely that changes would have occurred as quickly during prehistory (Nicholson 1987a:153).

Archaeological data was then interpreted using these models. Nicholson (1987a:203, 1987b:66) explained that Blackduck subsistence was characterized by adaptive flexibility with efficient exploitation of available subsistence resources of each biome or ecotone inhabited (Table 2-5). Boreal Forest Blackduck site faunal assemblages indicated a broad based subsistence strategy utilizing fish, beaver, moose, woodland caribou, bear and migratory waterfowl. In the Aspen Parkland, he cited the Stott, Gomph, Brockinton and Stendall sites as clear evidence of associated mass bison kills but argued that the Brockinton site bison assemblage was moderately processed, because only the humeri and femora were smashed for marrow extraction, and the more northern Stott site bison assemblage exhibited evidence of intensive processing because the radii, tibiae and metapodials were also butchered (Nicholson 1987a:201). The faunal assemblage information from five sites (Table 2-6) was presented as evidence that the makers of Blackduck pottery employed a Type B strategy to exploit the resources of the Boreal Forest and Parkland biomes (Nicholson 1987a:234).

Table 2-5: Animal food resource availability for three environmental zones of the Northeastern Plains. SP=spring, SU=summer, F=fall, W=winter, p=primary, s=secondary, m=minor (Nicholson 1987a:51).

Resource	Southern Boreal Forest				Aspen Parkland				Shortgrass Prairie			
	SP	SU	F	W	SP	S	F	W	SP	S	F	W
Bison					p	s	p	p	s	p	s	
Elk				m	p	p	p	p	m	m	m	
Moose	p	p	p	p	s	s	s	s				
Antelope					m	m	m	m	s	s	s	s
Deer					s	s	s	s				
Caribou	s	s	s	s								
Bear	s	s	s	s	s	s	s	s	m	m	m	
Large canid	m	m	m	m	m	m	m	m	m	m	m	
Lynx	m	m	m	m								
Small carnivore	m	m	m	m	m	m	m	m	m	m	m	m
Lagomorph	s	s	s	s	s	s	s	s	m	m	m	m
Beaver	p	p	p	p	s	s	s	s				
Muskrat	s	s	s	s	p	p	p	p				
Small rodent	m	m	m		m	m	m		m	m	m	
Waterfowl	p	s	p		p	s	p		s	s		
Grouse	m	m	m	m	m	m	m	m	m	m	m	m
Raptors	m	m	m	m	m	m	m	m	m	m	m	
Fish	p	s	s	?	p	s	s	?	m	m	m	

As indicated in Table 2-6, Nicholson (1987a) distinguished between Blackduck and Duck Bay pottery, which is often a minor component in Blackduck sites, usually comprising less than 5 percent of the assemblage. The *Aschkibokahn* site in central Manitoba, located in a marsh ecotone, is one site where Duck Bay pottery wares constituted a majority of the assemblage (Snortland-Coles 1979). It has been suggested that the site was used as a fishing and hunting base in spring, summer and fall and the inhabitants probably dispersed elsewhere during the winter (Hanna 1982:198). Based on the faunal assemblage from this site, Nicholson (1987a:235) contended that the site inhabitants followed a Type D strategy or intensive utilization of one or more ecotones, in this case a marsh environment.

Nicholson (1987a:206-207) hypothesized that during their occupation in southern Manitoba, the makers of Blackduck pottery initiated a strategy of bison exploitation using communal kills and utilized forest and waterway resources. He reasoned that their subsistence strategy changed during the period of expansion onto the Aspen Parklands from the southern Boreal Forest, suggesting that

Table 2-6: Faunal assemblage MNI and NISP counts for Manitoba Blackduck, Duck Bay and a Saskatchewan Selkirk site. BD=Blackduck, DB=Duck Bay (Nicholson 1987a:202).

Site Affiliation **Species Utilized**	**Lloyd Selkirk**	**Stott BD**	***Aschkibokahn* DB**		**Bjorkland BD**	**Lovstrom BD**
	MNI	NISP	NISP	MNI	NISP	NISP
S mammal		15				14
M ungulate		4				2
L ungulate		2				217
Bison	2	2016		1	5	48
Elk	3		22	2		1
Moose	1		125	5	12	
Caribou			2	1		
Deer	2	15	3	2		
Canid	4	30	22	4		
Bear	1	1	6	1	2	
Lynx	4	1	13	2		
Wolverine				1		
Otter			3	2		
Badger		1				
Racoon		3				
Fisher					3	
Skunk		5	2	1		
Marten					1	
Mink		2	2	1		
Weasel	1		5			
Porcupine	1					
Beaver	15	38	238	13	81	
Muskrat		2	41	6	1	
Small rodent		69		1		3
Rabbit	21	21	4	2	3	
Bird	1	8			2	1
Pelican			8	1		
Swan	1		4	2		
Great Blue Heron	1			1		
Sandhill Crane			3	1		
Canada goose			7	1		
Eagle/Hawk	1	1	9	2		
Duck	2		16	6		
Loon			6	2		
Turtle					1	
Fish		139				
Sturgeon						28
Pike	1		65	24		
Walleye	2		181	74		
Sucker	14		90	25	2	
Goldeye	2					
Perch	1		3	1		
Whitefish			10	3		
Mussel	3	51	46	43	2	
Totals	**84**	**2424**	**936**	**231**	**115**	**314**

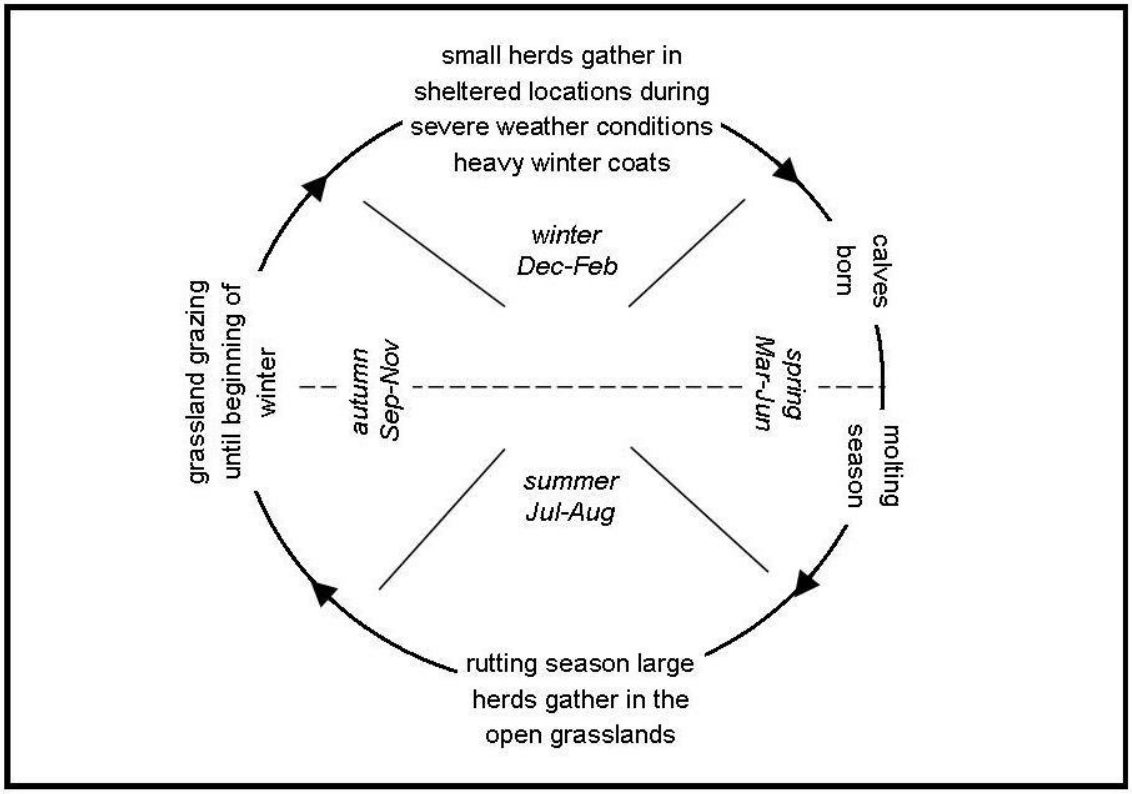
initially, Blackduck people may have begun to hunt ungulates in the parkland during the summer, returning to the Boreal Forest to harvest wild rice in fall and hunt beaver, moose and woodland caribou in their familiar forest biome. Eventually the Blackduck people increased their reliance on bison and utilized late fall and winter hunts to accumulate a surplus of dried meat and pemmican to provide for the lean season in spring.

Reconstructed Seasonal Bison Migration Patterns on the Canadian Northeastern Plains

Research on the Canadian Northeastern Plains over the past 25 years has led to the identification of many more sites inhabited by the makers of Blackduck pottery, and their occupation and use of the area appears to be even more diverse than these early models indicate. The previous models relied in whole or in part on Ray's (1998:33) Yearly Parkland-Grassland Bison Cycle Model (Figure 2-9). In this model, bison were thought to undertake mass migrations between the grasslands in the summer and the parklands in the winter, being available in the two different biomes during opposing seasons.

Historical observation, ecological modeling and modern analogy have all been employed to interpret bison movement patterns on the Northern Plains

Figure 2-9: Ray's Yearly Parkland-Grassland Bison Cycle Model as presented in Graham (2005:33).



(Arthur 1975; Chisholm et al. 1986; Epp 1988; Hamilton et al. 2006; Hanson 1984; McHugh 1972; Malainey and Sherriff 1996; Moodie and Ray 1976; Morgan 1980; Roe 1972). Early historical observations (Moodie and Ray 1976) and the location and utilization of C_3 versus C_4 vegetation (Chisholm et al 1986; Morgan 1980), were presented as evidence that bison undertook a mass seasonal migration between the Plains in the summer and the Aspen Parkland in the winter. The same historical observations were used by others (Hanson 1984; McHugh 1972; Roe 1972) to argue that bison movements were erratic and unpredictable. Epp (1988) offered a moderate view and felt that the contradictory historical record suggested that bison utilized a dual dispersion strategy as seen in other ungulates, such as the wildebeest and zebras of Africa, who formed two populations. A smaller group (about 12%) did not undertake mass seasonal migrations while the remaining animals did. North American bison herds may have followed a similar dual dispersion where sedentary small herds remain year round on the open plains near water, in wooded areas such as river valleys, uplands or sand hills. Other larger groups may have migrated each year from the wooded areas onto the plains and the herd size would vary seasonally with small herds joining together during the spring and fall migration as well as during the rut (Epp 1988:314-315).

Alternatively, Malainey and Sherriff (1996) were adamant that bison wintered on the open plains. Fundamental to this interpretation was the location of the Aspen Parkland transitional zone between the Plains and the Boreal Forest. They showed how different authors have variously described this zone (Malainey and Sherriff 1996:336), then offer their own interpretation based on historical accounts.

> These records show that the boundaries of the forest and to a greater degree, the grasslands were well north of their present location, resulting in a parkland belt narrower than that presented on most modern maps. The country west of Dauphin Lake, between Swan River Fort and Bird Mountain, as well as much of that along the Carrot River was open. The forest edge corresponded to the Saskatchewan River from Nipawin to the forks, then it followed the north branch a short distance. There were extensive grasslands in the vicinity of Edmonton House, Fort George, and in the region between Bird Mountain and Fort Alexandria. The edge

> of the grasslands was encountered west of the Red River in southeast Manitoba, and near Montagne á la Bosse and the Souris River forts in southwest Manitoba. It was located north of Good Spirit Lake in southeast Saskatchewan; it was found just west of modern Humboldt and at the elbow of the North Saskatchewan River in central Saskatchewan. The country around the Eagle and Bear Hills of southwest Saskatchewan was described as barren ground. . .

They presented historical observations to show that bison were in the Plains, Aspen Parkland and southern Boreal Forest at all times of the year (Malainey and Sherriff 1996:337-338).

Unlike previous researchers, Malainey and Sherriff (1996:348-351) undertook a survey of the archaeological record to determine if sites could be used to independently support their hypothesis. They concluded that the historical and archaeological evidence indicated that the majority of mobile hunter-gatherers formed winter camps on the grasslands of Western Canada where bison populations were large and stable. Those that were Plains-adapted wintered ‘far out’ on the open grasslands, while the parkland and forest adapted groups wintered closer to the northern edge of the grasslands (Malainey and Sherriff 1996:351).

Hamilton et al. (2006) agreed with Malainey and Sherriff (1996) that the Plains could have been occupied during the winter but emphasized that the observation scale is critical to understanding human land use. They too used historical maps and documentation to recreate a more fine-grained reconstruction of the Northeastern Canadian Plains, detailing critical microhabitats. Modern maps reflect the current situation where the Aspen Parkland has encroached and wetlands have been drained. The earliest Northeastern Plains vegetation maps, created by Ernest Thompson Seton in the early 1900s indicated that the Plains border was east of the Red River and extended north to Riding Mountain. More importantly, these maps showed forested river valleys, uplands and sand dunes (Hamilton et al. 2006:289). Such areas would have been supporting aspen groves, creating ecological complexity due to the edge effect where woodland adapted species exist near grassland sources. These small scale and localized forest/wetland microhabitats within the open Plains would have been critical for winter occupation of the Plains by both humans and their prey. Hamilton et al. (2006:296-299) believed that Ray's Yearly Parkland-Grassland Bison Cycle Model overstated the magnitude of bison migration and that significant numbers of bison remained in southern Manitoba year-round. During the summer months, the small herds of bison that did not undertake migrations further south were likely dispersed and probably unpredictable, their movements affected by conditions such as local forage, rainfall, fire and grasshoppers. Bison would have aggregated during the winter months within the forest/wetland microhabitats and would be simultaneously available in larger numbers and their locations would be more predicable relative to winter weather conditions (Hamilton et al. 2006:300).

Current Models of Blackduck Subsistence

The potential year-round availability of bison and importance of microhabitats were incorporated by Hamilton et al. (2007) to compare Blackduck land use and subsistence from Boreal Forest sites in northwestern Ontario to those found on the Northeastern Canadian Plains. This study specifically examined the 'plains-fringe' (referred to as Plains Blackduck) sites found in the prairie/parkland of southern Manitoba. Six Boreal Forest Blackduck occupations were compared to seven prairie/parkland Blackduck occupations (Table 2-7). As Boreal Forest-adapted Blackduck people moved onto the prairie/parklands of southern Manitoba, bison figured prominently, but forest resources would have still been obtainable in localized habitats such as incised river valleys, uplands and sand dunes. Many of the Plains Blackduck faunal assemblages indicated a shift from the Boreal Forest broad spectrum foraging to a specialized bison procurement. Any large communal kills would have required cooperation among several hunting bands and a significant level of political integration. These would have been necessary features of Boreal Forest Blackduck groups to coordinate and build burial mounds, construct fishing weirs and harvest wild rice during the warm season. The difference was the shift in season when communal kills took place, specifically during the late fall and winter. Variability in bison procurement

Table 2-7: Comparison of northwestern ON Boreal Forest and southwestern MB Plains Blackduck sites (information from Hamilton et al. 2007).

Northwestern ON sites	Location	Affiliation	Site Type	Site Usage	Subsistence & Seasonality
Manitou Rapids area	lower Rainy River Valley	Laurel & BD	burial mounds, habitation	aggregation along transportation corridor	fishery; spring and/or fall
Wenesaga Rapids	along Wenesaga River outlet near Lac Seul	Shield Archaic, Laurel, BD & Selkirk		aggregation	fishery
McClusky	northwest end of Whitefish Lake	often treated as 'pure BD' but Middle and Late Woodland present	habitation & burial sites nearby		fish, migratory birds, in wild rice area but no archaeological evidence of rice; warm season
Rowdy Lake Portage	portage between Sydney and Rowdy Lakes in headwaters of Sturgeon River	predominately BD, localized Shield Archaic and Laurel			seasonal encampment; diversified economy of aquatic and terrestrial mammals
Knox Lake Portage	portage around small falls where Knox Lake drains into Bloodvein River	Middle, Late Woodland up to fur trade	portage	localized encampment zone	few cultural materials
Kirk 6	junction of Stormer and Kirkness Lakes	BD and Laurel	encampment	repeated transitory use	
Summary:	*bias towards large, complex repeatedly occupied aggregations site; often associated with hydrologic features used for fish harvest; larger productive sites represent seasonally scheduled gatherings; last two sites less intensive*				
Southwestern MB sites					
Stott	north wall of Assiniboine River valley just west of Brandon, MB	BD	nearby burial mound, bison pound (no posts)	bison kill and food processing	dense bison bone bed
Gompf	north wall of Assiniboine River valley 34 km west of Stott	Pelican Lake, possible Besant and BD	bison kill	bison kill and primary butchering and nearby processing	site locations suggests warm season
Hokanson	Tiger Hills, adjacent to small wetland within valley between two	BD	bison pound and associated processing area	bison kill with bone uprights	processing area indicates intensive bone grease manufacture; kill zone

	low moraine ridges				December to late March based on bison dentition studies
Gosselin	Tiger Hills, shallow valley bisecting local relief of surrounding moraine uplands	BD		small encampments overlooking small wetland	small scale bison procurement, warm or cold season based on site placement
Heron	small valley along northeast flank of Tiger Hills overlooking extensive open plain, small lakes, marshes to southeast	main occupation is BD but also have Sandy Lake and Duck Bay pottery	nearby burial mounds, encampment		sparse and discontinuous deposits of fragment bone, no seasonality indicator
Bell	linear sandy storm beach on south margin of Lake Manitoba, beyond wetlands to south mixed grasslands and forest groves	surface collected BD	historically used as staging for portage		waterfowl hunting, plant collecting and fishing, bison in faunal assemblage; warm season
Oak Lake Island	eastern shore of Oak Lake on storm beach between Oak and Plum Lakes	multicomponent but BD prominent			no excavations, information from collectors include fish, clam, bison; site location suggests warm season
Summary:	*most southern MB sites in prairie or localized forest groves surrounded by prairie; reliance on bison except at Bell and Oak Lake Island which reflect persistence of generalized subsistence; variability in bison procurement; communal kills with dense assemblages suggest population aggregations; smaller, less intensive procurement utilizing individualistic kills*				

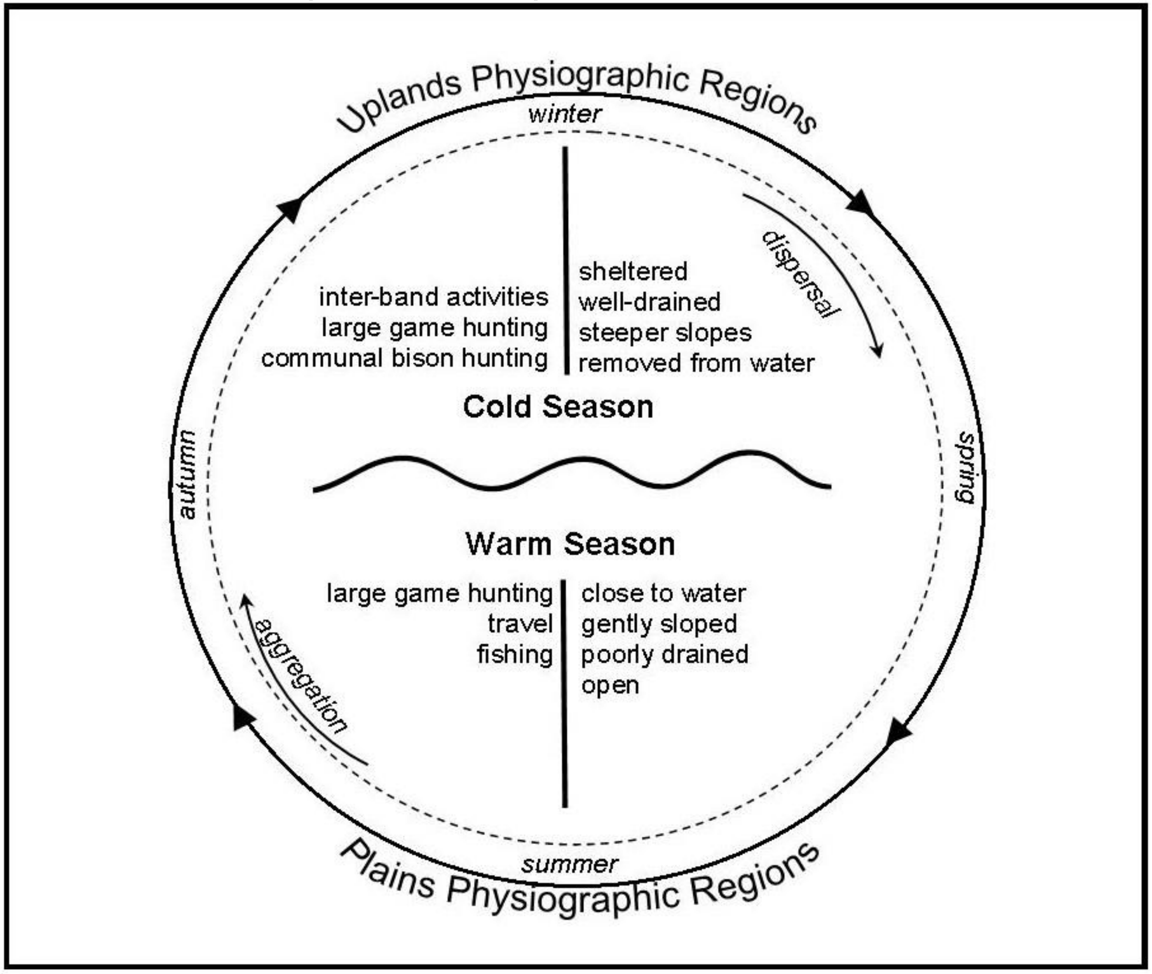
strategies is indicated by the presence of smaller Plains Blackduck sites with less dense material culture accumulation, suggesting an individualistic or opportunistic bison hunting strategy. These were interpreted as warm season sites where smaller groups of Blackduck people dispersed throughout southern Manitoba following small scattered groups of bison who did not undertake a mass migration further south. If the bison hunt failed, the nearby biotic diversity would have supported continued generalized foraging. Furthermore, Plains Blackduck sites situated adjacent to large water bodies in southern Manitoba yield faunal assemblages indicative of warm season foraging as well as bison hunting (Hamilton et al. 2007:128-130).

This possible year-round occupation of southwestern Manitoba by Blackduck peoples has been proposed by Graham (2005) based on his qualitative and quantitative analysis of Blackduck site location variables. He undertook visits to 27 Blackduck sites identified in the Manitoba Historical Resources Database and projected seasonality based on the basis of proximity to fresh water sources and the availability of shelter. He completed a quantitative analysis of these variables plus slope, aspect and drainage. Graham (2005:153) defined two seasons, warm and cold, and explained that these represent general climatic trends rather than actual calendar dates, noting that a normal warm season starting in April and running until September will have annual fluctuations.

The site location variables were plotted using GIS, and most warm season sites were found to be located in the upland physiographic regions of southwestern Manitoba, consisting of the Lower and Upper Assiniboine Deltas, the Tiger Hills and the Pembina Mountains. These warm sites were open, on relatively flat terrain with poorly drained soils and were close to fresh water sources. The cold season sites tended to be located in areas of current or past forest cover, were not close to fresh water and were on well drained soils (Graham 2005:117).

This seasonal site distribution led Graham (2005:122-124) to postulate that southwestern Manitoba was populated year round by people making Blackduck pottery (Figure 2-10). They lived in the physiographically defined Plains regions (as opposed to the vegetative Plains or the Plains Ecozone) during the warm season where they dispersed into small groups, hunting small herds of non-migrating bison. Other medium and large ungulates like elk, deer and antelope would have been available but are less visible in the archaeological record because they are not herd animals and would have only been hunted individually. Sites were close to water to provide a fresh

Figure 2-10: Graham's Regional-Environmental Model of Blackduck Settlement in southwestern Manitoba (Graham 2005:114).



water source as well as important aquatic food resources such as clams, vegetation, aquatic mammals and fish. These same waterways would have been important transportation corridors (Graham 2005:114-115). With winter conditions, these people would aggregate in the forested uplands of southwestern Manitoba. The forest provided critical resources such as wood, important not only for firewood but also for shelter (Vickers and Peck 2004). Large bison herds could be found in the uplands seeking shelter, and this would have enabled communal kill events enabling a storable surplus, before the Blackduck people dispersed in late winter or early spring to live out the remainder of the cold season at smaller sites. The forest uplands also provided other animal food resources such as moose, fox, rabbit, coyote and bear. These sites were removed from water because lakes and rivers are less sheltered and do not maintain their benefits of aquatic resources and transportation corridors during the winter (Graham 2005:117).

Graham (2005:122) suggested that the resident southwestern Manitoba Blackduck people interacted with the Boreal Forest adapted Blackduck people along the Aspen Parkland fringe or in the Boreal Forest to where some Plains Blackduck people might have travelled. This interaction would have maintained social ties and trade networks and may explain the unusual distribution of Duck Bay pottery in southern Manitoba.

> Duck Bay groups may occasionally have moved towards the prairies and encountered Plains Blackduck people, but is more likely that Duck Bay and Blackduck encountered one another in the boreal forest, where there was an exchange of group members to promote social ties. This network was increased when boreal forest Blackduck groups rendezvoused with Plains Blackduck groups and again exchanged band members. The occasional marriage of women from the Duck Bay core area to outside groups such as Blackduck may explain the distribution of Duck Bay ceramics in relatively low proportion to Blackduck ceramics at archaeological sites across the aspen parkland (Graham 2005:126).

Graham concluded by hypothesizing about the disappearance of Blackduck pottery from southwestern Manitoba’s archaeological record about 800 – 600 ya. A scenario presented by Nicholson (1996a), when it was believed that Blackduck people only occupied the Aspen Parkland during the winter, saw the Blackduck people being ‘outcompeted’ by an immigrant agrarian population who could occupy southern Manitoba year-round because of their agricultural surplus. However, the application of the Regional-Environmental Model of Blackduck settlement would have meant year-round occupation by Blackduck people too. Graham (2005:127) concurred that the Plains Blackduck people may have been pushed out of southwestern Manitoba by a large, well-adapted horticultural group. Their return to the Boreal Forest may be indicated by the appearance of what Lenius and Olinyk (1990) referred to as the Rainy River complex (or Late Blackduck), which was thought to be a coalescence of Blackduck and Laurel. Graham (2005:128) suggested that the Plains Blackduck people might have been part of this coalescence.

One aspect of Blackduck subsistence not yet explicitly reviewed was their use of plant resources. It has long been assumed that the makers of Blackduck pottery were also wild rice gatherers (Gibbon and Caine 1980; Johnson 1969; Rajnovich 1984), and their use is thought to represent an intensification over that practised by the earlier Laurel assemblages (Buchner 1979; Wright 1999). Some argued that the Middle to Late Woodland transition is not only identified by changing artifact styles, but also by a changing subsistence base heavily dependent on the harvesting of wild rice (Gibbon and Caine 1980). Gibbon and Caine (1980:64) suggested that archaeological complexes identified here as “Early Blackduck” transitioned from a diffuse hunter-gatherer adaptation to a focal subsistence economy centered on wild rice. Moffat and Arzigian (2000) however, suggested that the antiquity of wild rice use was not well established and that its importance may have been overstated by previous researchers. They advocated for the association of wild rice or ricing features in unmixed assemblages and direct dating on wild rice rather than the assumed association between ricing features and precontact components. Recent investigations by Boyd and Surette (2010) have identified not only wild rice in the residue from Blackduck pots, but also maize phytoliths and starches. This suggests that not only were wild plants important, but the makers of Blackduck pottery also had access to domestic food plants as well.

According to Nicholson (1996a:81), Blackduck pottery becomes much less visible in southwestern Manitoba after 1000 ya, with some sites such as the Stott site dating later (circa 800 ya). He suggested that the influx of other groups, especially the Vickers focus, triggered the disappearance of Blackduck from the area, although Blackduck pottery persisted in southeastern Manitoba up until about 600 ya (Syms 1977:107).

The Vickers focus

Avocational archaeologist Chris Vickers identified two cultures after excavating sites across southern Manitoba during the mid-1900s (Vickers 1949, 1950). The Rock Lake focus was represented at the Avery site by pottery similar to that which would later be classified as Blackduck. Pottery recovered at the

Lowton site represented the Pelican Lake focus and had more decorative variation such as finger pinched nodes, twisted cord impressions, tool impressions (TI), incising, punctates and possible effigy tabs. Vickers (1950) suggested that these cultures dated from AD 1600 – 1650, followed a hunting and gathering lifeway and were replaced by the historic Assiniboine. Nicholson (1991:167) renamed the Pelican Lake focus as the Vickers focus, both to honour the work of Chris Vickers and to avoid confusion as the term Pelican Lake had since come to designate a Middle Precontact point type and bison hunting archaeological complex.

The initial appearance of Vickers focus pottery in the Tiger Hills of south-central Manitoba occurs about 650 ya (Hamilton and Nicholson 1999:07; Nicholson et al. 2011:158). Their appearance here is thought to be a part of larger Eastern Woodland socio-political developments and eventual population movements expressed on the Northeastern Plains as the Plains Village and Plains Woodland traditions. Gregg (1985b, 1994) described these traditions as lifeways or general adaptive strategies defined in terms of variation in reliance on hunting, gathering and gardening as well as the production and use of pottery for cooking vessels. The Plains Woodland tradition was based primarily upon hunting and gathering but sometimes involved gardening, whereas the Plains Village tradition saw a balance between hunting, gathering and gardening (Gregg 1994:72). The Plains Village tradition is best known from the Middle Missouri subarea where there is a large archaeological database resulting from intensive salvage work and a rich ethnographic/historical record recounting Plains Village tribes such as the Mandan, Hidatsa and Arikara. The Plains Village tradition of the Middle Missouri subarea includes a hunting-gathering-horticultural subsistence economy, fixed semi-permanent villages near the flood plain of the Missouri River, earthlodges, large storage/refuse pits, distinctive pottery, large numbers of end scrapers and arrow points, bison scapula hoes and a well-developed bone tool industry (Gregg 1985b:137).

The antecedents of these traditions appear about a thousand years ago when Eastern Woodland Mississippian groups expanded onto the eastern plains during the Neo-Atlantic, a period of warmer, wetter conditions optimal for river valley horticulture. With the onset of the hotter, drier Pacific episode about AD 1250, Plains Village groups from the Central Plains moved north into the well-watered Middle Missouri subarea. These movements initiated changes in culture and social organization seen by increased levels of competition and eventual warfare after an initial period of peaceful coexistence (Gregg et al. 1981). These developments are thought to have caused a ‘demographic ripple’ across the Northeastern Plains, with some groups moving northward along waterways such as the Red, Pembina and Souris Rivers. It has been postulated that one group continued north along the Red River, inhabiting the Shea and Lockport sites while the Vickers focus people branched off westward following the Pembina trench into the Tiger Hills (Nicholson and Hamilton 1997a:31-32). Two clusters of Vickers focus sites have been identified in southern Manitoba and are thought to represent a time-transgressive shift in settlement and subsistence patterns from east to west.

Eastern Site Cluster

As the understanding of Vickers focus evolved over the past 25 plus years, so too has the description and identification of Vickers focus material culture and lifeways (Boyd and Surette 2010; Boyd et al. 2006a, 2006b; Hamilton and Nicholson 1999; Hartlen 1996; Mokelki 2007; Nicholson 1986, 1990, 1991, 1993, 1994, 1996a, 1996b; Nicholson and Gibson 1990; Nicholson and Hamilton 1997a, 1999, 2001; Nicholson and Kuijt 1990; Nicholson and Malainey 1991, 1995; Nicholson et al. 2002, 2003, 2006a, 2006b, 2006c, 2011; Playford 2001a, 2010; Playford and Nicholson 2006; Surette 2005). Originally, pottery from the Lovstrom site was defined as Lovstrom ware.

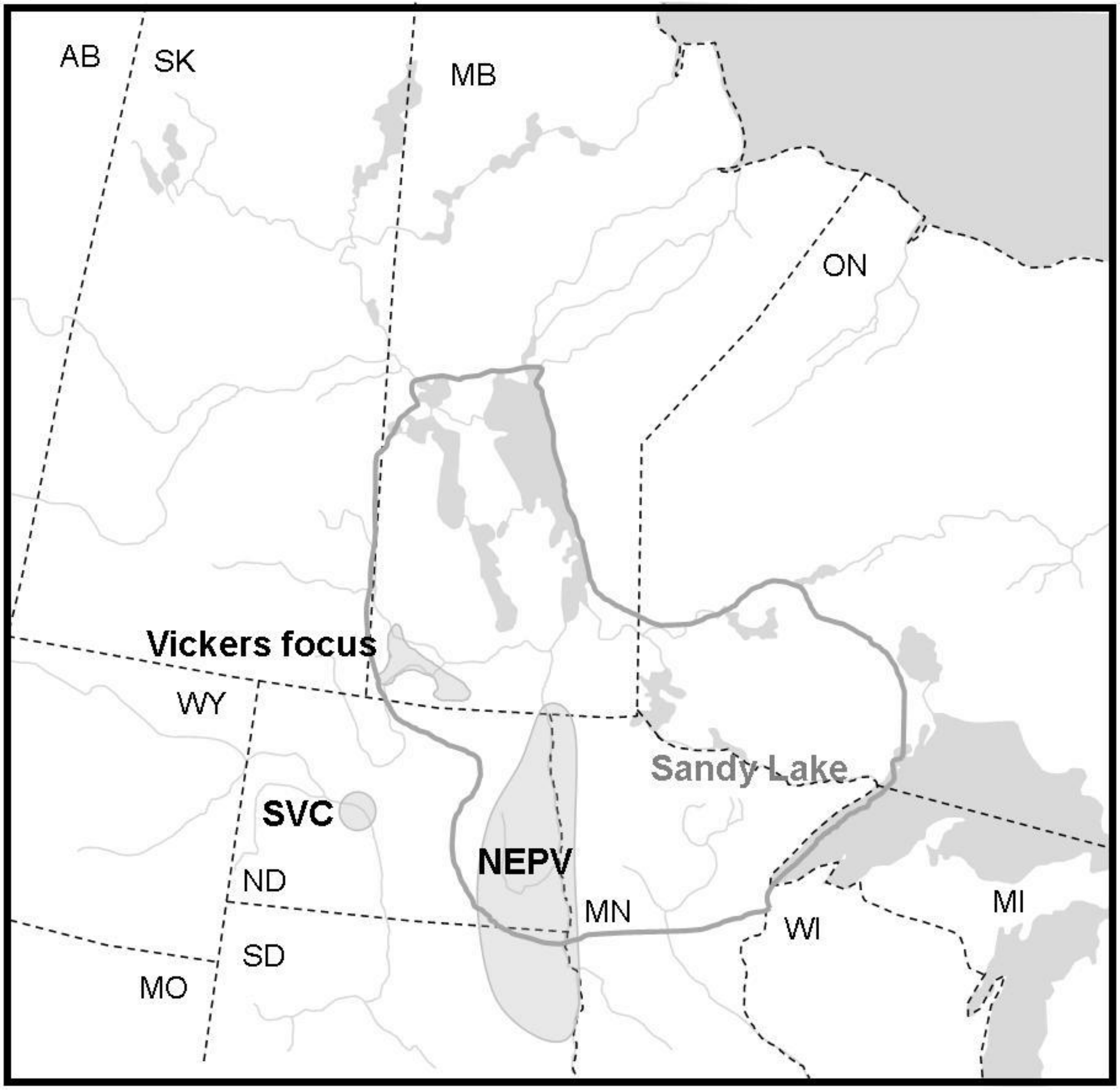
> These ceramics, in a broadly descriptive sense, appear to combine traits derived from the Woodlands and from the Plains. Lovstrom ware paste is variable but it is normally well worked with sand temper being most frequent, followed by grit. Grog is frequently encountered which contains both sand and grit temper. Vessels have medium thick walls (4-7mm) and are globular in outline. The rim profiles vary from flaring to straight with occasional incipient “S” rims (“S” rims occurring infrequently). The interiors of the vessels are smoothed and exterior surface finish usually displays some evidence of cord/fabric impression which ranges from a very rough

> textile impression to an almost smooth obliterated cord/fabric finish. Brushing is occasionally found. The rough textile finish vessels carry little or no other decoration. There may be tool impressions on the lips of these vessels. The lips of most vessels display various tool impressions made with rounded, sharp-edged or angular objects. Decoration may extend onto the neck or shoulder. In addition, finger pinching, several kinds of punctates and lip modeling are also present (Nicholson 1990:52-53).

Subsequent investigations at the Lowton and Johnas sites identified additional wares similar to Northeastern Plains Village (Red River ware), the Scattered Village complex (SVC), Campbell Creek, Sandy Lake, Great Oasis, Talking Crow, and Middle Missouri wares (Nicholson 1990, 1991; Nicholson and Gibson 1990; Nicholson and Kuijt 1990; Nicholson and Malainey 1991, 1995). More recently (Nicholson et al. 2006c:37), Vickers focus pottery has been described as owing ‘much of its ceramic tradition’ to the Sandy Lake wares of the Eastern Woodlands with a ‘nod’ towards the Middle Missouri area for single cord impressions and S-rims whereas the finger pinched nodes and twisted cord transverse lip impressions may have originated at the Lowton site (Figure 2-11).

Sandy Lake wares are considered part of the *Psinomani* culture, an Eastern Woodland manifestation that existed across Wisconsin, Minnesota, North Dakota, Ontario, Manitoba, and possibly into eastern Saskatchewan between 1000 and 250 ya. Pottery is the most distinctive trait and is characterized by thin walled, laminated, globular vessels that have little or no neck with grit and/or shell temper. Surface finishes tend to be vertical cord impressed, smoothed, or sometimes stamped, with decoration usually limited to tool or cord-wrapped object notching on the interior and/or exterior of the lip but sometimes present on the interior shoulder, or as punctates on the rim (Taylor 1999:06-09). Gibbon (1994:147) correlated intensified wild rice harvesting during *Psinomani* times with new roasting and storage techniques and suggested that the outcome was large semi-permanent palisaded villages, warfare, population growth and the development of more formal socio-political alliances. In terms of animal food subsistence from sites with Sandy Lake ware, bison dominate prairie sites, deer are most common in coniferous forest sites while moose and caribou are recovered from mixed coniferous and boreal forest sites (Shay 1985:31). Few

Figure 2-11: Vickers focus, NEPV, SVC and Sandy Lake distributions.



‘pure’ Sandy Lake sites exist, and the wares tend to be found with other contemporary archaeological cultures such as Selkirk, Duck Bay, Bird Lake, Clam River, Vickers focus, Northeastern Plains Village and Oneota (Taylor 1999:09).

Consequently, Vickers focus pottery is an amalgam of non-local wares that lack any major component of Woodland Blackduck or Duck Bay. The similarities between Vickers focus pottery assemblages and those associated with the Scattered Village complex has been identified by Nicholson (1994, 1996a), who has most recently classified Vickers focus as a northern expression of the

Scattered Village complex and therefore part of the Northeastern Plains Village complex/aggregate (NEPV) (Nicholson et al. 2011:154).

NEPV sites are found in eastern North Dakota along the James, Sheyenne, Maple and Red Rivers as well as on the shores of Devils Lake, and are described by Toom (2004:283) as 'villagers without villages'. As a whole, the complex is characterized by technologically and stylistically diagnostic pottery, high frequencies of KRF, regular occurrences of catlinite, semi-sedentary village settlements as well as open campsites, burial mounds with mortuary goods and a lifestyle based on hunting and gathering and less intensive gardening than that of the quintessential Plains Villagers in the Middle Missouri subarea. Pots are small to medium-sized globular vessels with distinct shoulders, simply shaped straight to outcurved rims and are decorated on the shoulder by trailing or in combination with tool impressions. Surface treatment on or above the shoulder is usually smoothed or sometimes burnished but below the shoulder can be smoothed, cord roughened, simple, or check stamped. There are a variety of lip forms, sometimes decorated with channels, tool impressions, or tab handles (State Historical Society of North Dakota 1990:B.46).

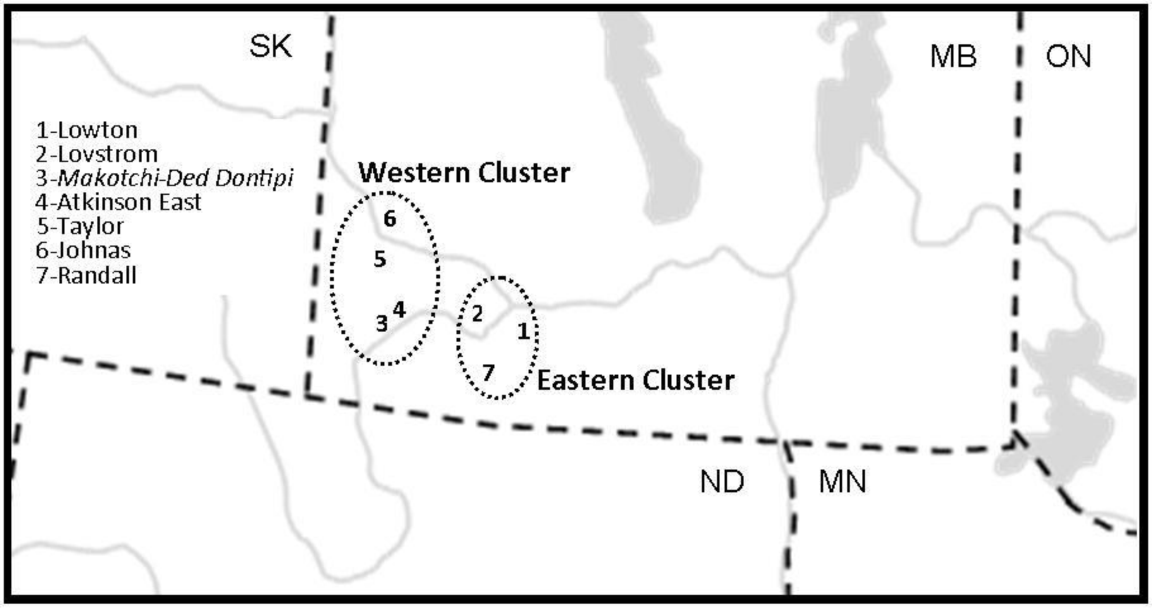
There are three periods of the NEPV complex, early (AD 1200 – 1300), middle (AD 1300 – 1600), and late (AD 1600-1800), each represented by varying percentages of Lisbon, Owego and Buchanan wares (Toom 2004:286). Between AD 1400 and AD 1650, NEPV sites are rare in eastern North Dakota; only the Shea and Horner Kane South sites date to this time frame, indicating a hiatus of about 200 years. NEPV sites reappear in the archaeological record of eastern North Dakota afterward, with a 'veritable cornucopia of types' including the earlier wares in addition to those clearly related to the Middle Missouri subarea (Toom 2004:286-289).

It is during the NEPV complex hiatus that the Scattered Village complex (SVC) becomes visible in the Knife River area of western North Dakota on the Missouri River (Ahler 1993). The SVC pottery assemblage is a heterogeneous mix of S-rims and straight rims with decorations consisting of trailing, incising, tool modification as well as stab and drag which "reflect an amalgamation of diverse vessel form and decoration ideas borrowed from several sources and fused into a pattern which lacks a dominant typological expression but which is nonetheless subtly coherent from site to site" (Ahler 1993:82).

This similar amalgamation of diverse wares recovered from eastern cluster Vickers focus sites (Figure 2-12) was interpreted as representing a composite society drawn from southern Minnesota and northern Iowa immigrants of the Eastern Woodlands as well as others from the Middle Missouri subarea, practicing either polyethnic co-residence or fused ethnicity (Nicholson 1991:171, 1994, 1996b).

Once in Manitoba, it appears that the Vickers focus people followed a Mississippian-influenced settlement pattern of a large central village, interpreted as the Lowton site, supported by smaller subsistence oriented satellite hamlets such as the Lovstrom and Randall sites (Nicholson 1993:217). The Lowton site has been designated the Vickers focus type site, meaning that it forms the diagnostic base for identifying other Vickers focus sites (Nicholson and Hamilton 1997a:24; Nicholson and Malainey 1995). The large size (35 ha) and copious artifact recovery from the Lowton site attests to the site's extended and/or perhaps repeated occupation(s) (Nicholson et al. 2006a:344), although most of the collection represents surface finds from the modern cultivated field

Figure 2-12: Vickers focus sites discussed in Chapter Two.



(Nicholson and Malainey 1995:87-88). A significant quantity of exotic lithic materials such as catlinite, obsidian, Tongue River silicified sediment and large amounts of KRF, coupled with the presence of luxury goods like imported Knife River Fine ware vessels, is reflective of the site's prestige, influence, and possible ceremonial importance (Nicholson 1993: 217; Nicholson et al. 2006a:344).

The similarity of Vickers focus pottery to the wares of southern horticultural groups, and the recovery of bison scapula and stone hoes as well as grinding stones from the eastern cluster Vickers focus sites, led Nicholson (Hamilton and Nicholson 1999; Nicholson 1990, 1991, 1994, 1996a, 1996b; Nicholson and Hamilton 1997a, 2001; Nicholson et al. 2006a, 2006c, 2011) to argue that the Vickers focus people were gardeners. It has been shown that the biophysical parameters of southern Manitoba would have been sufficient for cultigen horticulture (Nicholson 1990:34). In southern Manitoba, river channels and other depressions form cold sinks that are susceptible to late spring and early fall frosts and would not have been suitable for floodplain horticulture as is common in the Middle Missouri subarea. Instead, eastern cluster Vickers focus people quickly adapted and located their sites on high ground with medium to light-textured soil which warms early, and in areas where pothole water sources could have been utilized for crop irrigation (Nicholson 1993:212). In addition, these sites are located north of, and are not visible from, major waterways. Being difficult to approach, especially from the south, is perhaps a reaction to real or perceived fears from the south (their homeland) and may have been another influencing factor of site selection (Nicholson 1993).

It is also important to note that the Tiger Hills region is an area of ecological complexity with a rich resource base suitable for hunter-gather and forager-horticulturalists (Nicholson et al. 2002:323; 2006a335).

> . . . while Manitoba is one of the Prairie provinces, these grasslands contain numerous areas of ecological complexity with a rich resource base, such as river valleys, wetlands, glacial uplands and dune fields. Such biophysical units comprise ecosystems that may contain resources of the surrounding prairies in addition to resources that are uniquely their own within the larger biome. Some, such as wetlands, form an essential

> part of the larger system, others such as dune fields and river valleys contribute additional biological complexity to the larger system. All of these units provide resources that are uniquely configured according to the interaction of their constituent parts. In many cases, plants and animals that are useful for hunter-gatherers, foragers and horticulturists are present only in these distinctive biophysical units (Nicholson et al. 2002:323).

This type of habitat selection would have been suitable for the establishment of extended occupations or home-base camps (Lowton), as well as small subsistence oriented satellite hamlets (Lovstrom and Randall sites) (Nicholson 1993). Nicholson and Hamilton (1997a:30) proposed that dispersed populations lived in the hamlets during the summer to accumulate small surpluses of bison and horticultural produce but returned to Lowton for the winter. Malainey (1997:259) tested lipid residues from 14 Lowton site pottery samples and only one had a signature for mixed plant with large herbivore and the remaining signatures were all large herbivore. However, phytoliths and starch grain analysis has identified both maize and beans on Vickers focus pot sherds (Boyd and Surette 2010; Boyd et al. 2006b, 2008; Surette 2005). This practice of small scale horticulture is thought to have allowed Vickers focus people to sustain themselves year-round and perhaps maintain an advantage over resident Blackduck populations, whom they eventually displaced out of southern Manitoba (Nicholson 1996a:81).

The Vickers focus did not stay in the Tiger Hills region long. Following a brief success of their traditional forager-horticultural subsistence strategy for roughly 100 years, they apparently abandoned the area (Nicholson et al. 2011:344). One possible reason for leaving might have been persecution. There is a story recounted by Dave Daniels of Long Plains First Nation near Portage la Prairie, that his father told him about a group called *Ichininewuk*, who lived ‘in times past’. These were an agrarian people living in the Tiger Hills where they selected sites on south facing slopes so the soil would warm and they would be protected from the north winds. It was recalled that these people were ‘picked on’ by other groups (Nicholson et al. 2002:316) although there is no evidence of village fortifications at any Vickers focus sites (Nicholson 1996a:81).

Instead, short term climate change is suggested as the reason why Vickers focus people left the Tiger Hills and appear to have abandoned their forager-farmer way of life (Nicholson et al. 2002:316). Their disappearance from the area coincides roughly with the Neo-Boreal or the Little Ice Age, a period of cooler, wetter climate starting about AD 1300 and lasting about 500 years (Fagan 2000). Nicholson (Nicholson and Hamilton 2001:70; Nicholson et al. 2002:316) suggested that the eruption of the Kuwae volcano in the South Pacific which is linked to worldwide climatic deterioration between AD 1453 and 1454 (Briffa et al. 1998) would have made a deteriorating growing season unsuitable for maize horticulture in southern Manitoba. These dates also coincide with the oral tradition of the *Awatixa* Hidatsa returning to the Knife River area after having lost their corn. These people relate that they had "previously lived in a land of snow and boreal forest where there were moose. These conditions are fulfilled in many of the Manitoba uplands. . ” (Nicholson 1996a:82). The dates also agree with the terminal SVC and may have ended the horticultural phase of Plains Village occupations in Manitoba. After the Vickers focus withdrew from the Tiger Hills, the area became a ‘no-man’s land’. At contact, several Indigenous groups would use the area but none claimed it as their own (Nicholson et al. 2006b:330-331).

Western Site Cluster

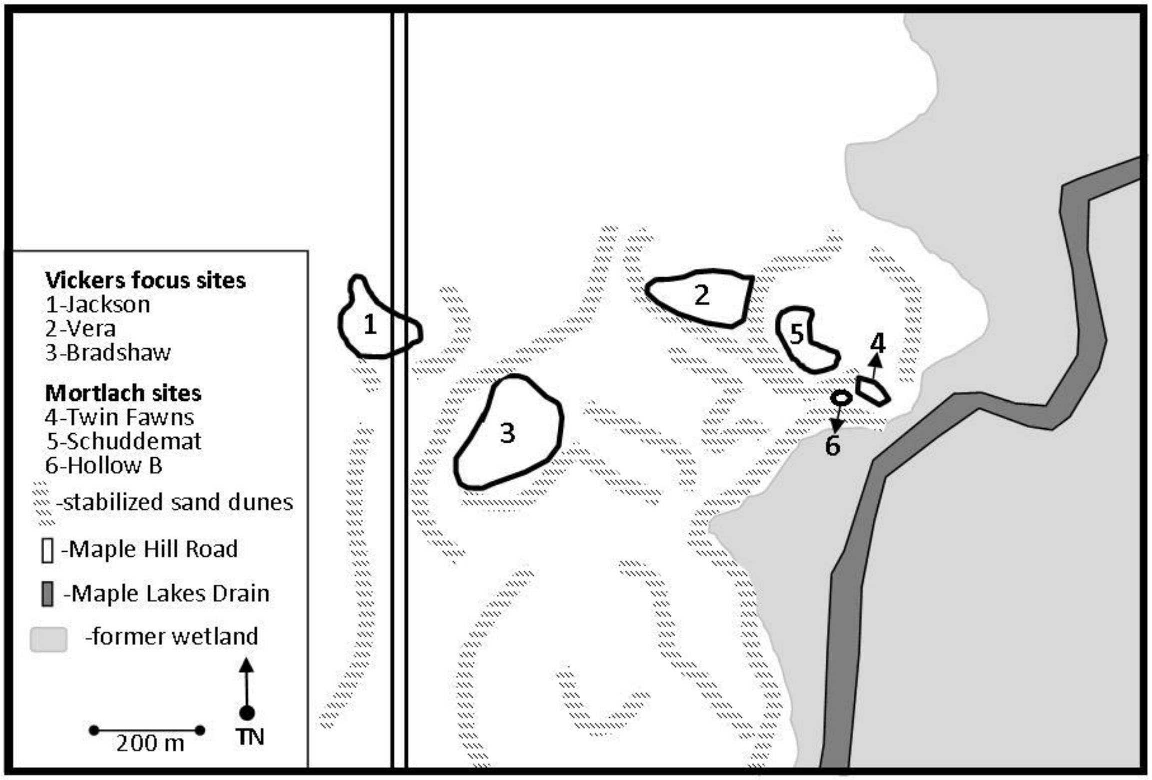
Shortly after the disappearance of Vickers focus pottery from the Tiger Hills archaeological record, it reappears in and around the Launder Sandhills of southwestern Manitoba. These sites comprise the western cluster, date to about 400 years ago (Nicholson and Hamilton 1997a:30) and show an increased Mortlach influence (Mokelki 2007; Nicholson et al. 2011:158). There is also a proposed major subsistence-settlement shift from horticulture-foragers in the east to intensive forager-bison hunters in the west (Nicholson and Hamilton 1997a).

Western cluster sites follow a similar pattern of site selection as those in the east. They are found in out of the way places, usually distant from major lakes or streams and are situated on sandy soils, in areas with a high water table and high biological complexity (Hamilton and Nicholson 1999; Nicholson et al. 2002;

Wiseman et al. 2006). Although the site locations could have been suitable for horticulture production, there is little evidence of horticulture paraphernalia. The Johnas and Atkinson-East site are two exceptions. Stone and possible bone hoes have been surface collected from the Johnas site and a stone hoe was found eroding out of the north bank of the Souris River at the Atkinson-East site (Nicholson et al. 2008).

Instead, the prevalence of bison procurement and processing observed in the Jackson and Vera faunal assemblages (Playford 2001a, 2010; Playford and Nicholson 2006) is thought to be a product of interaction with Mortlach groups (Mokelki 2007; Nicholson and Hamilton 1997a, 1999; Nicholson et al. 2006c, 2011). Such interaction is inferred from the spatial and temporal proximity of western cluster Vickers focus sites and Mortlach sites such as Twin Fawns, Schuddemat and Hollow B, also located in the *Makotchi-Ded Dontipi* locale (Figure 2-13). In addition, there is the presence of Mortlach pottery attributes such as angled, wedge and square wedge profiles in the western cluster pottery assemblages. Other differences between the two Vickers focus site clusters include smaller site sizes, a general lack of imported vessels and fewer exotics in the western cluster assemblages (Nicholson et al. 2011:161). However, a vessel by vessel analysis of the Vera, Jackson, Twin Fawns, Schuddemat and Hollow B pottery undertaken by Mokelki (2007:77-81) concluded that the Jackson and Vera site vessels were similar to each other and shared common Vickers focus pottery attributes. Sites from both clusters have similar vessel shapes, paste quality, temper, surface treatments and location of decoration along the inner and outer lip. In addition, distinctive Vickers focus traits of finger pinched nodes and single transverse cord impressions over the lip are present on vessels from Jackson and Vera, leading to the conclusion that these two should be considered Vickers focus sites.

Figure 2-13: Location of Vickers focus and Mortlach sites in the *Makotchi-Ded Dontipi* locale.



Vickers Focus Subsistence and Settlement Interpretations

Unlike the Blackduck complex, no formalized subsistence strategy model has been formulated for the Vickers focus. Instead over the past quarter century, theories about their lifeways have continually evolved with additional excavations and research. One constant, however, based on the recovery of horticulture tools and the similarity in pottery wares to known horticulture groups, has been the suggestion that the eastern cluster Vickers focus people were practicing local small-scale horticulture (Hamilton and Nicholson 1999; Nicholson 1990, 1991, 1993, 1994, 1996a, 1996b; Nicholson and Gibson 1990; Nicholson and Hamilton 1997a, 1999, 2001; Nicholson and Kuijt 1990; Nicholson and Malainey 1991, 1995; Nicholson et al. 2002, 2003, 2006a, 2006b, 2006c, 2011). The identification of maize and bean from Vickers focus pottery supports the argument that domesticated plants were part of their diet (Boyd and Surette 2010; Boyd et al. 2006a, 2006b, 2008; Surette 2005). What is now debated is the origin of these cultigens. Nicholson et al. (2011) maintained that they were being grown in the eastern cluster sites, while Boyd et al. (2008:2555) suggested "that a bison-based economy, supplemented *minimally* by maize, was the characteristic and dominant subsistence mode on the eastern Canadian prairies shortly before European contact" (emphasis in original). Trace element analysis is presented as further evidence that much of the maize may have been traded rather than locally produced (Boyd et al. 2008:2554).

The importance of animal food subsistence in the eastern cluster sites is acknowledged although there has been a variety of subsistence terms proposed to reflect its relative importance (Table 2-8). The faunal recoveries from the Lovstrom site were used to suggest that the horticultural components (Vickers focus) had a lower frequency of identified faunal remains, interpreted that other resources (i.e. maize) must have been exploited (Nicholson 1991). When compared to earlier hunter-gatherer Blackduck/Duck Bay sites, eastern cluster Vickers focus sites are said to have markedly less faunal material (Nicholson and Hamilton 2001:61). However, it is also stated that abundant faunal remains indicate intensive processing of bison for marrow and grease (Nicholson 1993:214) and that bison hunting dominated the subsistence strategy (Nicholson 1991, 1993; Nicholson and Malainey 1995). The most recent (Nicholson et al. 2011:164) interpretation stated that Vickers focus people harvested a wider range of faunal species than did Plains Blackduck groups. Surface collected and excavated faunal remains from the Lowton site is interpreted as indicating broad spectrum foraging rather than a specialized bison procurement strategy for the inhabitants. Similarly, at the Lovstrom site, the Vickers focus occupation indicates a greater diversity of faunal species in contrast to the Blackduck/Duck Bay occupation there, which are almost exclusively bison with small amounts of canid" (Nicholson et al. 2008:np).

The role of animal food subsistence is somewhat better understood for the western cluster sites because unlike eastern cluster sites, in-depth faunal analyses have been undertaken. Results of the Jackson and Vera site faunal assemblage analyses (Playford 2001a, 2010; Playford and Nicholson 2006)

Table 2-8: Eastern cluster Vickers focus subsistence strategy terminology.

Subsistence Term	Description	Reference
Mixed subsistence	small scale horticulture to supplement a hunting and gathering economy relying upon bison and other traditional hunter-gatherer food resources	Nicholson and Malainey 1991
Mixed subsistence	small scale horticulture to supplement hunting and gathering dominated by bison procurement	Nicholson 1991
Hunting/horticultural lifeway		Nicholson 1993
Horticulture and diverse hunting/gathering	small farming/hunting sites	Nicholson 1994
Hunter-gatherer/horticultural lifeway		Nicholson and Malainey 1995
Plains Woodland/Village horticulturalists	primarily through hunting and gathering with horticulture playing a limited role	Nicholson 1996a
	bison as well as other traditional hunter and gatherer food resources	Nicholson 1996b
Horticulture/foragers		Nicholson and Hamilton 1997a
Forager/horticulturists	horticulture playing supporting role	Nicholson and Hamilton 1997b
Forager/farmers		Hamilton and Nicholson 1999
Forager/horticulturalists		Nicholson and Hamilton 1999
Small scale horticulture		Nicholson et al. 2002
Forager horticulturalists		Wiseman et al. 2006
Horticultural foraging lifeway		Nicholson et al 2006b
Foraging and gardening lifeway		Nicholson et al. 2008
Forager horticultural lifeway		Nicholson et al. 2011

corroborated earlier claims that bison procurement and processing was a focal element of the western cluster subsistence (Hamilton and Nicholson 1997a, 1999). Inhabitants of both sites were intensively processing bison whereas other animal food resources like canids and small mammals represented a minor component of their diet (Playford and Nicholson 2006:420). The nearby Bradshaw site, tentatively identified as Vickers focus, is said to have far fewer faunal remains, including possible beaver and duck. Nicholson and Hamilton (1997a:31) proposed that this site represents a warm season occupation of intensive foraging by Vickers focus people.

The Vera faunal assemblage analysis also dispelled some erroneous misconceptions, namely that no foetal bison remains had been recovered and that all faunal remains were sparse from this site, suggesting a warm season occupation (Nicholson and Hamilton 1999:24, 2001:64-65; Nicholson et al. 2002:321). Almost 160 foetal bison specimens were recovered from the Vera site, most of which were larger than a comparative five month specimen. "The Vera site was occupied *at least* during the late winter and early spring and *possibly* into summer" (Playford and Nicholson 2006:419, emphasis added).

There has been a proposed shift in the western cluster sites from intensive foragers as seen at the Bradshaw site, towards specialized bison hunters as represented by a small localized bison kill at the north end of the Jackson site (Hamilton and Nicholson 1999; Nicholson and Hamilton 1999; Nicholson et al. 2006b; Wiseman et al. 2006). However, the identification of maize phytoliths and starch from both the western cluster Vickers focus sites that were sampled (Atkinson-East and Vera) as well as the recovery of horticulture implements from the Atkinson-East and Johnas sites, is taken to indicate that cultigens were still an important dietary component (Nicholson et al. 2011:164). However, the presence (and inferred importance) of native cultigens cannot be ascertained for the majority of western cluster Vickers focus sites as residue analysis was not undertaken on Jackson, Johnas, Taylor or Bradshaw site vessels.

One final aspect of the Vickers focus lifeway to be reviewed is their proposed settlement strategy. The terms *centre-based* and *central place* were first defined by Nicholson and Hamilton (1997b:39).

> The term *centre-based* refers to a settlement strategy wherein a large, extended occupation village was established to serve as "headquarters" for more short term, satellite or task-specific resource extraction settlements. The term *central place* refers to a settlement strategy in which a seasonal village was strategically placed and from which short-term, resource extraction task groups were dispatched into the surrounding area. A centre base would typically be occupied for more than a year and a central place would typically be chosen for seasonal extraction, although it might be reoccupied within a relatively short span of years, depending upon local availability of such materials as firewood, fresh water, plants, etc. Both systems allow for larger population aggregations than are typically represented in sites left by earlier hunter-gatherers.

The terms however have been used interchangeably in the literature. For example, the Lowton site is described as representing a *central place* strategy of a headquarter village occupied for greater than one year and the *Makotchi-Ded Dontipi* sites representing a shorter term, single season *centre-based* strategy (Nicholson and Hamilton 1999:15). It is suggested here that the original terminology and definitions provided by Nicholson and Hamilton (1997a:39) be retained, meaning that the eastern cluster sites represent a centre-based strategy whereas the western cluster sites represent a central place strategy.

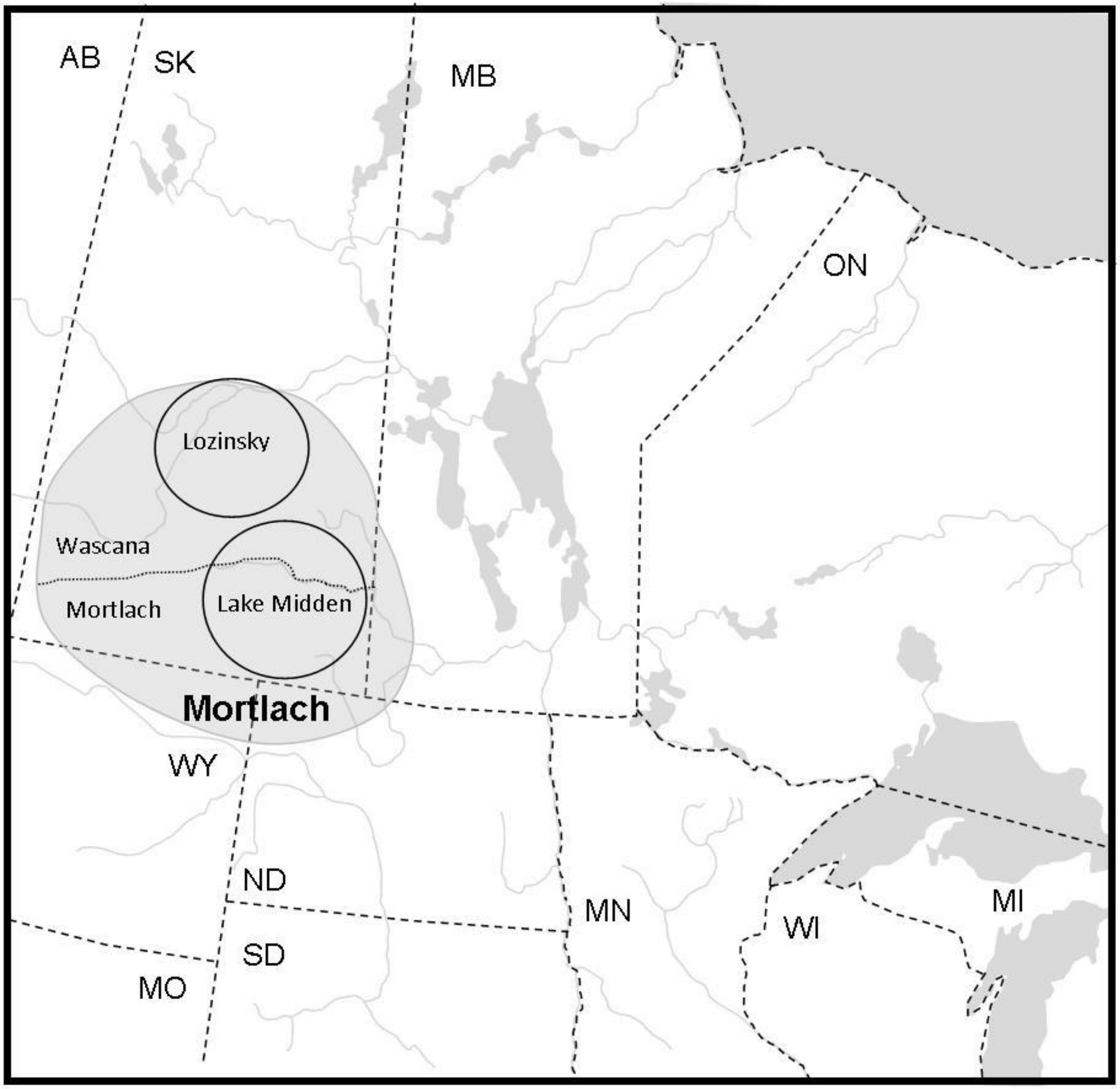
The disappearance of Vickers focus pottery from the archaeological record is believed to be connected to the presence of Mortlach pottery in the *Makotchi-Ded Dontipi* locale (Nicholson and Hamilton 1999; Nicholson et al. 2006c; Mokelki 2007). Mokelki (2007) argued that the shared pottery attributes and cultural connections to the Middle Missouri subarea of both groups, as well as the Vickers focus adoption of a plains oriented subsistence strategy is indicative of interaction with, and the eventual amalgamation of the Vickers focus people with those who made Mortlach pottery.

The Mortlach Complex

Mortlach pottery was first identified and defined by avocational archaeologist Boyd Wettlaufer based on check-stamped pottery recovered from the Mortlach site in southern Saskatchewan (Wettlaufer 1955). Since that time, several researchers have redefined the Mortlach entity, and it has variously been called a culture, aggregate, phase or ware, depending upon the assigned attributes (Byrne 1973; Johnson 1977; Joyes 1973; Kehoe 1959; Malainey 1991, 1995; Schneider and Kinney 1978; Syms 1977; Walde 1994, 2003; Wettlaufer and Mayer-Oakes 1960). The complex designation has been employed here simply for consistency’s sake.

Two major approaches of Mortlach pottery classification have developed. The first considers all terminal precontact pottery from south-central Saskatchewan as Mortlach (Meyer 1988; Meyer and Epp 1990; Walde 1994, 2003), while the second approach advocated by Malainey (1991) identified two late precontact archaeological entities. Her Wascana ware is indicative of the Moose Jaw complex located north of the Qu’Appelle Valley in Saskatchewan and reflects boreal forest pottery traits, whereas south of the valley, Mortlach ware is recovered from Mortlach aggregate sites and exhibits plains pottery traits (Figure 2-14) . Walde (1994, 2003) disagreed with Malainey and proposed instead two regional subphases of Mortlach differentiated by participation in separate trade networks. His Lozinsky subphase sites, from the Saskatchewan Parkland, show substantial Selkirk influence. The Lake Midden subphase sites are found south of the Parkland, and exhibit Middle Missouri pottery traits and contain artifacts such as gaming discs, ice gliders and southern sourced lithics such as KRF and fused shale. Most recently, Walde (2010:161) has changed his terminology, elevating Mortlach to a culture and referring to Lozinsky and Lake Midden as

Figure 2-14: Approximate Mortlach distribution showing Walde's (2003) subphases and Malainey's (Malainey et al. 1999) wares.



phases. Mokelki (2007) presented an excellent synthesis (Table 2-9) of the pottery attributes for the various Mortlach/Wascana definitions and compared them with those defined for the Vickers focus.

Although the 'correct' classification of Mortlach is debated, the temporal and spatial distributions are somewhat better understood. Conventional radiocarbon dating of Mortlach assemblages is problematic due to complexities of the

Table 2-9: Pottery attributes for Vickers focus, Mortlach and Wascana (Mokelki 2007:103).

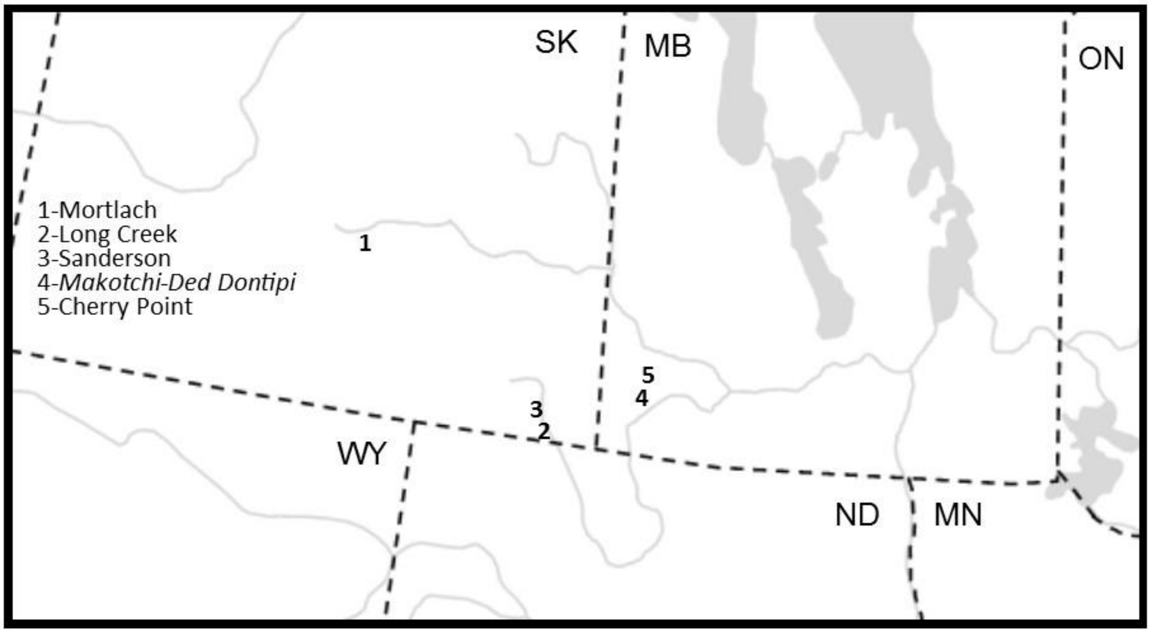
Attributes	Vickers focus	Mortlach	Mortlach	Wascana
Author	Nicholson (1991, 1996)	Walde (1994)	Malainey (1991, 1995)	Malainey (1991, 1995)
Profile	globular	globular		globular
Rim Shape	flaring-straight-occasional S-rim	vertical, angled rim, S-rim, wedge	at least 1/3 wedge; rest mostly straight with small % angled rim/square wedge and S-rim	most are straight, S-rim or angled; small % of wedge and short
Lip Shape	highly variable	highly variable	variable but high % of wedge	variable but high % flat
Paste	variable-well worked	relatively thin and compact	most good quality; consolidated	good quality; often fine lamination
Temper	most sand, some grit; shell	most grit, some sand and grit	most grit; some sand and grit; sand alone is rare	most grit; some sand and grit; sand alone is rare
Decoration Area	most confined to lip and upper exterior rim; some shoulder	most confined to lip and/or rim; some extends to shoulder	most confined to lip and/or brim	lip; rim neck; shoulder
Decoration Type	twisted cord; finger pinching; CWT; TI; lip modeling; punctate	dentate stamps; CWT, quills; solid, pointed and notched tools, fingers	most CWT or dentate; also fingernail impressions, notches and TI	CWT; punctates; incising; fingernail impressions; notching; pinching
Decoration Motif	finger pinched nodules; twisted cord loop impression; TI; incising; quartering	highly variable from undecorated-simple-complex; some evidence of quartering	most sparsely decorated but few show elaborate patterns	highly variable from simple to complex
Surface Treatment	cord or fabric roughened; some smooth, smooth/obliterated or brushed	roughened with cord or fabric wrapped paddles; simple or check stamped; smooth	plain; check or simple stamped; cord roughened; fabric impression rare	most (>80%) are fabric impressed, plain or cord roughened; also get simple, check or rolled CWT stamp; vertical fabric impression; brushed; burnished

radiocarbon calibration curve, but generally accepted dates range from about 700 ya through the protocontact into the contact period (Hamilton and Nicholson 2007:143). Spatial boundaries are delineated primarily on the presence of neighboring cultures, and are fairly well defined. The northern boundary lies in Saskatchewan’s Aspen Parkland/Boreal Forest interface marked by the presence of Selkirk while to the west there is the Old Women’s phase or the Cluny complex in southwestern Alberta. To the south, sites have been reported from Montana into the Middle Missouri subarea of North Dakota (Mokelki 2007:26). The eastern boundary had not been firmly established until the *Makotchi-Ded Dontipi* sites were excavated and analyzed (Mokelki 2007; Nicholson and Hamilton 1999) although early on, Syms (1977:125) indicated a Mortlach component at the Cherry Point site on the north end of Oak Lake.

Mortlach Subsistence Strategies

There is also very little debate about the economic lifeway followed by the makers of Mortlach pottery. It is generally agreed that Mortlach sites represent a specialized bison procurement and intensive bison processing subsistence strategy (Bryant 2002; Hamilton and Nicholson 2007; McCorquodale 1960; Magee 1997; Malainey 1995; Meyer 1988, 1993; Nicholson et al. 2011; Playford 2001a, 2010; Walde 1994, 2003). The original Mortlach site (Figure 2-15) was described as being a pound site and associated camp (Wettlaufer 1955), although the practice of the day was to disregard faunal remains so no inventory of the site’s faunal assemblage has been reported. Of sites with excavated and analyzed faunal remains, bison dominated the assemblage, and canids were the second most common species identified. Bison elements were heavily fragmented with only the densest elements being recovered whole. Even some of the carpals and/or tarsals from the Long Creek (McCorquodale 1960:94) and Sanderson (Magee 1997:208) sites were split. McCorquodale (1960:92) concluded that these elements were being utilized for marrow although Magee (1997:242) suggested that the unusual breakage pattern on the Sanderson site elements were likely a result of processing frozen limbs. A descriptive picture of Mortlach subsistence has been penned by Meyer (1993:64), who wrote Mortlach

Figure 2-15: Mortlach sites discussed in Chapter Two.



> is characterized by very large sites with dense deposits of materials. In particular, bison bones were intensively processed by being broken into tiny pieces and then boiled, the vats of water being heated with hot rocks. The marrow fat thus was rendered out of the bone and then was skimmed off. Apparently, the bone fragments were 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.

The pottery from three Mortlach sites in the *Makotchi-Ded Dontipi* locale, Twin Fawns, Hollow B and Schuddemat, were selected for residue analysis by Boyd et al. (2006:07) and all were positive for maize phytoliths/starch, while bean starch was also identified on a Hollow B vessel. Boyd et al. (2006:02) had tested the Twin Fawns material as a control sample, incorrectly attributing it with “general ‘Late Woodland’ attributes, no artifactual evidence of gardening and, in short, no clear archaeological connections to the Plains Village tradition”. Mokelki (2007:125) corroborated an earlier Mortlach identification by Nicholson and Hamilton (1999) as defined by both Walde (1994, 2003) and Malainey (1991, 1995) for the Twin Fawns material. Neither the Twin Fawns nor the Schuddemat materials correlated well with Wascana ware attributes and the vessel count from the Hollow B site was too small to determine an archaeological affiliation.

Mokelki (2007) concluded that the makers of Mortlach, Vickers focus and Wascana pottery were part of a larger eastern Woodland migration onto the Canadian Plains. By interacting with neighbor groups they became distinct entities that continued to share a number of similarities, reflecting their common ancestry. These similarities culminated at the *Makotchi-Ded Dontipi* locale where the interaction between, and eventual amalgamation of Mortlach and Vickers focus people is reflected in the Twin Fawn and Schuddemat pottery assemblages which Mokelki (2007:ii) considered to be a Vickers variant of the Lake Midden subphase of Mortlach as defined by Walde. This proposed amalgamation is used by Nicholson et al. (2001:166-167) to explain the presence of native cultigens within the *Makotchi-Ded Dontipi* Mortlach sites, stating that there is no indication of horticulture from Saskatchewan Mortlach sites.

Because the Mortlach complex extends into the historic time period, researchers have attempted to assign it an ethnic identity, a not uncommon practice for archaeologists and ethnohistorians working with late precontact and protohistoric Plains archaeological cultures (Schlesier 1994). Archaeologists often use what is called the direct historical approach (Wedel 1938), a method of relating the unknown (precontact sites) with the known (historic groups) (Strong 1953:39). Cultural continuity from the precontact to the contact time period is imperative for this to be a successful endeavour (Willey 1953:372). When direct links cannot be made, a common approach is the use of historical documents and ethnographic analogy to infer ethnicity but this method must be used cautiously. Relationships between ethnic groups and their material culture can be imprecise, and different ethnic groups (however defined) share many elements of subsistence, technology and lifestyle (Krause 1998:73). The proposed Mortlach ethnic identifications highlight a situation where different researchers can interpret similar data to reach far different conclusions.

Walde (1994, 2003, 2010) argued that Mortlach pottery was created by ancestors of the Assiniboine, while Malainey (1991) and others (Meyer and Russell 2006; Nicholson et al. 2011) suggest that some or all of the Mortlach people were ancestral Hidatsa. Walde (2010:159) presented four lines of evidence in support of his argument: written records establishing an early Assiniboine presence where Mortlach sites exist, linguistics, ice glider similarities with Siouan rather than Middle Missouri sites, and continuities with Sandy Lake pottery, which most often is identified as being ancestral Siouan. Nicholson et al. (2011:156) responded that the distribution of Mortlach pottery does not support an Assiniboine assignment given that the late historic Assiniboine range extended from northwestern Ontario to the Battlefords and that several historical groups co-existed in Mortlach territory (Meyer and Russell 2006:318-319). Walde himself (2010:159) articulated the problem of assigning ethnicity, ". . . treating as a single entity the many different groups glossed in the literature and present-day parlance as "Assiniboine" or "Nakoda" are again evident and the question of what we mean by "ethnicity" and how that relates to the self-perception and the social actions of past peoples remains a significant issue."

Other Cultures on or adjacent to the Northeastern Plains during the Protohistoric and Historic Time Periods

Blackduck, Vickers, and Mortlach were the main archaeological entities inhabiting the Canadian Northeastern Plains during the Late Precontact and into the protohistoric time periods. Important adjacent archaeological cultures include Selkirk with its associated complexes and Old Women's phase sites which overlap Mortlach distributions in Saskatchewan and Alberta.

Selkirk wares first appeared about 1000 ya and existed until the turn of the nineteenth century (Nicholson 1996b:71). Their presence is thought to be a result of a late Laurel population interacting with Blackduck groups in north-central Manitoba. Selkirk is usually referred to as a composite because of the recognized regional complexes stretching across the boreal forests of northern Manitoba and Saskatchewan, as well as from the southern boreal forest/parkland transition zone of eastern Saskatchewan. Initially, the Winnipeg River complex found in southeastern Manitoba was subsumed within the Selkirk composite (Meyer and Russell 1987:05), but it has since been recognized that the pottery is sufficiently distinct to warrant its association with the Rainy River composite as defined by Lenius and Olinyk (1990:103).

Smooth fabric impressed vessels with a single row of punctates around the exterior rim or neck are called Clearwater Lake Punctate and are found in all Selkirk complex sites (Gibson 1998:16). Selkirk complexes include Clearwater Lake, Kame Hills, Pehonan and Kisis. The Clearwater Lake complex is found in central western Manitoba and northern Saskatchewan, although vessels have been identified from a few sites in northern Ontario (Meyer and Russell 1987:12). The Kame Hills complex, restricted to South Indian and Big Sand Lakes as well as the Rat-Burntwood River system, contains Clearwater Lake Punctate vessels but also has distinctive punctate-decorated plates (Meyer and Russell 1987:15). Kisis complex sites are located in north-central Saskatchewan where vessels sometimes exhibit shoulder decorations, crushed temper and a roughened smooth fabric finish (Meyer and Russell 1987:19). Meyer (1981, 1984) defined the Pehonan complex based on the presence of Clearwater Lake Punctate vessels from sites extending into the northern parkland of central Saskatchewan. Also at these sites were vessels with S-rims and angular shoulders that were sometimes decorated. Meyer (1981:33) suggested that the Pehonan complex was essentially Selkirk in nature but had been modified by a result of contact with Plains groups.

Relatively little has been written about Selkirk lifeways with a few notable exceptions (Gibson 1998; McKeand 1995; Wondrasek 1997). This is mostly a function of Selkirk sites being located in the boreal forest where preservation is hampered by slow soil development and the presence of acidic soils which degrade organic materials (Gibson 1998:18). Several authors agree that Selkirk pottery was most likely manufactured by the people who would become known historically as the Cree (MacNeish 1958:47-49; Meyer and Hamilton 1994:127; Meyer and Russell 1987:25-26). Given their boreal forest site locations, and proposed evolution from Laurel/Blackduck to historic Cree people, the makers of Selkirk pottery most likely sustained a woodland foraging subsistence as described for Laurel and Blackduck. However, the most definitive study of Selkirk subsistence comes from the Bushfield West site near Nipawin in east-central Saskatchewan (McKeand 1995). Originally identified as a Pehonan complex site, Gibson (1998:213) has reclassified the pottery as belonging to his newly defined *Keskatchewan* complex, named for the Saskatchewan River in Cree. Late term foetal bison elements and immature bison remains point to a late spring site occupation. Bison clearly dominate, but the diverse assemblages represent exploitation of a wide variety of mammals, birds and fish, but especially beaver (McKeand 1995:347-348).

In contrast, Old Women's phase sites represent activities associated with specialized bison hunting like procurement pound and jump sites, bison processing camps, as well as burials and stone circle sites. Peck (2001) examined the proposed seasonal round for Old Women's phase sites in southern Alberta. After thin-sectioning bison teeth to establish season of mortality, he concluded that the makers of Old Women's phase pottery maintained a seasonal round following the bison herds. Winter sites were located on the Plains periphery or in large river valleys where bison would seek shelter from winter weather, and summer sites were located out on the open plains where bison foraged.

Old Women's phase sites are usually identified based on the presence of their distinctive pottery. Vessels are thick-walled, coconut to globular shaped, often with pronounced shoulders, and have a smoothed fabric or vertical impressed surface treatment. Decorations consist of punctates or incisions located on or below the lip, on the neck, or on the shoulder (Peck 2011:377). Sites first appear in the archaeological record between AD 800 and AD 900 and extend across the Plains of Saskatchewan, Alberta and eventually into northern Wyoming. The influx of Mortlach people into southern Saskatchewan appear to have displaced Old Women's phase people out of the area, but they continued to thrive across Alberta and northern Wyoming into the historic time period. The association between the historic Blackfoot and Old Women's phase has been observed by several authors (Byrne 1972; Magne et al. 1987; Peck 2011; Reeves 1983). Peck (2011:404) presented four lines of evidence he believes links Old Women's Phase sites with the Blackfoot people. First, there is the coincidental distribution of Old Women's phase sites and that of the historic

Blackfoot. Ammonites have been identified within Old Women's phase assemblages and these are known to have been used by the historic Blackfoot as *Iniskum* or buffalo charms. There are similarities in burial practices as both groups interred their dead within medicine wheels. Finally, the distribution and identification of human boulder effigies on the plains are thought to be tied to the Blackfoot trickster figure Napi. Also, the historic Blackfoot were well known for their bison hunting capabilities, as were the makers of Old Women's Phase pottery.

After European colonial settlement in the Americas in the late 1400s, the introduction of new epidemic diseases in quick succession meant that the non-immune indigenous populations were unable to rebound. Denevan (1992) believed that these diseases decimated over ninety percent of the population within a couple hundred years. As a result, social and political organization altered, populations coalesced, and subsistence strategies changed (Dobyns 1983). As early as the 1600s the Northeastern Plains experienced population displacements, and European technology was being adapted into Aboriginal exchange systems through indirect trade. As their participation in the fur and bison hide, and then the provision trade increased, culture change accelerated in part by pedestrian bison hunting societies' adaptation of the horse. Equestrian elements such as warfare, horse raiding and military alliances developed in addition to changing subsistence patterns. While many of these changes derived from European contact, it is thought that elements of precontact life can still be inferred from the descriptions of these rapidly changing societies (Nicholson and Hamilton 2006; 253-254).

Historic records consist of early explorer and missionary accounts, fur trade literature or diaries, and ethnographic studies. On the Northeastern Canadian Plains, the most extensive and useful body of literature is from the fur trade era dating between AD 1700 – 1870 (Nicholson 1987c:16). Ethnographic accounts which attempted to reconstruct life prior to the reservation system, were mostly gathered in the early twentieth century and were often second or third hand accounts (Malainey 2005:156). The fur trade literature is not without limitations.

It was mostly compiled by men interested in very specific elements of native society who often failed to distinguish between linguistically similar groups. Also, the reported westward shift of historic groups may be, in part, a function of the westward movement of European observers (Nicholson 1987c:17).

According to Butzer (1992:348-349), ethnographic records indicate three different subsistence strategies practiced in North America at contact although "maps for A.D. 1200, 1500 and 1750 would show different distributions." Hunter-foragers who did not practice agriculture inhabited California, the Pacific Northwest and the Canadian boreal forest while the hunter-foragers living in the centre of the continent planted supplementary crops. The eastern and southwestern parts of the United States were inhabited by groups who depended primarily on domesticated plants but used a substantial component of wild plants and animals. This macro-scale description does not adequately describe the variability reported in the ethnohistoric records (Hamilton and Nicholson 2006; Nicholson 1987c). Nicholson (1987a, b, c) has emphasized the wide range of subsistence resources available in southwestern Manitoba. He suggested (1987c:30) that all resources were utilized in conjunction with risk reducing strategies such as mobility, storage, trade and horticulture by protohistoric and historic occupants.

Hamilton and Nicholson (2006) extensively reviewed historical documentation and concluded that during the historic time period, three different economic orientations were being practiced on the Canadian Northeastern Plains. These included specialized bison hunting, generalized woodland foraging and mixed foraging with horticulture, and groups were not restricted to one orientation. The eastern and northern Assiniboine were generalized forest hunters and gatherers while those in the south were bison hunters. Similarly, Siouan groups initially encountered in central Minnesota were observed following a mixed economy of bison hunting on the grasslands in summer and moving into the forest for winter. Eventually, some Siouan people moved out onto the plains to exclusively hunt bison. The Cree were also generalized foragers inhabiting the subarctic. They lived in small fluid kin-based bands, likely using diffuse and patchy resources but aggregating into macrobands during seasons of resource concentration (i.e. fish runs, migratory waterfowl, etc.). One Cree group moved out onto the Plains in the early eighteenth century and adopted a Plains way of life including full-fledged bison hunting. When hunting bison, observers record hunts taking place within forest groves along river valleys, uplands, sand dunes or ephemeral wetlands. Historical evidence for horticulture is less apparent, but Hind referenced the presence of maize fields on the Assiniboine River. The historic time period was one of rapid transformation in response to the fur trade as well as the adoption of new technologies such as the horse and gun. A common theme of adaptive flexibility and resilience is evident for these historic groups (Nicholson and Hamilton 2006).

Summary

The Canadian portion of the Northeastern Plains has had a long and varied human occupation. A common theme of all archaeological groups encountered in the area appears to be one of flexible adaptability. While early inhabitants are often thought of strictly as big game hunters, ongoing research suggests that other foodstuffs were an important component of their diet. Changing climatic conditions may have been a factor of inferred changed subsistence strategies during the Middle Precontact time period although large game still dominates most Canadian Northeastern Plains sites. During the Late Precontact time period, major socio-political changes are reflected in the archaeological record by increased site size and frequency, as well as varied economic adaptations. Various terms have been used to describe the subsistence strategies of Blackduck, Vickers and Mortlach groups inhabiting the Canadian Northeastern Plains. The intensity of bison processing and the importance of non-bison species in the diet have been inferred to reflect varying degrees of foraging, farming/horticulture and specialized bison hunting.

CHAPTER 03: SITE SELECTION AND DESCRIPTIONS

Introduction

Six sites have been selected for analysis: two Plains Blackduck, two Vickers and two Mortlach. In this chapter, the rationale for choosing each specific site is explained, and the study area is delineated. Each site is described in detail, starting with the site location and environmental setting. When possible, environmental reconstructions are provided and the excavation history and procedures are reviewed. The cultural assemblages and affiliations are identified and specific site activities are reported, as is the faunal assemblage sample for each site. The chapter concludes by examining landscape diversity and uniqueness of the sites to determine their level of biological diversity.

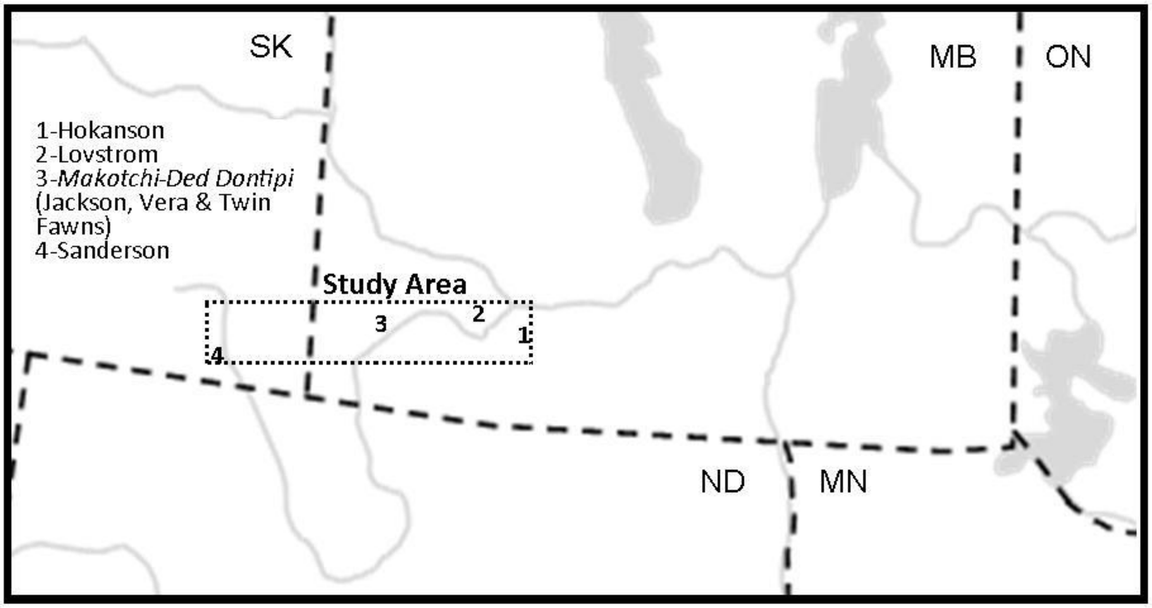
Site Selection Criteria

In order to undertake both inter- and intra-culture comparisons, two Plains Blackduck, two Vickers and two Mortlach sites were selected. Given the labour-intensive nature of detailed faunal analysis, it was initially decided that only sites with a published faunal report following analysis procedures as outlined in Chapter Four would be considered. Foetal bison elements had to be present in order to apply the FODS, and all sites needed to be within areas of similar biological diversity. Two Vickers sites, Jackson and Vera, fit these criteria and were included in the study. Two Mortlach sites, Twin Fawns and Sanderson, also fit the criteria of containing foetal bison elements and have been analyzed following the outlined procedures; although the Twin Fawn faunal analysis had been completed, it had not yet been published. Both sites however were analyzed following Chapter Four procedures and contained foetal material. However, there were no published Plains Blackduck faunal assemblages with foetal bison remains that had been analyzed in a similar manner. It was necessary then to revise the criteria, and two Plains Blackduck sites, Hokanson and Lovstrom were included. Both these sites had foetal bison listed in their primary catalogue, but it was necessary to reanalyze the faunal assemblages following the outlined methods. This enabled comparison of the subsistence strategies evident at all six sites.

Study Area

The general study area of this dissertation is considered to be the Canadian portion of the Northeastern Plains as outlined in Chapter Two. However, selection of the six sites limits the specific study area to a 270 X 40 km rectangle straddling the Manitoba-Saskatchewan border (Figure 3-1). All sites are located within this circumscribed study area.

Figure 3-1: Study area within the Canadian portion of the Northeastern Plains showing site locations.



Site Descriptions

Various types of information are required to describe a site. For this dissertation, six variables (location, environmental setting, environmental reconstruction, excavation history and procedures, cultural assemblage and affiliation, and selected faunal assemblage sample) are presented. The specific attributes considered within each variable are discussed below, and then each site is described using these six variables.

Site Location

Compiling and providing information as seemingly simple as site location and environmental setting can be problematic because site environments have been classified and described using various classification schemes and terminology. Knowing that site level comparison was an ultimate objective, it was necessary to describe site location and especially environmental settings in such a way that inter-site comparisons could be made. All site locations are given using UTM designations as well as distance from closest urban setting and have been plotted on an NTS map.

Environmental Setting

Placing sites in an environmental context was more of a challenge. Sites exist within a physical, biological and social environment, and those environments change over time. How archaeologists interpret and describe these environments has also evolved. To ensure consistency in environmental setting descriptions, the National Ecological Framework for Land Classification (Ecological Stratification Working Group 1996) was employed to describe each site at the macro and meso scales whenever possible (Table 3-1).

Table 3-1: Dissertation sites and their respective ecological classification using the National Ecological Classification.

Site	Ecozone	Ecoregion	Ecodistrict
Hokanson	Prairies	Aspen Parkland	Hilton (764)
Lovstrom	Prairies	Aspen Parkland	Hilton (764) & Manitou (766)
Jackson	Prairies	Aspen Parkland	Oak Lake (763)
Vera	Prairies	Aspen Parkland	Oak Lake (763)
Sanderson	Prairies	Moist Mixed Grasslands	(796)
Twin Fawns	Prairies	Aspen Parkland	Oak Lake (763)

Environmental Reconstruction

Environments can change over time, and this is especially true for the study area. The elimination of the bison herds, suppression of grass fires and cultivation of the unbroken land has greatly changed the biophysical environment since the Late Precontact period. For this reason, it is also necessary to attempt a site-level environmental reconstruction whenever possible.

Excavation History and Procedures

How a site is excavated can greatly affect the recovered artifact assemblage and so it is imperative that the procedures of excavation for each site are known and are reported. Because sites represent individual and unique circumstances that call for specific excavation procedures, these procedures are rarely identical. However, by reporting and accounting for the differences in site excavation procedures, it is possible to compare site assemblages.

Unless otherwise stated, sites were excavated using the following standard procedures. Units measuring one m^2 were excavated in arbitrary five cm levels, and divided into quadrants. Three-point provenience was taken on diagnostic artifacts recovered in situ. Except for collected soil samples, matrix was passed through a 0.635 cm (quarter inch) mesh screen with the recovered artifacts bagged and catalogued according to quadrant and level. Artifact rich levels were excavated using hand tools such as trowels, dental picks and brushes. Non-artifact dense levels were shovel shaved by quadrant. To ensure that no deeply buried occupations were missed, and to provide a deep sedimentary exposure, a small trench was excavated along at least one wall. Photographs (digital or analog) were taken upon the completion of each level and level summary forms were completed. A floor plan of recoveries, disturbances, and soil changes was drawn prior to excavating the next level. Features were extensively photographed and recorded on the level summary, unit summary and feature forms. If possible, feature soil samples were collected. Upon completion of a unit, a unit summary form was completed, photographs taken, and at least one wall profiled using a 1:10 scale.

Recovered artifacts were cleaned, sorted and identified. A catalogue was created using either the MacAdem or ArchWizard cataloguing programs. Artifacts were then bagged and stored with a catalogue card.

Cultural Assemblage and Affiliation

The artifact assemblage is summarized for each site and activity areas are described. Radiocarbon dates as well as the identification of diagnostic artifacts are presented to establish each site's cultural affiliation.

Sample Used in Dissertation

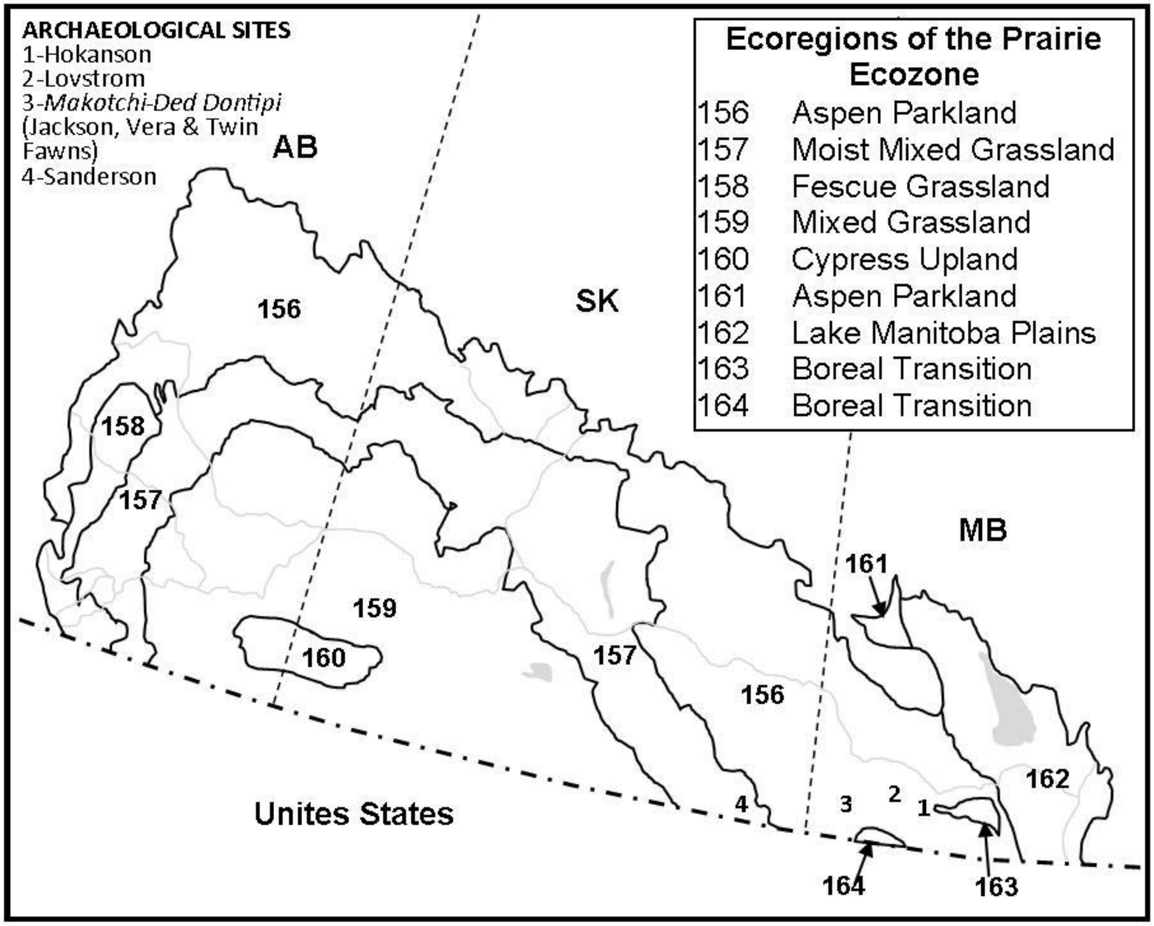
For various reasons, it was necessary to select a faunal assemblage sample for each site. Each site sample is described and the rationale for its selection is explained.

The Hokanson Site (DiLv-29)

Site Location

The Hokanson site is located about 200 km southwest of Winnipeg, Manitoba on NTS map 62G/5 with UTM designation 14U MK 461E 5470N. The site is located in the Prairie Ecozone (Figure 3-2), which is a northern extension of the former open grasslands of the Great Plains of North America.

Figure 3-2: Ecoregions of the Prairie Ecozone and study site locations.



Environmental Setting

The Prairie Ecozone is an area characterized by little topographic relief with large expanses of undulating and hummocky terrain intersected by large river valleys. The climate is continental, being subhumid to subarid. Summers are short and warm with a mean temperature ranging from 14°C to 16°C. Winters are long and cold with the mean temperature ranging from -12.5°C to -8.0°C. There is a low level of precipitation and high evaporation rates due in part to frequent, strong winds. Precipitation is variable across the Ecozone, ranging from 250 mm in the more arid southwest to about 550 mm in the east. Cretaceous shales and Paleozoic limestone underlay glacial moraine and sandy to clayey glaciolacustrine surface deposits. Prior to agriculture, the hummocky undrained depressions created numerous small wetlands. The Saskatchewan, the Assiniboine and the Red are the major rivers of the Prairie Ecozone in Manitoba although there are numerous smaller rivers and creeks. Chernozems are the dominant soils and are characterized by an organic rich surface horizon. Across the Prairie Ecozone, most of the native tall-grass, mixed-grass and Aspen Parkland have been cultivated.

The Aspen Parkland is found along the eastern and northern edge of the Ecozone and is a transition between grassland and Boreal Forest. Existing characteristic mammals of the area include elk, coyote, badger, white-tailed jack rabbit, Richardson’s ground squirrel and northern pocket gopher. In the west, pronghorn antelope and mule deer can also be found. Ferruginous hawk, sage grouse, American avocet, burrowing owl, great blue heron, black-billed magpie, Baltimore oriole, veery and brown thrasher are representative birds. Reptiles and amphibians of the Prairie Ecozone include the red-sided and western plains garter snakes, the blue-tailed skink, the western painted turtle, gray salamander and various toads and frogs (Smith et al. 1998:7.1-7.3).

The Hokanson site is located within the Aspen Parkland Ecoregion of the National Ecological Framework for Land Classification (Smith et al. 1998). This Ecoregion covers the southwest corner of Manitoba and is bounded on the east by the Manitoba Escarpment, which forms the dip slope of the Saskatchewan Plain. Surface deposits range from kettled to gently undulating loamy glacial till, glaciofluvial and glaciolacustrine deposits. Aeolian dunes are also present. The entire region slopes gently eastward and is drained by the Souris, Assiniboine, Qu’Appelle and Pembina Rivers. Soils are mostly well-drained Chernozemic Black on stone-free to moderate and very calcareous glacial till. Climate is continental. Vegetation in moist areas consists of trembling aspen and shrubs, while drier areas support bur oak and grassland. Fescues, wheat grasses, June grass and Kentucky bluegrass dominate while there is also a variety of deciduous shrubs and herbs. Poorly drained areas support slough grasses, marsh reed grasses, sedges, cattails and shrubby willows. Wildlife has been greatly impacted by grassland and wetland habitat destruction. Animals characteristic of the Prairie Ecozone are also characteristic of the Aspen Parkland Ecoregion (Smith et al. 1998:7.12-7.13).

More specifically, the Hokanson site is located in the Hilton Ecodistrict which lies north of, and is bordered by the Pembina River Valley. This 1347 km^2 ecodistrict consists of undulating to hummocky or kettled end moraine. Three watersheds drain the area: the Assiniboine in the northwest and eastern corner, the Souris in the central and west regions, and the Red in the southeast corner. Soils are well-drained, shallow Black Chernozems developed on calcareous glacial till. Local depressions of Grey sols are ringed by Gleyed Rego Black Chernozems. Natural vegetation would have consisted of north and eastern wooded slopes and grassland on the south and west facing slopes. Climate is cool, subhumid and classified as Boreal (Smith et al*.* 1998:7.30-7.31).

Environmental Reconstruction

The Hokanson site is located within the Tiger Hills, a localized height of land presently mantled with Aspen Parkland vegetation. Historically, much of southern Manitoba was open grassland dotted with forest groves. Wooded areas developed in suitable locales on uplands, within river valleys, surrounding lakes and other wetlands or in sand dune regions. Mid-nineteenth century documents indicate that wetlands areas protected from fires within the Tiger Hills were forested. This is supported by soil profiles which indicate that there was stable wooded vegetation for an extended time period in the eastern portion of the Tiger Hills before expanding southwest into former grassland (Norris and Hamilton 2004:18). The site itself is adjacent to a small wetland within a valley between two low moraine ridges (Hamilton et al. 2007:118).

Excavation History and Procedures

The Hokanson site was reported to Dr. Scott Hamilton by Mrs. Marilyn Hokanson in the summer of 2000. A previously undisturbed wetland within a cultivated field was partially drained to facilitate field expansion, and large quantities of bone were exposed along the field edge (Norris and Hamilton 2004:20). Initial testing that summer and fall indicated a possible bison kill activity area and an associated processing/encampment area about 300 m south of the kill. The following summer 35 shovel tests and 18-1 m^2 units were excavated in the processing area (Norris and Hamilton 2004:22). Excavations followed standard excavation procedures. In 2002, excavations focused on the bison kill and another 18-1 m^2 units as well as a number of test pits were completed (Figure 3-3). Again, standard excavation procedures were followed with the exception of water screening.

Cultural Assemblage and Affiliation(s)

Two activity areas have been interpreted at the site (Figure 3-4). Area A is thought to be the remnants of a probable bison pound. The topography suggests that bison were lured and then driven from the northeast, up the gentle back slope of ridge A. The lowland between ridges A and B were hidden from view of the bison until the top of ridge A. It has been hypothesized (DeChaine et al. 2002; Norris and Hamilton 2004; Hamilton et al. 2007) that bison were unable to detect the lowland area and were driven over ridge A and down into the open wings of a pound. The bison would have become trapped in mud or snow and killed (Hamilton et al. 2007:120). Nineteen small pits containing vertically oriented bone elements are believed to represent postholes used in the pound construction. The remains of at least 20 bison have been identified in the excavated portions of Area A, which is less than one percent of the estimated kill zone. The artifact assemblage consists mostly of projectile points (N=75), fire modified rock, identifiable bison elements and unidentified bone (Norris and Hamilton 2004:29).

Area B is located about 300 m southeast of Area A along the base of a north-facing slope. Norris and Hamilton (2004:22) speculated that at the time of site occupation, area B would have been forested, providing shelter and firewood. Nicholson et al. (2006a:347) further hypothesized that the camp served as a

Figure 3-3: Hokanson site unit map.

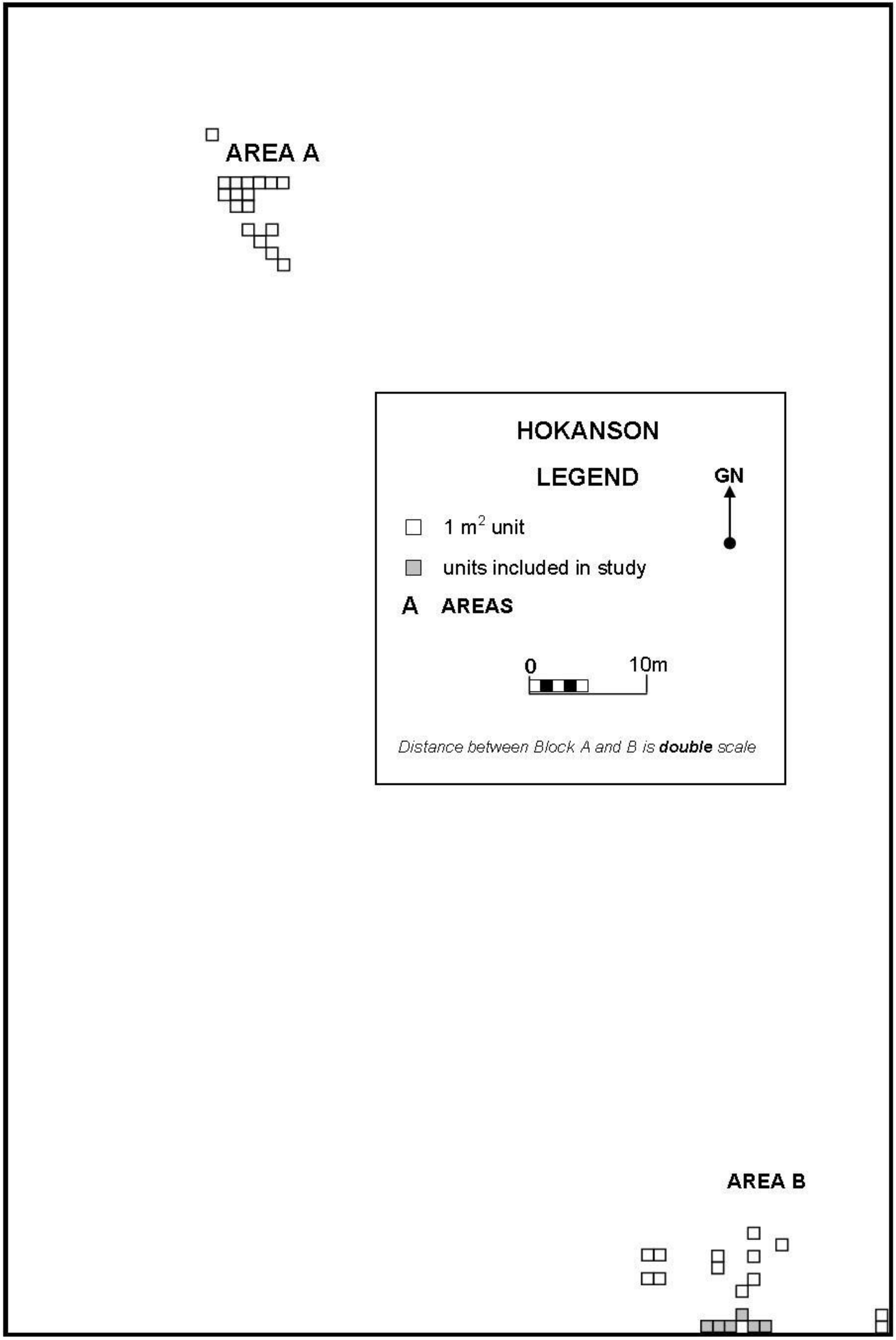
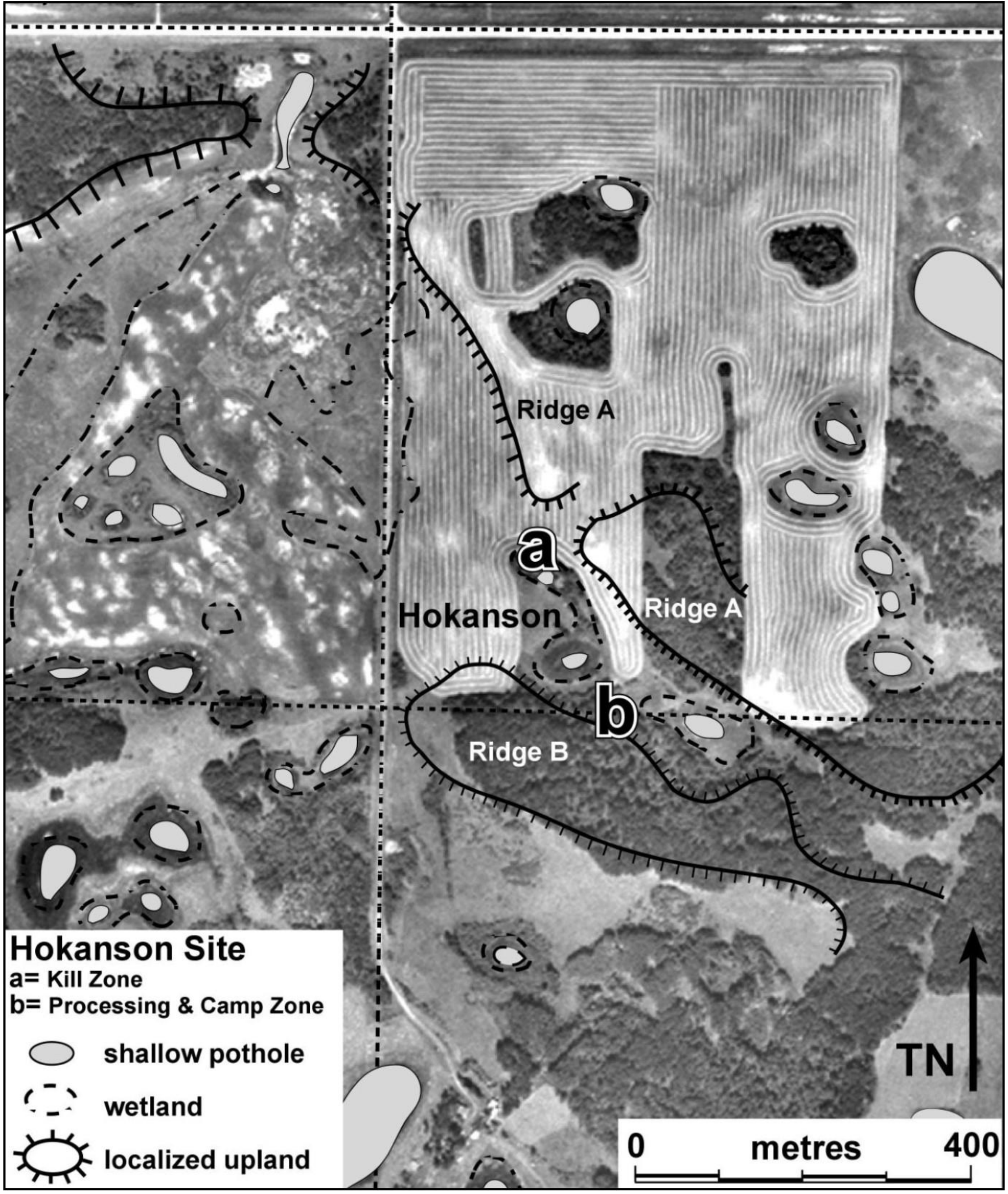


Figure 3-4: Landscape of the Hokanson site (courtesy Scott Hamilton).



home base for nearby pound construction and, “provided the resources for a timely and efficient processing of the meat, marrow and hides that resulted from the kill events.” Recovered artifacts include over 700 pieces of pottery, 27 projectile points, 23 scrapers, grinding stones, other tools, fire modified rock and a diverse range of faunal remains. Features include a hearth, a fire modified rock, discard piles including a stacked pile of bison elements, boiling pits and vertical bone uprights, in addition to a large pock marked boulder that is thought to have been used as an anvil. This artifact and feature diversity lends credence to the idea that this was a food processing and possible encampment zone (Norris and Hamilton 2004:22).

A preliminary analysis of the site faunal assemblage was undertaken to assess intra-assemblage variation between the proposed kill and processing areas in order to critically evaluate the generally accepted zooarchaeological signatures of kill and processing assemblages (Norris and Hamilton 2004). One would expect a high number of relatively complete low yield elements from the kill and higher yield elements from the processing area. However, because high yield elements are also rich in marrow and grease, these elements tend to be broken and reduced in size due to the processing technique, which can reduce the visibility of these elements. Bone grease processing further fragments elements into small unidentifiable pieces. While a higher frequency of low-yield elements were excavated in the kill zone, as would be expected, both areas had similar numbers and weights of unidentified bone fragments, suggestive that bone smashing was taking place in both areas (Norris and Hamilton 2004:35-38).

An examination of the bison mandibular eruption and wear patterns on specimens collected from the kill zone suggested an occupation between the first week in December to the last week in March (Playford 2001b). Graham (2005), in his study of Blackduck site selection and land use, supported a cold season occupation for the Hokanson site stating, “The seasonality proposed for bison pounding in the literature can be combined with the lack of adequate water resources and the well-sheltered nature of the camping and processing area to propose a cold season occupation of the Hokanson site”.

In the literature, the Hokanson site is almost always referred to as a Blackduck kill and associated processing encampment (Norris and Hamilton 2004; Hamilton and Graham 2004; Graham 2005; Nicholson et al. 2006a;

Wiseman et al. 2006 and Hamilton et al. 2007). As already discussed in Chapter Two, there is some ambiguity in defining Blackduck, especially outside of the Boreal Forest. To further complicate matters, the preliminary analysis presented by Norris and Hamilton (2004:23) discussed the recovery of parallel-grooved pottery, a diagnostic feature of Avonlea, although this identification has since been disregarded (Scott Hamilton, personal communication).

The majority of the Hokanson site radiocarbon dates cluster into two and possibly three discrete occupation events (Appendix 1). Two occupations are represented by clustered calibrated radiocarbon dates between AD 800 – 1000 and AD 1000 – 1200. One sample (TO-9658) is much older than the other samples, with a calibrated date of BC 374-111. This specimen had a very low bone collagen yield and is regarded as a non-reliable date (Norris and Hamilton 2004:22-23). Given that the radiocarbon date clusters fall within the Blackduck time period and because the majority of the pottery is Blackduck-like, this site is considered to be a Blackduck site. An analysis of the projectile points from the site corroborated this position. Belsham and Richards (2004) found that of the eight projectile point attributes considered to be unique to Blackduck, the Hokanson site points shared seven attributes. Thus strong correlation of point types in conjunction with the recovered pottery and radiocarbon dates all indicate a Blackduck occupation of the Hokanson site.

Sample Used in Dissertation

Several factors had to be taken into consideration when selecting the dissertation sample from the Hokanson site. It had to meet the site selection criteria so Area A, the kill zone, was excluded. Although it is recognized that the kill and subsequent butchering of animals may not be separate, discrete activities as outlined in Norris and Hamilton (2004), the lack of diagnostic pottery from the kill zone, and the possibility that the kill and processing areas were not contemporaneous necessitated its exclusion. Area B also had to be sampled for two main reasons. The faunal assemblage had only the basic level of identification completed (i.e. to element and species). The thesis sample would have to be re-examined and given the large quantity of faunal remains recovered, it would have been too time intensive to analyze all of the Area B faunal assemblage. Block B of Area B was selected for analysis. This block is the largest group of contiguous units and includes the anvil stone, vertical bone features and possible boiling pits, indicating that it is centered on a processing area. There was also a pile of stacked bison bone, suggestive of processing. The TO-9769 radiocarbon sample (see Appendix 1 for the calibrated date ranges) was directly associated with a Blackduck rimsherd from this block and the other radiocarbon dates fall within the accepted age range for Blackduck. It should be noted, however, that one radiocarbon sample (TO-9770) is about 300 years older than the other two dates. The bone sample for TO-9770 was recovered from the vertical bone feature and unlike other bones within the feature, its cortical surfaces were weathered. It is suggested that the weathered bone taken for the TO-9770 radiocarbon sample was an older piece of bone incorporated into the feature construction which is part of the Blackduck occupation of the site (Freeman 2006:477).

The Lovstrom Site (DjLx-1)

Site Location

The Lovstrom site is located approximately 40 km south of Brandon, Manitoba on NTS map 62G/12 with UTM designation 14U MK 314E 835N. This site is also located within the Prairie Ecozone.

Environmental Setting

Like the Hokanson site, the Lovstrom site is situated within the Prairie Ecozone and the Aspen Parkland Ecoregion as already described. It sits along the southern edge of the Tiger Hills on the top edge of a south-facing valley wall of the Souris River Trench. Although it is located more than 1200 m from the river (Graham 2005), its close proximity to the Souris River Trench places the site on a border between two ecodistricts; Hilton and Manitou. The Hilton ecodistrict has already been described and will not be repeated here. The Manitou ecodistrict encompasses 3295 km^2 and extends from the US border in south-central Manitoba westward along the Pembina River Valley. This ecodistrict is mostly undulating to hummocky glacial till plain except for the broad Pembina River Valley, which has deeply incised walls. Deep gullies and channels are also present along the Manitoba Escarpment. Several drainage divisions are present in the area. From west to east they are the Souris River watershed, the Red River watershed and the Morris River watershed. The area has a cool, subhumid, Boreal soil climate marked by short, warm summers and long, cold winters. The mean annual temperature is 2.7°C and the average growing season is about 183 days. Soils consist of well-drained Black Chernozems on glacial till of limestone, granite and the local shale bedrock. In localized depressions, imperfectly drained carbonated Gleyed Rego Black soils ring poorly drained Gleysolic soils. Even though much of the natural vegetation has been removed to support cultivation, significant patches of native plants are found on steeper slopes, along valley walls as well as in the ravines and gullies. Trembling aspen and bur oak dominate the north and east-facing slopes in the western valleys. West and south-facing slopes here have grass and artemisia vegetation. In the central portion of the ecodistrict, uncultivated valley bottoms support white elm, Manitoba maple, green ash, white birch, balsam poplar and willow, while the valley slopes are wooded with trembling aspen on the north side and bur oak on the south. The eastern valleys are quite steep and are wooded with a combination of bur oak, trembling aspen, hazel and saskatoon (Smith et al. 1998:7.34-7.35).

Environmental Reconstruction

The Lovstrom site is located on the rolling plain above the northern side of the Souris River (Figure 3-5). Most of the site is situated within shallow basins sheltered by small knolls of eroded glacial till. As with the Hokanson site environment, the modern forest cover along the Souris Valley is likely more extensive today than it was during the time of site occupation. While the river valley would have likely remained wooded, the undulating plains overlooking the Souris River would have consisted of extensive grasslands with sloughs and small ponds (Nicholson and Malainey 1991:51-54).

Excavation History and Procedures

The site was excavated over the course of five field seasons (Figure 3-6). The 1985 field season was limited to 9 1 m^2 test units. These were excavated following standard excavation techniques except that 10 cm rather than 5 cm levels were employed (Nicholson 1986:36). The following field season an additional 15-1 m^2 test units were excavated following standard techniques. Again, 10 cm levels were employed but these were divided into two sublevels of 5 cm each. Large block excavations were undertaken during the 1987 and 1988 field seasons. Blocks A-E were established in 1987 and 52-1 m^2 units were excavated (Nicholson and Gibson 1990:50). The following year blocks F-H were established and an additional 36-1 m^2 units were excavated across the site (Nicholson and Kuijt 1990:174). In 1991, 19 additional 1 m^2 units were excavated in Blocks E and H under the auspices of a field school. During these three field seasons, standard excavation techniques, including the use of arbitrary 5 cm levels, were employed.

Figure 3-5: Landscape of the Lovstrom site (courtesy of Scott Hamilton).

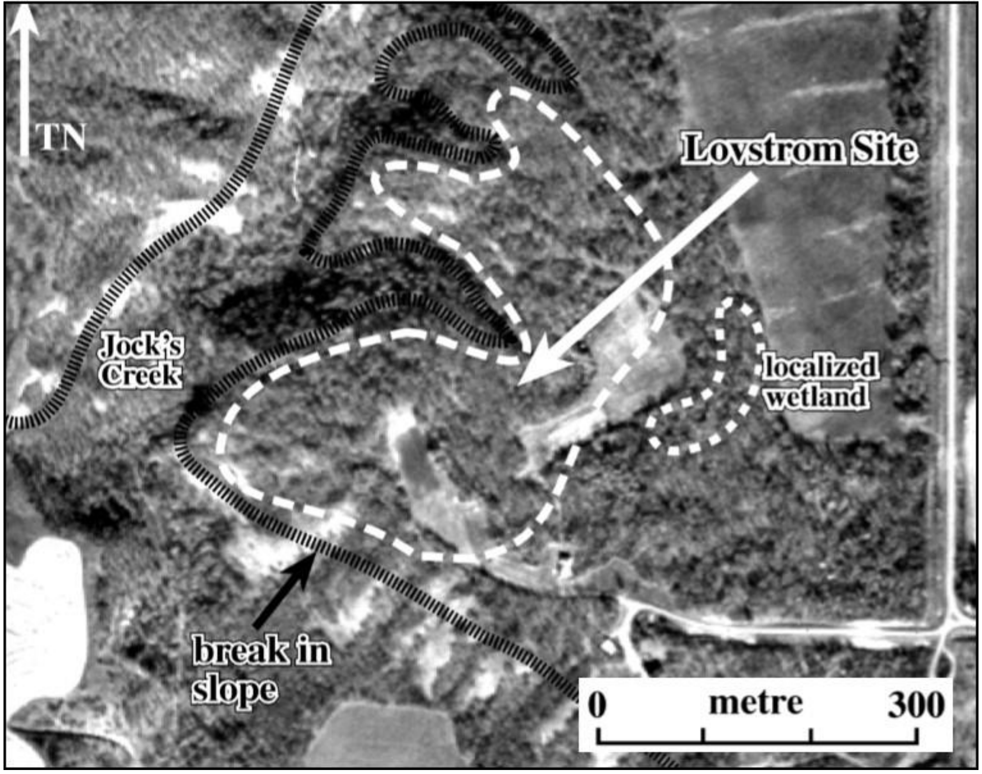
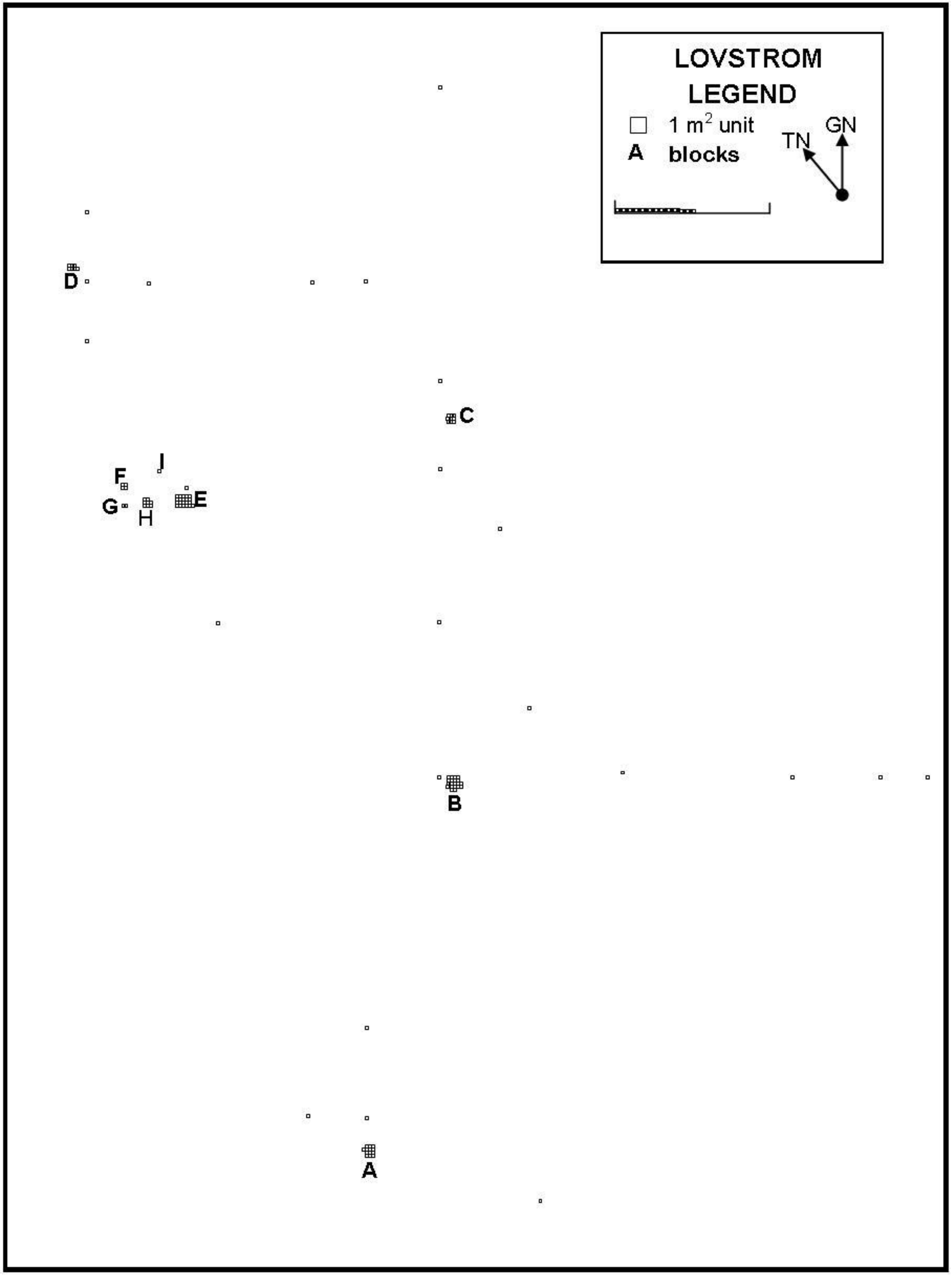


Figure 3-6: Lovstrom site unit map.



Cultural Assemblage and Affiliations

Lovstrom is a large multicomponent site with a minimum of three, if not four occupations (Appendix 1). Nicholson and Kuijt (1990:97) identified at least two major periods of occupation during the Late Precontact, with radiocarbon dates clustering at AD 1300 and AD 1600. The presence of two KRF gunflints and a late radiocarbon date (S-2823, see Appendix 1) points to an additional protohistoric occupation. There is also evidence (Appendix 1) of an earlier Late Woodland component at the site (Nicholson and Kuijt 1990:197; Nicholson 1990:38). Most of the site ceramics, however, have been identified as belonging to one of two groups: Late Woodland circa AD 1300 and what is later classified as Vickers focus circa AD 1600.

The Late Woodland component pottery is found throughout the site and is repeatedly identified as being consistent with Blackduck and Duck Bay wares (Nicholson 1986, 1990; Nicholson and Gibson 1990; Nicholson and Kuijt 1990; Nicholson and Malainey 1991). The associated tool assemblage is consistent with Late Precontact tool kits except for a surface collected Besant point (Nicholson 1986:34), a large Woodland side-notched point (Nicholson and Gibson 1990:61) and a completely reworked Avonlea point (Nicholson and Kuijt 1990:189). The Blackduck artifact assemblage and patterning are interpreted as being the result of primary bison butchering (2007), faunal processing, weaponry refurbishing, possible ceremonial activity (Nicholson and Kuijt 1990:202), pottery making (Brandzin 1994:120) and a living floor (Nicholson and Malainey 1990:75).

Ceramic materials “unlike any previously excavated in Southwestern Manitoba” (Nicholson and Gibson 1990:63) were also recovered from the site. The diverse ceramic assemblage included vessels that resembled wares such as Campbell Creek and Talking Crow in the Coalescent Tradition of the Middle Missouri (Nicholson and Gibson 1990), Sandy Lake and Red River, as well as Scattered Village complex pottery. All of the ceramics except for a Middle Missouri Fort Yates pot and a Saskatchewan Basin vessel appear to have been locally manufactured (Nicholson and Kuijt 1990). Nicholson (1990:52-53) initially defined these ceramics as Lovstrom ware and identified them as having obvious affinities to the Scattered Village complex. Later, Nicholson (1991) included these Lovstrom ceramics in his newly defined Vickers focus. The Vickers focus occupation at the Lovstrom site is quite small and is confined mostly to the northern part of the site (Nicholson 1994:105). In addition to the ceramic assemblage, bison scapula hoes, bison scapula knives and grinding stones have been excavated within the Vickers focus occupation (Nicholson 1990:38). It is hypothesized that the Lovstrom site Vickers focus occupation was focused on subsistence activities such as intensive butchering and processing of bison as well as small garden horticulture. An extended summer through fall occupation for the Vickers focus people is suggested (Nicholson 1994:120).

Although Nicholson (1994:105) stated that the Late Woodland and Vickers focus ceramics were recovered from distinct occupations and were stratigraphically and horizontally separated, initial concerns of assemblage mixing due to taphonomic variables have been published (Nicholson 1986,1990; Nicholson and Gibson 1990; Nicholson and Kuijt 1990; Nicholson and Malainey 1991). The Vickers focus ceramics were primarily recovered from Blocks E and H. Blackduck vessels were also excavated from these blocks. During the 1991 field season, slight differences in the A horizon thickness, distinct horizontal patterning of artifacts, and differential preservation of lower and upper faunal remains helped distinguish the Blackduck from the Vickers focus occupation (Nicholson and Malainey 1991:75, 81).

Sample Used in Dissertation

Areas of the Lovstrom site represent a single occupation, and Block B is one such area. The ceramic assemblage from Block B is “clearly Woodland in origin and could readily be subsumed under a Blackduck/Duck Bay typological scheme” (Nicholson 1990:40). The two radiocarbon dates from the block were directly associated with a Blackduck rimsherd and are consistent with the Blackduck time frame in Manitoba. Block B consisted of 20- m ^{2} contiguous units excavated in 1987, and recoveries suggested it was a secondary bison processing area (Nicholson and Gibson 1990:57). Initial testing of the site in 1985 and 1986 (Nicholson 1986:40) uncovered a near-term foetal bison bone, although its location within the site was not provided. A cursory appraisal of the Block B faunal assemblage did identify foetal bison elements, making it a suitable sample to be included in this dissertation.

The Jackson Site (DiMe-17)

Site Location

The Jackson site is found within the *Makotchi-Ded Dontipi* locale located along the southwestern edge of Lauder Sandhills, approximately 70 km southwest of Brandon, Manitoba. The UTM designation for the site is 14U LK 692E 745N and it is located on Map 62F/7. Like the Hokanson and Lovstrom sites, it is situated within the Aspen Parkland Ecoregion of the Prairie Ecozone as already described.

Environmental Setting

The entire *Makotchi-Ded Dontipi* locale is situated in about the middle of the 3424 km^2 Oak Lake Ecodistrict. This ecodistrict straddles the Saskatchewan border on the west and the North Dakota border to the south. It has a cool to moderately cool, subhumid Boreal soil climate with short warm to very warm summers and long, cold winters. Precipitation varies greatly on an annual basis with an annual mean of 470 mm. Winters tend to be dry with most precipitation falling in late spring through summer. The ecodistrict is not homogenous due to differences in surface form, drainage, water table depth and surface deposit depth and texture. The western edge is situated on a strip of outwash and delta gravels with a thin sandy-loam surface. A smooth plain of sandy-loam deltaic sediments are found in the centre of the ecodistrict while the area southeast of Oak Lake is hummocky, consisting of arid, duned sands. A strip of water-modified clay loam till comprises the southeastern border of the ecodistrict. The ecodistrict lies within the Souris River watershed and occupies most of its basin in southwestern Manitoba. Major waterways include the Souris and its associated tributaries and creeks that eventually drain into Oak Lake. Black Chernozemic dominate the region. These are well drained to the south and imperfectly drained to the north where the water table is higher. The duned area southeast of Oak Lake has significant areas of Regosolic soils interspersed with Gleysolic soils in the depressions. Around Oak Lake, Gleyed Rego Black Chernozems and poorly drained Rego Humic Gleysolic soils can be found. The naturally occurring vegetation is highly variable, and most has been removed or altered through farming practices. The duned area south of Oak Lake (i.e. the Lauder Sandhills) has a variety of vegetation including trembling aspen, willows, meadow grasses and cattail in low-lying areas. Slopes and knolls are covered with grasses. The central part of the ecodistrict supports prairie and meadow grasses while the gravel area to the west has both mixed and short grass prairie vegetation (Smith et al. 1998:7.28-7.29).

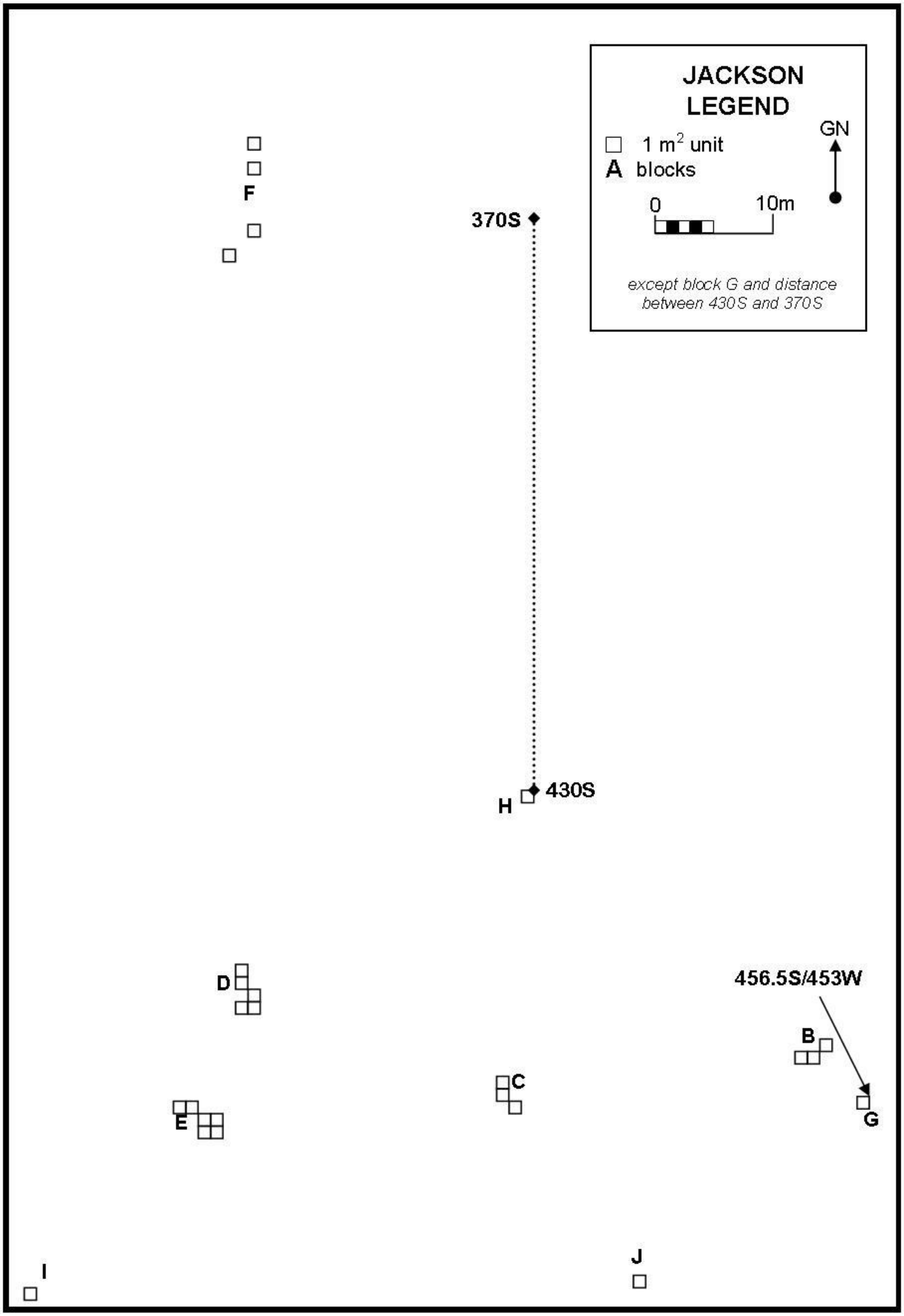
Environmental Reconstruction

The *Makotchi-Ded Dontipi* locale is situated in the Glacial Lake Hind Basin, a glacio-lacustrine plain that formed about 12,000 years ago. It consists of fine silts and sand on top of impervious sedimentary and bedrock deposits which contain the Oak Lake Aquifer. Ground water accumulated within the aquifer to the point that surface undulations filled to create small lakes and sloughs surrounded by arboreal vegetation (Hamilton and Nicholson 1999:09). Composite maps compiled from nineteenth century Dominion Land survey records provide a relatively comprehensive pre-homestead vegetation inventory, and illustrate that former wetlands consisted of sedge-willow wetlands or small pothole lakes, surrounded by aspen groves and mixed-grass prairie. The Jackson site is positioned within shallow hollows and localized knolls in a dense aspen grove. The forest cover is a recent phenomenon and during the time of site occupation, there would have been a much more open grassland-forest mosaic (Hamilton and Nicholson 1999:16-17).

Excavation History and Procedures

The Jackson site was first identified and tested in 1993 with units and test pits being excavated at the site during the next four field seasons. In total, 35-1 m^2 units and a single 1 x 1.5 m unit were excavated across the site (Figure 3-7). In 1994, 11-1 m^2 units were excavated in the extreme southwest part of the site as part of an Inter-University Field School (Playford and Pankratz 1994). The

Figure 3-7: Jackson site unit map.



following year, an additional 14-1 m^2 units were excavated by field school students while paid crew members excavated six other units to the north of the 1994 excavations (Playford 1995). Two additional units were excavated in Block E in 1996 while three other 1 m^2 units were excavated in Blocks D, F and J in 1997. Standard procedures were followed for all excavations except that the sandy soil allowed for the use of a .3175 mm mesh screen instead of the standard .635 mm mesh screen.

Cultural Assemblage and Affiliations

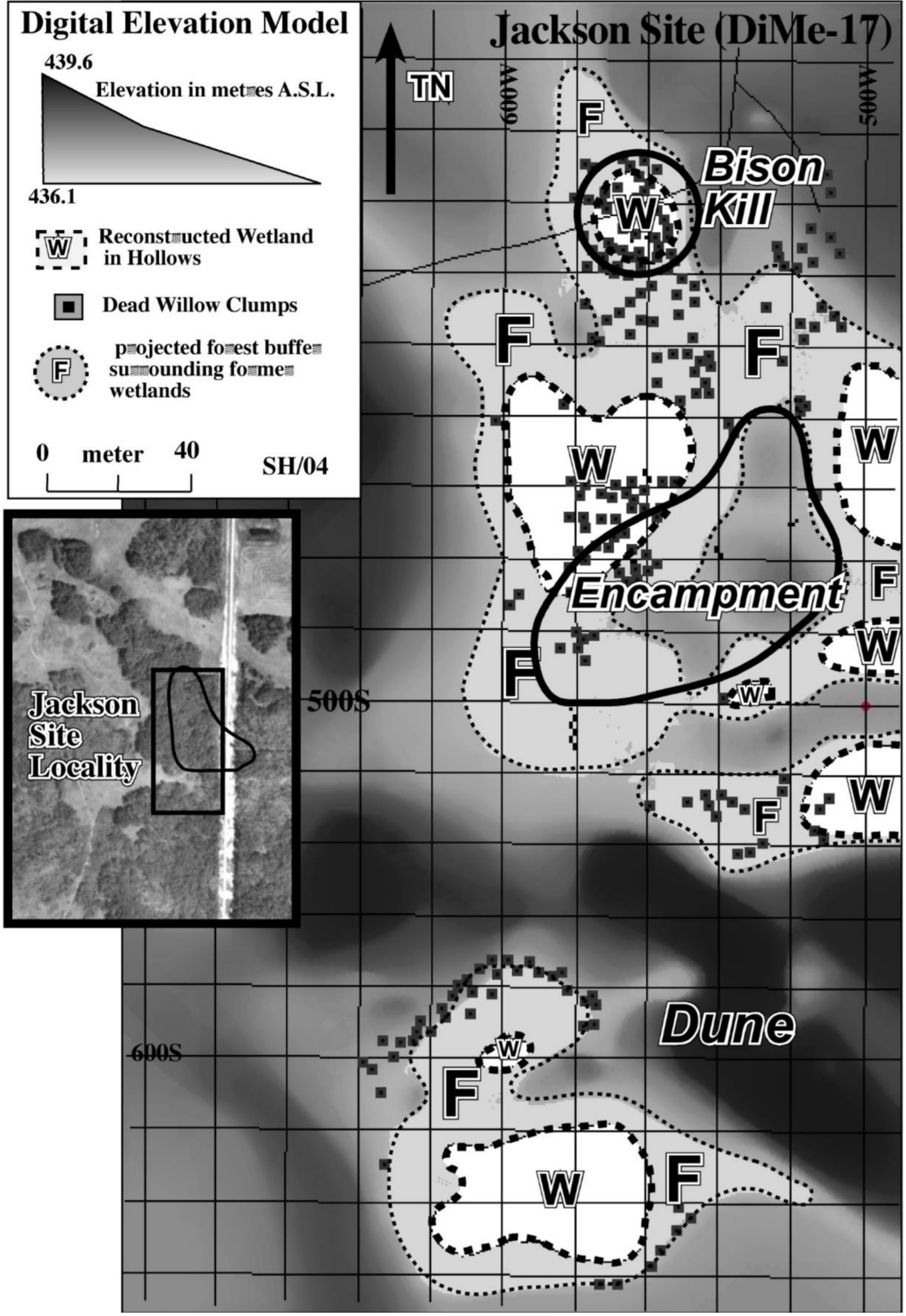
The Jackson site has been intensely analyzed by various authors (Belsham 2003; Hamilton and Nicholson 1999; Mokelki 2007; Nicholson and Hamilton 1997a, 2001; Nicholson et al. 2006c; Playford 2001a, 2010; Playford and Nicholson 2006). All of these studies have focused on the 1995 and later excavations. The first 11-1 m^2 units excavated in 1994 uncovered the usual late precontact tool kit with both Vickers focus and Blackduck pottery (Playford and Pankratz 2004:16-17). An early radiocarbon date (β-65952, see Appendix 1) of 620 ± 65 comes from a shovel test adjacent to Block A. The identification of a Blackduck rimsherd within/below the Vickers focus occupation was problematic for the current research design that sought to address a better understanding of the Vickers focus presence in southwestern Manitoba. Subsequent excavations (Blocks B to J) focused on an area of the site where no Blackduck ceramics were recovered. These are the excavations that have been most studied and will be described here.

The ceramics recovered from the 1995 and later excavations have consistently been identified as belonging to the Vickers focus (Belsham 2003; Hamilton and Nicholson 1999; Mokelki 2007; Nicholson and Hamilton 1997a, 2001; Nicholson et al. 2002, 2006a, 2006b, 2006c; Playford 2001a, 2010; Playford and Nicholson 2006) and the radiocarbon dates are consistent with this identification (Appendix 1). A comprehensive analysis of the 19 non-Blackduck pots recovered from the site was undertaken by Mokelki (2007). She examined rim profile, lip shape, paste quality, surface treatment, temper, decoration, fields of decoration as well as decorative techniques and motifs for all vessels. She concluded that, while the Jackson site pottery was quite varied, the attributes were consistent with those described for Vickers focus ware.

Site activity areas were interpreted by Hamilton and Nicholson (1999), using vegetation reconstruction and a preliminary analysis of shovel test results (Figure 3-8). They concluded that a small bison entrapment and kill was located at the north end of the site as indicated by minimally processed bison bone. Waste from intensive bone grease extraction accumulated about 100 m south of the kill within a midden area, and a possible domestic habitation to the east of the midden was situated upon a localized knoll (Hamilton and Nicholson 1999:21). Playford (2001a, 2010) examined the faunal remains from the excavation units and concurred a small bison kill was represented by the faunal remains at the north end of the site. However, she noted very few elements were recovered whole, as would be expected in a primary kill site, and there was also intensive processing of the bison adjacent to the kill/butchering area (Playford 2001a:71). The faunal recoveries immediately south of the kill were suggestive of animal food processing and waste disposal. These activities centred on blocks C, D and E (Playford and Nicholson 2006:407).

Belsham (2003) analyzed the lithic assemblage from the site and critically assessed the proposed activity areas put forth by Hamilton and Nicholson (1999). She concluded the lithic artifact distribution pattern confirmed the activity identifications, but the midden/processing and habitation areas required additional clarification regarding the discrete activity clusters (Belsham 2003:135). She found it difficult to infer specific activities taking place within the proposed habitation area because of the widely dispersed excavations and small sample size. Tool manufacture, re-sharpening of tools, general core reduction and discard appeared to be taking place. The lithic and faunal assemblages were quite different in the proposed habitation areas and she argued that several activities were taking place in this part of the site (Belsham 2003:162). Belsham (2003:163-168) further contended that there is an overlap in the sequence of processing and disposal and that there were likely several processing locales at the site. Both the lithic and the faunal assemblages suggest that there were

Figure 3-8: Landscape of the Jackson site (courtesy of Scott Hamilton).



discrete clusters of refuse due to the butchering and processing of animals (Belsham 2003:179).

Sample Used in Dissertation

The faunal analysis undertaken by Playford (2001a, 2010) will be used as the sample for this study. She analyzed all the faunal remains recovered from the excavation units in Blocks B through J. There were initial concerns regarding the association of the widely distributed excavation blocks. Block F (the kill zone) is located approximately 100 m north of the processing area and, “without stratigraphic continuity, however, it is impossible to decisively state that all recoveries belong to a single occupation. Radiocarbon dating and material culture evidence suggests that the majority of the Jackson site was produced by a single occupational event or by multiple, closely spaced events . . . “(Playford 2001a:33). Playford addressed this concern by analyzing each block separately and also analyzing the site as a whole for site-wide patterns. It was later discovered that a projectile point base from Block F refit onto a midsection recovered in Block E, confirming that the kill and the processing areas were part of a single event (Playford and Nicholson 2006:406). Foetal bison remains have also been identified and recovered from the site (Playford 2001a, 2010).

The Vera Site (DiMe-25)

Site Location

The Vera site is also found in the *Makotchi-Ded Dontipi* locale of the Lauder Sandhills. Being located only about one km northeast of the Jackson site, it too is found on Map 62F/7 with a UTM designation of 14U MK 370E 5476N.

Environmental Setting

Being so close to the Jackson site, the Vera site is also found in the Oak Lake Ecodistrict as already described.

Environmental Reconstruction

Again, given the close spatial proximity of the Vera and Jackson sites, the environmental reconstruction of the Vera site location is comparable to that of the Jackson site.

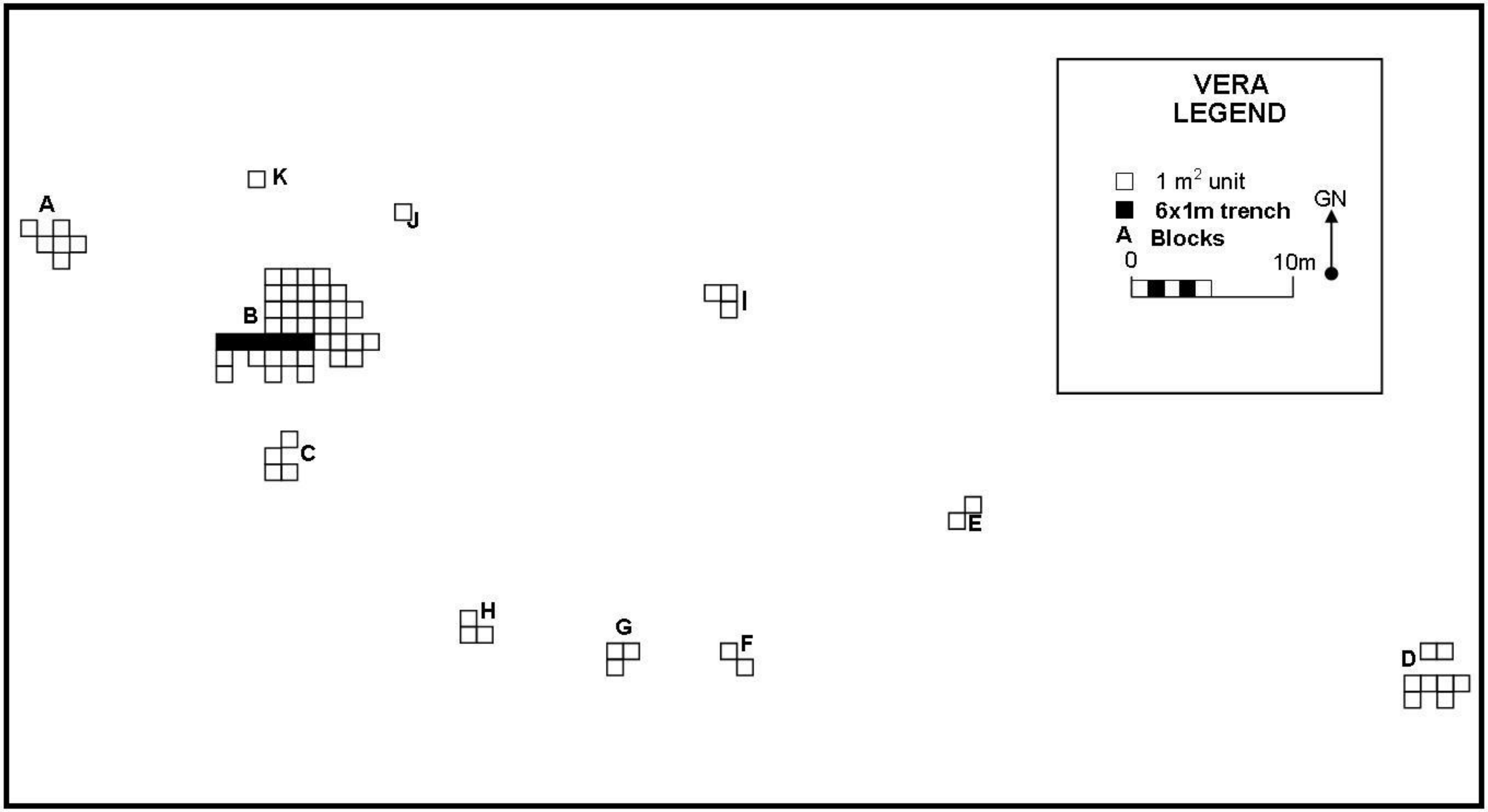
Excavation History and Procedures

The Vera site was first discovered in 1996 as part of an archaeological survey being undertaken in the *Makotchi-Ded Dontipi* locale by Drs. Nicholson and Hamilton. The initial test pit recoveries consisted of Late Precontact Vickers focus wares, and during that field season, mound features were identified at the site (Nicholson and Hamilton 1997b). The following summer, a field school as well as paid crew members excavated 20-1 m^2 excavation units and a 1 x 6 m trench (Watt 2003). The artifact recoveries confirmed the presence of a Vickers focus occupation, but the mound features proved to result from hitherto undocumented mid to late nineteenth century occupations at the site (Hamilton and Nicholson 2000). The identification of middle precontact occupations lead to further investigations the following year. A large 22-1 m^2 block excavation (Block B) was centred around the initial 1 x 6 m trench in order to expand on the middle precontact assemblage (Figure 3-9). This block was also centred on one of the large mound features. Because the objective of this field season was to better understand the middle precontact occupations, the upper levels of Block B were shovel shaved instead of hand-troweled (Playford and Nicholson 2006). Eleven other 1 m^2 units were excavated that year. The site was again excavated in 2002 when 7-1 m^2 units were excavated as part of a field school and paid crew members also excavated 7-1 m^2 (Watt 2003). All units were excavated following standard excavation procedures with the exceptions of the shovel shaved levels in Block B as already noted and the use of a .3175 cm mesh screen.

Cultural Assemblage and Affiliations

The Vera site is a multicomponent site with occupations dating from the historic until the middle precontact time period (Appendix 1). Watt (2003) identified Oxbow, McKean, Pelican Lake and Besant projectile points as well as a previously unidentified point type called a Vera point in the site assemblage. A description of the stone tools from these occupations was undertaken as part of Watt's (2003) undergraduate thesis research and she concluded that it was difficult to interpret activities because of poor bone preservation.

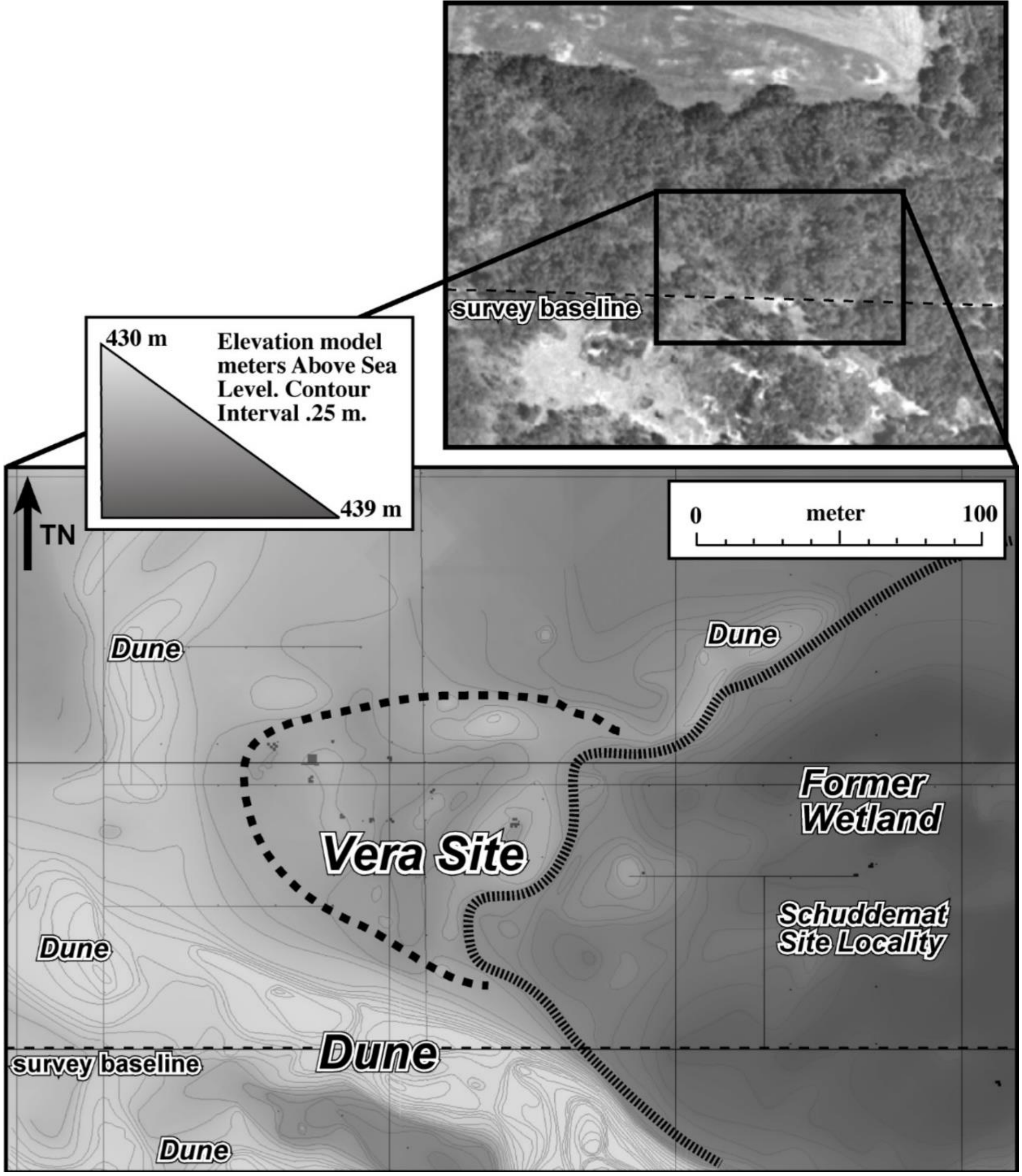
Figure 3-9: Vera site unit map.



Bone preservation, however, was excellent in the Vickers focus and historical occupations. There are at least two discrete phases of historic occupation of the Vera site. A scattering of late nineteenth and early twentieth century material culture suggests a casual use of the area for haying, wood cutting and refuse disposal. An earlier, pre-railroad, pre-homestead occupation of the site is more extensive and consisted of several widely dispersed features (as discussed above). Three features are quite large, about 65 m^2, and were tentatively identified as sod houses. Three depression features about 6 m^2 are thought to represent storage pits or ice houses (Hamilton and Nicholson 2000:251-252). Temporally sensitive artifacts such as square cut nails, wire drawn nails, British refined white earthenware, as well as brass and paper pin-fire cartridges, date this occupation between the mid to late 1800s (Hamilton and Nicholson 2000:257). Hamilton and Nicholson (2000) suggested that this occupation is a result of Métis groups inhabiting the area as subsistence farmers, hunters and trappers after the decline of the Souris River area bison hunts. The Métis occupation of the Lauder Sandhills was relatively short lived and lasted only until the railroad and homestead era, when large numbers of European immigrants flooded into the region.

An extensive Vickers focus occupation is located beneath the Métis occupation. Across most of the site, the Vickers focus occupation is located within a dark grey soil (A horizon) with a 10 cm sterile overburden. The historic artifacts generally appeared at contact with historic fill. Inside one of the house structures (Block B) the historic artifacts were in direct contact with the Vickers focus layer. The historic/Vickers focus contact inside the house structure is a result of sod being stripped inside the structure for wall construction (Nicholson and Hamilton 1997b:43). The Vickers focus occupation was identified based on the presence of distinctive Vickers focus pottery (Hamilton and Nicholson 2000; Nicholson and Hamilton 1997a,b, 2001; Nicholson et al. 2006a, 2006b, 2006c; Playford and Nicholson 2006; Watt 2003). The similarity of pottery wares from the Jackson and Vera site, in addition to the closeness of the two sites' radiocarbon dates led Dr. Nicholson (Nicholson and Hamilton 2001; Nicholson

Figure 3-10: Landscape of the Vera site (courtesy of Scott Hamilton).



et al. 2006c) to postulate that the Vera site represented a summer occupation by Vickers focus people, possibly by the same group as at the Jackson site.

Mokelki's (2007) analysis of the Vickers focus pottery from the *Makotchi-Ded Dontipi* locale concurred that the Vera site pottery was indeed Vickers focus and that there were similarities between the wares found at Vera, Jackson and the Vickers focus type site, Lowton. The initial interpretation that there were few faunal remains and an absence of foetal bison recoveries, suggesting a summer seasonality (Nicholson and Hamilton 2001:65) was not supported by a comprehensive analysis of the faunal assemblage (Playford and Nicholson 2006).

An analysis of the Vera site Vickers focus faunal assemblage was undertaken in order to make a comparison with the Jackson site (Playford and Nicholson 2006). Blocks A through J were defined for the site but only blocks A to D were analyzed due to either a lack of diagnostic Vickers focus materials or mixing between the Vickers focus and historic components. No features were visible in blocks A and C but the faunal remains indicated that both were areas of intensive bison processing. Block B was the largest block with a total of 34-1 m^2 excavation units. Four post moulds and two hearths were identified in the Vickers focus occupation, and this block is centered on a large processing area with an over-representation of bison appendicular elements and a high species diversity. Another hearth was excavated in Block D but there were very few other artifacts recovered, suggesting that this may be a possible living area (Playford and Nicholson 2006:408-410). The bison mandibles recovered from the site were estimated to be between .6-1.4 years of age, indicating a seasonality of anywhere between November and mid-July. The recovery of over 150 foetal bison elements representing at least four animals provides a more precise seasonality estimate. These foetal bison recoveries were compared to a modern four month gestation and a modern five month gestation foetal bison. With the exception of the rib elements, all the Vera site elements were larger than the modern specimens, suggesting that the animals were collected sometime after January. The presence of near-term or neonatal elements would imply that the site was inhabited at least until the spring. The lack of early developmental foetal bison suggests that the site was not occupied prior to January (Playford and Nicholson 2006:413). Similarly, the lack of other spring species such as migratory wildfowl and later term bison suggests that the site was abandoned soon after the bison calves were birthed.

Sample Used in Dissertation

A total of 72 square metres were excavated at the Vera site. Of these, the Vickers focus component from 47-1 m^2 were analyzed by Playford and Nicholson (2006). Given its large size (31 m^2), Block B was most productive and will be included in this dissertation. Separating the historic from the Vickers focus component in Block B was accomplished by eliminating all levels containing historic artifacts, usually the first 30 cm. The Vickers focus levels were identified by the precontact artifact assemblage and the increased frequency of faunal remains. The distinction between the Vickers focus and the lower occupations was easily discernible by an abrupt decrease in artifact density and lack of pottery (Playford and Nicholson 2006:405).

The Sanderson Site (DhMs-12)

Site Location

The Sanderson site is located six kilometres south of Hitchcock, Saskatchewan on NTS map 62E/03. The UTM designation for the site is 13U FE 340E 477N. It too is found within the Prairie Ecozone.

Environmental Setting

The Sanderson site is the only site in this dissertation not situated within the Aspen Parkland Ecoregion and instead is found within the Moist Mixed Grassland Ecoregion (Ecological Stratification Working Group 1996:94). This ecoregion is the northern extension of the open grasslands in Canada and is correlated with semiarid conditions as well as Dark Brown Chernozemic soils. Upper Cretaceous sediments are covered by hummocky to kettled glacial till and level to very gently undulating, sandy to clayey lacustrine deposits. Sloughs and ponds are intermittent and provide habitat for waterfowl. Common mammals include white-tailed deer, pronghorn antelope, coyote, rabbit and ground squirrel. Native vegetation includes spear grass and wheat grass as well as a variety of deciduous shrubs, including buckbrush, chokecherry, wolf willow and saskatoon (Ecological Stratification Working Group 1996:94).

Saskatchewan Ecodistrict descriptions have not been published, so it cannot be described as the Manitoba Ecodistricts have been (see Smith et al. 1998). Instead, the Sanderson site description as provided by Magee (1997) is summarized. Ecodistrict 796 encompasses the Souris River Basin in Saskatchewan from Weyburn south to the United States border and east to the Manitoba border. The Souris River Valley in Saskatchewan is characterized by gently rolling plains and hummocky areas, incised by the Souris River and its tributaries. Soils in the area are dark brown to black Chernozems, and prior to agriculture supported native prairie vegetation. Frequent prairie fires and bison grazing would have restricted woody vegetation to the slopes and bottoms of river and stream valleys. The climate is continental (Magee 1997:04-12). Magee (1997:04) noted that the Souris River basin is also in close proximity to the Aspen Parkland Ecoregion and this proximity would have increased the plant and animal diversity.

Environmental Reconstruction

The Sanderson site was located on the bottom of the south slope and valley bottom of a hogsback on the south end of McDonald Lake, adjacent to the Souris River. A digital elevation model of the site locale was created to determine the effect of past flooding events on the site. Given the site's location on a slope at the edge of the floodplain, it was determined that past flooding would not have impacted the site (Magee 1997:17-18).

Excavation History and Procedures

Construction of the Rafferty Dam during the late 1980s necessitated an archaeological survey and mitigation program along the Souris River Basin. Roy Sanderson of Estevan informed the Saskatchewan Research Council, who was undertaking the survey, about the site. Because the site location would be impacted by dam operations, it was tested and based on the recoveries, a large salvage excavation was undertaken. The site has since been completely inundated. A total of 211 m^2 were excavated in ten block excavations (Figure 3-11). Standard excavation procedures were followed except that the site was shovel shaved as opposed to hand troweled, and three point provenience was collected for diagnostic artifacts. Some material was fine screened using a 2 mm mesh in order to recover smaller cultural material (Magee 1997:33).

Cultural Assemblage and Affiliations

Two separate occupation levels are evident at the Sanderson site. At approximately 10-15 cm below surface, a layer of sterile gray clay varying from 1-5 cm thick separates occupation one found above the clay from occupation two located below the sterile clay. Artifact recoveries from both occupations consist of faunal remains, Mortlach phase ceramics, lithic debitage and tools. A limited amount of European trade goods were recovered from occupation one. The single radiocarbon date from the site was obtained from level one and is dated to 310 ± 75 (S-2968) with multiple calibrated intercepts ranging from the AD 1450-1950 (Appendix 1).

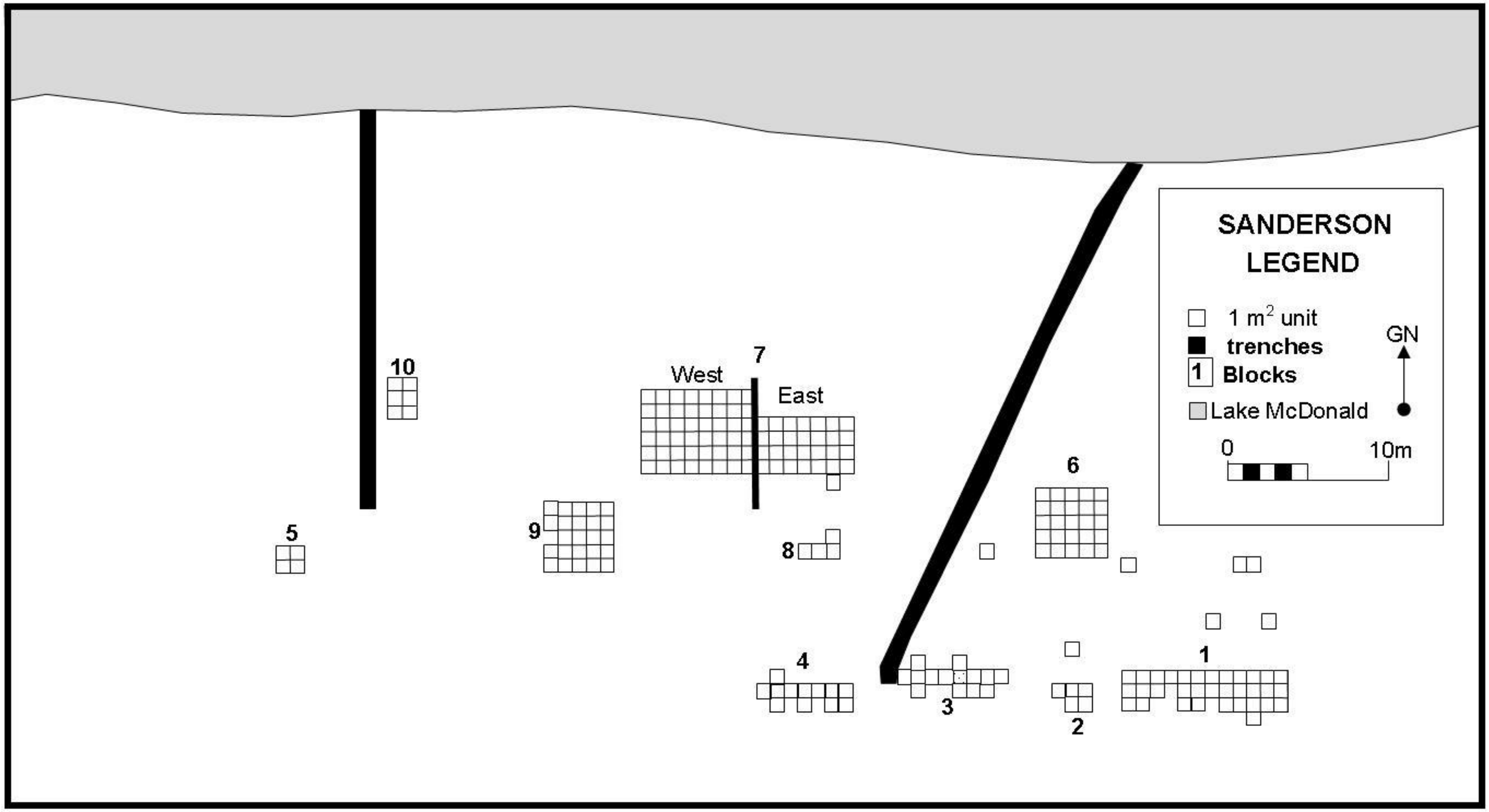
No comprehensive report of the Sanderson site materials has been published. Instead, Malainey (1991) and Walde (2003) have examined some of the pottery from the site while Magee (1997) examined a subset of the faunal remains. Forty-three vessels were identified in the Block 1 ceramic assemblage (Malainey 1991) while Walde (2003) identified 156 vessels from the first occupation. A brief description of the 228 whole and fragmentary Plains Side-Notch projectile points as well as 43 endscrapers is provided by Walde (2003).

Magee (1997) analyzed 48 square meters from the western half of Block 7 for his Master of Arts thesis from the University of Saskatchewan. He concluded that both occupations occurred over the cold months, possibly starting in the early fall (Magee 1997:247-248). The site was primarily used for animal food processing with bison marrow and grease being extracted. Several non-bison animals were also recovered and likely used as a food source.

Sample Used in Dissertation

The Sanderson site faunal assemblages examined by Magee (1997) was used by Playford (2001a, 2010) as a comparison for the Vickers focus faunal assemblage recovered at the Jackson site. For the purpose of this dissertation, it was necessary to further examine the foetal assemblage from the Sanderson site as it was not analyzed in Magee's thesis. Foetal bison elements are present in

Figure 3-11: Sanderson site unit map.



both occupation one and two assemblages. The presence of European trade goods and the radiocarbon date from occupation one suggests that this occupation is most similar in time to that of the Twin Fawns site (see below). For that reason, only the occupation one faunal assemblage as presented by Magee (1997), with further analysis of the foetal assemblage from that occupation, is included in this dissertation.

The Twin Fawns Site (DiMe-23)

Site Location

Like the Vera and Jackson sites, the Twin Fawns site is also found within the *Makotchi-Ded Dontipi* locale of the Lauder Sandhills. Its location about 500 m southwest of the Vera site (Hamilton and Nicholson 2000:254) also places it on Map 62F/7 with the same UTM designation, 14U MK 370E 5476N.

Environmental Setting

The Twin Fawns site is also found in the Oak Lake Ecodistrict as previously described.

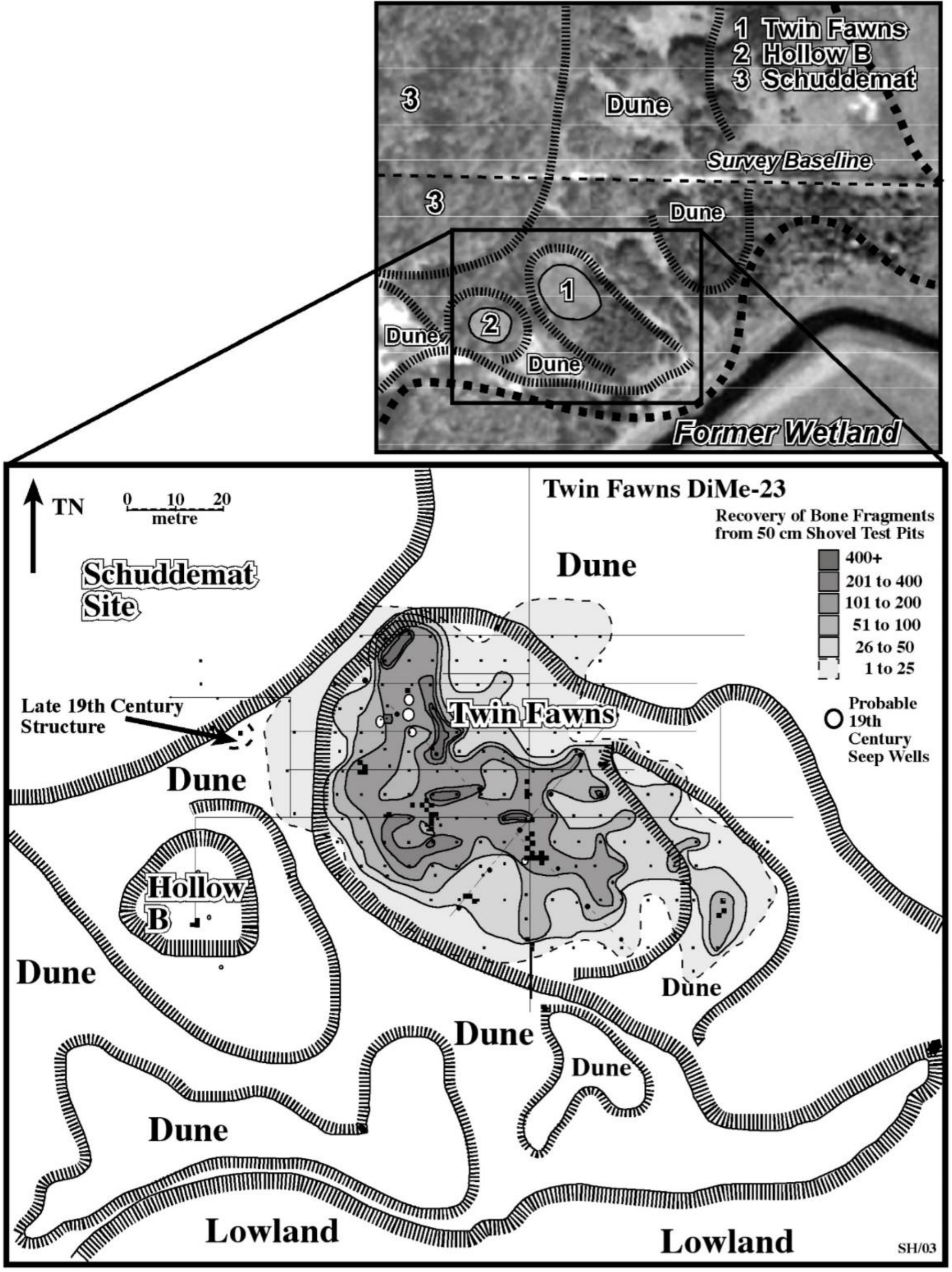
Environmental Reconstruction:

The environmental reconstruction for the Jackson and Vera sites can be extrapolated to the entire *Makotchi-Ded Dontipi* area and would therefore include the Twin Fawns site. Furthermore, at the microscale level, the site would have been in a forested meadow surrounded by stabilized sand dunes, with a now-dry wetland and shallow lake to the east (Hamilton and Nicholson 2007:146).

Excavation History and Procedures

The Twin Fawns site was discovered during a test pit survey of the area in 1995. By 2001, a total of 45-1 m^2 excavation units and 105-50 cm^2 test pits had been excavated at the site (Mokelki 2007:64). Eight units were excavated as part of a university field school while the rest of the site was excavated by paid crew members (Figure 3-13). All units were excavated following standard excavation procedures except that a .3175 cm mesh screen was used instead of the standard .635 cm mesh.

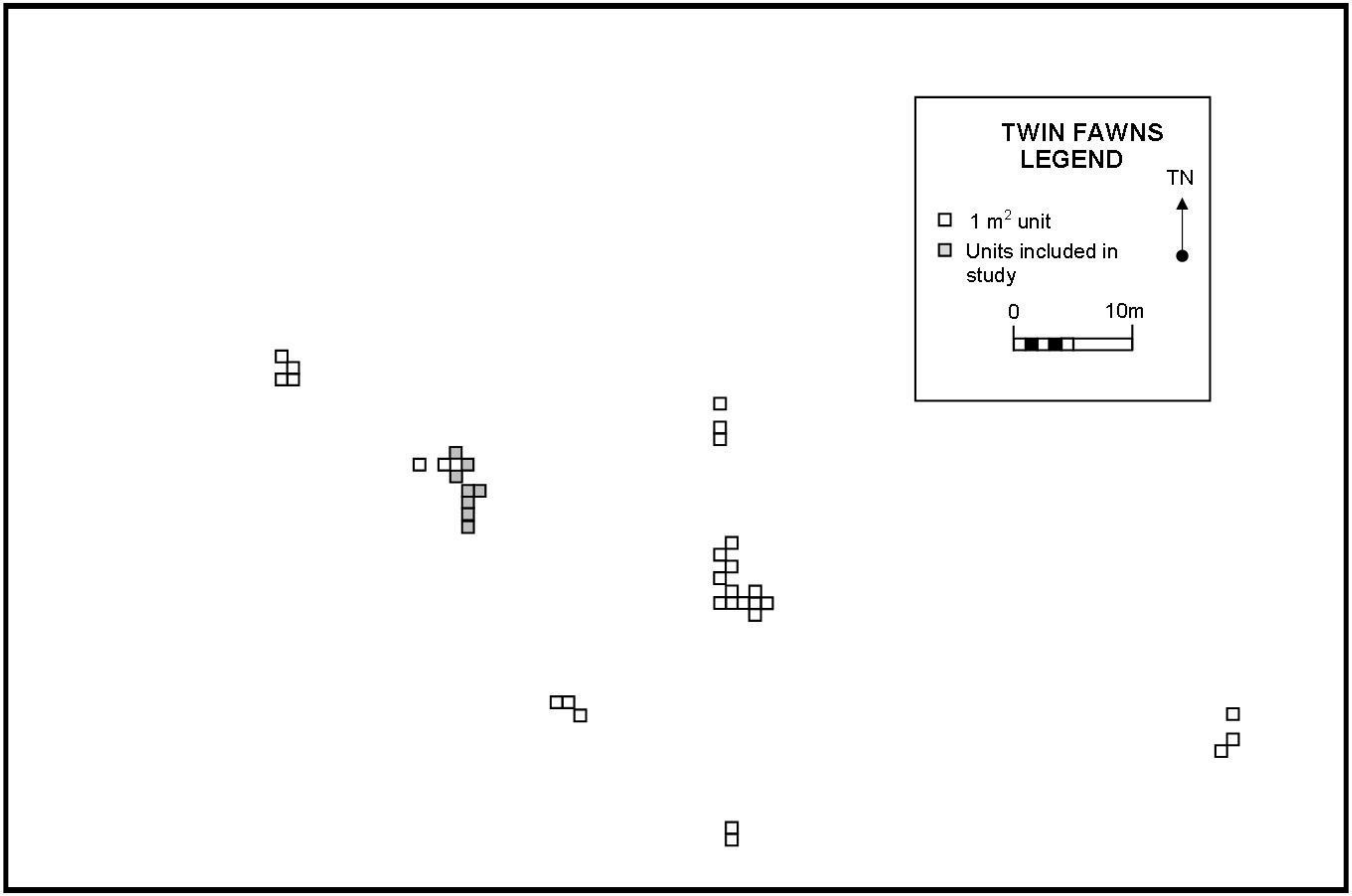
Figure 3-12: Landscape of the Twin Fawns site (courtesy of Scott Hamilton).



Cultural Assemblage and Affiliations

Two separate occupations were identified in the Twin Fawns artifact assemblage. Artifacts and features dating to the late nineteenth or early twentieth century are confined to two discrete areas of the site and tend to be located on top of, or on the side of the well-drained sand dunes. This occupation likely represents a part of the Métis use of the area after the demise of the bison

Figure 3-13: Twin Fawns site unit map.



hunts as seen at the Vera site (Hamilton and Nicholson 2000). The older component consists of a proto-contact Mortlach occupation radiocarbon dated to 150 ± 60 (Appendix 1). This radiocarbon date is complicated by fluctuations in the radiocarbon calibration curve for the time in question and the calibrated results place the date almost anywhere in the last 330 years (Hamilton and Nicholson 2007:142). Based on the dates of other Mortlach phase sites on the Northeastern Plains and the recovery of limited European trade goods at the site, Hamilton and Nicholson (2007:149) suggested that the occupation dates to the earliest radiocarbon intercept of the late 1600s to mid-1700s, and later refine the date to 1680-1780 AD (Nicholson and Hamilton 2001:62).

Although the site is always identified as containing Mortlach pottery (Hamilton and Nicholson 1999; Nicholson and Hamilton 1999, 2001; Nicholson et al. 2003: Nicholson et al. 2006c), preliminary observations (Nicholson and Hamilton 1999; Nicholson et al. 2003) noted that the ceramics at the site, “appear to represent both Mortlach and Vickers within the same assemblage” (Nicholson et al. 2003:126). Mokelki’s (2007) analysis of the Twin Fawns ceramic assemblage identified it as a variant of the Lake Midden subphase of Mortlach. She observed that the assemblage differed from the typical Mortlach assemblage but that the differences should be attributed to the location of the site, along the eastern edge of the Mortlach distribution and the probable interaction of the site’s inhabitants with the makers of Vickers focus pottery.

Although much has been written about the Twin Fawns site, research has focused on specifics such as an artifact type like the ice-gliders (Nicholson et al. 2003), slot knives (Hamilton and Nicholson 2007), the pottery assemblage (Nicholson et al. 2006c; Mokelki 2007) or the historic component of the site (Hamilton and Nicholson 2000). Likewise, the relationship between the Vickers focus and the Mortlach complex in the *Makotchi-Ded Dontipi* locale has been explored (Nicholson and Hamilton 1999, 2001) with the conclusion that the Twin Fawns site represents an intensive bison procurement strategy (Hamilton and Nicholson 1999; Nicholson and Hamilton 1999, 2011). The identification of a dense bone bed at the site is the only animal food subsistence evidence provided. A winter seasonality is estimated based on the presence of ice-gliders (Nicholson et al. 2003) as well as site placement within a meadow bottom. Sediment characteristics (iron oxide precipitants) suggest a high water table that might have included seasonal surface exposure of ground water (Hamilton and Nicholson 1999).

Sample Used in Dissertation

Even though there is no published description of the Twin Fawns faunal assemblage, it can be included in the dissertation. A preliminary report from the 2001 field school was prepared (Playford 2001b) and subsequently the faunal assemblage from that block was further identified and catalogued by the author. Foetal bison elements were identified within this block, making it a suitable candidate for inclusion.

Assessing Ecological Diversity of Individual Sites

To ensure that the observed subsistence strategy indices are reflective of human selection and behavior rather than a limiting factor of the environment, it is necessary for all six sites to have comparable levels of biophysical diversity. High biological diversity implies the site locations had more varied and different resources than those readily available elsewhere in the Prairie Ecozone (Wiseman and Graham 2007:253). The above descriptions of each site highlight the suggestion that all are located in areas of elevated biological diversity resulting from complexity in the landscape. However, because no two sites are ever located in identical settings, it can be difficult to make comparisons (Hardesty 1980:157).

Wiseman and Graham (2007) specifically addressed the issue of landscape diversity and uniqueness in the Prairie Ecozone. They attempted to validate the hypothesis that four separate study areas, including the Tiger Hills and the Glacial Lake Hind basin, exhibited increased levels of ecological uniqueness and complexity, and that precontact people sought out and inhabited these study areas. To quantify landscape diversity and uniqueness, geoindicators were used as proxy measures of ecological diversity and uniqueness. The attributes of landform, land surface form, surficial geology, soil development and soil texture were selected from the National Ecological Framework database at the ecodistrict level of classification for quantification. These attributes are thought to be “strong indicators of geomorphic processes resulting in characteristic landforms and associated physiographic, pedologic, and biotic conditions within the constraints of those typically occurring within the Prairie Ecozone. They are also good proxy indicators of the influence of local microclimatic effects and hydrologic conditions” (Wiseman and Graham 2007:206). They are also the most enduring and are likely to have changed little since their postglacial development as opposed to climatic or contemporary land cover attributes.

Two indices were developed to measure ecological diversity and uniqueness. The diversity index measured within ecodistrict heterogeneity, while the uniqueness index measured between ecodistrict heterogeneity and was based on the index of dissimilarity. A combined measure was derived by calculating the weighted mean of the diversity and uniqueness scores for each ecodistrict, and the combined index provided an overall measure of diversity and uniqueness (Wiseman and Graham 2007:261). Calculated scores were classified into three nominal categories based on standard deviations. The middle or average category was within 1.0 standard deviation above or below the mean while the lower category was greater than 1.0 standard deviation below the mean and the upper category was greater than 1.0 standard deviation above the mean.

For the Glacial Lake Hind Basin, the combined score was average for diversity and uniqueness while the Tiger Hills scored above average in diversity and below average in uniqueness for an average combined score. Unfortunately, the location of the Sanderson site was not one of the selected study areas, but results were also presented in map form. Based on the map information, the Sanderson site is located in an ecodistrict with average diversity and average uniqueness, resulting in an average combined index (Wiseman and Graham 2007:263-265). Wiseman and Graham (2007:266-267) concluded that the archaeological site frequency for the Tiger Hills and the Glacial Lake Hind Basin study areas were higher than expected given their average level of landscape diversity and uniqueness. They suggest that either the National

Ecological Framework geoindicators were of insufficient scale and/or precision to detect the diverse and unique nature of these landscapes or that other characteristics of the regions explain their attractiveness to precontact people. For the purpose of this dissertation however, given that all site locations had a combined average score for landscape diversity and uniqueness, they are deemed to be comparable.

Summary

Faunal assemblage samples from the Hokanson, Lovstrom, Jackson, Vera, Sanderson and Twin Fawns sites have been selected for subsistence strategy and season of site occupation analysis. All sites are interpreted as either being processing sites, or have identified processing activity areas within the site and foetal bison elements had been reported or observed in all site faunal samples. The Jackson, Vera and Sanderson site faunal assemblages have been published, while the Twin Fawns assemblage sample had been analyzed but not published. Neither the Lovstrom nor the Hokanson samples had been analyzed or published but were available for examination. All sites are located in the Prairie Ecozone and have comparable levels of ecological complexity. The excavation histories have been reported for each site, and all were excavated in similar ways except for that a smaller mesh size was used at the Jackson, Vera and Twin Fawns sites, although small screen samples were prepared for the Sanderson site assemblage.

CHAPTER 04: SITE FAUNAL ASSEMBLAGES AND SUBSISTENCE QUANTIFICATION

Introduction

The faunal assemblage sample data for each site can only be understood if the cataloguing methodology is known, so a detailed description of the cataloguing methodology is provided. The faunal assemblage data for each is presented in a series of tables listing the identified species as well as the bison elements identified. Animal food subsistence strategies can then be interpreted from the faunal assemblage data. Given the nature of the assemblage, two choices, species diversity and intensity of bison processing, were selected for quantification. Quantification methodologies and results are present for each subsistence choice, with discussion of the results presented in Chapter Seven.

Faunal Assemblage Cataloguing Methodologies

Prior to reconstructing each site's species diversity and bison processing intensity, the faunal assemblages must first be identified, catalogued and compiled. The process of reconstructing human behaviour from the inanimate objects recovered in an archaeological site consists of several different steps. For each step, especially during the identification stage of analysis, specific decisions must be made which will influence the end result. For example, deciding to classify large ungulate long bone fragments as indeterminate large ungulate rather than as bison will reduce the fragmentation rate calculated for bison. This implies that the site inhabitants were fragmenting bison bone to a lesser degree than if the long bone fragments had been classified as bison. For this reason, it is ideal to only compare sites that have been catalogued and analyzed using a consistent decision making process. Unfortunately, this is rarely possible, as the process is highly individualistic and can even evolve through time for a single researcher. Instead, it is necessary to document the step-by-step process of identification, cataloguing and analysis to ensure that end results reflect the site inhabitant's behaviour rather than that of the researcher.

Of the six site samples, only one, the Sanderson site, was not directly analysed by the author and instead the data was compiled from a pre-existing document (Magee 1997). Three of the five author-analysed sites had previously been examined by the author; two of which, Jackson and Vera have been published (Playford 2010, Playford and Nicholson 2006 respectively) while the Twin Fawns data had not. The Hokanson and Lovstrom faunal assemblages had initial identification and cataloguing completed by a third party, but the samples from these two sites were re-examined by the author. This was necessary to ensure correct and consistent identification and to implement the use of landmarks on the bison assemblages. The cataloguing methods are reviewed below.

The first step in interpreting subsistence from faunal remains is to distinguish between culturally and naturally deposited bones. In order to infer diet, the remains must *positively* be the result of cultural subsistence processes (Stahl 1996; Thomas 1971). With archaeological sites, the task of separating culturally deposited debris from naturally occurring bones is usually a straightforward task. The context of the deposits is vital; they are found in habitation, processing or kill areas. The association of the faunal remains with artifacts and features indicate that the bones are the result of human activity. However, it is also possible to get background fauna; animals present at the time of site occupation but not used as food. Naturally deposited carcasses are fairly easy to identify as they are usually localized, relatively complete and unmodified (Shaffer 1992a:686).

Bones that have been accumulated by non-human predators have specific signatures for each agent. For example, bones deposited by owls will be relatively complete except for scoring on the distal ends (Andrews 1990). Signatures have been identified for various carnivores as well as predatory birds (Andrews and Nesbit Evans 1983; Morlan 1994a; Schmitt and Juell 1994). There is even a distinct element distribution for rodent bones from animals that have fallen into abandoned roasting pits (Semken and Falk 1991).

Grayson (1991) outlined how to identify if animal remains are the result of food production. The criteria of element distribution, frequency and modification can be used to infer human consumption. Elements displaying two or more of the following criteria can be interpreted as being used as a food source: burning, cutmarks, bone breakage or association within or near hearth features (Webster 1999:200). This criteria is especially vital in establishing the importance of non-bison food resources.

For all sites, intrusive faunal remains have been removed from the catalogue. These are remains that are undeniably of recent origin as indicated usually by their colour and/or location and/or completeness of skeleton. Previously unanalyzed site assemblages had the intrusive remains removed during the cataloguing procedure. For sites with published data, intrusive specimens were removed.

Identifiable specimens were then separated from the unidentifiable recoveries. All unidentifiable specimens were examined for macroscopic evidence of thermal alteration. There is a generally accepted progression of bone colour from brown, black, grey, bluish white through to white thought to represent increasing temperature (Nicholson R. 1993:415). Correlating colour with temperature is more complex (Lyman 1994a:385) and the extensive analysis required to establish such a correlation is not necessary here. Instead, specimens which exhibit clear evidence of thermal alteration in terms of colour were identified as burned. Thermal alteration was also recorded for the identified assemblages.

There are two categories of identification; taxon and body part (Lyman 1994a:100). Specimens were identified to the lowest taxonomic level as possible. Without distinguishing features, some specimens could only be identified to a size class taxon. The following size class categories were used for all sites (Table 4-1).

For the body part category, most specimens were identified to a specific element. When possible, the elements were sided. For some specimens without distinguishing features, more generalized identifications such as appendicular or cranial fragment were made. Given the fragmented nature of the bison assemblages, landmarks were used to calculate a minimum number of elements

Table 4-1: Size class categories with corresponding weight or length ranges, associated terms and animal examples.

Size Class	Weight	Associated Terms	Animal Examples
SC 6	200+ kg	Very Large Mammal	Bison, Moose, Elk
SC 5	25-199 kg	Large Mammal	Bear, Deer, Wolf/Domestic Dog
SC 4	5-24 kg	Medium Mammal	Coyote, Beaver
SC 3	700-4999 g	Small-Medium Mammal	Fox, Rabbit
SC 2	100-699 g	Small Mammal	Ground Squirrels
SC 1	<100 g	Micro-Mammal	Mice, Voles
	Length (cm)		
Avian SC 5	75+	Large Bird	Crane, Eagle
Avian SC 4	55-74	Medium Bird	Raven
Avian SC 3	35-54	Small-Medium Bird	Duck
Avian SC 2	20-34	Small Bird	Robin
Avian SC 1	<20	Micro-Bird	Warbler
Vertebrate SC 2	-	Small Vertebrate	Ground Squirrel, Meadowlark
Vertebrate SC 1	-	Micro-Vertebrate	Mice, Frogs, Warbler

(MNE). Morlan (1994b:799) advocated the use of recording identifiable anatomical *features* or identifiable featureless areas called *zones* for each bison specimen in order to better analyze fragmented assemblages. Here, the term landmark includes both zones and features. The highest recorded landmark per element becomes the MNE. Morlan (1994b:800-802) published an initial list of elements with corresponding landmarks but was not exhaustive. Several elements such as phalanges, ribs, sternum, and the sacrum were not listed, nor was the cranium. Magee (1997:264-270) expanded the landmark list which was in turn expanded by Playford (2001a, 2003, 2010; Playford and Nicholson 2006). A complete landmark list is found in Appendix 2.

For all sites, with the exception of Jackson and Sanderson, specimens without a landmark were not identified beyond the size class category. In highly fragmented bison assemblages, there will be small pieces of bone, such as fragments of rib or indeterminate long bone, which are identifiable to element but without a distinguishing landmark. In assemblages without other identified SC 6 animals, it is probable that these specimens are indeed bison, which is why Magee (1997) and Playford (2001a, 2010) included them in the bison assemblage. For sites with other large animals, these types of specimens cannot, by default, be assigned to bison as they may be from another animal.

However, given that bison is the dominant species present in all sites, it is most likely that fragmented remains are indeed bison. For this reason, and to be able to compare fragmentation rates across sites, the identified SC 6 elements are presented alongside the bison elements for the Hokanson, Lovstrom, Vera and Twin Fawn assemblages.

For all sites, the number of identified specimens (NISP) is presented for each identified taxon. This is a basic quantification unit that represents the maximum number of individuals. NISP counts can be misleading when interpreting subsistence choices like species diversity, due to fragmentation (Cruz-Uribe 1988:181). An unbroken element representing one animal will have an NISP of one, but that same element can be fragmented into 20 pieces, giving an NISP of 20 for that same one animal. To better understand the abundance of animals, another quantitative unit is derived, and that is the minimum number of individuals (MNI) represented by the NISP. The MNI corresponds to the most abundant sided element (White 1953:397). Other factors such as age, sex or size can be taken into consideration to achieve a more accurate MNI (Lyman 1994a:100). An MNI for each genera was calculated for all sites. If there were specimens identified to a higher level (i.e. family, order, class) with no corresponding lower identification to genus, an MNI was calculated. For the bison assemblages, MNIs were calculated for immature as well as foetal remains. Immature specimens were recognized by a billowy appearance, the presence of unfused epiphyses or the absence of epiphyseal caps.

A separate table was created for the immature assemblages for all sites except Sanderson. Magee (1997:109-110) provided a qualitative description of the Sanderson sample immature bison assemblage but did not provide any quantitative data. The presence of immature specimens indicated the presence of at least one immature animal although the NISP for the Sanderson immature bison assemblage is unknown.

Calculating the minimal animal units (MAU) and the corresponding %MAU has become standard practice in faunal analysis. The term was coined by Binford (1984:50) to describe his method of deducing MNIs. He was interested in the survivorship of different skeletal parts and wanted to know how humans differentially dismember and transport carcass portions. To achieve this, he divided the observed bone count, or the MNE, by the number of times that anatomical unit occurs in one complete skeleton. This standardized the observed frequencies of all anatomical units. It is often presented as %MAU, where the result is then multiplied by 100 percent and divided by the maximum observed MAU. The %MAU and the MNE can then be used to measure how humans affect an assemblage with butchering practices and the survivorship of skeletal parts. All sites were catalogued using these methods and the results are presented below.

The Hokanson Sample Faunal Assemblage

A total of 29,389 faunal specimens weighing almost 42 kg were identified in the sample from the Hokanson site (Table 4-2). Almost 11 percent of the sample was identified at least to the size class taxon. A very small percent of the identified elements exhibited visible evidence of thermal alteration while a slightly larger percent of the unidentified specimens appeared to have been thermally altered.

Table 4-2: The Hokanson sample faunal assemblage separated into identified and unidentified categories by thermal alteration.

	Identified				**Unidentified**				**Total**	
	N	N%	g	g%	N	N%	g	g%	N	g
Unburned	3120	10.6	31165.6	74.4	21712	73.9	8902.4	21.2	24832	40068.0
Burned	76	0.3	146.7	0.4	4481	15.2	1683.3	4.0	4557	1830.0
Total	**3196**	**10.9**	**31312.3**	**74.7**	**26193**	**89.1**	**10585.7**	**25.3**	**29389**	**41898.0**

Bison was the most numerous species identified with at least seven mature animals, two juvenile and one foetal animal in the assemblage (Table 4-3). There was also a single cervid animal and at least two SC5 canids present. An assortment of other small to medium mammals was identified in the sample. A total of 1861 specimens could only be identified to size class (Table 4-4). Five hundred and twenty-four of the SC6 specimens could at least be identified to element and have been presented with the bison element summary (Table 4-5).

Table 4-3: Summary of the Hokanson sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	647	7
immature		37	2
foetal		32	1
Cervid	SC6	1	1
Medium-Large Canids	*Canis* sp.	33	2
Skunk	*Mephitis mephitis*	3	1
Hares & Jackrabbits	*Lepus*	9	2
Rabbit & Hare Family	Leporidae	14	-
Northern Pocket Gopher	*Thomomys talpoides*	1	1
Squirrel	*Scurius*	6	1
Birds			
Small-Medium Birds	Avian SC 3	2	1
Reptiles			
Turtle	Testudines	1	1
Miscellaneous			
Very Large Mammal	SC6	2396	-
Large Mammal	SC5	5	-
Medium Mammal	SC4	2	-
Small-Medium Mammal	SC3	5	-
Small Mammal	SC2	2	-
Total		**3196**	**20**

Table 4-4: Summary of the Hokanson sample miscellaneous specimens by size and class.

Common Name	Size Class	NISP	Elements represented
Very Large Mammal	6	1849	skull fragments, appendicular fragments, axial fragments, tooth enamel, indeterminate fragmented elements
Large Mammal	5	5	skull fragments, rib fragments, indeterminate appendicular fragments
Medium Mammal	4	2	petrous fragment, rib fragment
Small-Medium Mammal	3	5	skull fragment, caudal vertebrae, femur condyle fragment, appendicular fragment, indeterminate element fragment
Total		**1861**	

Another 23 of the SC6 specimens could be identified as being immature and are presented with the immature bison summary (Table 4-6).

Landmarks were used to calculate the bison MNE and %MAU values. A complete landmark list can be found in Appendix 2 Table 1. Seven mature bison were represented in the sample by seven left tibial anterior crests.

Table 4-5: Summary of the Hokanson sample SC6 and *Bison bison* recoveries.

Element	Bison NISP	SC6 NISP	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Cranium	111	258	369	8	5	66.7
Mandible	56	13	69	10	6	83.3
Hyoid	4		4	2	1	16.7
Sternum						0.0
Rib	30	180	210	8	1	5.0
Atlas						0.0
Axis	1		1	1	1	16.7
Cervical Vertebrae	19	1	20	3	1	6.7
Thoracic Vertebrae	47	6	53	10	1	11.7
Lumbar Vertebrae	14	1	15	5	1	16.7
Sacrum						0.0
Caudal Vertebrae						0.0
Forelimb						
Scapula	94	22	116	7	5	58.3
Humerus	34	3	37	8	4	66.7
Radius	24		24	6	4	50.0
Ulna	15	2	17	8	5	66.7
Radial Carpal	5		5	5	4	41.7
Central Carpal	4		4	4	2	33.3
Ulnar Carpal	3		3	3	2	25.0
Fused 2/3 Carpal	6		6	6	4	50.0
Fourth Carpal	4		4	4	3	33.3
Accessory Carpal	4		4	4	3	33.3
Metacarpal	5		5	2	1	16.7
5th Metacarpal	1		1	1	1	8.3
Hindlimb						
Innominate	9	4	13	4	2	33.3
Femur	15	5	20	4	2	33.3
Patella	2		2	2	2	16.7
Tibia	36	12	48	12	7	100
Lateral Malleolus	8		8	8	5	66.7
Astragalus	5		5	4	2	33.3
Calcaneus	4		4	3	2	25.0
Fused C/4 Tarsal	9		9	7	5	58.3
Fused 2/3 Tarsal	5		5	4	4	33.3
1st Tarsal	4		4	4	2	33.3
Metatarsal	20		20	5	4	41.7
2nd Metatarsal						0.0
Fore or Hindlimb						
1st Phalanx	16		16	16	4	33.3
2nd Phalanx	6		6	6	2	13.3
3rd Phalanx	15		15	9	3	18.3
Lateral Sesamoid	5		5	5	2	10.0
Medial Sesamoid	4		4	4	1	8.3
Distal Sesamoid	3		3	3	1	6.7

Miscellaneous						
Vertebrae indeterminate		5	5			
Metapodial indeterminate		12	12			
Total	**647**	**524**	**1171**	**213**	**7**	

Table 4-6: Summary of the Hokanson sample immature SC6 and *Bison bison* recoveries.

Element	Bison NISP	SC6 NISP	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Mandible	15		15	1	1	50
Rib		3	3	2	1	10
Axis	1		1	1	1	100
Cervical Vertebrae	2		2	1	1	10
Thoracic Vertebrae	5		5	2	1	10
Caudal Vertebrae		2	2	2	1	10
Forelimb						
Radius	1		1	1	1	50
Metacarpal	2		2	2	1	100
Hindlimb						
Femur	1		1	1	1	50
Calcaneus	3		3	2	2	100
Metatarsal	2		2	1	1	50
Fore or Hindlimb						
1st Phalanx	2		2	2	1	30
2nd Phalanx	1		1	1	1	10
Miscellaneous						
Vertebrae indeterminate		12	12			
Metapodial indeterminate	2		2			
Appendicular indeterminate		3	3			
Element indeterminate		3	3			
Total	**37**	**23**	**60**	**19**	**2**	

The Lovstrom Sample Faunal Assemblage

Nearly 24 kg of faunal remains were catalogued in the Lovstrom sample, with over 75 percent of the assemblage unidentified by count (Table 4-7). Almost none (0.1 percent by count and 0.6 percent by weight) of the identified specimens exhibited evidence of thermal alteration and a relatively small proportion of the unidentified specimens were burned (4.7 percent by count and 0.9 percent by weight).

Twenty animals in seven different taxa were identified (Table 4-8). Bison were the most numerous with nine adults, two immature and three foetal animals identified in the assemblage. All of the other identified taxa have a minimum of one individual in the assemblage. Of the 2186 SC6 specimens, 1991 (Table 4-9)

Table 4-7: The Lovstrom sample faunal assemblage separated into identified and unidentified categories by thermal alternation.

	Identified				Unidentified				Total	
	N	N%	g	g%	N	N%	g	g%	N	g
Unburned	2938	24.1	19208.8	80.5	8650	71.1	4295.0	18.0	11588	23503.8
Burned	9	0.1	138.4	0.6	577	4.7	223.5	0.9	586	361.9
Total	**2947**	**24.2**	**19347.2**	**81.1**	**9227**	**75.8**	**4518.5**	**18.9**	**12174**	**23865.7**

Table 4-8: Summary of the Lovstrom sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	626	9
Immature		30	2
Foetal		59	3
Medium-Large Canids	*Canis* sp.	19	1
Beaver	*Castor Canadensis*	1	1
Rabbit and Hare Family	Leporidae	3	1
Voles	*Microtus* sp.	1	1
Birds			
Medium Birds	Avian SC 4	1	1
Small-Medium Birds	Avian SC 3	4	1
Miscellaneous			
Very Large Mammal	SC 6	2186	
Large Mammal	SC 5	8	
Small-Medium Mammal	SC 3	5	
Small Mammal	SC 2	2	
Micro-Mammal	SC 1	1	
Small Vertebrate	SC2	1	
Total		**2947**	**20**

could only be identified to a general element category while 185 could be identified to element (Table 4-10) and 10 were identified as immature (Table 4-11). Landmarks were used to calculate the bison MNE and %MAU values and a complete list can be found in Appendix 2 Table 1. The MNI of nine was calculated based on the presence of nine left proximal ulnae.

Table 4-9: Summary of the Lovstrom sample miscellaneous specimens by size and class.

Common Name	Size Class	NISP	Elements represented
Very Large Mammal	6	1991	appendicular shaft fragments, metapodial condyles, indeterminate elements
Large Mammal	5	8	petrous fragment, rib fragments, indeterminate sesamoid
Small-Medium Mammal	3	5	incisor, rib fragment, appendicular shaft fragments
Small Mammal	2	2	humerus, calcaneus
Micro-Mammal	1	1	incisor
Small Vertebrate	SC2	1	indeterminate element
Total		**2008**	

Table 4-10: Summary of the Lovstrom sample SC6 and *Bison bison* recoveries.

Element	Bison NISP	SC6 NISP	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Cranium	16	9	25	3	2	27.3
Mandible	30		30	5	3	45.5
Hyoid						0.0
Sternum						0.0
Rib	83	152	235	14	1	9.1
Atlas						0.0
Axis						0.0
Cervical Vertebrae	23		23	1	1	1.8
Thoracic Vertebrae	141	18	159	7	1	9.0
Lumbar Vertebrae	5		5	3	1	10.9
Sacrum						0.0
Caudal Vertebrae	2		2	2	1	1.8
Forelimb						
Scapula	8		8	1	1	9.0
Humerus	29		29	5	3	45.5
Radius	19		19	8	5	72.7
Ulna	22		22	11	9	100
Radial Carpal	4		4	4	2	36.4
Central Carpal	3		3	3	3	27.3
Ulnar Carpal	8		8	8	7	72.4
Fused 2/3 Carpal	4		4	4	2	36.4
Fourth Carpal	1		1	1	1	9.1
Accessory Carpal	2		2	2	1	18.2
Metacarpal	13		13	6	4	54.5
5th Metacarpal	2		2	2	1	18.2
Hindlimb						
Innominate	8		8	2	1	18.2
Femur	7		7	1	1	9.1
Patella	7		7	6	3	54.4
Tibia	62		62	8	4	72.7
Lateral Malleolus	4		4	4	4	36.4
Astragalus	5		5	5	4	45.5
Calcaneus	6		6	4	3	36.4
Fused C/4 Tarsal	7		7	7	5	63.6
Fused 2/3 Tarsal	3		3	3	3	27.3
1st Tarsal	3		3	3	2	27.3
Metatarsal	11		11	5	3	45.5
2nd Metatarsal						0.0
Fore or Hindlimb						
1st Phalanx	16		16	16	2	36.4
2nd Phalanx	19		19	19	3	43.6
3rd Phalanx	24		24	21	3	47.3
Lateral Sesamoid	7		7	7	1	16.4
Medial Sesamoid	10		10	10	2	23.6
Distal Sesamoid	12		12	12	2	27.3
Miscellaneous						
Tooth indeterminate						
Vertebrae indeterminate		5	5			
Phalanx indeterminate						
Sesamoid indeterminate		1	1			
Total	626	185	811	219	9	

Table 4-11: Summary of the Lovstrom sample immature SC6 and *Bison bison* recoveries.

Element	Bison NISP	SC6 NISP	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Mandible	15		15	2	1	100
Rib		2	2	1	1	0
Forelimb						
Radius	1		1	1	1	50.0
Metacarpal	4		4	2	1	100
Hindlimb						
Tibia	3		3	2	2	100
Calcaneus	2		2	2	1	100
Fore or Hindlimb						
2nd Phalanx	5		5	5	1	60.0
Miscellaneous						
Vertebrae indeterminate		6	6			
Metapodial indeterminate		2	2			
Total	**30**	**10**	**40**	**15**	**2**	

The Jackson Sample Faunal Assemblage

There were 194,182 faunal specimens weighing over 67 kg identified in the Jackson site sample (Table 4-12). Roughly half of the unidentified specimens exhibited evidence of thermal alteration while only a small percent by count (1.7 percent) of the identified specimens appeared burned. Thirty-seven individuals were identified to at least the genus level and an additional three individuals were identified to the class level (Table 4-13). A minimum of thirteen bison were identified; eight adult, one juvenile and four foetal. Several other small to medium mammals were represented by a minimum of one individual except for two canids, four northern pocket gophers, seven meadow voles and three red

Table 4-12: The Jackson sample faunal assemblage separated into identified and unidentified categories by thermal alteration.

	Identified				Unidentified				Total	
	N	N%	g	g%	N	N%	g	g%	N	G
Unburned	9469	4.9	32442.3	48.2	92757	47.8	14920.2	22.2	102226	47362.5
Burned	3386	1.7	4018.5	6.0	88570	45.6	15943.4	23.6	91956	19961.9
Total	**12855**	**6.6**	**36460.8**	**54.2**	**181327**	**93.4**	**30863.6**	**45.8**	**194182**	**67324.4**

Table 4-13: Summary of the Jackson sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	4151	8
Immature		545	1
Foetal		95	4
Mule & Whitetail Deer	*Odocoileus* sp.	4	1
Medium-Large Canids	*Canis* sp.	107	2
Beaver	*Castor Canadensis*	1	1
Snowshoe Hare	*Lepus americanus*	1	1
Hare & Jackrabbit	*Lepus* sp.	1	
Rabbit & Hare Family	Leporidae	1	
Ground Squirrels	*Spermophilus* sp.	3	1
Northern Pocket Gopher	*Thomomys talpoides*	4	4
Meadow Vole	*Microtus pennsylvanicus*	17	7
Gaper's Red-Backed Vole	*Clethrionomys* cf. *gapperi*	6	3
Voles	*Microtus* sp.	2	
Mice and Voles	Cricetidae	3	
Shrews	*Sorex* sp.	1	1
Birds			
Medium Birds	Avian SC 4	1	1
Small-Medium Birds	Avian SC 3	4	1
Small Birds	Avian SC 2	2	1
Amphibians			
Tiger salamander	*Ambystoma tigrinum*	2	1
Toads	*Bufo* sp.	1	1
Frogs and Toads	Anura	1	
Reptiles			
Garter Snakes	*Thamnophis* sp.	20	1
Miscellaneous			
Very Large Mammal	SC6	6316	
Large Mammal	SC5	9	
Medium Mammal	SC4	19	
Small-Medium Mammal	SC3	23	
Small Mammal	SC2	6	
Micro-Mammal	SC1	4	
Indeterminate Mammal		1490	
Small Vertebrate	SC2	8	
Micro-Vertebrate	SC1	0	
Total		**12855**	**40**

backed voles. None of the 6316 SC6 specimens were identified to specific element and almost 1500 pieces of tooth enamel were only identified as indeterminate mammal (Table 4-14). The 4151 bison elements represented a minimum of eight adult animals, based on the presence of eight left second mandibular molars (Table 4-15). Landmarks were used to calculate the bison MNE and %MAU values and a complete list can be found in Appendix 2 Table 1. An additional immature bison was present in the assemblage (Table 4-16).

Table 4-14: Summary of the Jackson sample miscellaneous specimens by size and class.

Common Name	Size Class	NISP	Elements represented
Very Large Mammal	6	6316	skull fragments, tooth enamel, longbone shaft fragments, indeterminate elements
Large Mammal	5	9	skull fragments, rib head fragments, phalanx fragment
Medium Mammal	4	19	skull fragments, rib shaft fragments, vertebrae fragments
Small-Medium Mammal	3	23	skull fragments, caudal vertebrae, longbone shaft fragments, 2nd phalanx, indeterminate element
Small Mammal	2	6	incisor, mandible, calcaneus, indeterminate element
Micro-Mammal	1	3	skull fragments
Indeterminate Mammal	0	1490	tooth enamel
Small Vertebrate	2	8	rib fragment, long bone shaft fragments, proximal phalanx fragment, 2nd phalanges, indeterminate element
Total		**7874**	

Table 4-15: Summary of the Jackson sample *Bison bison* recoveries.

Element	NISP	MNE	MNI	%MAU
Axial Skeleton				
Cranium	443	8	5	57.1
Mandible	339	14	8	100
Hyoid	15	5	3	35.7
Sternum				0.0
Rib	967	27	1	14.3
Atlas	245	1	1	14.3
Axis	112	3	3	42.9
Cervical Vertebrae	36	10	2	20.0
Thoracic Vertebrae	349	25	2	25.7
Lumbar Vertebrae	53	3	1	8.6
Sacrum	1	1	1	14.3
Caudal Vertebrae	3	2	1	1.4
Forelimb				
Scapula	86	6	5	42.9
Humerus	92	5	3	35.7
Radius	49	8	4	57.1
Ulna	72	6	4	42.9
Radial Carpal	6	6	4	42.9
Central Carpal	13	10	5	71.4
Ulnar Carpal	8	8	4	57.1
Fused 2/3 Carpal	7	4	2	28.6
Fourth Carpal	11	6	4	42.9
Accessory Carpal	3	3	3	21.4
Metacarpal	26	7	4	50.0
5th Metacarpal	2	2	1	14.3
Hindlimb				
Innominate	125	5	3	35.7
Femur	13	3	2	21.4
Patella	3	3	2	21.4
Tibia	76	4	2	28.6
Lateral Malleolus	6	6	4	42.9
Astragalus	16	11	6	78.6
Calcaneus	21	7	4	50.0

Fused C/4 Tarsal	21	10	6	71.4
Fused 2/3 Tarsal	9	8	5	57.1
1st Tarsal	7	7	4	50.0
Metatarsal	171	11	8	78.6
2nd Metatarsal	1	1	1	7.1
Fore or Hindlimb				
1st Phalanx	85	24	3	42.9
2nd Phalanx	27	20	3	35.7
3rd Phalanx	58	23	3	41.4
Lateral Sesamoid	17	15	2	27.1
Medial Sesamoid	23	24	3	42.9
Distal Sesamoid	23	15	2	27.1
Miscellaneous				
Tooth indeterminate	82			
Vertebrae indeterminate	405			
Phalanx indeterminate	6			
Sesamoid indeterminate	10			
Total	**4151**	**360**	**8**	

Table 4-16: Summary of the Jackson sample immature *Bison bison* recoveries.

Element	**NISP**	**MNE**	**MNI**	**%MAU**
Axial Skeleton				
Rib	6	3	1	10.0
Cervical Vertebrae	55	7	1	100
Thoracic Vertebrae	114	9	1	60.0
Lumbar Vertebrae	5	2	1	40.0
Caudal Vertebrae	2	2	1	10.0
Forelimb				
Humerus	1	1	1	50.0
Fourth Carpal	2	1	1	50.0
Metacarpal	8	2	1	100
Hindlimb				
Femur	13	1	1	50.0
Tibia	9	1	1	50.0
Calcaneus	2	1	1	50.0
Metatarsal	1	1	1	50.0
Fore or Hindlimb				
1st Phalanx	4	3	1	40.0
2nd Phalanx	6	4	1	50.0
3rd Phalanx	1	1	1	10.0
Miscellaneous				
Vertebrae indeterminate	92			
Metapodial indeterminate	2			
Unidentified	222			
Total	**545**	**40**	**1**	

The Vera Sample Faunal Assemblage

The analysed Vera faunal sample contained 206,434 specimens weighing 50 kg (Table 4-17). By count, only 2.9 percent of the assemblage was identifiable, but by weight, this increased to 54.0 percent. The unidentified specimens exhibited greater thermal alteration (41.5 percent by count and 17.8 percent by weight) than identified specimens (0.3 percent by count and 2.2 percent by weight).

Table 4-17: The Vera sample faunal assemblage separated into identified and unidentified categories by thermal alteration.

	Identified				Unidentified				Total	
	N	N%	g	g%	N	N%	g	g%	N	G
Unburned	5318	2.6	26058.1	51.8	114787	55.6	14188.9	28.2	120105	40246.9
Burned	718	0.3	1131.3	2.2	85611	41.5	8948.1	17.8	86329	10079.5
Total	**6036**	**2.9**	**27189.4**	**54.0**	**200398**	**97.1**	**23137.0**	**46.0**	**206434**	**50326.4**

Twenty-five mammals were catalogued to 10 general and two families. Avian specimens were identified to four different size classes and there was also at least one turtle, gartner snake, fish and tiger salamander present (Table 4-18). Of the 2595 SC6 elements (Table 4-19), 2094 of these were identified to element and are presented with the bison element summary (Table 4-20). There were a minimum of eight adult bison in the assemblage represented by eight left radial carpals, central carpals, 2/3 carpals and central and fourth tarsals. The bison MNE and %MAU were calculated using landmarks, with the complete list present in Appendix 2 Table 2. Two immature bison were represented in the assemblage by two femora, tibiae, calcanei and two metatarsals (Table 4-21) and at least two foetal bison wereidentified in the assemblage.

Table 4-18: Summary of the Vera sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	702	8
Immature		75	2
Foetal		142	2
Elk	*Cervus canadensis*	7	1
Moose or Elk	Cervidae (SC6)	3	
Medium-Large Canids	*Canis* sp.	61	2
Fox	*Vulpes* sp.	6	1
Snowshoe Hare	*Lepus americanus*	4	1
Rabbit & Hare Family	Leporidae	4	
Ground Squirrels	*Spermophilus* sp.	1	1
Grey Squirrel	*Sciurus carolinensis*	3	1
Red Squirrel	*Tamiasciurus hudsonicus*	1	1
Meadow Vole	*Microtus pennsylvanicus*	10	5
Gaper's Red-Backed Vole	*Clethrionomys* cf. *gapperi*	7	1
Birds			
Medium Birds	Avian SC 4	1	1
Small-Medium Birds	Avian SC 3	7	1
Small Birds	Avian SC 2	5	1
Micro-Birds	Avian SC1	4	1
Amphibians			
Tiger salamander	*Ambystoma tigrinum*	12	1
Frogs	*Rana* sp.	1	1
Frogs/Toads	*Anura*	1	
Indeterminate Amphibian		2	
Reptiles			
Turtle	Testudines	1	1
Garter Snakes	*Thamnophis* sp.	5	1
Piscine			
Fish	Piscine	3	1
Miscellaneous			
Very Large Mammal	SC 6	4781	
Large Mammal	SC 5	10	
Medium Mammal	SC 4	4	
Small-Medium Mammal	SC 3	18	
Small Mammal	SC 2	34	
Micro-Mammal	SC 1	96	
Small Vertebrate	SC2	9	
Micro-Vertebrate	SC1	4	
Indeterminate Class		12	
Total		**6036**	**35**

Table 4-19: Summary of the Vera sample miscellaneous specimens by size and class.

Common Name	Size Class	NISP	Elements represented
Very Large Mammal	6	2595	skull fragments, tooth enamel, distal right humerus, long bone fragments, indeterminate elements
Large Mammal	5	10	skull fragments, tooth enamel, vertebrae fragments, indeterminate sesamoid fragment
Medium Mammal	4	4	skull fragments, rib fragments, indeterminate appendicular element
Small-Medium Mammal	3	18	skull fragments, vertebrae fragment, rib fragments, indeterminate tarsal, metapodial fragments
Small Mammal	2	34	skull fragments, vertebrae, rib fragments, proximal femur fragment, tibia, tarsal, 2nd phalanx fragment, 3rd phalanx fragment
Micro-Mammal	1	96	skull fragments, vertebrae, humerus, ulna innominate fragment, femur, tibia fragments, indeterminate element fragments
Small Vertebrate	SC2	9	vertebrae fragment, 1st phalanges, indeterminate phalanx fragments, indeterminate element fragments
Micro-Vertebrate	SC1	4	vertebrae fragment, indeterminate appendicular element, 3rd phalanges
Total		**2770**	

Table 4-20: Summary of the Vera sample SC6 and *Bison bison* recoveries.

Element	NISP (Bison)	NISP (ILU)	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Cranium	48	116	164	5	3	35.7
Mandible	97	12	109	10	5	71.4
Hyoid	2	2	4	1	1	7.1
Sternum						0.0
Rib		190	190	3	1	1.4
Atlas	41		41	2	2	28.6
Axis	3		3	2	2	28.6
Cervical Vertebra	1		1	1	1	1.4
Thoracic Vertebra	2	7	9	1	1	1.4
Lumbar Vertebra	4	2	6	1	1	2.9
Sacrum						0.0
Caudal Vertebra	8		8	8	1	5.7
Forelimb						
Scapula	29	20	49	4	3	28.6
Humerus	23	13	36	6	4	42.9
Radius	49	27	76	14	7	100
Ulna	36	5	41	10	6	71.4
Radial Carpal	9	1	10	9	8	64.3
Central Carpal	12		12	10	8	71.4
Ulnar Carpal	5		5	5	4	35.7

2/3 Carpal	11		11	11	8	78.6
4th Carpal	7		7	7	6	50.0
Accessory Carpal	6		6	6	5	42.9
Metacarpal	30	3	33	6	4	42.9
5th Metacarpal	5		5	5	3	35.7
Hindlimb						
Innominate	6	2	8	2	2	14.3
Femur		8	8	1	1	7.1
Patella	7		7	7	6	50.0
Tibia	11	25	36	4	3	28.6
Lateral Malleolus	7		7	6	4	42.9
Astragalus	20	1	21	14	7	100
Calcaneus	30	1	31	9	5	64.3
C/4 Tarsal	14	3	17	7	4	50.0
2/3 Tarsal	12		12	11	8	78.6
1st Tarsal	5		5	5	5	35.8
Metatarsal	59	2	61	8	6	57.1
2nd Metatarsal	5	2	7	5	3	35.8
Fore or Hindlimb						
1st Phalanx	19	4	23	12	2	21.4
2nd Phalanx	19	3	22	15	2	27.1
3rd Phalanx	10	5	15	10	2	18.6
Lateral Sesamoid	24	1	25	24	3	42.9
Medial Sesamoid	9	1	10	9	2	14.7
Distal Sesamoid	17	3	20	17	3	30.0
Miscellaneous						
Tooth Indeterminate		1645	1645			
Vertebrae Indeterminate		31	31			
Phalanx Indeterminate		5	5			
Sesamoid Indeterminate		4	4			
Total	**702**	**2094**	**2796**	**310**	**8**	

The Sanderson Sample Faunal Assemblage

All information for the Sanderson site faunal assemblage with the exception of the foetal bison analysis was initially undertaken by Magee 1997. The information here is adapted from Playford's Master of Arts thesis (2001). The Sanderson faunal sample is comprised of 173, 097 faunal elements weighing 134 kg. Of these, 6434 specimens could at least be identified to the size class category and of the identified specimens only 3.7 percent by count exhibited evidence of thermal alteration (Table 4-22). Bison were the most numerous species identified in the sample with 12 adult animals and likely two foetal specimens. Magee (1997:53) did not catalogue immature bison specimens as a separate category but did comment on their presence and distribution in the site.

Table 4-21: Summary of the Vera sample immature SC6 *and Bison bison* recoveries.

Element	NISP (Bison)	NISP (ILU)	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Mandible	3		3	1	1	25.0
Caudal Vertebra	1		1	1	1	5.0
Forelimb						
Radius	1		1	1	1	25.0
Hindlimb						
Femur	15		15	4	2	100
Tibia	8		8	3	2	75.0
Astragalus	1		1	1	1	25.0
Calcaneus	6		6	3	2	75.0
C/4 Tarsal	2		2	1	1	25.0
Metatarsal	7		7	2	2	50.0
Fore or Hindlimb						
1st Phalanx	5		5	4	1	25.0
2nd Phalanx	8	1	9	6	1	40.0
3rd Phalanx	18		18	5	1	20.0
Miscellaneous						
Tooth Indeterminate		1	1			
Vertebrae Indeterminate		3	3			
Phalanx Indeterminate		4	4			
Appendicular Indeterminate		11	11			
Unidentified Element		72	72			
Total	**75**	**92**	**167**	**30**	**2**	

Table 4-22: The Sanderson sample faunal assemblage separated into identified and unidentified categories by thermal alteration.

	Identified				Unidentified				Total	
	N	N%	g	g%	N	N%	g	g%	N	g
Unburned	3504	2.0	n/a	n/a	87057	50.3	n/a	n/a	90561	n/a
Burned	2930	1.7	n/a	n/a	79606	46.0	n/a	n/a	82536	n/a
Total	**6434**	**3.7**	**57480.4**	**42.9**	**166663**	**96.3**	**76615.9**	**57.1**	**173097**	**134096.3**

It is impossible to determine exactly how many immature bison elements were represented by these specimens but an MNI of one can safely be presumed. The bison MNE and %MAU were calculated using landmarks, with the complete list present in Appendix 2 Table 2. A relatively large number of canid specimens were present in the Sanderson assemblage, and given the completeness of the recovered mandibles, Magee (1997:141) was able to identify two wolf, one coyote and two medium-large canids. Three swift foxes were also identified in the assemblage. The remaining 11 mammalian taxa were all represented by a single individual. Three bird species and two families were represented by at least one individual (Table 4-23).

Table 4-23: Summary of the Sanderson sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	2014	12
Immature			1
Foetal		71*	2
Pronghorn	*Antilocapra americana*	3	1
Wolf	*Canis lupus*	97	2
Medium-Large Canids	*Canis* sp.	12	2
Coyote	*Canis latrans*	15	1
Swift Fox	*Vulpes velox*	10	3
Beaver	*Castor Canadensis*	5	1
Badger	*Taxidea taxus*	2	1
Skunk	*Mephites mephitis*	2	1
American Mink	*Mustela vison*	2	1
Whitetail Jackrabbit	*Lepus townsendii*	4	1
Hare & Jackrabbit	*Lepus* sp.	2	
Franklin's Ground Squirrel	*Spermophilus franklini*	1	1
Richardson's Ground Squirrel	*Spermophilus richardsonii*	12	1
Thirteen Lined Ground Squirrel	*Spermophilus tridecemlineatus*	1	1
Meadow Vole	*Microtus pennsylvanicus*	1	1
Rat/Mice/Vole Family	Cricetidae	1	
Birds			
Tundra Swan	*Cygnus columbianus*	4	1
Canada Goose	*Branta Canadensis*	12	1
Mallard	*Anas platyrhynchos*	3	1
Blue Winged Teal	*Anas discors*	6	1
Hawk/Eagle/Kite Family	Accipitridae	1	1
Pheasant & Partridge Family	Phasianidae	2	1
Ducks/Geese/Swan Family	Anatidae	8	
Miscellaneous			
Medium Mammal	SC 4	18	
Medium Bird	Avian SC 4	6	
Total		**2244**	**39**

* foetal elements not included in taxa total because unsure how Magee (1997) identified the foetal elements

According to Magee (1997:53-54), there were 2014 specimens identified as bison (Table 4-24). The bison MNE and %MAU were calculated using landmarks with the complete list present in Appendix 2 Table 2. Included in this total were 645 miscellaneous specimens identified to general element. An additional 1713 pieces of indeterminate ungulate tooth enamel (not included in the total for *Bison bison*) were catalogued. No other specimens were identified solely to size class and it is assumed here that if such specimens existed in the assemblage, Magee

Table 4-24: Summary of the Sanderson sample *Bison bison* recoveries.

Element	NISP	MNE	MNI	%MAU
Axial Skeleton				
Cranium	241	15	11	100
Mandible	225	14	9	93.3
Hyoid	3	2	1	13.3
Sternum				0.0
Rib	43	43	2	21.3
Atlas	1	1	1	13.3
Axis	7	2	2	26.7
Cervical Vertebra	31	6	1	12.0
Thoracic Vertebra	86	10	1	10.7
Lumbar Vertebra	49	17	3	37.3
Sacrum	6	6	6	80.0
Caudal Vertebra	3	3	1	2.0
Forelimb				
Scapula	20	3	3	20.0
Humerus	45	8	6	53.3
Radius	52	13	7	86.7
Ulna	30	6	4	40.0
Radial Carpal	11	10	6	66.7
Central Carpal	14	11	7	73.3
Ulnar Carpal	11	10	5	66.7
2/3 Carpal	12	9	6	60.0
4th Carpal	7	7	5	46.7
Accessory Carpal	4	4	3	26.7
Metacarpal	18	6	3	40.0
5th Metacarpal				0.0
Hindlimb				
Innominate	23	6	5	40.0
Femur	29	11	6	73.3
Patella	3	3	2	20.0
Tibia	136	15	11	100
Lateral Malleolus	11	11	6	73.3
Astragalus	12	6	3	40.0
Calcaneus	15	5	4	33.3
C/4 Tarsal	21	15	12	100
2/3 Tarsal	13	13	10	86.7
1st Tarsal	2	2	1	13.3
Metatarsal	19	4	3	26.7
2nd Metatarsal	3	3	1	20.0
Fore or Hindlimb				
1st Phalanx	33	21	3	34.7
2nd Phalanx	52	35	5	57.3
3rd Phalanx	16	9	2	14.7
Lateral Sesamoid	26	26	4	43.3
Medial Sesamoid	24	24	3	40.0
Distal Sesamoid	12	12	2	20.0

Miscellaneous			
Vertebrae Indeterminate	48		
Rib Indeterminate	128		
Metapodial Indeterminate	24		
Appendicular Indeterminate	445		
Indeterminate ungulate dental enamel (not included in total)	1713		
Totals	2014	427	12

catalogued them as unidentifiable. An examination of the assemblage identified 71 foetal elements representing two animals.

The Twin Fawns Sample Faunal Assemblage

In the Twin Fawns sample, 161,517 faunal specimens weighing almost 47 kg were identified. By number, nearly all of these were unidentifiable (96.9 percent) but by weight, only 46.9 percent are unidentifiable (Table 4-25). Almost none (0.1 percent/count and 1.2 percent/weight) of the identified specimens appear burned while a slightly larger amount (15.9 percent/count and 6.6 percent/weight) of the unidentified specimens exhibited indication that they had been heated. Twenty-six individuals represented nine mammalian, two amphibian and one reptilian genera as well as four bird size classes (Table 4-26). Bison dominated the assemblage with six mature spacing hereanimals, one immature and one foetal animal. The adult bison MNE and %MAU were calculated using landmarks, with the complete list present in Appendix 2 Table 2. An additional 2235 SC6 specimens could not be identified beyond general skeletal category (Table 4-27) while 1872 specimens could at least be identified to element (Table 4-28 and Table 4-29). Of the 1872 identifiable SC6 specimens, 55 were catalogued as immature in addition to the 40 immature specimens identified in the sample (Table 4-29).

Table 4-25: The Twin Fawns sample faunal assemblage separated into identified and unidentified categories by thermal alteration.

	Identified				**Unidentified**				**Total**	
	N	N%	g	g%	N	N%	g	g%	N	G
Unburned	4836	3.0	24259.0	51.9	130772	81.0	18837.7	40.3	135608	43096.7
Burned	120	0.1	577.2	1.2	25789	15.9	3060.7	6.5	25909	3637.9
Total	**4956**	**3.1**	**24836.2**	**53.1**	**156561**	**96.9**	**21898.4**	**46.9**	**161517**	**46734.6**

Table 4-26: Summary of the Twin Fawns sample faunal assemblage by taxa.

Common Name	Taxa	NISP	MNI
Mammals			
Bison	*Bison bison*	432	6
Immature		40	1
Foetal		61	1
Deer	*Odocoileus* sp.	4	1
Medium-Large Canids	*Canis* sp.	20	1
Snowshoe Hare	*Lepus americanus*	1	1
Hares & Rabbit Family	Leporidae	17	
Ground Squirrels	*Spermophilus* sp.	6	1
Red Squirrel	*Tamiasciurus hudsconicus*	3	1
Squirrels	Sciuridae	8	
Deer Mouse	*Peromyscus maniculates*	2	1
Chipmunk	*Tamius* sp.	1	1
Meadow Voles	*Microtus pennsylvanicus*	8	3
Voles	*Microtus sp.*	3	
Birds			
Medium Birds	Avian SC4	2	1
Small-Medium Birds	Avian SC3	8	1
Small Birds	Avian SC2	3	1
Micro-Birds	Avian SC1	4	2
Amphibians			
Leopard Frog	*Rana pipens*	2	1
Frogs	*Rana* sp.	27	
Toads	*Bufo* sp.	1	1
Frogs and Toads	Anura	35	
Indeterminate Amphibian		17	
Reptiles			
Garter Snakes	*Thamnophis* sp.	66	1
Miscellaneous			
Very Large Mammal	SC6	4107	
Large Mammal	SC5	13	
Medium Mammal	SC4	7	
Small-Medium Mammal	SC3	4	
Small Mammal	SC2	40	
Micro-Mammal	SC1	17	
Totals		**4956**	**26**

Table 4-27: Summary of the Twin Fawns sample miscellaneous specimens by size and class.

Common Name	Size Class	NISP	Elements represented
Very Large Mammal	6	2235	indeterminate appendicular elements, indeterminate elements
Large Mammal	5	13	skull fragment, tooth fragment, rib fragments, vertebrae fragment, sesamoid fragments
Medium Mammal	4	7	skull fragments, rib fragments, vertebrae fragments, phalanx fragment, sesamoid fragments, unidentified element
Small-Medium Mammal	3	4	skull fragment, appendicular element fragment, indeterminate element fragment
Small Mammal	2	40	skull fragments, incisor fragment, rib fragments, lumbar vertebrae, caudal vertebrae, humerus, radius, ulna, femur, 3rd metatarsal, central tarsal, calcaneus, 3rd phalanx, indeterminate appendicular elements, indeterminate elements
Micro-Mammal	1	17	skull fragments, left partial mandible, thoracic vertebrae, lumbar vertebrae, left innominate, tibia fragment
Total		**2316**	

Table 4-28: Summary of the Twin Fawns sample SC6 and *Bison bison* recoveries.

Element	NISP (Bison)	NISP (ILU)	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Cranium	39	391	430	5	3	41.7
Mandible	59	108	167	6	3	50.0
Hyoid	4	5	9	2	2	16.7
Sternum	2	1	3	1	1	16.7
Rib	25	243	268	9	1	5.0
Atlas						0.0
Axis		1	1	1	1	18.2
Cervical Vertebra	3		3	2	1	0.5
Thoracic Vertebra	20	31	51	7	1	8.3
Lumbar Vertebra	24	10	34	10	2	33.3
Sacrum		1	1	1	1	16.7
Caudal Vertebra	6	4	10	4	1	3.3
Forelimb						
Scapula	6	8	14	2	1	16.7
Humerus	24	12	36	4	2	33.3
Radius	4	8	12	4	2	16.7
Ulna	7	10	17	4	3	33.3
Radial Carpal		1	1	1	1	8.3
Central Carpal						0.0
Ulnar Carpal	3		3	3	2	25.0
2/3 Carpal	1		1	1	1	8.3
4th Carpal						0.0
Accessory Carpal	1		1	1	1	8.3
Metacarpal	8	1	9	2	1	16.7
5th Metacarpal						0.0

Hindlimb						
Innominate	4	17	21	2	1	16.7
Femur	7	29	36	6	5	50.0
Patella	3		3	3	2	25.0
Tibia	24	47	71	12	6	100
Lateral Malleolus	1		1	1	1	8.3
Astragalus	1		1	1	1	8.3
Calcaneus	4		4	4	2	33.3
C/4 Tarsal	4	1	5	4	2	33.3
2/3 Tarsal	4		4	4	3	33.3
1st Tarsal	7	3	10	7	4	58.3
Metatarsal	10	5	15	4	2	33.3
2nd Metatarsal	2		2	2	1	16.7
Fore or Hindlimb						
1st Phalanx	31	2	33	27	4	56.7
2nd Phalanx	23	9	32	22	3	46.7
3rd Phalanx	22	7	29	22	3	46.7
Lateral Sesamoid	12		12	12	2	25.0
Medial Sesamoid	12		12	12	2	25.0
Distal Sesamoid	24	4	28	24	3	50.0
Miscellaneous						
Tooth Indeterminate		830	830			
Vertebrae Indeterminate		19	19			
Metapodial Indeterminate		3	3			
Phalanx Indeterminate		4	4			
Sesamoid Indeterminate		2	2			
Totals	431	1817	2248	240	6	

Establishing Subsistence Strategies at Archaeological Sites

There are a variety of methods archaeologists use to infer what people had been eating in the past. Coprolite analysis provides the most direct method of deducing past diets. The recovery and identification of macrofossils, phytoliths and pollen from ancient fecal material can identify archaeologically invisible food items (Bryant and Dean 2006), however coprolite preservation requires specific environmental conditions rarely achieved on the Northeastern Plains. Stable carbon and nitrogen isotope analysis in human remains reflects actual diet chemistry and provides another direct measure of subsistence (DeNiro 1985). Residue analysis is another fairly direct method of inferring diet. Cooking residue adhering to pottery, fire cracked rock or other implements can be analyzed to determine chemical composition and these chemical signatures can sometimes

Table 4-29: Summary of the Twin Fawns sample immature SC6 and *Bison bison* recoveries.

	NISP Bison	NISP (ILU)	NISP Total	MNE	MNI	%MAU
Axial Skeleton						
Cranium	1		1	1	1	50.0
Mandible	11	1	12	2	1	100
Rib	4		4	1	1	0.0
Atlas	1		1	1	1	100
Thoracic	1		1	1	1	10.0
Lumbar	2		2	2	1	40.0
Caudal	6		6	6	1	33.3
Forelimb						
Radius	2		2	2	1	100
Ulna	1		1	1	1	50.0
Metacarpal	1		1	1	1	50.0
Hindlimb						
Femur	2		2	1	1	50.0
Metatarsal	1		1	1	1	50.0
Fore or Hindlimb						
1st Phalanx	4		4	2	1	12.5
2nd Phalanx	3	1	4	3	1	37.5
Miscellaneous						
Tooth enamel		1	1			
Vertebrae Indeterminate		32	32			
Appendicular Indeterminate		2	2			
Metapodial		1	1			
Phalanx Indeterminate		2	2			
Element unidentified		15	15			
Totals	**40**	**55**	**95**	**25**	**1**	

identify specific substances (Malainey et al. 1999; Quigg et al. 2001). Phytoliths and starch remains have also been extracted from cooking residue to infer plant foods (Boyd et al. 2006), however it must be remembered that non-food items were also processed by cooking in pottery vessels.

The more traditional method of inferring subsistence has been faunal analysis (Binford 1978, 1981; Chaplin 1971; Frison 1992, 2004; Gilbert 1969; Grayson 1984; Lyman 1982, 1994a, 1994b; Schmitt and Lupo 1995). As already discussed, only those recoveries that are believed to be a result of food procurement, preparation and discard should be considered and of course, faunal analysis results can only make direct inferences about the animal food subsistence being practiced by the site inhabitants.

Two choices of animal food subsistence, species diversity and intensity of bison processing, have regularly been offered as distinctive cultural traits and are used to distinguish alternate subsistence strategies such as generalized foragers versus specialized bison hunters as highlighted in Chapter Two's culture history review (Brink and Dawe 1989; Brumley 1975; Frison 1992; Hamilton and Nicholson 1999, 2006; Hill 2007; Nicholson 1987a, 1987b, 1990, 1991, 1994, 1996a, 1996b, Nicholson and Hamilton 2001; Nicholson et al. 2006a; Playford 2001a, 2001b, 2002, 2010; Playford and Nicholson 2006; Smith and Walker 1988; Syms 1977). A further examination and discussion of differing subsistence strategies are explored in Chapter Seven. The two choices of species diversity and intensity of bison processing were selected for quantification because 1) they have been used as cultural identifiers, 2) both are observable in the archaeological record, and 3) they can easily be quantified using existing statistical methodology. The species diversity and intensity of bison processing has been calculated for each site with the methods and results presented below.

Species Diversity Quantification Methodology and Results

Archaeological faunal studies have borrowed the ecological concept of diversity which attempts to describe "complex interspecific interaction between and within communities under a variety of environmental conditions" (Bobrowsky and Ball 1989:05). It has three distinct aspects: richness, evenness and heterogeneity, although archaeologists have sometimes used the term diversity to mean one, two or all of these concepts. Richness is the number of species present in a collection containing a number of specified individuals. Evenness is the absolute distribution of individuals across all species and attempts to describe the similarity in abundance of several species in the community. Heterogeneity simultaneously measures both richness and evenness. It assesses the variability in both the number of species and the abundance of individual species within a single value (Bobrowsky and Ball 1989:05).

Archaeologists have often used the direct count of observed species as a measure of richness and simply compare assemblage NISP counts. The main concern with this approach is the dependent nature of richness and sample size, where the number of species encountered will increase asymptotically as the total number of individuals increase (Bobrowsky and Ball 1989:05). Grayson (1984:138-149) observed a strong correlation between mammal richness and sample size as measured by the NISP. He also argued that because MNI is a function of NISP, it too is correlated with sample size. Cruz-Uribe (1988) refuted the notion that diversity and richness have limited archaeological value. She suggested using MNI rather than NISP because the effect of element fragmentation is compounded when counting the number of species (Nspecies). She found that the correlation between diversity measures and sample size were also influenced by the index being used and whether MNI or NISP values were used. After examining 95 assemblages with sample sizes ranging from an MNI of two to 1105, she concluded that indices of diversity and richness could be useful when used properly. The simple index of the Nspecies, as determined by MNI counts, did have a strong correlation with sample size, but other indices such as the Shannon index of diversity was not correlated with sample size when samples contained at least 25 individuals (Cruz-Uribe 1988:193).

To assess the species diversity for each site, the Shannon index of diversity (H'), as suggested by Cruz-Uribe (1988), was calculated for each assemblage. Bison, immature bison and foetal bison species categories were collapsed into a single species. The MNI of all species categories were counted, as were higher taxonomic levels if no lower taxonomic categories were present. The Shannon index of diversity (H') is also known as the Shannon-Wiener information function and is calculated as follows:

$H' = -\sum(n_i/N) \log (n_i/N)$ or $- \sum P_i \log P_i$

where n_i equals the importance of each species, in this case the MNI; N equals the total of importance values or the total MNI, and Pi equals the importance probability for each species (n_i/N).

Evenness (E) was also calculated using the following equation:

$E = H / log(S)$

Data was entered into the ChangBioscience online calculator (http://www.changbioscience.com/genetics/shannon.html) for the evenness and Shannon index of diversity; these along with Nspecies and MNI for each site are presented in Table 4-30 and the results will be discussed in Chapter Seven.

Table 4-30: Richness, evenness and the Shannon-Wiener Diversity Index of site samples.

Site	MNI	Nspecies	Evenness	Shannon index of diversity
Hokanson	20	9	0.776	1.706
Lovstrom	20	7	0.590	1.148
Jackson	40	16	0.815	2.259
Vera	35	19	0.827	2.434
Sanderson	39	21	0.810	2.466
Twin Fawns	26	16	0.878	2.438

Bison Subsistence Choices

The inhabitants of the North American Great Plains are almost always portrayed as big-game hunters who either followed the herds year round, or exploited them on a seasonal basis from horticultural villages (Wedel and Frison 2001). The ubiquitous recovery of bison remains from archaeological sites spanning all five subareas of the Great Plains since Early Precontact times, and the description of Plains Indian bison hunters prevalent in the historical record have reinforced this perception (Arthur 1975; Bozell 1995; Dillehay 1974; Dyck 1983; Dyck and Morlan 2001; Frison 1992, 2004: Hanson 1998; Winham and Calabrese 1998). This dominance of bison procurement and utilization has been being reexamined, as a variety of wild plants, animals and cultigens are identified in archaeological assemblages and some researchers have deemphasized the prominence of bison subsistence (Boyd et al. 2006b, Boyd and Surette 2010; Dering 2008; Koch 1995; Lints 2012; Stanford 1999; Waguespack and Surovell 2003). Determining bison’s dietary contribution to precontact subsistence strategies is an essential component to understanding and defining such strategies.

Evaluating the importance of bison in the diet of precontact peoples is more complex than simply noting the presence or absence of bison in an assemblage. Bison subsistence consists of several steps or stages that may or may not be reflected in the archaeological record, and include procurement, butchery, transport, processing/preparation and discard. Choices are made at each stage and it is the summary of these choices that constitute a bison subsistence strategy. At any point between procurement and discard there are also various storage options. A brief review of each stage illustrates the reason why processing procedures were chosen for quantification.

There are many different methods of bison hunting, dependent upon a myriad of factors such as seasonality, landscape topography, available hunting technology, bison herd demography, spiritual responsibilities as well as human population size and social organization. Bison hunting methods during the historic time period included the use of communal pounds or traps, often incorporating topographic features, equestrian chases, surrounds, and pedestrian stalking and decoys (Arthur 1975; Hamilton and Nicholson 2006). This likely reflects a similar precontact situation except for the equestrian chase scenario. Although understanding the bison procurement choices of Blackduck, Vickers and Mortlach people is imperative for a comprehensive interpretation of bison subsistence, this is only possible when kill sites have been conclusively identified for each group.

After large animals have been hunted they usually must be butchered to reduce the carcass into manageable pieces (often referred to as primary butchering) for transport, processing and/or preparation. It has been suggested that a similarity in butchering techniques may reflect cultural relationships between sites (Keyser and Murray 1979:174). Indeed, the inhabitants of the Jackson and Sanderson sites both appear to have used a chop and strip technique of dismemberment indicated by broken elements and few observable incision marks (Playford 2001a:141-142), but this basic method of butchery is common throughout the Northern Plains, especially during the late Precontact (Frison 1982a:159). Similarity in stylized element breakage might also be useful in determining cultural connections between groups but this type of information is not always recorded. Also, the nature of bison processing as described below, reduces elements into small, often unidentifiable fragments and can remove butchering signatures.

The more easily archaeologically-observed bison subsistence choice is transport and processing of the butchered animal into useable food and non-food items. It is well known that virtually every part of the bison was utilized in some way by First Nations people (Haines 1975:26). Hides were used for a variety of items such as clothing, bedding, tipi covers, and containers. Organs were also used for containers or sometimes as medicine, and specific organs had specific functions, such as the use of brains for tanning. Bones and horns were fashioned into tools, utensils and items of personal adornment while sinew (tendons and ligaments) was used for bow strings, rope, and thread. Bison skulls played an important role in ceremonial and spiritual activities, and the whole animal was/is considered a totem. Food products could potentially include the muscle, marrow, fat, blood, and organs. It is suggested here that while the processing choices were likely motivated by the production of both food and non-food items, obtaining sustenance was the primary consideration for processing bison during the Late Precontact time period, and non-food items were by-products of this activity.

Archaeologists have long contemplated the contribution of bison to precontact diets. White (1953:397) was one of the first to estimate how much meat a mature bison may have provided. Based on modern butchery percentages of a 60 percent meat yield from live weights, he suggested a 50 percent usage rate because “it is presumed that the prehistoric peoples were not as efficient in the manufacture of by-products as the meat packers and, correspondingly, it is doubtful if the percentage of usable meat obtained by their methods of butchering will run as high” (White 1953:397). Based on live weights of 1800 pounds and 800 pounds for male and female bison, pounds of usable meat would have been 900 and 400 respectively or an average of about 600 pounds.

Lyman (1979) differentiated between available meat, or all parts of the animal exclusive of bone and hide, and that of consumable meat, which is the portion that was consumed by the group under study and included muscle tissue, fat, and organs. Available meat does not always equal consumable meat based on MNI counts because entire carcasses are often not represented in archaeological assemblages, with the exception of some kill sites where complete carcasses represent unused animals (Frison 1992; Wheat 1967). Instead, Lyman considered meat yields of butchering units such as limb, rib or neck segments as better estimates of consumed meat (Lyman 1979:544). Assessing these types of behaviours requires the recovery of these butchering units, or at least elements of such units. The subsequent processing activities of marrow extraction, but especially grease rendering, can obliterate individual elements, making butchering units difficult to identify. It is this processing for marrow and grease that creates highly fragmented faunal assemblages, often interpreted to represent a focal bison subsistence (Dering 2008; Hamilton and Nicholson 1999; Nicholson 1987a, 1991, 1993; Playford 2001a, 2010; Scheiber 2007; Syms 1977).

Marrow Extraction and Grease Rendering Activities

The subsistence decisions to extract marrow and render grease from animal bones are not unique to inhabitants of the Plains. These activities have been observed the world over on various animals, and are considered to be indicative of fat seeking behaviour (Binford 1978; Logan 1998; Outram 1999; Speth and Spielmann 1983).

Fats were, and still are, an integral diet component not only for their high caloric value, but also for the role they play in metabolizing protein. It is well known that fats are the most calorie dense food with a ratio of 9:4 compared to protein or carbohydrates (Outram 2001:401). Diets high in lean protein with little to no fats or carbohydrates can lead to a condition known as protein starvation. This occurs because digesting lean meat increases a person's metabolism, requiring them to consume larger and larger amounts of protein (Speth and Spielmann 1983:13). There are several ethnohistoric descriptions of this condition, one of which is particularly revealing.

> We tried the meat of the horse, colt and mules, all of which were in a starved condition, and of course not very tender, juicy, or nutritious. We consumed the enormous amount of from five to six pounds of this meat per man daily, but continued to grow weak and thin, until, at the expiration of twelve days, we were able to perform but little labor, and were continually craving for fat meat (Marcy 1863:16).

Also important is the protein-sparing effect of other types of dietary energy. In calorie-deficient diets, bodily energy needs are satisfied first, so ingested protein will be used as an energy source rather than replacing lost body protein and this situation will eventually result in the breakdown of muscle tissue. The ingestion of carbohydrates or fats will reduce the loss of body protein. Fats also provide essentially fatty acids and are important in calcium and some vitamin absorption (Speth and Spielmann 1983:14-16).

Bison is a lean meat, and during the winter and spring, both male and female bison experience fat depletion. Male bison lose between 10-15 percent of their body weight during the fall rut and will continue to deplete their body-fat reserves over winter. Females usually start winter with higher fat reserves, but these are depleted over the winter due to pregnancy, and are further reduced in spring because of lactation. Both sexes are in the poorest condition in the spring and may be severely fat depleted (Speth and Spielmann 1983:3).

According to Speth and Spielmann (1983:19-20), to compensate for increased levels of lean protein in the diet, people will selectively procure and process animals with a higher fat content to avoid protein starvation. They will also store fat and carbohydrate rich foods or exchange these foods with other groups. Hunters will shift from fat-depleted ungulates to animals rich in body fat such as bear, beaver, fish and migratory waterfowl. Alternatively, they may store fat through labour-intensive activities like bone grease rendering. They may also store carbohydrates or trade for these items.

As ungulates deplete fat stores over the winter, they do so in a specific order. Back fat is first metabolized, followed by fat within the body cavity and finally the marrow fat reserves in the limbs and mandibles are metabolized last. Fat depletion within the bones also follows a fixed order, progressing distally from the core. Mandibular marrow is depleted at about the same time as the limb elements, but retains moderate levels of fat even after the limb bones are largely depleted. In severely stressed animals, remaining fat stores will be confined to the mandible, phalanges and brain, and important lipid deposits persist in the cancellous tissue of the vertebrae. As fat stores are replenished, they are replaced in the reverse order (Speth 1990:52). Knowledge of these within-bone nutrients results in their exploitation in the form of marrow extraction and grease production (Marshall and Pilgram 1999).

Marrow and grease processing have often been treated as two stages of a single event (Binford 1978; Brink and Dawe 1989; Vehik 1977; Zierhut 1967). It is most likely that grease extraction would succeed marrow removal, but elements processed for marrow may not be selected for grease rendering, nor do these events have to occur simultaneously or in the same location (Outram 2002a, 2002b, 2003). Both activities have been identified in the ethnohistorical (Catlin 1972; Wilson 1924; Peale 1871; Skinner 1914), ethnoarchaeological (Binford 1978; Enloe 1993; Yellen 1977; Zierhut 1967), and archaeological records (Brink 1997; Byers 2002; Karr et al. 2010; Logan 1998; Outram 1999; Scheiber 2007; Vehik 1977).

The greatest quantity of marrow is located in the shaft portion of appendicular elements and this marrow is easily obtainable by cracking open the bone and scooping it out. The Calling Lake Cree of Northern Alberta were observed cracking bones of moose and deer for marrow.

> The meat is first stripped from the bones from which marrow is to be taken. Once this is accomplished the bones are thrown on or next to the coals of an open fire. They are heated in this manner for a very short time, being turned over occasionally to prevent burning. The Indians relate that this procedure makes the bones easier to break. Likewise, fresh bones break more easily than do dry bones. Next the bones are taken from the coals and allowed to cool. Meanwhile two large oval stones are placed on the ground about 8 to 10 inches apart. When the bone is cool enough to handle, it is placed so that the proximal and distal ends rest upon the stones; the midshaft is thus suspended between the stones. The bone is then struck in the middle, using the blunt end of a small axe. With only one or two vertical blows the bone is broken into two major halves; during this operation a number of small fragments or chips of bone are generally detached from the point of impact. The rather fluid marrow is collected from the two sections of bone with the aid of a willow stick (Zierhut 1967:33-34).

Wilson (1924:268) described the Hidatsa eating bison marrow in a similar fashion after a kill. The Hidatsa also recounted using the marrow from the leg bones in a blood broth or eating it as a snack (Wilson 1924:301, 237).

There are two discernible types of marrow, white or yellow and red. White/yellow marrow is found in the long bone shafts and red marrow is concentrated in the epiphyseal ends (Outram 2001; Vehik 1977:172). The Nunamiut expressed a preference for “tasty marrow that melts in your mouth” obtained from long bones. Least-favoured elements were the pelvis, calcaneous, mandible and scapula (Binford 1978:23, 42). Other Inuit groups also made this distinction, although both types were known to be consumed (Morin 2007:70).

After bones have been cracked and the yellow marrow extracted, the epiphyseal ends were smashed into small pieces and boiled to extract the red marrow from the spongy cancellous tissue for bone grease (Binford 1978; Church and Lyman 2003; Leechman 1951 Vehik 1977; Zierhut 1967).

> When the marrow is collected in quantity for storing during the hunting season, which occurs usually twice a year, the bones of the larger animals are broken into small fragments and boiled in water until all the marrow in which they contain and the grease which adheres to them are separated, and rise to the surface, when they are skimmed off and packed in bladders, or in the muscular coat of the stomach and in the large intestine, which have been previously prepared for this use. Not only is the marrow of the large bones of the limbs preserved in this manner, but also that of the vertebral column (Peale 1871:390-391).

Bone grease rendering accounts are almost identical for the Cree, Hidatsa, Nunamiut and Loucheux of the Northern Yukon, regardless of the animal being processed (Binford 1978; Leechman 1951; Wilson 1924; Zierhut 1967). The small size of the bone fragments is an important factor in bone grease rendering. Church and Lyman (2003) found that bone grease could most efficiently be rendered in about two to three hours, if the fragment size was five centimeters or smaller.

Element preference for bone grease production has been recorded. According to Wolf Chief of the Hidatsa, leg bones were the best.

> A winter stage was not used for drying corn, of course, but for drying meat. Dried in the cold winter air, meat tasted differently from that dried in the summer sun, or in the smoke of a fire, and I liked it best. Meat hung on the winter stage, or anything laid on the stage floor, was out of reach of the dogs. It was upon the floor of the winter stage, out of reach of the dogs, that my mother used to toss buffalo bones, to await the time when they could be pounded up for boiling to make bone grease or marrow butter. My mother, I remember, gathered up the leg bones to pound separately; for the bone grease so obtained was of a better kind, being yellow and never hardening. Bone grease from leg bones my mother called "footbone grease." Bone grease from shoulder bones and backbones was harder (Wilson 1924:174).

Bone grease was used for a variety of purposes, including as hair grease, tanning oil, waterproofing of hides, treatment of bowstrings, fuel for candles and as a fire-starting aid (Baker 2009:20). However it is predominantly described as a food resource, used much like butter or lard, although it was also eaten raw or added to other meals such as broths and stews (Binford 1978; Saint-Germaine 1977; Vehik 1977). It was an important component in the production of pemmican. Pemmican is a combination of dried pounded meat (usually bison) mixed with animal fat, normally bone grease, and can contain other foodstuffs, notably berries (Reeves 1990:169). Pemmican production was a method of preserving surplus bison meat for future use and could be stored for several months or up to three years (Leechman 1951:75). The benefits of pemmican were that it was easily stored and was portable as well as nutritionally dense, containing up to four times the calories as fresh meat (Quigg 1997:158).

Since Leechman (1951) observed and recorded the bone breaking activities of the Calling Lake Cree, archaeologists have interpreted highly fragmented faunal assemblages as evidence of bone fat extraction (Bonnischen 1973; Bozell 1991; Frison 1970, 1992; Quigg 1997, 1998; Reeves 1990; Smith and McNees 2000; Vehik 1977). Church and Lyman (2003:1077) noted that the interpretation of comminuted assemblages as evidence of grease production has become ubiquitous in archaeological investigations.

The final step of bison subsistence is discard. Animal food refuse can be discarded in a number of different ways depending upon several factors, including but not limited to the nature of the refuse, site activity and duration of occupation. With the exception of special purpose sites such as burials, resource quarries, pictographs, vison quests, etc., most precontact archaeological sites on the Canadian Northeastern Plains consist of refuse from animal kills and processing areas, or from habitations.

Although somewhat difficult to interpret archaeologically, the storage of bison food products is an important component of bison subsistence. Storage is a risk-reducing strategy that can preserve peak abundant resources for future use in times of uncertainty and/or for sharing obligations (Driver and Vallières 2008:252; Testart 1982:523). Ethnographic and historical records describe the production of jerky, where long strips of freshly butchered bison meat were hung from racks to dry in the sun, although meat could also be dried in winter (Arthur 1975; Wilson 1924; Hind 1860). Meat caching was another warm or cold season storage option and both types are represented in the archaeological record (Frison 1982b, 1998; Magee 1997; Morlan 1994c; Nicholson 1985). The antiquity of this practice is demonstrated from a Clovis site in Wyoming where mammoth bone piles are interpreted as cold-weather meat caches (Frison and Todd 1986), as are the remains of extinct bison limb elements from an Early Precontact site in northeastern British Columbia (Driver & Vallières 2008). Possibly the best known bison meat storage technology is the production of pemmican. The appearance of mauls and large quantities of fire-cracked rock associated with hearths and fragmented bison bone assemblages about 5000 years ago is thought to signal the beginning of pemmican production (Reeves 1990:170).

Assessing the bison subsistence of Blackduck, Vickers and Mortlach groups is imperative to understanding and defining their subsistence strategies. Ideally, this would entail a comprehensive analysis of bison subsistence choices from procurement through to discard. However, sites with processing areas were specifically selected for analysis to better understand the role of non-bison food subsistence, but these types inhibit a comprehensive study of bison subsistence because processing for grease and marrow can obliterate butchery and preparation signatures. Instead, marrow extraction and bone grease production are quantified in an attempt to ascertain the importance or intensity of these activities for the inhabitants of each site.

Bison Processing Quantification Methodology and Results

Marrow extraction and grease rendering activities have traditionally been evaluated by examining two different components of a faunal assemblage. The first examines the proposed selection of bison elements for processing. This is accomplished through the application of economic utility indices which measure the quantity or quality of marrow and grease for each element. The frequency of bison element recovery from an assemblage is then compared to the index to determine if the site inhabitants were selecting for marrow and grease (Binford

1978, 1981; Brink 1997; Brink and Dawe 1989; Emerson 1990; Jones and Metcalf 1988; Lupo 2006; Metcalfe and Jones 1988; Morin 2007).

While economic utility indices results can be quite informative, especially in terms of establishing site formation processes, they do have limitations. Some of these limitations are associated with optimal-foraging theory and diet breadth models on which they are based. They also assume that the differential frequency of elements within a site is solely the result of human behaviour. The site type itself, as well as other taphonomic agents such as carnivores, can impact faunal assemblages (Blumenschine 1988; Lyman 1985, 1994). For this reason, interpreting bison processing behaviour solely from economic utility indices is unadvisable.

Outram (1999, 2001, 2002a, 2002b, 2003, 2004a, 2004b; Karr et al. 2010) developed a method of assessing marrow and grease extraction by quantifying the degree of fragmentation and indexing bone fracture type. His method utilized both the identified and the unidentified faunal remains from a site. In his studies, unidentified bone fragments were identified as either cancellous or cortical bone and sorted into categories based on size or completeness. These categories were then compared based on count and weight to identify assemblages with high numbers of small fragments (Outram 1999:105). Fracture outline, fracture surface texture and fracture angle of shaft fragments were recorded and quantified to determine if bones were broken in a fresh or dry state. Based on actualistic studies, Outram (2004a:60) concluded that elements processed for marrow and grease will exhibit a mixture of fresh and dry bone breakage traits. Schreiber (2007) has also addressed the question of processing intensity by examining element representation and the quantity of surface bone modifications such as incision and impact scars. Enloe (1993) employed a mixture of these two methods by categorizing unidentified fragments into size classes and quantifying them by count and weight, as well as recording and quantifying impact scars. He also included element representation as a way to determine if assemblages were a result of meat and incidental marrow consumption or if they represented specialized processing of raw bones for marrow (Enloe 1993:93).

While these methods of analysis and quantification have proven suitable for interpretation of marrow and grease processing intensity, the identification and recording of all the necessary attributes (size classes for unidentifiable bone, separation between cancellous and cortical bone, fracture outline, texture and angle) had not been undertaken on the six study sites. The analysis, recording and cataloguing of this data was considered too time intensive for the quality of information return. Instead, fragmentation rates for both the unidentified bones and the bison assemblage were quantified by count and weight and separated into burned and unburned categories. The percent completeness, as defined by Morlan (1994b), was calculated for each bison element as it has been recognized as one of the most effective systems for analyzing fragmentation (Outram 2004b:176). Unlike Outram's method (1999, 2001, 2002a, 2002b, 2003, 2004a, 2004b; Karr et al. 2010) it makes no assumptions regarding the breakage pattern of bone in ascertaining fragmentation. An examination of both the element representation (or absence) and the fragmentation rates will be analyzed to assess intensity of bison processing for each site.

Bison Economic Utility Indices

Bison element representation is believed to reflect patterned behavior in terms of animal food choices, although it can be influenced by several other factors, most notably site type (Binford 1978, 1981; Brink 1997; Brink and Dawe 1989; Emerson 1990; Jones and Metcalf 1988; Lupo 2006; Metcalfe and Jones 1988; Morin 2007; White 1953). Binford (1978) attempted to address the economic utility of individual elements by measuring the meat, marrow and grease collected from elements of two domestic sheep and a caribou. He created separate meat, marrow and grease economic utility indices for both species. This was accomplished by comparing the ranked orders of the quantity of meat, marrow or grease against the number of elements represented in an assemblage (Binford 1978:23-33). A utility index measuring all three variables was constructed, and then modified to account for butchering practices (Binford 1978:74). This modified general utility index (MGUI) was used to construct utility curves explaining subsistence strategies. When skeletal elements of low economic value were recovered, a reverse utility strategy was indicated, and when elements of higher economic value were more numerous, it was labeled a gourmet utility strategy (Binford 1978:81).

However, other factors can affect element representation. Kill-butchering sites will also usually contain low economic elements (reverse utility strategy) whereas consumption sites would be expected to have high frequencies of high economic elements (gourmet utility strategy) (Lyman 1992:08). Non-cultural taphonomic agents such as carnivores or in situ density-mediated destruction can also effect element representation (Lyman 1982, 1985). Understanding site formation processes is necessary to properly interpret the results of bison economic utility indices and will be further discussed in Chapter Seven.

Since Binford published his sheep and caribou economic utility indices, similar indices have been calculated for a number of other species, including bison (Brink 1997; Brink and Dawe 1989; Emerson 1990). As well, researchers have re-examined Binford’s methodology and have reworked his original indices so they are easier to understand and calculate (Jones and Metcalfe 1988; Metcalfe and Jones 1988; Morin 2007).

Two sets of economic utility indices have been created for bison (Brink 1997; Brink and Dawe 1989; Emerson 1990) and both will be applied to the site faunal samples. The first set of indices was created by Brink and Dawe (1989; Brink 1997) to analyze the bison assemblage from Head-Smashed-In Buffalo Jump in Alberta. They obtained three Plains bison (*Bison bison*), a 6.5 year-old male, a 3.5 year-old female and a 3.0 year-old male. They measured the marrow and fat content for the proximal, midshaft and distal portion of the appendicular long bones as well as the volume of each element (Brink and Dawe 1989:127). With this data, a grease index (GI) for the proximal and distal appendicular elements was derived by multiplying the percent of fatty acids by the bone value and dividing by 100 (Brink and Dawe 1989:134). Brink and Dawe considered marrow extraction and grease rendering to likely be related events, so they combined the marrow and grease values into a single bone utility index (BUI) which also incorporated the midshaft grease content values (Brink and Dawe 1989:140).

The second set of bison economic utility indices were created by Emerson (1990), based on the results from both immature and adult male and female bison. She measured edible resources for each carcass portion, and weighed total meat, individual muscle, fat and other tissue, demuscled bone, bone marrow, bone grease and dry bone for all four animals. Emerson created single class indices based on an individual bison which could be used to interpret assemblages dominated by a single type of bison (i.e. immature, male, female). Standard averaged indices were created by including all four bison values and would be the most useful when analyzing mixed herds. Three of Emerson's utility indices have previously been applied to the Jackson, Vera and Sanderson sites. These include the standard modified average data total product index (S)MAVGTP, the standard averaged data grease index (S)MAVGGRE, and the standard averaged data marrow index (S)MAVGMAR. The grease and the marrow index measure these aspects of bison utility while the total products index attempts to measure meat, marrow and grease processing.

The results of these two sets of bison economic utility indices have proven to be fairly complementary (Brink 1997). However, differences do exist. Fat weights for the first set of indices exceed those reported by Emerson. Brink (1997:268) suggested this was a result of the method of extraction. Emerson (1990) extracted fat by breaking the bones of one animal but boiling the elements from the other animals whole. She also used the traditional method of boiling the elements in water and skimming off the fat. The second set of indices used comminuted bone fragments soaked in a chemical degreaser to extract bone grease, resulting in a much higher yield. This may explain why the radius-ulna rank is higher for the Brink and Dawe indices. For these reasons, both sets of utility indices will be calculated for each faunal sample. By comparing the ranked utility values produced for each index with the frequency of that element in the assemblage (as measured here by %MAU), inferences can be made about the marrow and grease processing activities at each site (Table 4-31). Negative correlations indicate that high ranked marrow and/or grease elements are underrepresented and positive correlations indicate the presence of high ranked elements. It must be remembered that the %MAU values were calculated from MNE values, which do not necessarily represent whole elements. The significance of the calculated bison economic utility indices will be explored in Chapter Seven.

Table 4-31: Bison bone utility indices for site samples.

	(S)MAVGMAR	(S)MAVGGRE	GI	(S)MAVGTP	BUI
Hokanson	0.0	0.03	-0.17	0.02	0.16
Lovstrom	-0.15	-0.39	-0.78	-0.18	-0.42
Jackson	-0.63	-0.62	-0.63	-0.40	-0.43
Vera	-0.41	-0.65	-0.84	-0.63	-0.62
Sanderson*	0.19	0.12	-0.20	0.01	0.01
Twin Fawns	-0.14	0.19	-0.49	0.05	0.02

* Magee (1997) calculated bison economic utility indices based on whole elements

Faunal Assemblage Fragmentation Rates

Faunal assemblage fragmentation rates can also provide valuable information pertaining to bison subsistence choices, especially regarding bone grease manufacture (Church and Lyman 2003). Fragmentation can be assessed by examining the unidentified category of a faunal assemblage as well as assessing the completeness of the bison assemblages. The unidentified percent by count (N%unid) and by weight (g%unid) of each assemblage is presented. As well, with the exception of the Sanderson site material which was not reported, the percentages of the unidentified category that are unburned and burned was also tabulated (Table 4-32).

Table 4-32: Percent of unidentified bone fragments from each faunal sample presented by count and weight for unburned and burned categories.

	Total N%unid	Total g%unid	Unburned N%unid	Unburned g%unid	Burned N%unid	Burned %gunid
Hokanson	89	25	74	21	15	4.0
Lovstrom	75	19	71	18	5	1
Jackson	93	46	48	22	46	24
Vera	97	46	56	28	42	18
Sanderson	93	57	50	na	46	na
Twin Fawns	97	47	81	40	16	7

These results reflect the percent of unidentifiable bone in the entire assemblage and give an indication of how much of the assemblage has been broken into unidentifiable pieces. A ratio of the unidentified category weight (g) divided by the number of unidentified specimens (N) gives an indication of how fragmented the specimens are, for a larger number would indicate few specimens and less fragmentation. This ratio has been calculated for the unidentified specimens of each site and separated by burned and unburned, except for Sanderson material (Table 4-33).

Table 4-33: Ratio of weight to number of unidentified specimens for each site, and by unburned and burned categories.

	Unidentified total g/n	Unburned unidentified g/N	Burned unidentified g/N
Hokanson	0.40	0.41	0.38
Lovstrom	0.49	0.50	0.39
Jackson	0.17	0.16	0.18
Vera	0.12	0.12	0.11
Sanderson	0.46	n/a	n/a
Twin Fawns	0.14	0.14	0.12

Another method of assessing the fragmentation of a faunal assemblage is to calculate the percent completeness (%CN) as devised by Morlan (1994b:805) where,

$$\%CN = \frac{(PP)(NISP)}{PD} \times 100$$

and

PP = Total number of Portion Preserved

NISP = sum of number of identified specimens

PD = number of portions defined (i.e. landmarks).

Calculating the %CN was completed by establishing a standard list of the defined portions using identified landmarks. Some elements, such as the sacrum, had more landmarks defined for one site. In cases such as this, a minimum number of defined portions were created and the %CN was calculated using the standard list (See Appendix 2). The %CN for all bison elements for each site is presented in Table 4-34. The results of these fragmentation calculations indicate that all six sites are highly fragmented, and determining if differences in bison processing intensity exist for the six sites will be discussed in Chapter Seven.

Summary

The faunal assemblages from two Blackduck, two Vickers and two Mortlach sites were analyzed and the subsistence choices of species diversity and intensity of bison processing were quantified. Cataloguing methodology was the same for all sites and landmarks were recorded for all identified bison elements. Species diversity for each site was quantified using the Shannon diversity index

Table 4-34: Percent completeness for site samples.

	Hokanson	Lovstrom	Jackson	Vera	Sanderson	Twin Fawns
Axial Skeleton						
Cranium	2.5	3.7	0.7	3.1	1.0	6.0
Mandible	5.0	6.5	1.6	3.1	2.6	8.0
Hyoid	16.7	0.0	23.3	50.0	66.7	100
Sternum	0.0	0.0	0.0	0.0	0.0	50.0
Rib	50.0	15.7	2.9	1.6	25.1	36.0
Atlas	0.0	0.0	0.6	2.0	40.0	0.0
Axis	16.7	0.0	1.0	27.8	11.9	0.0
Cervical	18.4	2.9	18.1	16.7	13.4	5.6
Thoracic	9.8	4.1	2.6	20.0	12.1	14.0
Lumbar	15.7	20.0	2.6	10.0	5.1	17.5
Sacrum	0.0	0.0	100	0.0	100	100
Caudal	0.0	100	66.7	100	100	66.7
Forelimb						
Scapula	4.6	1.8	2.5	3.0	2.1	9.5
Humerus	7.1	6.9	1.4	5.6	10.3	6.0
Radius	18.2	21.0	8.9	14.0	9.9	9.4
Ulna	36.7	29.5	6.3	12.5	12.2	33.3
Radial Carpal	100	100	100	100	90.9	100
Central Carpal	100	100	76.9	83.3	78.6	0.0
Ulnar Carpal	100	100	100	100	90.9	100
2/3 Carpal	100	100	57.1	100	75.0	100
4th Carpal	100	100	54.5	100	100	0.0
Accessory Carpal	100	100	100	100	100	100
Metacarpal	20.0	33.1	13.5	9.0	18.9	6.3
5th Metacarpal	100	100	100	100	100	0.0
Hindlimb						
Innominate	24.7	6.9	1.0	11.1	11.6	11.1
Femur	9.3	5.7	5.4	1.0	9.0	12.9
Patella	100	85.7	100	100	100	100
Tibia	13.6	6.1	1.6	10.9	5.1	11.7
Lateral Malleolus	100	100	100	85.7	100	100
Astragalus	80.0	100	59.4	70.0	50.0	100
Calcaneus	50.0	62.5	27.4	22.5	23.3	100
C/4 Tarsal	77.8	100	47.6	50.0	71.4	100
2/3 Tarsal	80.0	100	88.9	91.7	100	100
1st Tarsal	100	100	100	100	100	100
Metatarsal	13.5	26.4	8.2	5.9	7.9	19.0
2nd Metatarsal	0.0	0.0	100	100	100	100
Fore or Hindlimb						
1st Phalanx	96.9	100	24.7	60.5	63.6	75.8
2nd Phalanx	83.3	100	70.3	76.3	67.3	91.3
3rd Phalanx	56.7	68.8	30.2	70.0	56.3	70.5
Lateral Sesamoid	100	100	88.2	100	100	100
Medial Sesamoid	100	100	100	100	100	100
Distal Sesamoid	100	100	65.0	100	100	100

as well as richness and evenness. Processing of bison elements for marrow and grease were the only two bison food subsistence choices that could be quantified because of the highly fragmented nature of the assemblage. This was accomplished by examining fragmentation rates for each site and through the application of economic bison utility indices to each site.

CHAPTER 05: DEVELOPMENT OF THE FODS AND ITS APPLICATION in ARCHAEOLOGICAL ASSEMBLAGES

Introduction

Knowing the season of site occupation is critically important information when seeking to interpret past lifeways. Several methods using bison remains have been developed to estimate site seasonality. One such method involves documentation of foetal bison elements, and has been widely used to suggest anything from a late fall, early winter, winter, late winter, early spring to early summer seasonality (Brumley 1976; Haug 1975; Landals et al. 2004; McKee 1985; Malainey and Sherriff 1996; Morgan 1980; Nicholson 1986; Peck 2011; Playford 2001a, 2010; Playford and Nicholson 2006; Quigg 1978, 1997, 1998; Reeves 1983; Walde 1994; Wilson 1974). Although preliminary studies have been undertaken on modern foetal bison elements, none have adequately developed a method of establishing season of site occupation. The collection and processing of ten modern foetal bison specimens, in addition to two newborns, a one-week calf and a three- to four-week calf (hereafter referred to as the one-month calf), was undertaken. Appendicular elements were measured and plotted against gestational age in days to create linear regression curves, which could then be used to age unknown specimens recovered from archaeological sites. The linear regression curve was tested using seven specimens of known gestational age.

Prior to creating the FODS, an extensive review of the literature was undertaken to determine the viability of such a method, as only a few researchers have attempted to correlate foetal bison element size or development with seasonality (Frison et al. 1978; Landals et al. 2004; McKee 1985; Wilson 1974). A review of these studies will highlight the assumptions that must be made in order to use modern foetal bison specimens as a model for archaeological samples. Ethnohistorical records as well as modern bison herd data will be presented to show that bison appear to have a relatively restricted rut and birth schedule where approximately 80 percent of calves are born within a two month period between April 15th and June 15th. This chapter concludes with the application of the FODS to the selected archaeological foetal bison assemblages with varying success rates.

Methods of Estimating Site Seasonality Using Bison Remains

The presence of seasonally restricted resources such as migratory waterfowl is one of the simplest methods to estimate site seasonality, but is only viable when such species are recovered. Many Plains sites simply do not contain these types of seasonally restricted species and instead are dominated by bison recoveries (Monks 1981). Archaeologists have devised three main ways of estimating site seasonality from bison recoveries.

The first proposes that bison undertook mass seasonal migrations between distinctive vegetation zones such as grasslands in the summer and parkland in the winter, as discussed in Chapter Two (Chisholm et al. 1986; Morgan 1980). In such a scenario, seasonality could be inferred from site locations, and this approach was undertaken by Syms (1979:295-296) to explain site patterning of the Devils Lake-Sourisford burial mounds in southern Manitoba and Saskatchewan as well as northern North Dakota. This uncritical application of historically documented bison herd migration patterns to precontact sites may have limited validity. As already discussed in Chapter Two, bison herd migration patterns are more complicated than originally thought, and bison may have been available on the Canadian Northeastern Plains year-round.

Another potential source of seasonal information is herd composition, which varies according to sex, age, season, foraging conditions and habitats. Mixed or cow/nursery herds consist mostly of females and immature males up to two years of age, although one or a few older males may be part of the herd (McHugh 1958). During the fall rut, males increasingly join the mixed herd but afterwards are found either alone, in pairs or in bullgroups of up to 30 animals (Fuller 1960). Methods have been devised to differentiate between male and female/immature archaeological bison recoveries based on measurements of long bones (Walde 2004), metapodials (Bedord 1978), carpals and tarsals (Morlan 1991) or phalanges (Duffield 1973; Roberts 1982). One shortcoming of this approach is the idea that mixed herds only occurred during the rut and can be indicative of fall seasonality because males have been observed in mixed herds year round. Also, it is only useful when the archaeological bison assemblages were derived from a single kill event rather than from successive hunts of mixed and bull herds.

The restricted rut and birth schedule of bison reproduction provides another avenue for seasonality estimations through dental analysis, as well as the recovery of foetal bison elements. Because bison are reported as having a seasonally restricted rut and birth schedule, cohorts will be born each spring. Bison age can be inferred based on dental eruption and wear sequence established from modern specimens. Age can then be converted to a specific time of year because of the restricted birth season (Frison and Reher 1970). Published bison dental eruption and wear sequences have been developed for several sites on the Plains, usually based on modern herds from Wyoming and Montana (Frison 1982c; Frison and Reher 1970; Frison et al. 1976; Reher 1973, 1974; Todd and Hoffman 1987; Todd et al. 1990). Applying these sequences to archaeological sites outside the northwestern Plains is problematic because tooth wear has been shown to be influenced by local environment (Haynes 1984:490) while latitude can effect rut and birth schedules (McHugh 1972:192). Adequate sample size is another concern. Bison dentition schedules are only useful in sites where large numbers of relatively complete mandibles have been recovered, a situation most common at kill sites. Mandibles recovered from processing areas are often fragmented for tongue or marrow removal and are not as useful for these types of studies.

Peck (2001) devised a method of estimating site seasonality based on dental cementum growth layers. Comparative modern bison mandible samples of known age were collected in February, March, June, August, October and December from local bison producers in Alberta. The first mandibular molar of each animal was thin-sectioned to observe the dental cementum growth layers. According to Peck (2001:166-168, 279) the growth layer deposits accelerated in summer, decelerated in winter and exhibited incipient rapid growth in spring and incipient slow growth in fall, although growth layer deposit rates could not be determined in almost 30 percent of the modern samples. Application of this method requires the preparation and reading of modern comparative collections and would require specialized equipment such as a thin sectioning system and polarizing light microscope (Burke 1995:16-17).

The seasonal nature of bison parturition has provided archaeologists with another method of estimating site seasonality. If bison rut in the fall and birth in the spring, foetal bison elements recovered from an archaeological context could indicate seasonality. The presence of foetal bison remains in archaeological sites has been used by numerous archaeologists across the entire Plains to estimate site seasonality. Most seasonality estimates simply correlated the presence of foetal bison with winter to early summer occupations and do not consider the growth and development of foetal bison. The potential for foetal bison remains to provide a more precise seasonality estimates is the focus of the remainder of this chapter.

Using Foetal Bison Remains to Estimate Site Seasonality: Creation of the FODS

Previous Research

Wilson (1974) was the first to address foetal bison remains in an archaeological site in his examination of the Casper site, a Hell Gap bison kill in Wyoming. He compared the archaeological remains to a modern three-day-old sample and concluded that there were two near-term and a seven-month gestation animal in the archaeological assemblage (Wilson 1974:146). An attempt was made to count the periosteal layers in the archaeological remains and in the humerus of the modern sample. The older animals consistently had more strata, but small sample size and difficulty identifying growth rings led Wilson (1974:147) to suggest that this method needed refinement.

In a second study addressing foetal remains from the Big Goose Creek site, a Late Precontact bison kill and campsite in Wyoming, 13 foetal individuals representing a wide range of developmental stages were identified. These specimens were compared to a modern seven-month foetus and a comparison of the humeri diaphyseal measurements suggested that 12 of the archaeological samples ranged in age from three to six months and the last was near full term (Frison et al. 1978:43). Humeri measurements were presented for the archaeological remains, the modern seven-month gestation sample and a three day-old neonate sample (Frison et al. 1978:44).

McKee (1985) also undertook a study of foetal bison elements in an attempt to establish the seasonality of the River Bend site, a proto-historic site in Wyoming. His modern sample was quite large, with 18 specimens, but consisted only of animals aged seven months gestation to three months old. Both measurements and periosteal layer counts were examined in an attempt to establish age of the foetal elements in the archaeological assemblage. Measurements provided a good 'general' statement regarding age, but McKee (1985:33-34) felt it was too simplistic although he did not explain why. Instead, he argued that the periosteal layer counts provided a more reliable method of aging archaeological specimens, and that the comparative samples separated into discrete age groups based on these counts. There were some discrepancies between the archaeological and comparative collections. Periosteal counts from the largest archaeological femora were identical to the comparative eight month gestation foetus, but metric measurements and visual inspection indicated that the modern sample was significantly larger. Small sample size and/or modern herd management were suggested as potential causes for this variation (McKee 1985:36).

Landals et al. (2004) identified 2696 foetal elements scattered around a central hearth from the Miniota site, an Avonlea campsite located in the Assiniboine River valley. The archaeological remains sorted out into five general developmental stages (Table 5-1). These stages were then compared to samples of known age from cows killed on March 2nd and May 3rd as well as the published descriptions by Wilson (1974) and Frison et al. (1978). Twenty-one foetal animals indicate a site occupation between mid-November and mid-April (Landals et al. 2004:134).

Table 5-1: Miniota site foetal bison developmental stages (information from Landals et al. 2004:130).

	Description	Humerus (mean mid-shaft anterior/posterior diameter)	Collection Month
Stage 1	extremely small, delicate, porous	4.5 mm	December
Stage 2	> stage 1 but < March 2 sample	7.0 mm	January
Stage 3	similar to March 2 sample	13.5 mm	February
Stage 4	variation in size; all > March 2 sample < stage 5	16.5 mm	March/April
Stage 5	near term; close to May 2 sample	19.6mm	May

These studies attempted to age archaeological foetal bison remains based on modern foetal bison samples of known age and then extrapolate that age to infer seasonality. This is based on the critical assumptions as described below.

Critical Assumptions Regarding the Application of Modern Foetal Bison Samples to Infer Seasonality of Archaeological Sites

The application of modern foetal bison samples to age archaeological specimens and infer seasonality is complicated by three critical assumptions. For the modern samples to accurately reflect archaeological seasonality, it is necessary to assume that the size or development of an element reflects the gestational age of the animal. It is also necessary to assume that the gestational age (as reflected by size or development of element) is an acceptable proxy for collection date because bison have a seasonally restricted birth season. The final assumption is that modern animals accurately replicate the archaeological situation.

The uncritical acceptance of these assumptions by past archaeologists allowed them to provide generalized seasonality estimates based on the mere presence of foetal bison elements within an archaeological assemblage. Very little was known about bison reproduction at the time. Ideas concerning the synchronized nature of bison conception and parturition were derived mainly from ethnohistoric and ethnographic observations. These observations are of varying qualitative value, as they were rarely undertaken by trained professionals and were sometimes second or third hand accounts. Furthermore, as Roe

(1972:97) observed, many explorers did not have access to calendars and used lunar phenomena to estimate dates.

Bison numbers have been increasing across America since the near decimation of the animal in the late 1800s (Roe 1972). Herd management practices and the development of a bison ranching industry have necessitated a renewed interested in bison studies, including bison reproduction (Berger 1989, 1992; Berger and Cain 1999; Cook et al. 2004; Dorn 1995; Gogan et al. 2005; Green and Berger 1990; Green and Rothstein 1991a, 1991b, 1993; Kirkpatrick et al. 1991, 1993; Rutberg 1984, 1986, 1987; Wolff 1988,1998). While these modern studies have the benefit of producing accurate quantitative data collected by professionals, they have been undertaken on animals that no longer live in a completely wild state. Furthermore, the near extinction of bison created a genetic bottleneck with all modern animals being descended from a small relict population. To increase bison numbers during the first half of the twentieth century, breeding between subspecies took place, as did the introduction of cattle genes into the bison population. It needs to be determined if modern bison can be used as a model for the archaeological population.

In order to accept these assumptions, it is necessary to identify the potential factors influencing foetal element size. Because of the previously described limitations of both historical and modern bison data, information from both sources was compiled to determine whether or not the size of modern foetal bison elements can be used to estimate the seasonality of archaeological sites.

The size and/or growth development of foetal bison bone can be used as a proxy for archaeological site seasonality only if bison reproduction is a seasonally restricted event. While other factors such as sex, maternal condition and genetics may influence foetal growth and development (as discussed below), the seasonal nature of bison reproduction has the greatest potential to influence element size. Although there is little doubt that bison have a synchronized birth season, the question is how much variability is there in the length of that season.

Walde (2006c) questioned the validity of using foetal bison elements as an indicator of site seasonality. While he acknowledged that bison breeding was a seasonally defined activity, he argued that a significant proportion of animals were regularly conceived and born out of season. Walde (2006c:485) used conception dates that had been estimated by Pac and Frey (1991) for 48 foetal bison collected during the 1988-1989 winter in Yellowstone National Park. Walde (2006c:485) simulated 12 three-day kill periods starting February 11th and ending February 25th. Using the estimated conception dates, he concluded that the bison mating pattern is simply too extended, lasting upwards of four months from July 1st to October 24th, to provide anything other than a coarse 'winter' seasonality estimate (Walde 2006c:489).

While it is always useful to challenge untested assumptions, the information presented in Walde (2006c) can also be interpreted to support a restricted bison birth season. The estimated conception dates ranged from June 26th to October 24th for a total of 121 days, but the estimated calving dates have a slightly more narrow date range: April 21st to August 9th. Conception dates do not necessarily directly correlate with birth dates, as bison have been shown to shorten conception in order to maintain birth synchronicity (Berger 1992). Of the 51 estimated foetal bison calving dates (cf. Walde 2006c:485) only 7 (13.73 percent) fell outside a 60- day period from April 15th – June 15th.

Walde's (2006c) use of estimated conception dates to create hypothetical three- day kill events failed to determine whether or not size or development of the *foetal element* was a reliable indicator of seasonality. Conception date is only one factor influencing foetal growth. If conception date is to be used as a defining characteristic, the conception dates should be known rather than estimated. Pac and Frey (1991:12-13) estimated gestational age of the specimens using cattle weight and crown-rump measurements. They then extrapolated from foetal cattle size and characteristics to estimate the conception and calving dates for the bison specimens. The justification for applying cattle measurements to foetal bison was a personal communication from a doctor of veterinary medicine**.** To most accurately determine the onset and duration of the bison birth season, it is best to utilize actual observations of the event and consider other influencing factors.

Walde's (2006c:489) primary argument against the use of foetal bison as a seasonality indicator is the extended range of bison conception of up to 121 days. While there is little doubt that bison conception and subsequent birth schedules occur over a period of time, it is the distribution of these events that is important. The bison calving season has consistently been defined as the period during which 80 percent of calves are born (Berger and Cunningham 1994; Green and Rothstein 1993; Rutberg 1984) although Walde (2006c:482) suggested that 95 percent of births would be a better definition. Gogan et al. (2005:1717) have classified bison parturition levels. A high level of synchronized parturition is said to occur when 50 percent of births happen with 13-27 days or when 80 percent of cumulative births occur within 23-60 days. A low level of synchronized parturition is when it takes up to 90 days for 50 percent of calves to be born. Evidence presented below will show that bison have a high level of synchronized parturition because 80 percent of cumulative births occur within 23-60 days.

Studies reported by Walde (2006c:485) to support a wide conception range fail to provide empirical evidence of conception or birth event or actually support a restricted birth range. For example, Haugen (1974:3) stated that conception occurred between July 1st and October 3rd, but these dates were estimated from a collection of 131 foetal specimens and did not reflect observed events. Furthermore, Haugen's study (1974:3) supports a restricted birth schedule by stating that there was a peak of conception between July 26th and August 9th and again between August 25th and September 3rd.

Walde also (2006c:489) referred to the Antelope Island bison herd which exhibited asynchronous calving (Wolfe and Kimball 1989) as well as substantial temporal fluctuation in bison conception (Wolfe et al. 1999). Wolfe and Kimball (1989) compared herd size and composition estimates from aerial to a ground survey for the Antelope Island bison herd. Sixteen aerial surveys were undertaken between January 2nd and July 27th, 1987. Calves were identified in the aerial survey based on their size and pelage colour. The aerial surveys were discontinued due to the decreased visibility of calves as they sought out shade.

In early November, the herd was corralled into a holding pen and examined. The results of the ground inspection indicated that the aerial surveys underestimated the calf population. “This was partly due to termination of these counts before the end of the calving season, which extended into October. Numerous ‘new’ calves were observed during the period between July and October and several calves estimated to be <1 month old were captured in the roundup" (Wolfe and Kimball 1989:595). Because the purpose of this study was a comparison of survey methods, there was no attempt to quantify the number of calves that were born after the end of July. How these calves were identified is not explained, nor is there any indication as to when the calves were born. The statement that 'several' calves were less than one month at the roundup is also problematic because there is no indication of how these calves were aged nor how many were estimated to be less than a month old. Several calves out of 90 could represent less than ten percent of the assemblage.

A second report on the Antelope Island herd (Wolfe et al. 1999) did provide quantitative information regarding conception rates. During the annual roundup in the last week of October or first week of November, adult female bison were examined for pregnancy by rectal palpation, and foetal ages were estimated for six years of study. A review of the foetal age distribution graphs (Figure 3, Wolfe et al. 1999:109) show that for four of the six years, over 90 percent of the pregnancies ranged between 75 and 135 days. This would place conception between June 24th and August 23rd. The other two seasons had 75 percent and 70 percent of pregnancies estimated to these ages. It is important to note that this study was undertaken specifically because of what was considered to be the 'unusually protracted calving period' for this herd and the reduced pregnancy rates compared to other herds. It was hypothesized that the extended conception range was due to an absence of predation and low-quality, temporally unpredictable forage (Wolfe et al. 1999:105). While the results of this study do indicate a range of conception, the foetal age distribution for four of the six years suggests that conception even in this herd, which was considered unusually asynchronous for bison, to be relatively restricted.

When taken as a whole, historical and modern observations also point to an extended calving season beginning in March and ending in August (Table 5-2 and Table 5-3). When the observations are tallied individually, a more precise season emerges. Of the 34 observations, 30 cited a birthing date in April or May. The end date observations are not as numerous because some authors simply stated a date when bison were born or provided a 'peak' season, lasting only one month. Of the 26 observed end dates, 24 provide May or June as an end date, while one listed July and another listed August. The overall variability seen in these records is most likely a result of how the birth season was determined (calf counts, backdating foetuses or actual observations) rather than a reflection of the actual birth season length (Rutberg 1987:704).

Table 5-2: Ethnohistoric accounts of bison calving dates.

Start Date	End Date	Reference	Location
Beginning of March	end of June	Allen (1877:463)	
March	June	Grinnell 1904:132	
Early April		Haines 1975:30	Texas
Mid April	end of June	Roe (1972:94)	
April 19 1802		Henry the Younger in Roe (1972:94)	Along the Red River near the Canada/USA Border
April	June	Grinnell 1970:271 in Arthur (1975:52)	
April	May	Ray (1998:33)	Manitoba and Saskatchewan
April	August	Seton 1909:277-279 in Roe (1972:96)	
May	May	Ross (1855:126-127)	East of the Rocky Mountains
May		Alexander Mackenzie in Roe (1972:94)	Upper Peace River
May 9th		Bradbury (1904:84)*	Upper Missouri River

* describes the hunting of two cows, with calves. Cows ran off with so much speed, that the calves could not keep up; the hunters ended up harvesting the two calves.

A better understanding of bison birth synchronization is necessary if an acceptable birth season length is to be established. Ungulates synchronize parturition for one or two reasons: as an anti-predator strategy or as an adaption to resource availability (Berger 1992; Berger and Cain 1999; Gogan et al. 2005; Green and Rothstein 1993; Rutberg 1984, 1987). There is agreement among

Table 5-3: Modern accounts of bison calving dates.

Start Date	End Date	Peak	% born	Reference	Herd	Location
March 10-April 7			1st calf over 12 year period	Halloran 1968:25	Wichita Mountain Wildlife Refuge	Oklahoma
April 9/82 April 9/83 April 5/84	June 4/82 June 18/83 May 10/84	April 15-30 April 15-30 Early May	80	Green and Rothstein 1993:921	Wind Cave National Park	South Dakota
April 9	May 15		85	Berger 1989:349	Badlands National Park	South Dakota
April 7/85 April 8/86 April 8/87 April 3/88 April 6/89	June 6 May 19 June 8 June 11 May 20		80	Berger and Cunningham 1994	Badlands National Park	South Dakota
April 12	May 21		95	Berger and Cain 1999:363	Wind Cave National Park	South Dakota
April 13	July 10		95	Berger and Cain 1999:363	Badlands National Park	South Dakota
April 15	May 31	May 1-15		McHugh 1958	Lamar Valley	Yellowstone National Park
April 20	May 31		95	Berger and Cain 1999:363	National Bison Range	Montana
April 20	June 2	April 23-May 15	97	Rutberg 1984	National Bison Range	Montana
April 20	June 1		90	Wolff 1998	Fort Niobrara National Wildlife Refuge	Nebraska
April 29	June 28		95	Berger and Cain 1999:363	Grand Teton National Park, National Elk Refuge, Bridger-Teton National Forest	Wyoming
Last few days of April		May		Nelson 1965:31	Henry Mountain	Utah
May	June			Shaw and Carter 1989:897	Wichita Mountains Wildlife Refuge	Oklahoma
May 7	June 2		80	Haugen 1974	Wind Cave National Park, Custer State Park, Fort Niobrara National	South Dakota, Nebraska

					Wildlife Refuge	
May 10	Early June			Soper 1941:378	Wood Buffalo National Park*	N. AB & NWT
		late May-early June	“most”	Meagher 1973	all herds	Yellowstone National Park
		2nd - 3rd week in May	"most"	Engelhard 1970	National Bison Range	Montana

researchers that resource availability is the main factor influencing bison birth synchronization in contemporary herds (Gogan et al. 2005:1726). Late born calves have less time to amass body reserves necessary for winter survival (Berger 1992:323; Gogan et al. 2005:1726). Between 1988 and 1990, four of the ten calves born after July 15 in the Fort Niobrara National Wildlife Refuge died before the end of August (Wolff 1998:537). It is also beneficial for the mother to calve earlier as lactating is much more energy intensive than pregnancy (Green 1986:739). Late born calves are at a further disadvantage because they are usually sired by low-ranking bulls (Wolff 1998:543).

How bison synchronize the birth of their calves is a complex process. Early observers noticed a correlation between onset of the rut and the birth season. Historical accounts (Table 5-4) place the rut with the months of July, August and/or September. Modern accounts (Table 5-5) are more specific and place the onset of the rut in mid-June, July or the beginnig of August with an end in mid-late August or sometimes in September. Historical accounts relied extensively on male behavioural characteristics such as restlessness, bellowing, and tending to identify the rut (Fuller 1960; Meagher 1973; Roe 1972). Understanding the female oestrus cycle enables a more accurate detection of conception and pregnancy. It is important to verify if bison are polyestrous, as a second or third cycle has the potential to extend the birth season.

Endocrine studies have facilitated a more comprehensive understanding of the bison oestrus cycle (Kirkpatrick et al. 1991, 1993; Matsuda et al. 1996; Vervaecke and Schwarzenberger 2006). Dorn (1995:14) stated that the average bison oestrus cycle lasts 21 days and has a six to twelve hour receptive oestrus. Progesterone metabolite samples from sexually mature female Plains bison in northern Wyoming reflected a 19-26 day cycle (Kirkpatrick et al. 1991:545), while

Table 5-4: Ethnohistoric accounts of bison rut dates.

Start Date	End Date	Single Date Reference	Reference	Location
		July 7	Frémont 1845	Upper Platte River (Nebraska)
		July 11	DeVoto 1981:422	Upper Missouri (Montana)
Early July	Late September		Branch 1929:06	generalization
July	August		Ray 1998:33	Manitoba and Saskatchewan
July	August		Seton 1909:288 in Arthur 1975:50	
July	August		Grinnell 1904:131	
July	Peaks in August		Allen 1877:463	
		July 20	Bradbury 1904:188-189	Upper Missouri River
July 15			Coues 1897:308	Plains Cree country (MB/SK)
August	September		Catlin 1972:249	Upper Missouri River
August	September		Seton 1974:291	
		September 9	Coues 1897: 407	Eastern edge of Canadian Plains

Table 5-5: Modern accounts of bison rut dates.

Start Date	End Date	Reference	Herd	Location
June 15	September 30	McHugh 1958:23	Hayden Valley Herd	Yellowstone National Park
July 1	August 10	Berger 1989:350	Badlands National Park	South Dakota
Mid July	Early September	McHugh 1958		Yellowstone National Park
July 15	August 31	Kirkpatrick et al. 1993:410	Mary Mountain Herd (Central Region of Park)	Yellowstone National Park
July 20	August 14	Wolff 1988:130	National Bison Range	Moiese, Montana
Mid-late July	Late August	Maher and Byers 1987:92	Fort Niobrara National Wildlife Refuge Herd	North-Central Nebraska
Late July	September 15	Nelson 1965:29	Henry Mountain Herd	Utah
Beginning of August	End of August	Soper 1941:391	Wood Buffalo National Park*?	N. AB & NWT
4 months		Fuller 1966:51	Wood Buffalo National Park	N. AB & NWT

a similar study on Wood bison presented a 17-31 day cycle (Matsuda 1996:1433). These correspond closely to the 18-22 and 17-24 day cycles reported for European bison and cattle respectively.

These endocrine studies disputed earlier claims that bison have only one oestrus cycle per breeding season. When Haugen (1974) examined the corpora lutea from slaughtered bison, he concluded that a second oestrus and ovulation rarely occurred. Rutberg (1986:91) concurred, reporting that he observed breeding only once per season in the National Bison Range herd. Kirkpatrick et al. (1993:407) noted a second oestrus cycle occurred in a commercial herd, "suggesting that under some conditions bison are seasonally polyestrous". When the first copulation did not lead to pregnancy in the Fort Niobrara National Wildlife Refuge Herd, females were observed breeding again 19-21 days later (Wolff 1998:530).

A study by Vervaecke and Schwarzenberger (2006) examined the fecal progesterone metabolite patterns of 13 individual animals. The first cycle occurred in all cows between the last third of July and the middle of August. Hormone levels during this cycle were low and reflected a transition from non-breeding to breeding. The second hormone cycle occurred between August 3rd and1st September and corresponded with mating behaviour. Nine of 10 cows became pregnant during the second cycle. One cow became pregnant during a third oestrus which occurred 18 days after the second. Of the other three cows, two either did not conceive or reabsorbed the foetus. The last animal reabsorbed the first foetus then conceived at the beginning of October to calve on July 4th after a 262-272 day gestation.

Gestation length is another factor influencing synchronized parturition. Various gestation length ranges have been recorded for bison (Table 5-6). Rutley (2001:330) reported that gestation can last anywhere from 257-300 days. He concluded that bison have a 100 day anestrous lactation period, so he subtracted 100 from a 365 day year to arrive at a 265 day gestation period. Berger (1992) found that females in good condition who bred late in the rut reduced their gestation by an average of 5.9 days in order to synchronize

Table 5-6: Recorded days of bison gestations.

Gestation Length (days)	Information Type	Herd	Reference
262-272	known copulation and birth dates	Bison Range National Wildlife Refuge, Montana	Rutberg 1986
265-272	Known copulation and birth dates	Yellowstone National Park	Gogan et al. 2005:1721
270		Wichita Mountain Wildlife Refuge	Halloran 1968
275	Breeder information	Various herds	Dorn 1995:14
277-293	known copulation and birth dates	Badlands National Park, South Dakota	Berger 1992:324

parturition. Interestingly, Gogan et al. (2005:1721) found that intensively managed herds also had a six day shorter gestation length than non-managed herds; 265 days versus 272 days respectively.

Based on the previous literature, the 60 day period between April 15th and June 15th is classified here as the peak birth schedule of bison. Eighty-six percent of calves have been recorded in modern studies as being born during this period, and the majority of the ethnohistoric and ethnographic sources list the start of the calving season as beginning in April and/or May and ending in May and/or June.

Correlating size with gestational age is based on embryonic and foetal development studies. These studies are well known for humans and it is standard to use element measurements to infer gestational age (Chitty and Altman 2002). No such studies have been undertaken on the genus *Bison*, but Kähn (1989) examined 19 pregnant heifers and concluded that gestational age can be inferred by the length of limb elements. In fact, long bone length was determined to be the most useful single measurement for predicting the developmental stage of the bovine foetus (Richardson et al. 1990). Given the genetic and evolutionary relationship between bison and cattle, is assumed here that these studies can be extrapolated to bison.

The assumption that modern foetal bison are an acceptable model for archaeological specimens is more difficult to address. The genetic make-up of modern bison may not accurately reflect precontact populations due to founder effect as well as the introduction of cattle genes into the bison lineage.

At one time, bison ranged across a large portion of North America. The majority of these animals were considered Plains bison (*Bison bison bison*), although the animals in northern Alberta and the Northwest Territories belong to another subspecies known as Wood bison (*Bison bison athabascae*). These subspecies are morphologically distinct, with the Wood bison being larger, having a larger hump and darker coat with reduced chaps and no obvious cape (COSEWIC 2004). It has been debated whether these morphological differences are the result of environmental or genetic factors (Geist 1991, van Zyll de Jong et al. 1995). In the late 1800s, bison were almost exterminated due to habitat loss and overhunting. Plains bison were saved from extinction in five private herds and a sixth herd at the New York Zoological Park established from less than 100 wild-caught bison. There was also a small remnant wild herd in Yellowstone National Park. Nearly all present-day Plains bison are descended from this founder population of less than 100 animals. A population of about 250 Wood bison survived in what is now Wood Buffalo National Park (Hedrick 2009:411).

Since the early 1900s, bison have experienced a tremendous rebound and in 2002, there was estimated to be 500, 000 Plains bison in North America. Most of these animals (96 percent) were commercial herd animals (Boyd 2003:38). There has been ongoing concerns regarding the genetic makeup of both conservation and commercial herds. In the early 1900s, there was a concentrated effort to cross-breed bison and cattle to incorporate favourable agricultural traits in bison. The cross between these two species was difficult and in these early studies, only male bison would breed with female cattle. The result was a low birth rate (39 births of 102 impregnations) and no fertile male offspring. After initial interbreeding, the first generation females could be backcrossed with bison bulls, but again, most offspring were female. In 2007 (Freese et al.) it was estimated that only 1.5 percent of Plains bison did not contain cattle genes; however, another study (Halbert et al. 2005) identified six public Plains bison herds that had no evidence of mitochondrial or domestic cattle introgression. A review of cattle genetics in bison by Hendrick (2009) concluded that the level of cattle ancestry is very low at less than 1 percent. The cattle ancestry in these bison herds is not a result of contemporary mating but is the result of artificial crosses made over one hundred years ago. Most importantly, there are no published reports of individual bison with cattle ancestry being phenotypically different from bison without cattle ancestry (Hedrick 2009:412). These results suggest that the critical assumptions regarding the application of the FODS to archaeological specimens have been met.

Methodology of Creating the FODS

A total of ten foetal bison with known collection dates were obtained from a local bison butcher. In addition, two newborns, a one-week calf and one-month calf were collected from a local bison rancher. This same rancher also provided a six-month and a 9.5-month calf, although these two animals were not included in the FODS. When possible, each animal was sexed, weighed and measured. All were given a unique alpha-numeric identity code. Animals were butchered and processed for the skeleton following standard zooarchaeological techniques at the Brandon University Zooarchaeology Laboratory.

Measurements were taken on all long bones when possible. Maximum diaphyseal length and minimum anterior-posterior midshaft diameter were taken on the humerus, radius, femur, tibia and metatarsal. Scapula measurements included the medial-lateral length, minimum anterior-posterior neck width, and maximum anterior-posterior length of the head. For the ulna, only the maximum diaphyseal length was calculated. All measurements were calculated in mm using standard digital callipers with a 0.01mm resolution. Both the left and right elements of each animal were measured. Results were recorded in a Microsoft Excel worksheet. The values for each left and right element were averaged to provide one measurement per animal for each measurement.

Each measurement is plotted against gestation age (in days) to create a series of linear regression curves (Table 5-7). Gestation age for each collected specimen will be assigned, assuming a peak conception date and gestation length as determined from the literature.

Table 5-7: Linear regression equations for each measurement where x=gestational age in days and y=measurement in mm (see Appendix 2 for modern sample measurements).

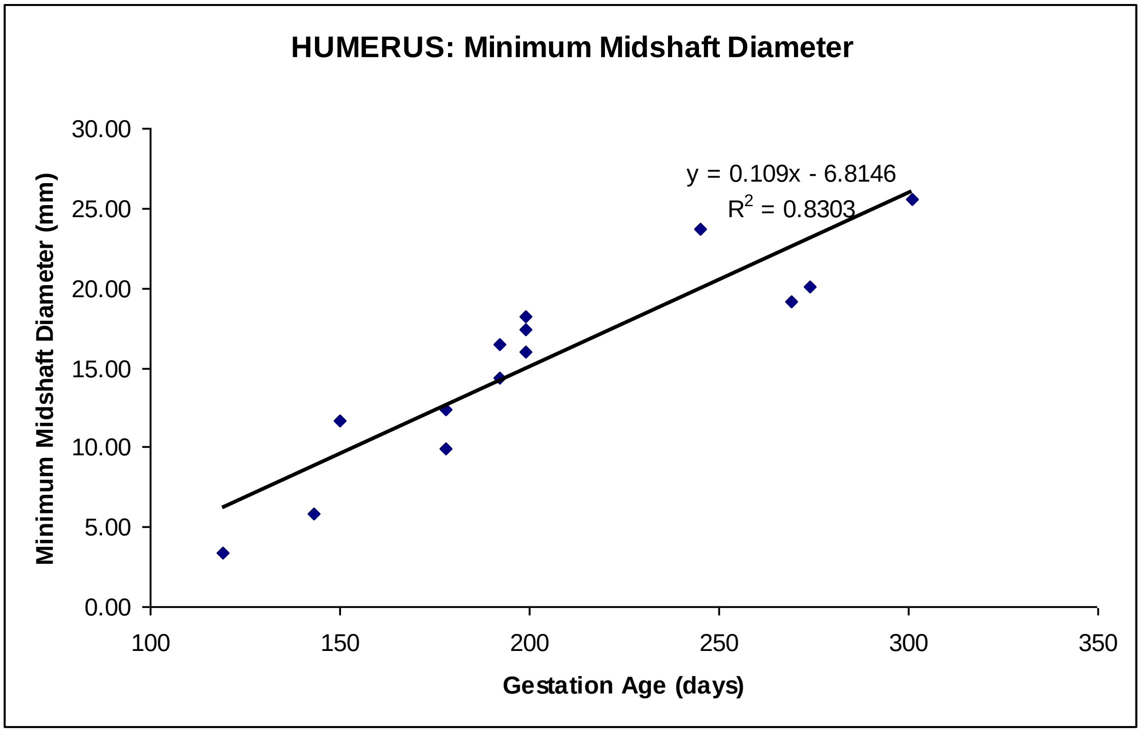
Element	Measurement	Equation	R^2	N
scapula	max M-L length	Y = 0.8712x - 68.738	0.8502	13
	min A-P neck width	Y = 0.1176x - 7.3211	0.8242	14
	max A-P head width	Y = 0.2028x - 16.537	0.8466	14
humerus	max diaphyseal length	Y = 0.7443x - 64.257	0.8938	14
	min midshaft diameter	Y = 0.109x - 6.8146	0.8303	14
radius	max diaphyseal length	Y = 0.6859x - 52.31	0.8773	14
	min midshaft diameter	Y = 0.0688x - 3.7772	0.7542	14
ulna	max diaphyseal length	Y = 0.8029x - 55.409	0.8189	11
metacarpal	max diaphyseal length	Y = 0.5968x - 43.57	0.7990	8
	min midshaft diameter	Y = 0.0556x + 0.4444	0.5983	8
femur	max diaphyseal length	Y = 0.8372x - 72.608	0.8979	14
	min midshaft diameter	Y = 0.108x - 7.3652	0.8548	14
tibia	max diaphyseal length	Y = 0.9006x - 74.207	0.8882	14
	min midshaft diameter	Y = 0.0873x - 3.8188	0.7218	14
metatarsal	max diaphyseal length	Y = 0.6769x - 37.895	0.7970	12
	min midshaft diameter	Y = 0.0695x - 0.8579	0.7166	12

Establishing Gestational Age of Modern Foetal Bison Elements

Before a bison FODS can be created, it is necessary to estimate the age of the collected specimens. The known collection dates can be presented as gestation age in days if a peak conception date can be established and if gestation length is known. The evidence from the previous section indicates that a peak birth date of May 15th can be assumed as can a 270-day gestation length. This would make August 19th the first day of conception. Using these dates, gestational age in days was assigned to each specimen by simply counting forward from August 19th. One example (Figure 5-1) shows the relationship between gestational age in days and the minimum anterior-posterior midshaft diameter of the humerus.

Testing of the linear regression curves was accomplished by applying the equations to elements of known gestational age. The Archaeology and Anthropology Department at the University of Saskatchewan has four foetal specimens (US01-04), a one-week calf (US05), a three-week calf (US06) and a

Figure 5-1: Graphical representation of minimum anterior posterior humerus midshaft diameter measurements (mm) plotted against gestation age in days.



four-week calf (US07). Two of the foetal specimens were listed as two-month calves, one was listed as a four and a half-month calf and the other was listed as a seven-month calf. No collection dates were recorded for the specimens except the two-month calves which were collected in October. Gestational ages had been recorded for the specimens but it is unknown how those were calculated. Measurements were taken on both right and left appendicular elements when possible (Appendix 4). The results indicate mixed success of the FODS application. The maximum length measurements were most successful for estimating the gestational age of the specimen within the 60-day period. The scapula, ulna, femur, tibia and metatarsal maximum length measurements had success rates of 93-100 percent. The metacarpal had the lowest success rate of 50 percent followed by the humerus (64 percent) and the radius (71 percent). The vast majority of the incorrect gestational ages were reported for the one-week and the three-week calf. The FODS measurements consistently underestimated the ages of these specimens. Given that the collection date of these animals is unknown, the FODS may in fact reflect the actual collection date. The gestational date range for these two specimens was based on an assumed peak birth date of mid-May, so the one-week calf was assumed to have been about 277 days (270 days gestation plus 7 days) and the three-week calf was assumed to be about 291 days (270 days gestation plus 21 days). The actual collection dates of these animals could have been earlier.

The other measurements generally did not correlate well with gestational age. Again, most of the incorrect results came primarily from the one- week, three-week and four-week calf, although the humerus, radius and tibia minimum midshaft diameter was incorrect for the two-month gestation animals also.

Testing of the FODS on the University of Saskatchewan foetal bison collection indicates the maximum length measurement of the scapula, ulna, femur, tibia and metatarsal will provide an accurate estimate of gestational age. The testing results are complicated because the actual collection date of the University of Saskatchewan samples is unknown. It does appear that the minimum midshaft diameter is not a good indicator of gestational age.

In order to further assess the applicable of the FODS, the results were compared to other foetal specimens of known measurement. Landals et al. (2004:130) provided minimum anterior-posterior midshaft measurement on the humerus for five developmental stages (Table 5-1). Again, the results of the FODS were consistently younger than should have been expected. This supports the conclusion that the midshaft diameters are not adequate measurements to estimate gestational age.

Application of the FODS to archaeological assemblages

The bison FODS can be applied to foetal elements of unknown age to determine date of collection and hence seasonality. The bison foetal assemblages from the six selected sites are presented, and when possible, elements were measured and gestation age determined using the appropriate linear regression equation. As indicated above, the maximum length measurements of the scapula, ulna, femur, tibia and metatarsal are most reliable. All measurements, however, were taken on the foetal assemblages whenever possible. It is noted here that the results of the minimum midshaft diameter of the humerus, radius and tibia are especially suspect, as is the maximum anterior-posterior head width of the scapula.

The Hokanson Sample Foetal Bison Assemblage

A very small sample of foetal bison remains were identified in the Hokanson faunal sample, but this is not unexpected given that only six excavation units were selected for analysis. Unfortunately the majority of the foetal specimens are small unidentifiable fragments and only three identifiable elements are present in the assemblage (Table 5-8). Because no appendicular elements were recovered, the FODS could not be applied to the Hokanson foetal bison assemblage. The three identified elements were compared to the modern samples, and one rib head was similar in size and morphology to the newborns collected May 14th and 19th. The thoracic vertebrae specimen was represented by the top portion of the thoracic spine. Its size and morphology is comparable to thoracic vertebrae ten through fourteen of the one-month calf. Based solely on these two comparisons, the site would have been occupied sometime between April and May. Given the paucity of foetal bison recoveries, and the lack of appendicular elements, this seasonality assignment is tenuous.

Table 5-8: Foetal bison recoveries from the Hokanson site faunal assemblage sample.

Element	NISP	MNE	MNI
Axial Skeleton			
Rib	2	1	1
Thoracic Vertebrae	1	1	1
Miscellaneous			
Cranial indeterminate	1		
Ribs indeterminate	6		
Appendicular indeterminate	2		
Unidentifiable	20		
Total	**32**	**2**	**1**

The Lovstrom Sample Foetal Bison Assemblage

A total of 59 foetal bison recoveries were identified in the Lovstrom faunal sample (Table 5-9). Both axial and appendicular elements are well represented, but only six elements could be measured. Eight FODS

Table 5-9: Foetal bison recoveries from the Lovstrom site faunal assemblage sample.

Element	NISP	MNE	MNI
Axial Skeleton			
Mandible	1	1	1
Rib	1	1	1
Cervical Vertebrae	2	1	1
Thoracic Vertebrae	3	1	1
Lumbar Vertebrae	1	1	1
Forelimb			
Scapula	1	1	1
Humerus	5	3	2
Radius	1	1	1
Metacarpal	2	1	1
Hindlimb			
Innominate	2	2	1
Femur	1	1	1
Tibia	1	1	
Metatarsal	3	3	2
Fore or Hindlimb			
1st Phalanx	4	2	1
3rd Phalanx	1	1	1
Miscellaneous			
Cranial indeterminate	2		
Vertebrae indeterminate	1		
Ribs indeterminate	9		
Metapodial indeterminate	1		
Appendicular indeterminate	3		
Unidentifiable	14		
Total	**59**	**21**	**2**

measurements were taken on these six elements and the results are presented in Table 5-10.

The FODS results indicate the presence of at least three foetal animals, one collected mid-October to the beginning of November, one collected in February, and another collected at the end of March. Although tempting to include the March 29 specimen with those collected in February, the recovery of three separate metatarsals indicates the presence of two later term specimens.

A discrepancy between the FODS measurement results and the comparative collection is evident for the proposed October collection. The FODS linear regression curve equation indicates a gestation age of between 57 and 65 days. However when the archaeological specimen measurements are compared to those taken on the modern samples, they fall within the range of the December and January comparative samples. They are also visually similar to December and January modern samples. This is not surprising given that the gestational age was determined from the scapula maximum anterior-posterior head width which has low reliability, as does the humerus minimum midshaft diameter. The most reliable measurement, the humerus maximum diaphyseal length, estimates an occupation date of mid-February.

Table 5-10: FODS measurements on foetal bison recoveries from the Lovstrom site.

Artifact Number	Element	Measurement (mm)	Gestation Age in Days	Date
56-3-49c	scapula	maximum anterior/posterior head width = 8.35	57	October 15
51-2-2	humerus	minimum midshaft diameter = 5.95	61	October 19
56-3-49c	scapula	minimum anterior/posterior neck width = 7.86	74	November 1
50-2-30	femur	minimum midshaft diameter = 16.47	170	February 5
47-2-359	humerus	minimum midshaft diameter = 17.96	172	February 7
47-3-303	metatarsal	minimum midshaft diameter= 12.23	177	February 12
47-2-359	humerus	maximum diaphyseal length = 94.18*	190	February 25
47-2-33	metatarsal	minimum midshaft diameter = 15.37	222	March 29

* slight gnawing is evident on epiphyseal ends of element, so measurement may be inaccurate

The recovery of non-measured elements also compare well with the modern January sample, suggesting that this is a more accurate reflection of collection date. Other non-measured elements were comparatively similar to those collected in February and March, The proposed seasonality for the Lovstrom site based on foetal bison remains is from January to the end of March.

The Jackson Sample Foetal Bison Assemblage

An analysis of the Jackson site foetal bison assemblage was previously undertaken by Playford (2001a, 2010) as part of her Master's thesis. There were a total of 95 foetal bison elements identified in the assemblage, representing four individuals, based on developmental stage (Table 5-11).

The archaeological collection was compared to four *Bos* foetal samples housed in the University of Saskatchewan zooarchaeology comparative collection. Two samples were estimated to be two months gestation, one was

Table 5-11: Foetal bison recoveries from the Jackson site faunal assemblage sample.

Element	NISP	MNE	MNI
Axial Skeleton			
Cranium	1	1	1
Rib	4	3	1
Thoracic Vertebrae	6	3	1
Lumbar Vertebrae	10	1	1
Sacrum	1	1	1
Forelimb			
Scapula	1	1	1
Metacarpal	3	2	2
Hindlimb			
Innominate	3	2	2
Femur	1	1	1
Tibia	2	2	2
Metatarsal	8	3	3
Fore or Hindlimb			
1st Phalanx	2	1	1
2nd Phalanx	2	3	1
3rd Phalanx	1	1	1
Miscellaneous			
Vertebrae indeterminate	15		
Ribs indeterminate	15		
Metapodial indeterminate	3		
Unidentifiable	17		
Total	**95**	**25**	**4***

*MNI of 4 based on size

four and half months and one was eight months gestation. An attempt was made to accommodate for the potential size differences between *Bos* and *Bison* with the foetal *Bos* specimens potentially being larger due to domestication. The archaeological samples were also compared to the developmental stages proposed by Landals et al. (2004). Playford (2001a:85) concluded that four developmental stages, corresponding to stages one through four at the Miniota site, were represented in the Jackson site assemblage. A single stage one specimen was identified in the assemblage and it was estimated to be between three and four months gestation. Stage two specimens were smaller than the modern four and a half-month gestation *Bos* sample but larger than the two-month sample and were estimated to be about five months gestation. The stage three specimens were similar to the four and a half-month gestation modern sample. Wilson and Davis (1978:324) stated that foetal bison metapodials fuse during the last two months of gestation. This gestational event was used as a developmental marker for stage three specimens, and was estimated to be between six and seven months gestation. The stage four specimens were comparable in size to the eight-month modern *Bos* sample and similar to those from the same stage at the Miniota site, indicating a seven to eight month gestation age. Playford (2001a:92) assumed a peak calving date of May 1st, and concluded that the foetal developmental stages indicated a site occupation between December and late April or early May. She cautioned that the small sample size of only one individual per developmental stage could skew the results if one or more of the specimens represented an out of schedule pregnancy.

An in-depth reexamination of the Jackson site foetal bison assemblage was not undertaken. Instead, measurable elements were selected from the assemblage for application of the FODS. The fragmented nature of the assemblage resulted in only four measurements taken on three measurable elements (Table 5-12). The FODS results support the seasonality estimate with an occupation between December and March.

Table 5-12: FODS measurements on foetal bison specimens recovered from the Jackson site.

Artifact Number	Element	Measurement (mm)	Gestation Age in Days	Date
19-4-107	tibia	minimum midshaft diameter = 7.73	92	December 2
19-4-107	tibia	maximum diaphyseal length = 46.73	123	December 23
18-4-81	tibia	minimum midshaft diameter = 16.15	189	February 24
19-4-45	metatarsal	minimum midshaft diameter = 13.85	200	March 7

The Vera Sample Foetal Bison Assemblage

The Vera site foetal bison assemblage had also previously been analyzed by the author, who at the time, compared it to two modern foetal bison samples of four and fivemonths gestation (Playford and Nicholson 2006:411). With the exception of several rib fragments, all the identifiable elements appeared larger than the five-month gestation sample and some elements were significantly larger than the comparative samples, including two bison third phalanges tentatively identified as newborn based on their small size, compared to the adult bison in the Brandon University zooarchaeological comparative collection. This suggested at least two developmental stages, a newborn and a foetal animal older than five months gestation. Seasonality was estimated to be from between late winter to spring, perhaps extending into early summer. The presence of one turtle element and three fish vertebrae also suggested a warmer season of open water, although the provenience of the fish remains were problematic as they were associated with a historic post mold and could have be intrusive (Playford and Nicholson 2006:413).

Only the Block B faunal assemblage from the Vera site was included for analysis and 142 specimens were identified as foetal bison (Table 5-13). After comparing the two third phalanges initially thought to represent a newborn animal with the modern comparative sample, they were removed from the foetal bison assemblage and included with the immature bison assemblage because they were much larger than those of the newborns, one-week and one-month calf. The archaeological specimens were only slightly larger than the 9.5-month comparative calf, suggesting that the archaeological specimens are at least older

Table 5-13: Foetal bison recoveries from the Vera site faunal sample.

Element	NISP	MNE	MNI
Axial Skeleton			
Rib	1	1	1
Cervical Vertebrae	1	1	1
Thoracic Vertebrae	7	2	1
Lumbar Vertebrae	1	1	1
Forelimb			
Humerus	1	1	1
Ulna	2	1	1
Hindlimb			
Innominate	6	3	2
Femur	2	1	1
Tibia	2	1	1
Metatarsal	1	1	1
Fore or Hindlimb			
1st Phalanx	1	1	1
Miscellaneous			
Vertebrae indeterminate	3		
Ribs indeterminate	52		
Metapodial indeterminate	9		
Appendicular indeterminate	19		
Unidentifiable	33		
Total	**142**	**14**	**2**

than 9.5 months. There are still at least two foetal animals based on the recovery of three innominates. Both axial and appendicular elements are represented, but the vast majority of the foetal recoveries were unidentifiable or indeterminate rib or appendicular fragments.

Of the fourteen identified elements, only two were complete enough for application of the FODS (Table 5-14). The femur measurements indicate a mid-January occupation while the humerus suggests a late January to early February occupation. This information correlates well with non-measurable elements which are comparable in size to modern specimens collected in February and the beginning of March.

Table 5-14: FODS measurements on foetal bison specimens recovered from the Vera site.

Artifact Number	Element	Measurement (mm)	Gestation Age in Days	Date
36-6-16	femur	minimum midshaft diameter = 12.27	144	January 10
34-5-92	humerus	maximum diaphyseal length = 73.89	164	January 30
34-5-92	humerus	minimum midshaft diameter = 17.59	168	February 3

The Sanderson Sample Foetal Bison Assemblage

The logistics of examining the Sanderson site foetal material negated a comparison with the modern samples. Because Magee (1997) had not included a description or list of the foetal bison elements identified in the Sanderson site faunal sample, a re-examination of the assemblage was required. However, access to the assemblage, which is currently housed by the Royal Saskatchewan Museum, was restricted to an on-site examination. Also, because an original catalogue for the faunal assemblage was not accessible, an examination of the foetal material required manually searching each artifact box for foetal elements. The results indicate a presence of at least 71 foetal specimens representing two animals (Table 5-15). Although 21 elements were identified, most offered minimal information, comprising either axial elements or phalanges, with only seven of the more informative appendicular element being recovered. Of those seven elements, only two were measurable (Table 5-16).

Table 5-15: Foetal bison recoveries from the Sanderson site faunal sample.

Element	NISP	MNE	MNI
Axial Skeleton			
cranium	8	1	
Rib	2	2	1
Thoracic	2	2	1
Lumbar	1	1	1
Caudal Vertebrae	5	2	1
Forelimb			
Humerus	2	2	1
Radius	1	1	1
Metacarpal	3	2	1
Hindlimb			
Tibia	2	1	1
Metatarsal	1	1	1
Fore or Hindlimb			
1st phalanx	2	2	1
2nd phalanx	2	2	1
3rd phalanx	2	2	1
Miscellaneous			
Ribs indeterminate	12		
Metapodial indeterminate	9		
Appendicular indeterminate	7		
Unidentifiable	10		
Total	**71**	**21**	**2**

The early seasonality estimate inferred for the humerus exhibits the same discrepancy as the youngest foetal elements from the Lovstrom site. The linear regression curve equation provides an estimate about a month and half younger than the measurement alone would indicate. When compared to the modern specimens, it is similar to those collected in January/February. However, Magee (1997:247) proposed a late fall/early winter seasonality for both occupations of the site based on the faunal recoveries (including the presence of migratory waterfowl and foetal bison elements) and paleobotanical recoveries which correspond well with the linear regression equation. The bison bone breakage

Table 5-16: FODS measurements on foetal bison specimens recovered from the Sanderson site.

Artifact Number	Element	Measurement (mm)	Gestation Age in Days	Date
32077	humerus	minimum midshaft diameter = 9.06	89	November 16
67288	metatarsal	minimum midshaft diameter = 12.5	180	February 15

pattern observed at the site is interpreted as evidence of frozen meat cache utilization and is presented as evidence of winter site occupation (Magee 1997:248). Based on this evidence it is suggested here that the site was occupied sometime between November and February.

The Twin Fawns Sample Foetal Bison Assemblage

Although the Twin Fawns faunal assemblage sample had the highest per unit recovery of bison foetal elements (over seven per unit), only about 20 percent were identifiable to element (Table 5-17). Only two elements could potentially be aged using the FODS measurements but these specimens were highly fragmented and no measurements could be taken. A comparison of the archaeological specimens to the modern samples indicates one development size corresponding closely to the modern samples collected in February through to the beginning of March.

Table 5-17: Foetal bison recoveries from the Twin Fawns site faunal assemblage.

Element	NISP	MNE	MNI
Axial Skeleton			
Cranium	1	1	1
Rib	6	3	1
Cervical Vertebrae	1	1	1
Thoracic Vertebrae	2	2	1
Forelimb			
Metacarpal	1	1	1
Hindlimb			
Femur	1	1	1
Fore or Hindlimb			
1st phalanx	2	2	1
3rd phalanx	1	1	1
Miscellaneous			
Ribs indeterminate	10		
Metapodial indeterminate			
Appendicular indeterminate	14		
Unidentifiable	22		
Total	**61**	**12**	**1**

The above results indicate that application of the FODS to archaeological specimens must be undertaken cautiously. Although maximum diaphyseal measurements of most limb elements are expected to provide accurate results, these elements are not recovered in large numbers from archaeological sites. Testing of the FODS suggest that the minimum midshaft diameter measurements of certain elements, notably the humerus, radius and tibia were not reliable indicators of gestational age. In order to best ascertain gestational age and hence seasonality of these six sites, all foetal samples were compared to the modern samples to provide a more dependable seasonality estimate. In most cases, these results supported the FODS results. This does not mean that the FODS is without use. Further refinement of the FODS is necessary for it to be widely applied to archaeological specimens.

Summary

A bison FODS was created by taking measurements on the scapula, humerus, radius, ulna, metacarpal, femur, tibia and metatarsal of 10 modern foetal samples of known collection date as well as two newborns, a one-week calf and a one -month calf. These measurements were plotted against gestational age in days to create a series of linear regression equations. Based on the ethnohistorical record and data from modern bison herds, a peak conception date of August 19th is assumed for the Canadian Northeastern Plains. Studies of modern bison genetics suggest that while cattle genes are present in some bison populations, it comprises less than once percent of the genetic makeup of bison. Testing of the FODS on modern foetal bison from the University of Saskatchewan indicates that the maximum diaphyseal length is the most accurate measurement to ascertain gestational age.

The foetal bison assemblages from each site were compared to the modern samples and FODS measurements were taken, with the exception of the Hokanson and Twin Fawns sites that did not contain measurable elements. A discrepancy between the measurements and the results of the linear regression equation is apparent for early gestation animals (before February). Based on FODS measurements and comparisons to the modern foetal bison collection, the Hokanson site was likely occupied between April and May, the Lovstrom site was occupied between January and March, the Jackson site was occupied between December and March, the Vera site was occupied between January and March, the Sanderson site was occupied between November and February and the Twin Fawns site was occupied between February and March.

CHAPTER 06: ABORIGINAL CONCEPTS OF SEASONALITY

Introduction

Seasonality is a major environmental factor influencing a host of biological and cultural phenomena (Rocek and Bar-Yosef 1998; Ulijaszek and Strickland 1993). Anthropologists and ethnologists have long argued that seasonal variation shapes human activity (Huss-Ashmore 1988:05) and archaeologists have also recognized the relationship between seasonality and human existence. Thus, establishing site seasonality is a critically important first step in any attempt to better understand subsistence strategies. In Chapter Five, the season of occupation was established for each site. These estimates were presented as months of occupation rather than seasons because terminology such as spring, summer, fall and winter are cultural constructs and may not adequately represent how the site inhabitants perceived seasonality. A review of the westernized four season paradigm is contrasted with Aboriginal seasonality concepts to illustrate the cultural construction of seasons and seasonality. Understanding site seasonality within the Aboriginal seasonality concept is attempted. This is accomplished by using the moon-names as a way to understand important biophysical seasonal markers or seasonal food procurement activities.

Westernized Four Season Paradigm

Season and seasonality are often used interchangeably in the literature. Jones (2007:18-19) explained that the word season is related to agriculture as it originated from the Latin for sowing. The term today has a variety of meanings concerned with the periodization of time. One definition describes seasons as the period of the year associated with a particular activity or phenomenon such as agriculture, animal activity or weather. Alternatively, the term season can be used to describe one of the four quarters into which the year is commonly divided. This is the concept most often applied by archaeological researchers. With this usage, seasonality simply becomes a study of the seasons.

European cultures usually recognize four discrete seasons: spring, summer, fall and winter. The onset and length of each season can vary according to how they are defined. These ‘natural’ seasons are identified either by meteorological or astronomical events (Trenberth 1983). Astronomical seasons are calculated according to the earth's rotation around the sun. Winter is defined as the period from the winter solstice to the vernal equinox or from about December 22 until March 22. Spring lasts until the onset of the summer solstice (June 22) and summer ends at the beginning of the autumnal equinox about September 23. Fall lasts until the beginning of the winter solstice (Trenberth 1983:1276).

Seasons can also be defined using meteorological criteria. The most widely used meteorological seasonal breakdown is to divide the year into four three-month periods. In the Northern Hemisphere, winter is the coldest three months (December to February) while summer is the warmest three months (June, July and August). Spring and fall are transitional seasons following winter and summer respectively. This four equal season breakdown is associated with the 365-day solar radiation sine wave which would naturally give rise to the concept of two extreme and two transitional seasons. Because temperature is related to solar radiation, it too follows a 365-day cycle and it becomes one of the most common criteria used to define the seasons (Trenberth 1983:1276-1277).

An examination of surface temperature and solar radiation across the earth's surface indicates temperature and solar radiation do not correlate well in the tropics, the Arctic, or Antarctic Circle. In the mid-latitudes of the Northern Hemisphere, neither the astronomical nor the meteorological seasons fit exactly with the temperature cycle. This discrepancy is due in part to the temperature differences between the mid-continent and the ocean regions. Because most people live on land in the continental regions of the hemisphere, the seasons as defined by the mean temperature over the United States would be appropriate and differ from the meteorological definition by only a few days (Trenberth 1983:1281).

While these four seasons appear to be a natural construct, they are in fact a cultural concept. The number of seasons in a year can vary for different cultures. Understandably, people residing outside the mid-latitudes may choose to conceptualize seasonality according to the solar radiation cycles in their regions (i.e. in the tropics, temperature fluctuations are not large so precipitation is used as a seasonal criteria, resulting in dry and wet seasons) (Trenberth 1983:1277). The Saami of Northern Europe recognize eight seasons while in Finland, there are three separate winter seasons (Jones 2007:20). Europeans along the North Coast of Australia identify two seasons, wet and dry. The Indigenous Aborigines in the same area, the Yolngu, recognize six separate seasons: end of the wet season, dry season, hot dry season, 'nose' of the wet season, breaking of the wet season and the wet season proper.

These ethnographic observations identify a fundamentally analytical flaw in how archaeologists have attempted to reconstruct and interpret past Aboriginal lifeways on the Canadian Northeastern Plains. That is, they have persistently relied on a Westernized four season concept. There are likely two reasons for this. Many of the archaeological researchers are themselves of European descent and are/were simply unaware that alternate ideas of seasonality exist. Also, because most of the explorers, fur-traders, missionaries and anthropologists were of European descent, our earliest records of Aboriginal life are described from an ethnocentric perspective featuring a four season paradigm. As an example, Ewers (1955, 1958) interviewed a Blackfoot elder on the Blackfeet Reservation in Montana and the Blood Reserve in Alberta who had experienced the last of the equestrian buffalo hunts. Based on these accounts, Ewers described the Blackfeet as following a seasonal round. During the winter, bands camped along major river valleys from Late October or early November until spring. People moved in late March or early April as the ice broke up and bison were calving. This could be a period of scarcity, so the bands went their separate ways, to reassemble in summer for the bison hunt and Sundance ceremony which coincided with berry picking. In the fall, bison cows were hunted for the production of pemmican, and come winter, bands moved back into the river valleys. While recognizing a series of seasonally driven events, they were organized into a four season model.

However, according to Wissler (1911:44) the Blackfoot said that spring and fall originated with the whites and that there were only two seasons, winter and summer. Each season was about seven months (or moons) long. The tendency was to count moons from about October as the start of a new winter. While important ecologically-driven (seasonal) transitions might be reflected in the Blackfoot round of activities described by Ewers, for Wissler, they were perhaps less conceptually important in face of the important binary distinction between mobile warm season foraging activities versus comparatively sedentary cold season ones.

This difference between European and Aboriginal seasonal conceptions is not surprising given that the Aboriginal worldview can be quite unlike the Westernized scientific worldview. It is well known that many nomadic groups, including North American First Nations, consider (or considered) time to be cyclical instead of linear. Given that seasonality is related to time, will this invalidate any attempt by archaeologists to establish seasonality of Aboriginal sites? Probably not. Instead, researchers should attempt to interpret sites with the knowledge that seasonality constructs may be different than that of the researchers. In order to accomplish this, it is necessary to understand alternative world views.

Aboriginal Worldview and Seasonality Perspective

Trosper (1998) identified four commonly shared Amerindian values: respect, community, connectedness and humility. Many Aboriginal people do not (and most likely did not) separate themselves from nature; they are part of both a physical and social environment. The physical world is connected to the social world and there is a reciprocal obligation between these realms (Berkes 1999:79). This spiritual connectedness with the physical world is also reflected in the economic rhythm of activities designed to place people in strategic locations on the landscape where resources could be predicted and cost-effectively harvested. This connection between people and their physical environment is also evident in the temporal realm, particularly in a seasonally cyclical round of activities.

Seasons are identified not by astronomical or meteorological events, but instead by changes occurring in the biophysical environment (Davidson-Hunt and Berkes 2003). “Fishing seasons are part of the seasonal cycle of harvesting activities, and they are signalled by biophysical events in the landscape such as the spring ice breakup in the river and change of colour of the vegetation in September. Fishers know how to recognize and responded to a variety of environmental feedbacks that signal what can be fished where and when" (Berkes 1999:140). The same is true for the Anishinaabe of the Iskatewizaagegan Number 39 First Nation of the shores of Shoal Lake that border Manitoba and Ontario. Fall (*tagwaagin*) begins when the leaves turn color and fall from the trees. Fall turns into young winter when the leaves have fallen from the trees and the snows are falling. Winter turns into spring when the ice on the lakes begins to melt and break up (Davidson-Hunt and Berkes 2003:05).

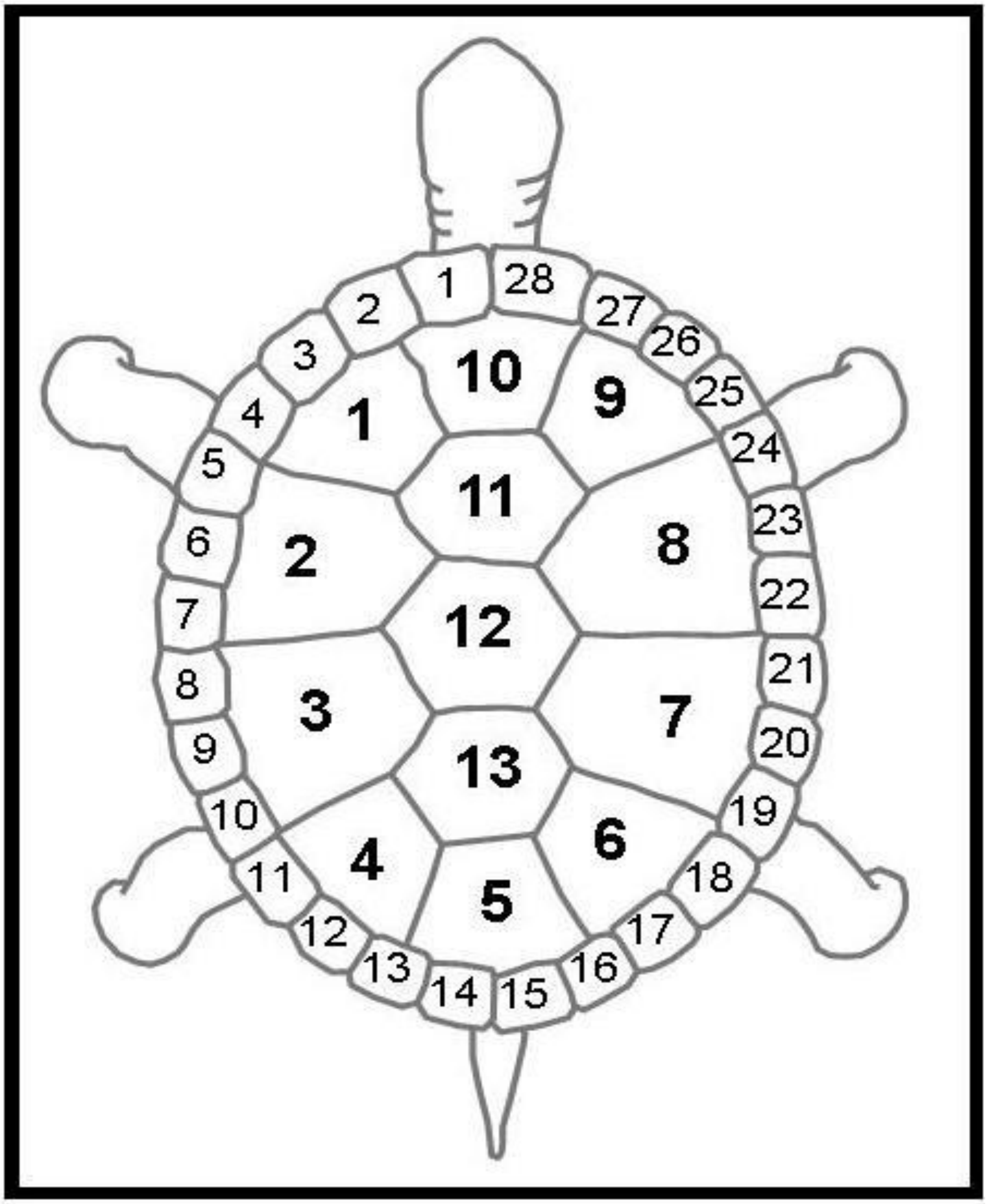
The importance of waterways in Woodland societies such as the Woodland Cree is demonstrated by their seasonal conception. Rather than four seasons, they have identified six: fall, freeze-up (young winter), winter, spring, break-up (early summer) and summer (Davidson-Hunt and Berkes 2003; School District of Mystery Lake 2014). Alternatively, Skinner's (1911:48) work with the Eastern Cree identified eight seasons: *sigun* or spring before open water, *miluskamin* which is spring after the water is open and before summer, *nipin* as early summer, *mégwanipiu* is middle summer*, tûkwagun* is early autumn, *mïgîskau* is late autumn, *pïchïpïpun* is early winter just before the frost, and *mégwapïpun* is later winter. Daniel Harmon, a fur trader with the North West Company noted in his published journal that the Cree only had four seasons. These were winter (*apepook* or *pepoon*), spring (*meiskamick* or *segumuck*), summer (*nicpin*) and fall (*tuckwágin*) (Harmon 1904:321). This case highlights the difficulty of adjusting preconceived notions of seasonality. Harmon identified four seasons, but provides terminology for six. His solution was simply to collapse the Cree seasons from six into four.

Also unlike Indo-European meteorological or astronomical seasons, First Nation seasons are periods of transition. A season may change more quickly in one given year if the biophysical changes occur quickly that year. Differences in how seasons change from year to year are measured and provide a baseline for noting anomalies (Davidson-Hunt and Berkes 2003). When describing the seasons of the Assiniboine, Denig stated (1961:415), “These are only seasons and do not each contain a certain number of days, but times – a growing time, a hot time, a leaf-falling time, and a snow time. These four seasons make a year which again becomes *mankoch* or the same as a season. This is difficult to explain. They count by the moon itself and its different phases, not computing so many days to make a moon, nor so many moons to make a year”. For the Santee, five moons are counted as winter and five as summer, leaving only one each as spring and fall. “The Dakotas often have very warm debates, especially towards the close of the winter, about what moon it is. The raccoons do not always make their appearance at the same time every winter; and the causes which produce sore eyes are not always developed precisely at the same time in each successive spring. All these variations make room for strong arguments in the Dakota tent for or against *Wićeata-wi* or *Iśtawićayazan-wi”* (Riggs 1893:165-166). With the Cree identifying eight, six or four seasons, the Santee identifying four seasons and the Blackfeet identifying only two, how many Aboriginal seasons are there? Identifying the number of Aboriginal seasons is not as important as identifying activities that were culturally significant during certain times of the year.

Recognizing Seasonal Change and Using Moon-Names to Identify Significant Seasonal Events

In many parts of North America, Native Americans relate the cycles of the moon (often called Grandmother Moon) to the seasons (Bruchac and London 1992). The moon cycle can then provide a standardized approach to understanding Aboriginal time passage during the year. A turtle’s back has been used as a sort of calendar for several Native American groups. There are 13 large scales representing 13 months, and 28 smaller scales representing the days of each month (Figure 6-1) (Bruchac and London 1992). The month names are culturally specific. In Anishinaabe, *Migizi giizis* is translated as ‘bald eagle

Figure 6-1: Aboriginal turtle-back calendar.



moon' and marks the time when the bald eagles return. *Maangwag giizis* is the month when the loons return and begin to nest. Other Anishinaabe moon names mark the time period of different livelihood activities such as blueberrying moon and ricing moon. Yet other moons refer to times when certain ceremonies are undertaken, such as *Manitoo giizis* or 'Creator's Moon' (Davidson-Hunt and Berkes 2003).

Even when Native groups do not use the turtle calendar as a mnemonic device for remember the moons, all incorporate culturally important events as their moon names. Many of these events reflect important changes in the biophysical environment. Wilson (1917) provided a unique opportunity to study seasonal language markers because his accounts of Hidatsa agriculture were translated directly from Hidatsa informants with relatively little European cultural filtering. Buffalo Bird Woman related activities as she understood them, and then she ‘interpreted’ those activities into a European Calendar. The following are several direct quotes from Wilson (1917):.

> The first seeds that we planted in the spring was sunflower seed. Ice breaks on the Missouri about the first week in April, and we planted sunflower seed as soon after as the soil could be worked. Our native name for the lunar month that corresponds most nearly to April is *Mapi’-o’-cë-mi’di*, or Sunflower-planting-moon.
>
> We knew when the corn planting time came by observing the leaves of the wild gooseberry bushes.
>
> The first corn was ready to be eaten green early in the harvest moon, when the blossoms of the prairie golden rod are in full, bright yellow, or about the end of the first week in August.
> The season for watching the fields began early in August when green corn begin to come in.
> We Indians call the present moon the wild cherry moon, because June berries ripen in the first half, and choke-cherries in the second half of the moon . . . Our next moon we call the harvest moon, and in it the wild plums ripen and the first frost falls.

Not surprisingly, the Hidatsa language includes many agricultural references such as when to plant sunflowers. It is expected that different economic strategies would be reflected in the language markers of different groups and a survey of moon-names (Table 6-1 and Table 6-2) shows this to be so.

Table 6-1: Algonquian language moon names.

	J	F	M	A	M	J	J	A	S	O	N	D
Ojibwa (Wilson 1874**)**	great spirit	sucker	snow crust	broken snow-shoe	blossom	strawberry	raspberry	berry	rice	falling leaves	freezing	small spirits
	muhne doo keezis	*nubmā bene keezis*	*onáhbune keezis*	*babooq uadáhg imingkeezis*	*wáhbegoon ekeezis*	*odāëmenek eezis*	*misquéem ene keezis*	*meen keezis*	*muhnóomen ekeezis*	*penáhquek eezis*	*kushkúd ene keezis*	*múhnedook eezisoons*
Eastern Cree (Skinner 1911)	old fellow spread the bush	old month	eagle	gray goose	frog	leaves come out	ducks molt	young ducks fly	wavy/ snow goose	birds fly south	rivers begin to freeze	young fellows spreads the bush
	gïshép apïwaté ïkmum pizun	*cépizun*	*mïgîsupizun*	*mîskïpizun*	*alïgïpizun*	*sagïpukawipizun*	*opaskwuwipizun*	*opunhopizun*	*wéwéopïzun*	*opïnahamowipizun*	*kaskátinopizun*	*papiwatiginashispizun*
Plains Cree (Mandelbaum 1979)	great moon	eagle	goose	frog	leaves appear	egg laying	moulting	start flying	breeding	leaves change colour	falling leaves	frozen over
	kicepicim	*mikiciwpicim*	*miskihpicim*	*ayikipicim*	*sakipakawpicim*	*pinawewipicim*	*paskowipicim*	*ohpahowicicim*	*notcihitopicim*	*pinackopicim*		*okaskatanopicim*
Cheyenne (Grinnell 1972)	hoop and stick game	few buffalo calves appear	buffalo begin to fill out	fat	bright sun shine	no names-just summer when green grass is up			plum	water begins to freeze	freezing	big freeze
	okseye shihis	*makkokkstsiutsi*	*pootaneishi*	*mahke omeshi*	*oassiowahtut*				*wahkanuneishi*	*seine*	*hikomini*	*makhikomini*
Blackfoot (Wissler 1911)	uncertain	geese	beginning summer	frog	thunder	big Sunday	berry	chokecherry	beginning winter	wind	cold	2 big Sunday

Table 6-2: Siouan language moon names.

	J	F	M	A	M	J	J	A	S	O	N	D
Dakota (Hind 1859)	hard	raccoon	snow-blind (sore eye)	geese lay eggs	planting	ripe strawberries	ripe choke-cherries	harvest	rice is laid up	drying rice	deer rutting	deer shed horns
(of Minnesota Valley)	*witehi*	*wienta wi*	*istawieayar nnwi*	*magaek adnwi*	*wogupiwi*	*wazuteen anwi*	*canpeaspa*	*wasutouwi*	*psinhunketo wi*	*wiworapi*	*takiyubawi*	*tabecape unwi*
Lakota (McHugh 1972)		foetal bison begin to grow hair	foetal bison grow thick hair	na	bison cow drop calf	na	na	na	leaves fall	leaves fall		foetal bison grows large
Assiniboin (Denig 1963)	NA	NA	sore-eye/snow-melting	frog	buffalo-calf	hot	yellow-leaf	buffalo become fat	first snow	middle	lengthening day's brother	days lengthen
				tapághe nahoto	*petaichincháton*	*weemush tu*	*wahpázeze*	*wahpaichpáah*	*yokawahhow wee*	*wechokun*	*omhaska*	*omhaska*
Oglala Sioux (Neihardt 2000)	frost in the tipis	dark red calves	snow-blind	red grass appears	ponies shed	making fat	ripe red cherries	cherries turn black	calves grow hair	chang-ing season	falling leaves	popping trees

Especially interesting is the references to bison reproduction events and foetal bison development. It is apparent from several moon names that First Nations people were knowledgeable about foetal bison development.

In the process of developing his internalist archaeology, Eldon Yellowhorn (2002) sought to refute the historical and ethnographic claims that the Blackfoot occupation of the Plains was a recent occurrence. He argued that there was a long-standing relationship between Blackfoot people and the bison and that the Blackfoot survival depended upon knowing the daily, seasonal and yearly habits of this animal. The Blackfoot encoded their bison ecology knowledge in a mnemonic system of narratives. Yellowhorn (2002:158) ascertained that the Blackfoot oral narrative about ‘the lost boys’ contains information for successfully scheduling a communal bison hunt. He believed that the information in this story is critical to explaining the florescence of communal bison hunting about 2000 years ago with the Besant culture. Yellowhorn (2002:163) postulated that the people who made Besant projectile points were able to meet and cooperate in communal hunts because they were able to organize the logistics of timing of communal kills in early spring. Both Besant culture and Blackfoot winter camps were established by small bands and were dispersed across the landscape. Isolated in these winter camps, people augmented any fresh meat with dried food, and travel during this time was perilous and avoided if possible. Breaking camp and departing for a communal kill location needed a fixed signal that would bring together these small isolated groups. “These assemblies were made possible by the discovery about 2000 years ago that the movement of the constellation known in Blackfoot as ‘the lost boys’, in English as the Pleiades, was an accurate device for timing the buffalo calving season” (Yellowhorn 2002:164).

The ‘lost boys’ story has been recorded from various communities in Alberta and is used to explain the origin of the star motif that appears on the smoke flaps of the Blackfoot tipis. A brief recap of the story as presented in Yellowhorn (2002:172-179) is as follows: After a long and difficult winter, people congregated for the communal bison hunt. Because of the difficult winter, there were not as many bison as usual and a decision was made to distribute the highly sought-after calf skins to families with toddlers and young girls. A family who joined the group late forgot to tell their seven sons of this decision. When the brothers did not receive the calf skins they expected after the hunt, they left the earth to go live in the sky country. In the sky country, they were befriended by Moon who was angry that people would neglect their children and she agreed to keep them. The brothers asked Moon's husband, Sun, to punish their relatives on earth by taking away water for seven days. He did so, and on earth everyone was suffering from the lack of water, including the dogs. The dogs suspected that the lost boys were behind the catastrophe and the chief dog prayed to the Moon and explained why the brothers did not receive any calf robes. He asked moon to forgive the people and when Moon heard the dogs baying, she understood their predicament. She told Sun that the other animals should not have to suffer along with the people and they decided to turn down the heat. Sun told the boys that they would become star people and live in the sky country forever. In the winter night sky, one can see the lost boys travelling their path, but at the time of year when the bison calves have yellow robes they disappear beyond the western horizon to send their vindictive message back to earth. Here, the yellow robes refer to the newly born calf hide, often described as red as opposed to yellow.

According to Yellowhorn (2002:186), the lost boys story aided in the scheduling of communal bison hunts. This scheduling breakthrough allowed bison hunting to transform from local individualist hunts to regional-scale organized communal kills.

Summary

Aboriginal seasonality concepts may differ from the standardized four season paradigm. Their concepts of seasonality are closely related to the changing biophysical environment which provides clues to organize and schedule events. An examination of the moon names used by Plains-adapted groups provides clues as to what some of these important biophysical events may have been. The Siouan language family includes several references to bison ethology, specifically correlating the month of December as when the foetal bison grow large and the month of February as when the foetal bison coat turns red. March and May are identified as calving months. These moon-names associated with foetal bison development and other culturally mediated seasonal land use and subsistence activities, have the potential to enable a method of inferring a more precise estimate of site seasonality.

CHAPTER 07: DISCUSSION

Introduction

An examination of various definitions of subsistence strategy definition reveals dichotomies between generalized/diffuse/extensive and specialized/focal/intensive ends of a continuum. These dichotomies have been perpetuated by various authors when characterizing Blackduck, Vickers and Mortlach subsistence strategies based, for the most part, on qualitative faunal analysis from a limited number of sites. Furthermore, subsistence strategy variation within some archaeological cultures has been interpreted as culture change or evidence of cultural contact, without sufficient temporal control or reference to other material culture classes. For reconstruction of a subsistence strategy, the *minimum* unit of analysis should be a seasonal year (i.e. the entire subsistence round for a group of people), and both plant and animal food subsistence choices should be considered. A comparison of the species diversity and bison processing intensity for the Hokanson, Lovstrom, Jackson, Vera, Sanderson and Twin Fawn faunal assemblage samples enables an examination of these two aspects of animal food subsistence choice. By knowing the season of site occupation as established by application of the FODS, and placing sites within an Aboriginal seasonal framework, the variability of species diversity and bison processing intensity, between sites of the same culture, and between cultures, can be better explained and understood.

Subsistence Strategy Definitions and Their Role in Archaeological Taxonomies

As outlined in Chapter Two, subsistence strategies are considered to be a defining characteristic, often at the highest taxonomic level of archaeological classifications (McKern 1939; Syms 1977). This idea is not unique to archaeologists. Lomax and Arensberg (1977:661) identified subsistence type as one of the most dependable classifiers of culture regions, more so than language. Their study attempted to classify ‘all known cultures’ into a social-evolutionary hierarchy using the following scale of subsistence production:

1. Extractors, harvesters of wild products.

2. Incipient producers, as above but with agriculture.
3. Animal husbanders, as above, but with large domesticated animals to convert vegetation into protein.
4. Plow agriculturalists, as above, but with the plow with animal traction to increase the range and intensity of cultivation.
5. Irrigators, as above, but with control of water for crops (Lomax and Arensberg 1997:661).

They used 17 criteria, 10 of which were subsistence traits that gave rise to the specific order of the developmental stages above, to classify and order 1308 cultures. Their results documented six general stages of subsistence, where extractors consisted of two categories: collectors or hunters and fishers. Collectors obtained at least 40 percent of their diet from collecting roots, berries, seeds or small animals and this was an activity usually carried out by women. Hunters and fishers tended to be men and obtained 40 percent or more of their diet from either hunting or fishing, or 50 percent from hunting and fishing (Lomax and Arensberg 1977:668). Lomax and Arensberg (1977:668) suggested that the term hunter-gatherer is a deceptive misnomer and that “those cultures which live on what the women collect, with extra provision of meat by the men, belong in a category of their own”.

Reaction to this evolution hierarchy included methodology concerns, notably equating subsistence modes with productivity levels, and the exclusion of European mercantile industrialized groups. Also troubling was the use of value-laden terminology such as ‘successful’ and ‘progressive’ to describe and categorize cultures. More troubling was the belief that the classification scheme, based on ethnographic data of living groups, could be used to project evolutionary relationships and create a cultural evolutionary tree (Lomax and Arensberg 1977:702-705). The scheme however, can be useful as a descriptive tool, and the five stages of subsistence are standard strategies presented usually as modes or types rather than stages in introductory social anthropological text books. Although these five modes may be useful on a world scale, the complexity of ‘extractors’, including subsistence mode variations, has since been recognized (Arnold 1996; Lee and Daly 1999; Price and Brown 1985).

Archaeological subsistence strategy concepts and definitions have been derived mostly from ethnographic or ethnoarchaeological studies. Many of these have maintained some elements of the extractor versus collector dichotomy, but have introduced new terminology. Cleland (1966, 1976) distinguished between focal and diffuse economic adaptations where the focal pattern is centered on a single, or a few species exploited by similar tools and techniques. A diffuse adaptation required careful scheduling to exploit a wide variety of different resources (Cleland 1976:61, 64). Similarly, Dunnell (1972) distinguished between extensive human systems which exploit a wide array of resources, and intensive human systems which exploit only a few resources. Grayson (1984:131) used the terms generalist and specialist to describe societies that feed on a wide variety of organisms in roughly equal numbers, and those that prey on fewer taxa but utilize larger numbers of those taxa. Cleland (1976:60-61) visualized the focal-diffuse model as a continuum with the two ideal types at polar extremes. He recognized that few adaptations would be purely focal or diffused, but argued that they would cluster at one end or the other because the complexities of energy commitment precluded the development of an adaptation somewhere in the middle.

The previous distinctions were all based on the number or type of taxa exploited. Binford (1980) distinguished how food resources were obtained and he differentiated between foragers, as exemplified by the San of Africa, and logistical collectors such as the Nunamiut. Foragers in this sense do not store food, but gather it daily and procure it on an encounter basis and return to residential bases each evening (Binford 1980:05). Logistical collectors are characterized by food storage for at least part of the year, and by specialized food procurement task groups that leave residential bases for extended periods to specifically selected locations to procure specific resources (Binford 1980:10).

While some archaeological subsistence strategy terms such as big game hunting do not require an explicit definition to understand the concept, other terms such as hunter-gatherers, foragers, generalized foragers, broad-spectrum foragers, hunter-foragers, forager-farmers or bison-hunting farmers are much more ambiguous (Ahler and Kay 2007; Hamilton et al. 2011; Nicholson and Hamilton 2006; Robertson 2006; Webster 2004). Does foraging in these cases refer to Binford's concept (1980) with the implied settlement pattern? Or is it used as a synonym for hunter-gatherers as used by Lee and Daly (1999:03), to mean a subsistence based on hunting of wild animals, gathering of wild plant foods, and fishing, with no use of domesticated plants or animals except for the dog? Combined terminology such as diffuse hunter-gatherers or forager-farmers and use of the term focal, as in focal wild ricers or focal bison hunters is also problematic. Not because the general ideas may be inadequate or misunderstood, but because the precise definition of the terms was not specified. Where is the dividing line between foraging and farming, or between foraging and specialized bison hunting? What is the difference between bison hunters and specialized bison hunters? At what point along the continuum is the shift? Furthermore, how do we identify these sometimes very subtle, undefined distinctions in the archaeological record, particularly as subsistence orientation shifted with seasonal availability?

Distinguishing the individual components of a subsistence strategy can provide some answers, but such an approach has largely been ignored in the literature. The term subsistence relates to the food getting or the food sources, and a strategy would be the decision making processes associated with acquiring such resources. Lyman (1982:335) defined a subsistence strategy as how site inhabitants made a living in terms of animal food. Renfrew and Bahn (2004:275) provided a more comprehensive definition as the quest for food documented by plant and animal food preparation and discard products. They also distinguished between meals and diet. Meals are direct evidence of the various foods people were eating and diet is their consumption pattern over a long period of time. Floral and faunal remains from archaeological sites are remnants of meal preparation and discard. The collective assemblages for a specific archaeological culture would be representative of their diet and would reflect the subsistence strategy of that group.

When the subsistence *strategy* of an archaeological culture is interpreted, it should represent all aspects of diet, both plant and animal, and because of the seasonal availability of resources, must represent an entire seasonal year.

> The subsistence group is that group of people who regularly cooperate in the production and exchange of food, as long as the food produced supplies the minimum amount of energy necessary to maintain the group. Although we must be concerned with the specific resources and exploitative techniques employed by this group, the long term cycle of repetitive choices in energy expenditure through a total subsistence round determines the adaptive patterns. The fact that the *total* subsistence round is the minimal unit of consideration is vital to the focal-diffuse concept (Cleland 1976:59-60, emphasis in original).

The subsistence strategy interpretations of Blackduck, Vickers and Mortlach have not been based on a quantified analysis of both plant and animal foods, and rarely considered the entire subsistence round. There is a growing realization that subsistence strategies are much more diverse and complex across the entire Plains culture area than previously considered (Dering 2008; Hamilton et al. 2007; Koch and Bozell 2003; Kornfeld 2003; Lints 2012; Scheiber 2007; Syms and Spiers 2012; Waguespack and Surovell 2003; Wandsnider 1999). In light of these findings, does this invalidate attempts to analyze and interpret only faunal or only botanical remains? The answer is no. Separate faunal and botanical studies still provide valuable insight on a range of subjects from proposed site activity, paleoenvironmental reconstruction, seasonality, social organization, to trade patterns as well as subsistence. It is only with data integration that a more complete picture of archaeological subsistence strategies can be accomplished. To fully address Blackduck, Vickers and Mortlach subsistence strategies, the faunal and botanical assemblages from a range of sites occupied during different seasons need to be analyzed in a consistent manner, enabling inter-site comparisons. When only one aspect of subsistence (i.e. animal food or plant food) is being addressed, it is a subsistence choice that is being analyzed, not an entire strategy. It is suggested here that the two animal food subsistence choices of species diversity and intensity of bison processing can be compared for the Hokanson, Lovstrom, Jackson, Vera, Sanderson and Twin Fawns sites because all faunal samples were analyzed following similar procedures, the excavation history for each site is known and all are located within environments of similar biological diversity. The season of site occupation, while not identical for each site, has been estimated and can be contextualized using Aboriginal concepts of seasonality.

Variability of Species Diversity

Previous studies of Blackduck, Vickers and Mortlach subsistence choices have examined species diversity by describing or presenting a list of identified species for various sites and observing which sites had the greatest number of identified taxa (Hamilton et al. 2007; Nicholson 1987a; Nicholson et al. 2011; Playford, 2001a, 2010; Playford and Nicholson 2006; Syms 1977). As discussed in Chapter Four, the number of species present in an assemblage can be closely related to sample size and the use of a diversity index is recommended. The species diversity results from Chapter Four are presented below with all categories ordered from greatest to least (Table 7-1).

Table 7-1: Ranked species diversity results.

MNI		Nspecies		Evenness		Shannon index of diversity	
Jackson	40	Sanderson	21	Twin Fawns	0.880	Sanderson	2.466
Sanderson	39	Vera	19	Vera	0.827	Twin Fawns	2.438
Vera	35	Jackson	16	Jackson	0.815	Vera	2.434
Twin Fawns	26	Twin Fawns	16	Sanderson	0.810	Jackson	2.259
Hokanson	20	Hokanson	9	Hokanson	0.776	Hokanson	1.706
Lovstrom	20	Lovstrom	7	Lovstrom	0.590	Lovstrom	1.148

The species diversity reflected in the Sanderson, Twin Fawns and Vera faunal samples are almost identical, with the Jackson sample exhibiting a similar level of diversity and the Blackduck sites exhibiting the lowest species diversity. It is also worth noting that the Shannon index of diversity closely mimics the species richness (Nspecies). These results would suggest that the two Mortlach sites, consistently identified in the literature as ‘specialized bison hunters’ have the highest level of species diversity of the six selected sites. The evenness index indicates that all sites except Lovstrom have a relatively even species distribution. What these indices do not impart is the relative importance of the different taxa.

Waguespack and Surovell (2003) addressed this question when determining whether Clovis subsistence was specialized or generalized. The initial discovery of Clovis artifacts with extinct megafauna in the early to mid-1900s, coupled with the high visibility and hence oversampling of large animal kill sites in the archaeological record, has led to their classification as specialized big game hunters. Critiques of this model acknowledge that Clovis people killed large game occasionally, but suggest that the bulk of their diet was comprised of small game and plant resources, and that the majority of Clovis sites represent a generalist subsistence strategy rather than a specialized one (Olsen 1990; Stanford 1999).

Waguespack and Surovell (2003) recognized the need to define these terms and stated that generalists would utilize a broad range of species, and specialists would exploit a more narrow range. The optimal diet-breadth model postulates that return rates are maximized by focusing on taxa whose return rates exceed the average environmental return rate, leading to the proposal that taking low-ranked taxa lowers overall return rates. According to this model, specialized subsistence strategies will be present in environments where high-ranked items are frequently encountered, and/or return rates for highly-ranked prey is far greater than the low-ranked items. A generalized strategy would be expected where high-ranked taxa were rare or were difficult or risky to capture, or where little variation exists in return rates among prey.

Variability of environmental and species-specific return rates, as well as differences within a human population related to age, skill and technology, in addition to mobility can all potentially influence diet breadth. For example, if a low-ranked prey item is encountered with minimal handling costs, the effective return rate of that item will increase and it will likely be exploited. For these reasons, the number of utilized taxa is not a good measure of subsistence specialization, but instead, the relative degree to which taxa were exploited when encountered is considered to be the critical variable. Since generalists are believed to exploit prey items upon encounter, prey frequencies in the archaeological record should be positively correlated with encounter rates. Because encounter rates for archaeological assemblages are unknown but are thought to be primarily a function of population density, estimated population densities can provide a reasonable measure for encounter rates. Waguespack and Surovell (2003:338) further contend that relative precontact population densities can be estimated based on animal size. This is because equal amounts of biomass will be consumed either by many small-bodied animals, or fewer large-bodied animals. A negative correlation should exist for specialists between encounter rates (estimated by animal size) and archaeological abundance, because high-ranked prey are generally larger-bodied animals that tend to have low population densities.

For their study of Clovis subsistence, Waguespack and Surovell (2003:342) analyzed the faunal assemblages from 33 sites and found a strong negative correlation between body size class and MNI values. Mammoth and/or mastodon were the most consistent component of the faunal assemblages and when small game was present, it represented a broad range of species. These results are taken to support the interpretation that Clovis people were large game specialists. A similar calculation of the Spearman Rank Correlation coefficient between taxa size and MNI values for the six selected sites was undertaken. For this correlation, taxa size was equated with animal size class as outlined in Chapter Four. No site had a significant negative correlation between MNI values and taxa size (Table 7-2). Instead, the Sanderson and Lovstrom site taxa are strongly positively correlated with body size and all other sites exhibit either weak negative (Jackson, Vera and Twin Fawns) or weak positive (Hokanson) correlations.

Table 7-2: Spearman Rank Correlation between taxa size and MNI values.

	Spearman Rank Correlation	Degrees of Freedom	Probability
Sanderson	0.971	4	0.01
Lovstrom	0.647	4	0.1
Hokanson	0.075	4	0.09
Vera	-0.086	4	0.8
Jackson	-0.214	4	0.6
Twin Fawns	-0.319	4	0.5

These results all seem to suggest that none of the site inhabitants were selectively choosing one size taxa over another and that all sites represent a generalized subsistence strategy. However, visual representations of the identified taxa show that bison is the only large mammal consistently recovered from every site. When NISP values are considered, bison represent the dominant recovery from all sites (Figure 7-1). The Twin Fawns assemblage has the lowest percent of bison NISP (61 percent) while the Jackson site has the highest (94 percent). Because fragmentation rates can influence NISP values, the MNI values are also presented (Figure 7-2). The MNI results are significantly different from the NISP values and indicate that bison remains only dominate in the Hokanson and Lovstrom faunal assemblages. When smaller animals are recovered, each taxa is represented by one or a few animals for most of the sites. According to Waguespack and Surovell (2003:342) this would be indicative of a specialized subsistence strategy.

What is interesting to note with the MNI distributions is the relatively high number of SC6 animals (bison), the high numbers of SC 1 and 2 animals (voles, etc.) and the relatively low numbers of medium-sized animals for most sites, with the exception of the Lovstrom and Sanderson sites. When the dietary contribution of each species is considered, bison undoubtedly contributed the most meat and food products to the diet for the inhabitants of each site. For this reason, all site inhabitants are considered to have relied primarily on bison for animal food subsistence.

Before other statements can be proposed about the subsistence choice of species diversity for these Blackduck, Vickers and Mortlach sites, screen size is an important factor that must be considered. It has been well established that screen size influences the number of identified taxa (Casteel 1972; Gordon 1993; Shaffer 1992b; Shaffer and Sanchez 1994). Although Vale and Gargett (2002) argued that finer mesh does not correlate with increased taxa and that it simply increases the number of identified specimens per taxa, their study considered only fish remains which are distinctly different from small vertebrate remains. A study by Shaffer and Sanchez (1994) was undertaken on the recovery rates of small and medium mammals using quarter (6.35 mm) and one-eighth (3.175 mm) inch mesh size. They concluded that more elements and elements of smaller taxa were recovered using the smaller mesh size, and the increase was most notable for animals weighing between 18 and 340 g. It is not surprising that

Figure 7-1: Site taxa NISP counts.

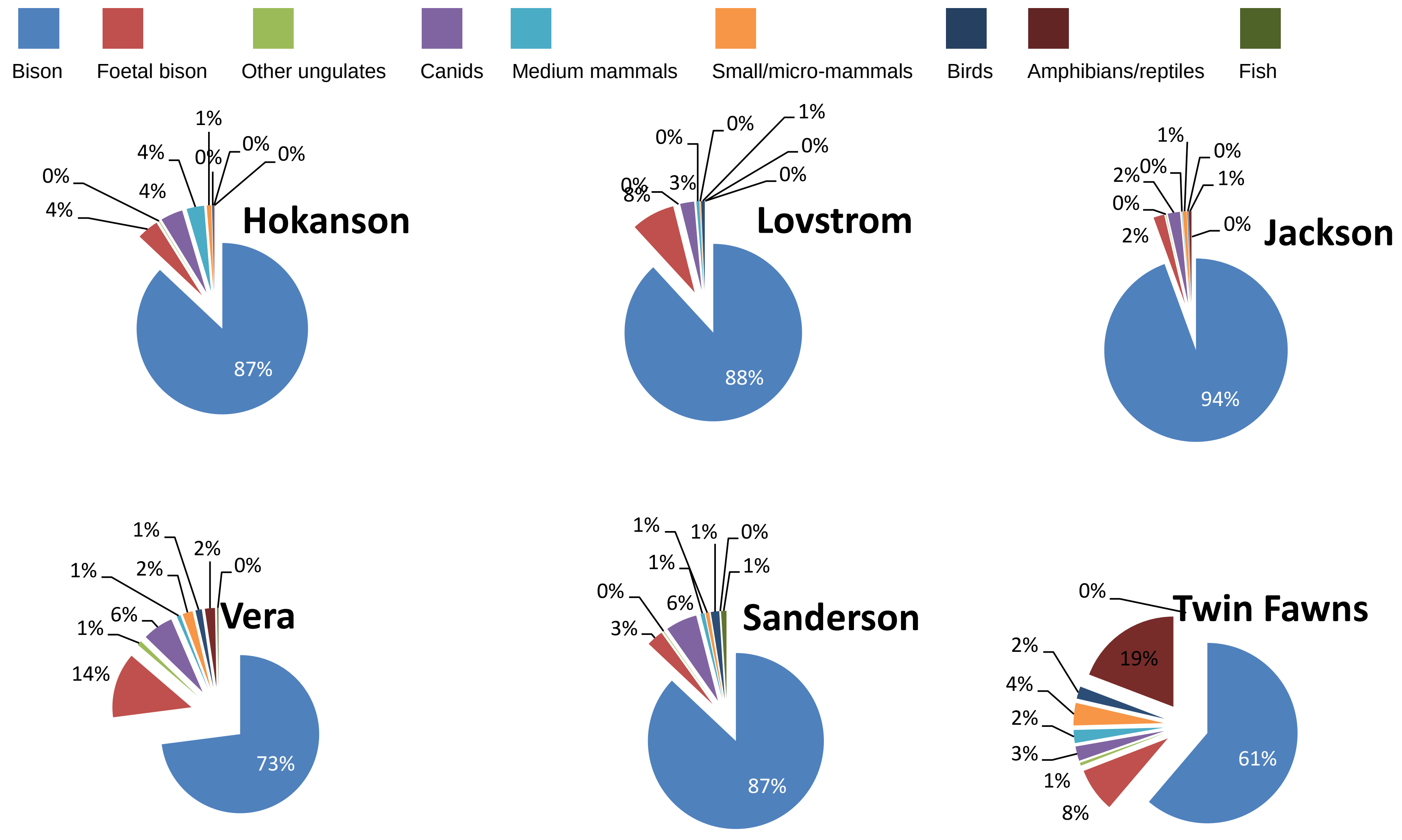
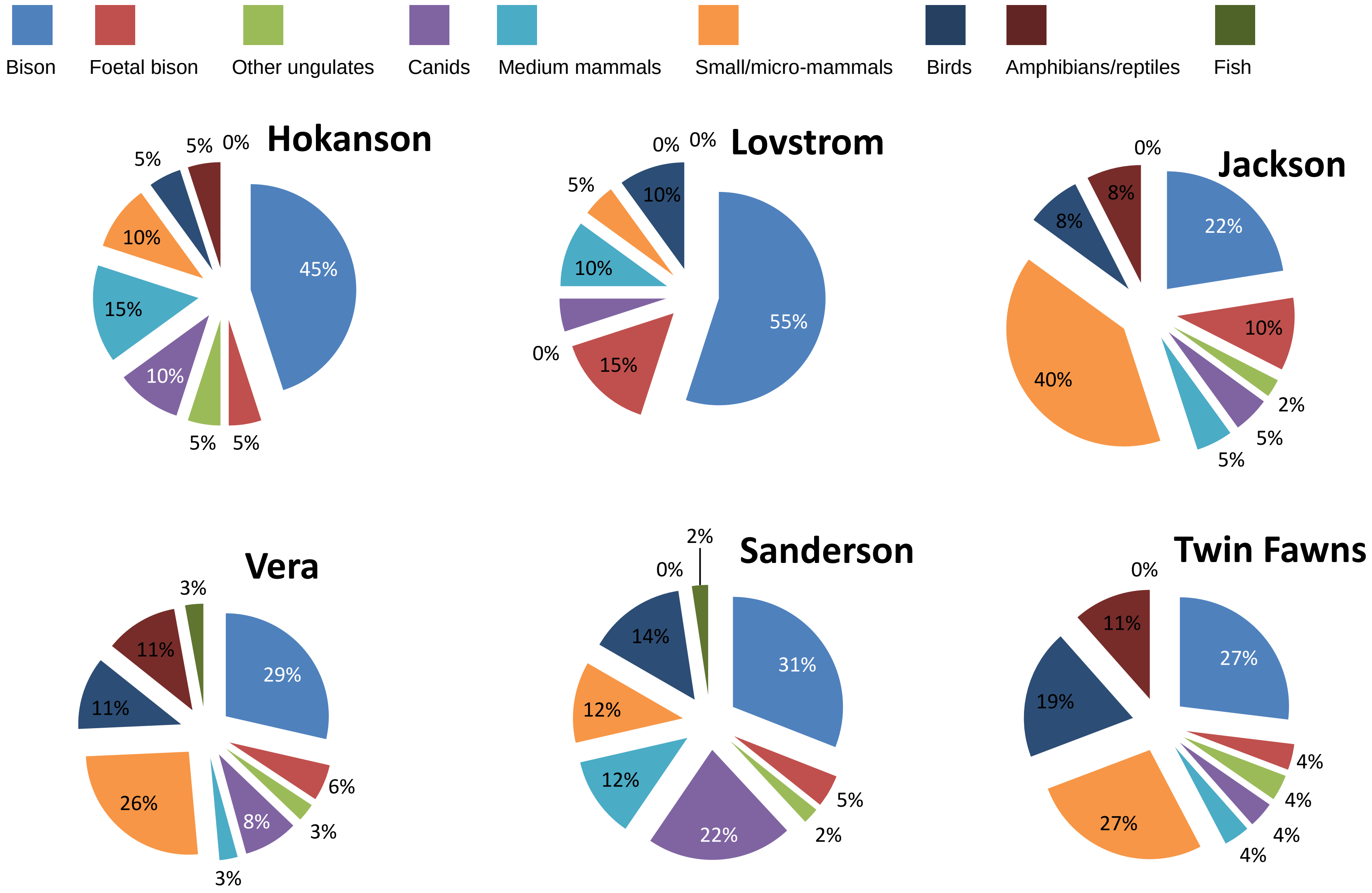


Figure 7-2: Site taxa MNI counts.



the two sites screened using the larger mesh size, Hokanson and Lovstrom, have the lowest species diversity. The Sanderson site, also screened using 6.35 mm mesh has the highest diversity, but ‘some’ of the faunal assemblage was fine screened using a 2.0 mm mesh (Magee 1997:33). While this explains why the Sanderson site species diversity is higher than that of the Hokanson and Lovstrom assemblages, it does not explain why it has the highest diversity.

Comparing the species diversity index of these six sites without taking into account the screen size bias has the potential to produce deceptive results. To account for the differences in screen size, the SC 1 and SC 2 taxa were removed from the Vickers and Mortlach site faunal samples, and the species diversity indices were recalculated (Table 7-3). The removed size classes correlated closely with the 18 to 340 g specimens not recovered in the Shaffer and Sanchez (1994) study.

Table 7-3: Recalculated species diversity indices with SC 1 and SC 2 taxa removed.

MNI		**Nspecies**		**Evenness**		**Shannon index of diversity**	
Sanderson	38	Sanderson	20	Sanderson	0.804	Sanderson	2.409
Jackson	25	Vera	11	Hokanson	0.776	Vera	1.779
Vera	23	Hokanson	9	Twin Fawns	0.769	Hokanson	1.706
Hokanson	20	Jackson	9	Vera	0.742	Jackson	1.608
Lovstrom	19	Twin Fawns	8	Jackson	0.732	Twin Fawns	1.600
Twin Fawns	15	Lovstrom	6	Lovstrom	0.558	Lovstrom	1.000

With the recalculated results, the Sanderson site maintains a high level of diversity but Twin Fawns, Vera and Jackson diversity levels are now similar to that calculated for the Hokanson sample, and the Lovstrom site still has the lowest diversity. While it may seem counterintuitive to remove identified taxa from a species diversity index, it is the only way to make valid comparisons between these six sites. In summary, the inhabitants of all six sites relied primarily on bison food products for sustenance. People processing food at the Hokanson, Lovstrom, Jackson and Vera sites were incorporating similar numbers of non-bison animal foods into their meals, while the Lovstrom site inhabitants were processing the fewest number of non-bison species.

Variability of Bison Processing Intensity

Processing of the bison carcass for foodstuffs encompasses several steps. Activities such as obtaining muscle, fat, organs, etc. from the animal and preparing them for immediate consumption, or preserving them for later use is most cost effective in terms of return rate (Lupo 2006). These activities, however, can either leave few archaeological signatures or the signatures can be obliterated by subsequent processing for grease and marrow. Marrow extraction and grease rendering are both time and labour intensive activities, resulting in a reported lower economic return (Binford 1978; Brink 1997). The decision to invest increased time and energy for a lower caloric return product has been interpreted as a processing choice reflective of specialized bison hunters, or alternatively that the site inhabitants were experiencing nutritional stress (Binford 1978; Church and Lyman 2003; Magee 1997; Outram 2002b, 2003; Playford 2001a, 2010).

As outlined in Chapter Four, determining whether an assemblage had been processed for marrow and grease might be accomplished by comparing the frequency of marrow and grease rich elements in an assemblage to the rank order for marrow and grease established for each element. Positive correlations would indicate that elements high in grease or marrow were present in the site while negative correlations would indicate they were absent from an assemblage.

The results of both sets of bison economic utility indices are presented in Table 7-4 and are ordered from least to most processed. These results of the (S)MAVGMAR index suggests that marrow rich elements were not present in the Jackson assemblage, were minimally present in the Vera assemblage and the other site inhabitants were not actively selecting marrow rich bones.

Table 7-4: Ranked bison economic utility indices.

(S)MAVGMAR		(S)MAVGGRE		GI		(S)MAVGTP		BUI	
Sanderson	0.19	Twin Fawns	0.19	Hokanson	-0.17	Twin Fawns	0.05	Hokanson	0.16
Hokanson	0.00	Sanderson	0.12	Sanderson	-0.20	Hokanson	0.02	Twin Fawns	0.02
Twin Fawns	-0.14	Hokanson	0.03	Twin Fawns	-0.49	Sanderson	0.01	Sanderson	0.01
Lovstrom	-0.15	Lovstrom	-0.39	Jackson	-0.63	Lovstrom	-0.18	Lovstrom	-0.42
Vera	-0.41	Jackson	-0.62	Lovstrom	-0.78	Jackson	-0.40	Jackson	-0.43
Jackson	-0.63	Vera	-0.65	Vera	-0.84	Vera	-0.63	Vera	-0.62

(S)MAVGMAR=standard modified average marrow index; (S)MAVGGRE=standard modified average grease index; GI=grease index; (S)MAVGTP=standard modified average data total products index; BUI=bone utility index

Two grease utility indices were created, the (S)MAVGGRE and the GI, using slightly different methodologies, but the results of both are fairly similar for the selected sites. The (S)MAVGTP attempts to address a general utility encompassing all processing decisions including meat use, so it included axial elements, while the BUI combined the economic utility of marrow and bone grease into a single index and examined proximal, midshaft and distal appendicular long bones. Although the correlations vary slightly, they are consistent and the relative site order is almost identical. The Vera faunal assemblage is missing the greatest number of higher ranked elements. The Lovstrom and Jackson sites mostly have mostly weak negative correlations. The remaining three sites have weak positive correlations, approaching zero, suggesting that there was no correlation between the general utility of bison elements and their recorded frequency for each site.

Interpreting the bison economic utility indices results is not quite as straightforward as simply equating strong positive correlations with marrow and/or grease processing activities. This is due to the nature of these activities, especially bone grease rendering, which can effectively destroy elements and removes them (or at least removes the ability to identify them to a specific element) from the archaeological record. Bone grease rendering usually occurs after marrow removal (Binford 1978; Brink and Dawe 1989; Emerson 1990; Vehik 1977). A strong negative correlation between marrow and grease index values and element frequency could also be indicative of these activities, and this is the scenario considered by both Magee (1997) and Playford (2001a, 2010) for the previous Sanderson, Jackson and Vera site subsistence interpretations.

When all three indices are considered together, the Vera and Jackson sites have negative correlations with all indices. This negative correlation is interpreted here to mean that these elements were processed for marrow and grease to the extent that they are invisible in the archaeological record. The relatively weak (either positive or negative) correlations between all indices and the remaining three sites is interpreted as minimal selection for grease or marrow elements. One outlier is the negative correlation (-0.49) between the Twin

Fawns faunal sample and the grease index developed by Brink and Dawe (1989). This result is markedly different from the weak positive (0.19) correlation with Emerson’s (1990) grease index. This difference is likely due to the high frequency of low ranking elements such as the scapula and central and fourth tarsal being incorporated into the (S)MAVGGRE. When these were removed from the sample and the (S)MAVGGRE was recalculated, a negative weak correlation (-0.19), similar to the GI, was calculated. None of the indices had a strong negative or positive correlation with the Hokanson faunal assemblage, suggesting that marrow and grease rich elements are neither over nor underrepresented in the Hokanson assemblage.

The use of bison landmarks to extrapolate MNE values rather than counting the frequency of whole or proximal and distal long bone ends has the potential to inflate the frequency of recorded specimens. For example, the proximal tibia is ranked highest in the (S)MAVGMAR index and the Vera site faunal sample has a frequency of one proximal tibia. However, this is based on the presence of a single lateral condyle. The use of derived MNE values based on landmark presence was deemed necessary because of the fragmented nature of most of the site assemblage samples.

While there is little doubt that these indices measure the available amount of marrow, grease and general products for each bison element, it is questioned whether economic utility alone explains bison processing behaviour (Lupo 2006). Consideration of other factors can influence human behaviour. For example, neither index attempted to account for marrow or grease quality. Binford (1978) considered oleic acid content to be the key dimension in the Nunamiut evaluation of bone marrow and he included it, as well as processing time, into his caribou economic utility indices. Oleic acid is an unsaturated fatty acid that remains in liquid form at room temperatures. In terrestrial ungulates, the proportion of unsaturated fats increases with distance from the body core (Morin 2007:741). Although the Nunamiut expressed a preference for oleic rich elements, they did not process the phalanges, which have the highest percent of oleic acid (Jones and Metcalfe 1988:419).

Both Brink (1997) and Morin (2007) disagreed with Binford and stated that economic utility can accurately measure processing behaviours based solely on quantity of marrow and grease. Morin (2007) re-examined Binford's marrow and grease indices and found that although the Nunamiut expressed a preference for marrow of high quality (high oleic acid), they selected elements with the greatest quantity of marrow regardless of oleic content. This explains their decision to not process the phalanges which provide small amounts of high oleic acid marrow. Morin (2007:80) suggested that the desirability for high oleic content marrow may be a function of palpability as well as storage, for unsaturated fatty acids become rancid more quickly than saturated ones.

With the exception of Emerson (1990), bison utility indices were usually calculated for long bones only and did not include axial elements, carpals, tarsals or phalanges (Binford 1978; Brink 1997; Jones and Metcalfe 1988; Metcalfe and Jones 1988). Zierhut (1967:35) observed that the only bones not broken by the Calling Lake Cree for either marrow or grease were the carpals, tarsals and phalanges. Binford (1978:165) observed processing of caribou carpals and tarsals for grease by pounding them with a steel axe and stone anvil prior to boiling. The astragali and calcanei were fragmented but the other carpals and tarsals remained whole. Marean (1991:680) argued that bovid and cervid carpals and tarsals have little to no grease or marrow and should only rarely be processed for consumption. The Nunamiut were not observed processing low ranking elements like phalanges for marrow, although elders recounted using them during times of food scarcity in the past. This led Binford (1978:32) to the conclusion that the intensity of phalanx processing can be used as a measure of subsistence stress.

Jones and Metcalfe (1988) estimated the return rates for caribou marrow and came to the same conclusion. They divided the caloric marrow yield of each element by the time the Nunamiut took to process the element as described by Binford (1978). They found that the tibia had the highest caloric yield (1670kcal/hour) and the second phalanx had the lowest (57kcal/hour), and that the Nunamiut would only process elements with caloric yields greater than

500kcal/hour. The cut-off point between processed and unprocessed fell between the metacarpal and the mandible. As the availability of high-ranked food items decrease, bison subsistence choice will expand to include lower ranked items such as the mandible, followed by the pelvis, scapula and then the phalanges (Jones and Metcalfe 1988:222-223).

Assessing the percent completeness (%CN) of both the high and low ranking marrow and grease bison elements may provide further insight to these activities. The %CN was calculated in Chapter Four for all the bison elements from all six sites. Because the marrow, grease and total utility indices measure different products, and were created using different methods, the ranked order of the elements are not identical. However, the proximal and distal ends of the femur, humerus and tibia were consistently the highest ranked elements for marrow and grease, and when the axial elements are removed from the total product index by Emerson, the highest ranked in all indices. A comparison of the %CN of these high ranked elements (Table 7-5) indicates that all sites exhibit fragmented bison elements high in marrow and grease. No consistent pattern is apparent for the %CN of these three elements within or between archaeological cultures other than Vera and Jackson sites, as they are the only sites that have elements less than five percent complete. The majority of the elements from most of the sites are between five and 10 percent complete, although the tibia is over 10 percent complete in the Vera, Twin Fawns, and Hokanson site assemblages. The Twin Fawns assemblage had a relative high %CN for the femur (12.9) and the Sanderson site had relatively high %CN for the humerus (10.3).

Table 7-5: Comparison of %CN for high ranked grease and marrow bison elements.

Femur		Humerus		Tibia	
Vera	1	Jackson	1	Jackson	2
Lovstrom	6	Vera	6	Sanderson	5
Jackson	5	Twin Fawns	6	Lovstrom	6
Sanderson	9	Lovstrom	7	Vera	11
Hokanson	9	Hokanson	7	Twin Fawns	12
Twin Fawns	13	Sanderson	10	Hokanson	14

A comparison of the low ranking elements might be more informative as suggested by Binford (1978). The lowest ranked elements of the utility indices were the metapodials and the radius. When the %CN for these elements are compared (Table 7-6), the Lovstrom and Hokanson elements are notably more complete than those recovered from the other sites. Screen size should have no or minimal bias on these comparisons because landmarks are usually of sufficient size to be recovered with the larger screen size.

Table 7-6: % CN for low ranked utility indices for all six sites.

Metacarpal		Metatarsal		Radius	
Twin Fawns	6	Vera	6	Jackson	9
Vera	9	Sanderson	8	Twin Fawns	9
Jackson	14	Jackson	8	Sanderson	10
Sanderson	19	Hokanson	14	Vera	14
Hokanson	20	Twin Fawns	19	Hokanson	18
Lovstrom	33	Lovstrom	26	Lovstrom	21

When the carpals and tarsals are compared (Table 7-7 and Table 7-8) two patterns emerge. The carpals are less fragmented than the tarsals for all sites, and the Lovstrom site has the most complete carpals and tarsals. The Jackson and Sanderson sites have the highest number of fragmented carpals; only the central carpal was fragmented in the Vera site assemblage, and the other sites have no fragmented carpals.

Table 7-7: %CN for carpals for all six sites (np=not present in assemblage).

Radial		Central		Ulnar		2/3		4th	
Sanderson	91	Twin Fawns	np	Sanderson	91	Jackson	57	Twin Fawns	np
Twin Fawns	100	Jackson	77	Twin Fawns	100	Sanderson	75	Jackson	55
Vera	100	Sanderson	79	Vera	100	Twin Fawns	100	Sanderson	100
Jackson	100	Vera	83	Jackson	100	Vera	100	Vera	100
Lovstrom	100	Lovstrom	100	Lovstrom	100	Lovstrom	100	Lovstrom	100
Hokanson	100	Hokanson	100	Hokanson	100	Hokanson	100	Hokanson	100

np=not present

Table 7-8: %CN for tarsals for all six sites.

Lateral Malleolus		Astragalus		Calcaneous		C/4		2/3	
Vera	86	Sanderson	50	Sanderson	23	Jackson	48	Hokanson	80
Hokanson	100	Jackson	59	Vera	23	Vera	50	Jackson	89
Lovstrom	100	Vera	70	Jackson	27	Sanderson	71	Vera	92
Jackson	100	Hokanson	80	Hokanson	50	Hokanson	78	Lovstrom	100
Sanderson	100	Lovstrom	100	Lovstrom	63	Lovstrom	100	Sanderson	100
Twin Fawns	100	Twin Fawns	100	Twin Fawns	100	Twin Fawns	100	Twin Fawns	100

All the tarsals from the Twin Fawns and Lovstrom sites are complete while all the tarsals for the Vera and Jackson site are fragmented. The small tarsal bones such as the lateral malleolus and second and third tarsal from the Sanderson sample are complete, but the large tarsals consisting of the astragalus, calcaneus, and central and fourth tarsal are fragmented. A similar scenario is observed in the Hokanson sample.

If the fragmented carpal and tarsal elements are a result of food processing behaviour, it would suggest that the inhabitants of Jackson, Vera and Sanderson sites were intensively processing bison for marrow, whereas the Lovstrom and Twin Fawns site inhabitants were not. The Hokanson site inhabitants were processing the bison skeleton more intensively than were the inhabitants of the Lovstrom and Twin Fawns sites, but less so than the people at the Jackson, Vera and Sanderson sites.

However, carpal and tarsal bones can become fragmented in other ways. Consistent bone breakage patterns have been explained as part of the butchery process. For example, removal of the *tuber calis* on the calcaneus is chopped loose to remove the relatively small gastrocnemius muscle (Frison 1970:16) and this pattern was interpreted for the Jackson site calcanei (Playford 2001a:128). Some question whether these elements would be used as food. Marean (1991), in his study on post-depositional bone breakage patterns, argued that carpal and tarsal bones were rarely utilized by humans for food. They are also structurally dense and compact, so he argued that fragmentation of these elements would indicate post-depositional destruction such as carnivore modification or sediment loading.

A study undertaken by Darwent and Lyman (2002) specifically addressed the post-depositional destruction of carpals, tarsals and phalanges and found that spherical compact bones do have minimal grease, and virtually no marrow value. However, phalanges and the calcaneus were more rod-like than spherical, did have nutritional value and there are accounts of these elements being utilized for food. They further observed (Darwent and Lyman 2002:265) that contrary to popular belief, the intentional breakage of carpals, tarsals and phalanges does not necessarily leave prominent, easily recognized impact marks. For example, the 10 astragali they broke with a hammerstone produced 70 pieces, and of these pieces, only 17, or 12 percent clearly displayed percussion damage.

Magee (1997) hypothesized that the slab fractures observed on the Sanderson site carpals and tarsals might be a result of frozen limb butchery rather than processing for marrow. Morlan (1994c:773) suggested that this fracture pattern, extending across both articular ends of an element, could be a function of processing frozen limbs. He hypothesized that the frozen joints might behave as brittle solids, and the fracture fronts would travel through the epiphysis of the impacted longbone into the adjacent carpals or tarsals. To test this hypothesis, Magee (1997:237-243) undertook an experimental study of fresh and frozen bovine limbs with attached carpals and tarsals. He froze eight limbs, four of each leg, for two weeks then thawed one set of legs for 48 hours before smashing them with an axe. The second set of limbs he left frozen for processing. He found that a mixture of fresh and dry fracture patterns were observed on the frozen limb elements while only fresh fracture patterns were observed on the thawed limbs. Processing of the frozen limbs also resulted in severe destruction of the metapodial bones, but did not fragment the carpals and tarsals. The similar fracture morphology of the limb elements, underrepresentation of metapodials, and presence of stacked limb elements at the Sanderson site was presented as evidence of frozen meat cache storage and subsequent butchery of frozen bison limbs.

Outram (2004a) also undertook a study of bone fracture morphology on fresh and frozen limb elements. In his study, he attempted to replicate marrow and grease extraction behaviour as described in the ethnohistorical literature. In particular, he noted reference to the stock-piling of limbs for fat extraction. Both the Nunamiut (Binford 1978) and Hidatsa (Wilson 1924) recount saving limb elements until a later date, then warming the bones either by the fire or in water prior to processing. Outram (2004a:56) fractured fresh limbs and limbs that had been frozen for two, four and twenty weeks which were thawed prior processing. A set of limbs frozen for ten weeks were fractured without thawing. He also applied various amounts of oven and radiant heat as well as boiling limbs that had previously been frozen. An examination of the fracture outline, texture edge and angle were recorded for each category, and Outram (2004a:62) concluded that bones subject to marrow extraction as described in the ethnohistorical literature would exhibit a mixture of dry and fresh bone breakage patterns. Unlike Magee (1997), Outram (2004a) created an index to quantify the mixture of fresh and dry bone break which he correlates with marrow and grease processing.

These results bring into question the interpretation of frozen limb element processing at the Sanderson site based solely on the presence of mixed fresh and dry bone breakage morphology. Outram (2004a) did not process carpals and tarsals and the experimental study undertaken by Magee (1997) did not result in fracture patterns observed on the Sanderson site carpal and tarsal bones. Magee (1997:212-213) dismissed the possibility that the fragmented carpal and tarsal bones in the Sanderson assemblage were a result of processing because there were few impact scars on the elements. However, as Darwent and Lyman (2002) reported, obvious impact scars are not reliable indicators of carpal or tarsal processing.

Darwent and Lyman (2002:360) suggested that because the phalanges contain more marrow and grease, they should be utilized before carpals and tarsals and for the same reason, the first phalanx is more likely to be broken than the second. Because the calcaneus is more rod-like with more marrow and grease, it will be relatively more broken than the other tarsals. This is the observed pattern for the thesis sites, as the calcaneus is the most fragmented from all sites with the exception of the Twin Fawns site, where none were fragmented. The fragmentation of this element could be a result of either processing for marrow and grease or as part of the butchery process as indicated by the Jackson site material.

A comparison of the %CN for the identified phalanges may help determine if the carpal/tarsal fragmentation is due to processing for fat (Table 7-9). As highlighted by Darwent and Lyman (2002), if being processed for food, one would expect the first phalanx to be the most processed, followed by the second then the third which has no marrow and virtually no grease content. Processed phalanges would seem to indicate the most intense grease processing activity.

The %CN for the first, second and third phalanges of each site are presented in Table 7-9. The Jackson site has the most intensively processed first phalanges while the Lovstrom and Hokanson site elements are relatively complete. Those from the Vera, Sanderson and Twin Fawns sites are between 60 and 75 percent complete. A similar pattern is evident for the second phalanges although the Jackson site elements are less fragmented than the first phalanges were. These results corroborate Darwent and Lyman's (2002) observations and indicate that phalanx marrow was being intensively processed by the Jackson site inhabitants, to a lesser degree by Vera, Sanderson and Twin Fawn site inhabitants, and was virtually ignored by the Lovstrom and Hokanson site inhabitants.

Table 7-9: %CN of phalanges for all six sites.

1st Phalanx		2nd Phalanx		3rd Phalanx	
Jackson	25	Sanderson	67	Jackson	30
Vera	61	Jackson	70	Sanderson	56
Sanderson	64	Vera	76	Hokanson	57
Twin Fawns	76	Hokanson	83	Lovstrom	69
Hokanson	97	Twin Fawns	91	Vera	70
Lovstrom	100	Lovstrom	100	Twin Fawns	71

The fragmented third phalanges, especially in the Lovstrom sample, requires an explanation. There is no marrow in the third phalanx (Jin and Mills 2011:1801), so if phalanx breakage is a factor of fat extraction, the third phalanx should be the least utilized. In the Lovstrom assemblage, where neither the first nor the second phalanx is fragmented, it is unexpected to have fragmented third phalanges. Jin and Mills (2011) provided a potential explanation. They observed split and fragmented phalanges from sites in China where there was little evidence of food scarcity based on the minimal processing of other elements. They suggest that processing of disarticulated phalanges in conjunction with extraction of the third phalanx digital cushion would be a high return endeavour. The digital cushion is composed of fat and a small amount of fibers and cartilage. When combined with the marrow from the first phalanx, the total calories of these products can exceed that of limb bone marrow in large ungulates, depending on animal condition (Lupo 1998). Removal of the digital cushion requires disarticulation of the first and second phalanx. If the digital cushion was already being consumed, the extra time required to process the already disarticulated phalanges is minimal (Jin and Mills 2011:1808). Jin and Mills (2011:1808) suggested that the quality and not the quantity of fat may have been an important factor in deciding whether to process phalanges. They point out that Evenki hunters, who live in a non-marginal environment with abundant prey, select carcass portions based on preference rather than economic utility. Their conclusion is that phalanx marrow processing by itself cannot be used as an indicator of nutritional stress. It is possible that the third phalanges are broken at the Lovstrom in an effort to extract the high fat digital cushion.

Because grease extraction comminutes the bone into small, unidentifiable fragments, it is necessary to consider the unidentified specimens of each assemblage. Basic NISP counts however, can be a factor of sample size, so a ratio of weight to count was calculated on the unidentified fragments for each site (Table 7-10). When possible, burned and unburned categories were also calculated.

Table 7-10: Unidentified bone fragments (g/N) ordered by burned, unburned and total ratio.

Unidentified total g/N		Unburned unidentified g/N		Burned unidentified g/N	
Vera	0.15	Vera	0.12	Vera	0.11
Twin Fawns	0.14	Twin Fawns	0.14	Twin Fawns	0.12
Jackson	0.17	Jackson	0.16	Jackson	0.18
Hokanson	0.40	Hokanson	0.41	Hokanson	0.38
Sanderson	0.46	Lovstrom	0.50	Lovstrom	0.39
Lovstrom	0.49	Sanderson	na	Sanderson	na

The ratios seem to corroborate the general results of the bison utility indices and the bison element %CN. However, these results may reflect screen bias. The sites with the smaller-sized mesh will have larger numbers of small unidentified fragments and will result in a much smaller ratio. It is not surprising that the Sanderson site ratio is similar to that of Hokanson and Lovstrom given it too was screened with the quarter-inch mesh.

Potential Non-Human Taphonomic Agents

Taphonomy is a paleontological concept developed in the early 1940s which initially studied the transition of animal remains from the biosphere into the lithosphere, but the term has since evolved to include plant remains. So taphonomy is now the study of all organic material from the biosphere to the lithosphere. Although the term has been borrowed by archaeologists to describe site formation processes and their impacts on non-organic artifacts and features, taphonomic studies are specifically concerned with once living organisms (Lyman 2010).

Taphonomic studies have become an integral component in zooarchaeological studies, especially those concerned with the agents of bone modification thought to represent early human tool use (Brain 1989). In these studies, establishing the agents of bone modification was necessary to determine if the assemblages were the result of human activity. In the six archaeological fauna assemblage samples studied here, the context of each assemblage and their association with cultural materials leaves little doubt that humans represent the main agent of accumulation. However, other factors can create fragmented assemblages which are assumed to be the result of human activity (Lyman 1985:222). Natural destructive and attritional processes differentially affect skeletal parts and can produce quantitative patterns that are mistakenly attributed to human butchery, transport and processing decisions (Kreutzer 1992:271). Correlating bison element density values with element representation within a site can indicate if attrition is density mediated (Kreutzer 1992:271). However, the agent of attrition remains unknown, and Lyman (1992:18) recognized that the volume density and utility of a skeletal part is at least partly dictated by functional anatomical principles. Less dense elements are those with thinner cortical bone and larger marrow cavities which are most often selected by humans for food resources. While it has been a standard practice to correlate bison element volume densities with site skeletal element frequencies, this was not undertaken here. As Magee (1997:188) astutely noted, correlating bison element density values with skeletal representation based on landmark identification will skew results. A proximal humerus identified by a small landmark will be identified as complete although only a small identifiable portion had been recovered.

Instead, as outlined by Lyman (1985:226), the degree of skeletal disarticulation and the presence of human modifications, in addition to element representation and the geological context are examined to determine the agent of accumulation. It is also important to recognize other agent modifications, especially carnivore attrition, because carnivores, like humans, choose grease-rich elements for consumption (Binford 1981:221).

Each faunal assemblage sample was examined for non-cultural taphonomic processes such as carnivore and rodent gnawing, weathering, rootlet etching and abrasion. Although not quantified here, these results indicate that while each assemblage was minimally impacted by various agents, the element representation and fragmentation of bison elements were not a result of natural processes. The recovery of small, porous foetal bison elements strengthens this argument. Human behaviour, most likely related to subsistence decisions, were the primary cause of the faunal assemblage samples.

Contextualizing Animal Food Subsistence Choices within an Aboriginal Seasonal Framework

The estimated seasons of site occupation for the six sites were established using the FODS and comparing the foetal assemblages to those of known gestational age as outlined in Chapter Five. Of all six sites, four (Lovstrom, Jackson, Vera and Twin Fawns) were primarily occupied during the significant event of the foetal bison developing its red coat. The Sanderson site seasonality estimate is earlier. It appears to have been occupied in the time when the geese were flying and up to the time when the foetal bison were developing their coats.

Bison is undoubtedly the primary animal food being prepared at all six sites, regardless of site inhabitant or season of site occupation. One of the Mortlach sites, Sanderson, exhibited a high species diversity compared to all other sites. This diversity, however, is most likely a factor of seasonality. The Sanderson site would have initially been occupied as the seasons changed, as water was starting to freeze, and as birds were flying south. The site location, adjacent to water, signifies the importance of these events. The identification of migratory waterfowl indicates that the site inhabitants were actively procuring and consuming these resources. The fish remains (n=19) recovered from the site had been dismissed by Magee (1997) as being intrusive because a fish cannery was located nearby during the historic time period. However, given the seasonality of the site and without an extensive discussion of context, it is difficult to determine whether or not fish was being consumed by the Mortlach site inhabitants.

The increased species diversity for this occupation is partly due to the avian recoveries, but the Sanderson site also had a relatively high number of large canids (n=4) compared to the other sites, and was the only site to have a significant number of medium-sized mammals (n=9), mostly fur bearers. The presence of the fur bearers in the assemblage would suggest a ‘woodland’ subsistence for the ‘quintessential bison hunting’ Mortlach and could be a factor of both seasonality and/or site location. Fur bearing animals can be trapped year round, although they are most desirable in fall and winter. However, this does not explain the absence of these animals at the other sites. Another possible reason for the fur bearers is that the Mortlach people at the Sanderson site may have been procuring furs for the fur trade. Given the relative paucity of historical artifacts recovered from the site, the site was likely occupied during the protohistoric time period and there is a possibility that the fur bearers were being selected at the site for trade.

The large number of canid recoveries, especially of cranial elements, allowed Magee (1997:149-151) to differentiate between wolf (n=2), and medium-large canid (n=2). Also identified in the assemblage were a coyote and a swift fox. The association of these remains within a processing area and exhibiting cultural modifications such as burning indicates that they were likely being used as food. Canid consumption is well documented in the ethnohistorical literature either as an emergency food source, or incorporated into social/spiritual ceremonies (BozeII 1988; Morey 1992, 1994; Morey and Wiant 1992; Snyder 1991).

White (1953:397) calculated the pounds of usable meat for wolf (30 pounds) and coyote (12.5 pounds). These amounts seem trivial when compared to the average 600 pounds of usable meat for bison. Perhaps more important is the high percent of fat in canids. During the winter, most other Plains animals such as bison, deer, beaver and raccoons can lose up to 90 percent of their body fat (Snyder 1991:372). Wild canids however, exhibit a different pattern of seasonal fat stores. They tend to maintain them throughout the coldest months of the year, and only begin to deplete them come spring. An average mean total body fat percent for coyotes in the summer is only about 10 percent but increases to almost 20 percent in the winter, and these percentages exhibit little variation between male, reproductive female, and non-reproductive female coyotes (Poulle et al. 1995). Domestic dogs may retain their fat stores year round because of their accessibility to camp refuse and represent an easily accessible high fat food item. Uncooked dog meat has more calories than bison; 247cal/100g compared to 138cal /100g, and is higher in calcium, potassium and other minerals (Bozell 1988:105).

The consumption of dog was also an important social ritual (Mandelbaum 1979; Pond 1986). Dog flesh was considered a valuable gift. According to Mandelbaum (1979:66) a person in need would gift cooked dog meat in exchange for requests. Several different ceremonies integrate dog meat as part of the ceremony. Once such ceremony of the Plains Cree is called the Dog Feast, and is the principle rite given for the spirit powers of medicine (Mandelbaum 1979:224). Although no description of seasonality is provided for these ceremonies, moon-names indicate that the months of December (creators, small spirits) and January (great spirit) were times when ceremonies were undertaken (Davidson-Hunt and Berkes 2003). It is almost impossible to determine from the archaeological record whether the canid meat consumption at the Sanderson site is reflective of a need for fat in the diet, or as part of ceremonial activities, or both. Perhaps the timing of ceremonies incorporating dog meat consumption developed in response to nutritional requirements. If the Sanderson site inhabitants were relying on fat depleted bison, there should be evidence for other fat seeking behaviours.

According to Magee (1997), the Sanderson site carpal and tarsal bones were fragmented, and exhibited evidence of mixed fresh and dry fracture. He suggested that this pattern of bone breakage was a result of butchering frozen limb elements, and that the Sanderson site inhabitants were utilizing frozen meat caches. A pile of stacked bone elements in the Sanderson assemblage is interpreted as a remnant meat cache that was unutilized either because it had been ‘frozen in’ or the site inhabitants left the site before utilizing it. However, the dry and fresh bone breakage morphology could also be a function of processing stock-piled limbs. It is possible that the limbs were collected, and then processed either frozen or thawed. This might help explain the relatively high number of fractured carpals at the Sanderson site. Although the other sites also had fractured tarsals, the Sanderson site had the highest incidence of fractured carpal bones, approximately 70-80 percent complete. No actualistic studies have been undertaken on frozen, then thawed articulated limb elements. The studies undertaken by Outram (1999, 2001, 2002a, 2002b, 2003, 2004a, 2004b) concentrated on shaft portions and did not address breakage of the carpal, tarsal or phalanges.

The fragmented tarsal bones and phalanges in the Sanderson site faunal assemblage were most likely a function of marrow extraction and perhaps grease rendering, although butchery practices cannot be discounted. The proposed abandonment of the Sanderson site sometime in February explains the lack of foetal bison recoveries when ‘they develop their red coat’. This is also a time referred to as Bone Month in Eastern Cherokee; because there was so little food people had to gnaw on bones and eat bone marrow soup. Some Lakota refer to it as Moon When the Wife Had To Crack Bones for Marrow Fat for the same reason. The proposed abandonment of the site at this time makes it difficult to interpret the fragmented faunal assemblage. Marrow extraction and grease rendering activities were being undertaken at the site, but not as intensively as seen at the Jackson and Vera sites. The production of bone grease at the Sanderson site could have been part of pemmican production. It also could have been undertaken as a result of consuming fat-depleted bison in the colder months just before site abandonment; however, the relatively high number of canids and the limited number of foetal bison may have offset lean bison meat.

The Lovstrom, Jackson, Vera and Twin Fawns sites were all occupied during the 'hard' month' when there was 'frost in the tipis'. Like the Sanderson site, bison represent the largest dietary contribution for all sites. There is also an increased presence of foetal bison in these assemblages, as these sites were occupied after the time ‘when the buffalo foetus is getting large’ and during the late development stage of 'foetal bison is growing hair' and the 'dark red (foetal) calves’.

The species diversity of the Jackson, Vera and Twin Fawns sites is similar. All have utilized at least one other ungulate, all have at least one or two large canids, and small and micro mammals appear to have been utilized as a food source. After accounting for different recovery methods, these sites have similar species diversity albeit a bit higher than the Hokanson site and quite a bit greater than the Lovstrom site. This would suggest that the comparatively low species diversity calculated from the Lovstrom assemblage is not a factor of seasonality.

The recovery of canid remains from these sites could, like Sanderson, be a result of fat seeking behaviour, a result of ceremonies, or possibly both. The Jackson and Vera site inhabitants were processing bison the most intensively of all six sites. The bison assemblages from both these sites were highly fragmented, including carpals, tarsals, and phalanges. Marrow and grease rich elements were absent from the site, and it is interpreted that they were fragmented beyond recognition during grease rendering. The production of bone grease and utilization of phalanx marrow does not seem to be correlated with pemmican production. Unlike the Sanderson and Hokanson sites, no articulated limb elements or bone stacks were observed in the Jackson or Vera assemblages. The decisions to use these fat products most likely is a factor of seasonality, as these sites were occupied during the Bone Month.

The Twin Fawns site presents a slightly different pattern. There is almost no correlation (either negative or positive) between the frequency of marrow and grease rich elements and their rank order for these products. The fragmented nature of the bison assemblage suggests a minimum of marrow processing. However, the relatively complete nature of the carpals, tarsals, and especially phalanges would indicate that these site inhabitants were processing bison slightly less intensively than the Vera and Jackson site inhabitants. One issue with the Twin Fawns assemblage is the small sample size. Only eight square metre units were included in this study. The recovery of a relatively high number of distal limb elements, including some split phalanges, may represent a specialized activity area for distal limb marrow extraction as described in the ethnohistorical literature. Because the site sample is so small, such a specialized activity has the potential to greatly distort site level interpretations. The almost complete lack of fragmented carpals and tarsals would indicate that marrow extraction of these elements was not being undertaken as it was at the Jackson, Vera and possibly Sanderson sites.

Again, although occupied during the same cold months when bones were being cracked open, the Lovstrom site inhabitants were not heavily processing bison. All the phalanges, except for the third are complete as are almost all the carpals and tarsals. Fragmented third phalanges may be a result of extraction of the digital cushion, a high fat product. There were only weak negative or positive correlations with the marrow and grease utility indices but marrow and grease rich bison elements, while not fragmented to the same degree as observed in the other sites, were still very fragmented. This would suggest moderate fat seeking behaviour. The animal food subsistence decisions being undertaken at the Lovstrom site are markedly different from those at the Sanderson, Jackson, Vera and Twin Fawns sites. There are also differences when compared to the other Blackduck site, Hokanson. However, the observed differences may be a factor of seasonality. Based on the FODS seasonality estimates, the Lovstrom, Jackson, Vera and Twin Fawns sites appear to have been abandoned just as the grass was beginning to appear but before the bison calves were beginning to drop.

The Hokanson site is the only one that does not appear to have been inhabited over the coldest months of the year and instead was occupied immediately afterwards when the green grass was appearing and bison calves were being born. The seasonality estimate for Hokanson however, is very tenuous because it has been based on a limited recovery of foetal bison elements. Given the small sample size, it is possible that the seasonality estimate is incorrect. This site had the smallest sample size of only six square meters. There was, however, a relatively high number of bison represented: six adult, two immature and at least one foetal animal. Bison undoubtedly were the primary animal food source being utilized at the Hokanson site. The species diversity of the site is more similar to the Vickers and Mortlach sites than to the other Blackduck site. There is another ungulate; canid remains, and a few medium and small mammals. It appears that the Hokanson site inhabitants did not choose to process bison as intensively as the Vickers focus and Mortlach complex people did.

Significance of Results

The preceding results confirm many of the statements that have been proposed for Blackduck, Vickers and Mortlach subsistence. In terms of prey selection, bison would have provided the greatest amount of animal food products in every site. Without knowing the contribution of plant food products, this would lead to the conclusion that all six site inhabitants were primarily bison hunters or what has been termed focal bison hunters. The recovery and identification of immature and foetal bison elements from each site strengthens this classification. The presence of bison in all sites is far from unexpected given that all were occupied during a time of year when bison would have been readily available.

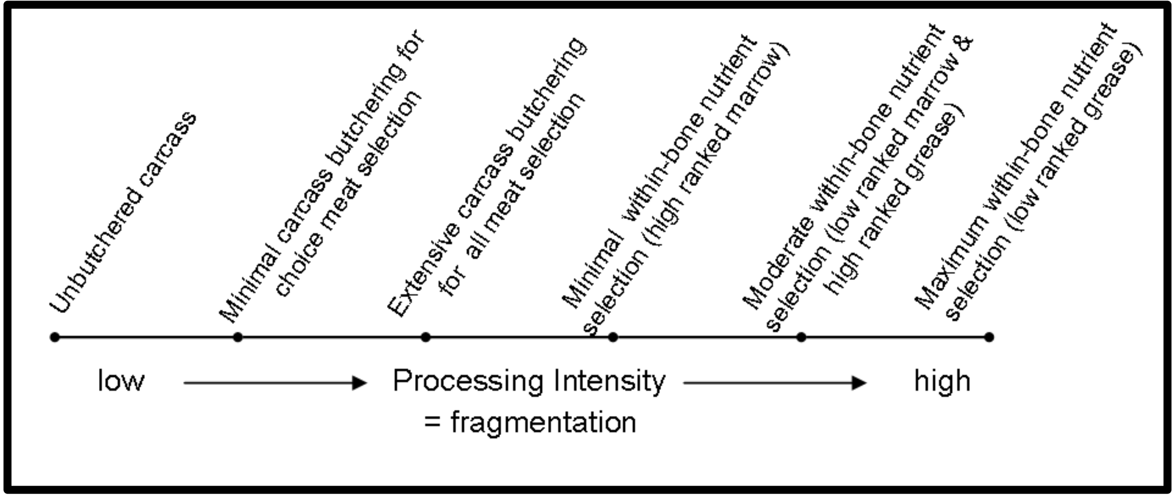
Without knowing the procurement method, it is difficult to ascertain whether site inhabitants should qualify as ‘specialized’ bison hunters. Although never explicitly defined, specialized bison hunting can refer to the use of communal procurement methods usually requiring sophisticated entrapment techniques such as jumps, pounds or corrals, and results in a large surplus of bison products (Arthur 1975; Walde 2006a). Driver (1990:12) argued for a different definition of communal hunting and considered it to be a system of hunting that requires a minimum of two hunters to participate in a previously conceived plan. In this definition, the number of animals procured is irrelevant; it is the act of cooperation that is essential. Jackson is the only site studied with irrefutable evidence that the bison remains in the processing areas were the result of communal bison procurement due to the projectile point refit from the kill area and the processing area of the site. A strong case has also been made for a larger communal procurement by the Hokanson site inhabitants (Norris and Hamilton 2004). The close proximity of the kill to the processing areas of these two sites enables procurement strategy interpretation. This does not mean, however, that the bison remains from the other four sites are necessarily the result of non-communal kills. There is the possibility that the communal kill events for these sites simply have not been identified in the archaeological record. Similarly, there is always the possibility that some of the bison remains in the Jackson and Hokanson processing areas were the result of individualistic hunts. The label ‘specialized’ in this usage can therefore only be applied when there is strong archaeological evidence for communal efforts. This is only visible when a large number of animals have been taken and results in the creation of extensive bone beds or other features such as drive lanes or post molds (Landals 1990:08). This naturally leads to a bias towards kill site identification, which will of course reinforce the perception of a ‘specialized’ procurement strategy. Specialized bison hunters have also been used as a synonym for focal bison hunting, where bison represent the largest contribution to the diet and it does not consider the procurement method. The ambiguity in usage of the term ‘specialized bison hunters’ showcases the problems with archaeological subsistence terminology.

By choosing to examine processing areas of Blackduck, Vickers and Mortlach sites, the relative importance of non-bison animal food could also be examined. The use of optimal foraging models by researchers to explain prey choice selection behaviour has retained a dichotomy of specialized versus generalized or focal versus diffuse subsistence (Cleland 1966; Grayson 1984; Waguespack and Surovell 2003). The results from this study indicate that these dichotomies are not necessarily an accurate reflection of animal food subsistence choice. Bison was undoubtedly the primary animal food source for all six site inhabitants. But the relative proportion and inferred importance of non-bison food varies within and between the three examined archaeological cultures.

The people occupying the Sanderson site were selecting a greater diversity of animal food prey than at any of the other sites. This is interpreted here as a function of site seasonality because the Sanderson site, unlike the other five sites, was occupied during a time when a diversity of prey, such as migratory waterfowl would have been available. The relatively high proportion of fur bearing animals in the assemblage, including a high proportion of canids may be a function of seasonality or something else. The other Mortlach site, Twin Fawns, also had a relatively high species diversity when compared to the Blackduck and Vickers sites. These results suggest that Mortlach people, at least at these two sites on the Northeastern portion of the Plains, were consuming a more diversified animal food diet than previously thought. All other site inhabitants, with the exception of those at the Lovstrom site, seem to have been processing small mammals to supplement their bison-rich diet. These behaviours can be conceptualized as a mixture of specialized and generalized subsistence choices. The only site exhibiting clear evidence of what would traditionally be considered a 'focal ' bison subsistence strategy is the Plains Blackduck Lovstrom site which had little species diversity.

The significance of the bison processing intensity results are more difficult to interpret. The problem stems in part because the term *intensity* (in regards to bison or other animal processing) has never explicitly been defined. This is likely because the concept of intensity is self-explanatory, but the term itself is qualitative and relative. Figure 7-3 presents a simplified version of bison processing intensity. Fragmented faunal assemblages that are believed to result from human subsistence decision making processes are believed to represent utilization of within-bone nutrients such as marrow and grease. This has been interpreted by archaeologists as intensive processing (Byers 2002; Dering 2008; Falk 1994; Frison 1992, 2004; Graves 2008; Logan 1998; Magee 1997; Outram 1999, 2001a, 2003, 2004a; Playford 2001a, 2010; Playford and Nicholson 2006; Quigg 1998; Reeves 1990; Scheiber 2007).

Figure 7-3: Continuum of bison processing intensity.



However, intensive processing of bison during the Early Precontact time period differs significantly from what has been described as intensive processing of bison during the Late Precontact time period. The Agate Basin faunal assemblage from Locality II of the Hell Gap site in eastern Wyoming was positively correlated with bison element economic utilities measuring marrow. Byers (2002:368) quantified processing intensity by counting the number of conchoidal flake scars and dividing by the MNE for each long bone. Based on these results, elements highest in marrow were heavily processed and this is cited as evidence of fat-seeking behaviour. None of the carpals or phalanges from this site appear to have been processed for within-bone nutrients. While this situation is considered unusual for the Early Precontact time period and is considered to be evidence of intensive bison processing (Byers 2002), the same faunal pattern during the Late Precontact would be considered moderate fat-seeking behaviour, especially when compared to the six study sites.

The results of this study can only be used to interpret these two subsistence choices being executed by the inhabitants of each site. These results cannot be extrapolated across time or space to describe the subsistence strategies of other Blackduck culture, Vickers focus or Mortlach complex sites. These results are an important contribution to developing the cultural chronology of the Canadian Northeastern Plains. Too often, archaeologists have identified subsistence patterns for a few key sites of an archaeological culture and those patterns become identified in the literature as the de facto subsistence strategy without consideration of other site types, sites occupied in different seasons, or sites occupied in different geographical regions. On the Canadian Northeastern Plains this is not by any means a reflection of the quality of archaeological research being undertaken, it is a reflection of the quantity of studies. With the exception of the Glacial Lake Agassiz Basin Surveys in the mid 1960s, which focused on Early Precontact occupation of the province (Pettipas 1965), the extensive research program directed by Dr. Nicholson of Brandon University, as well as the impact mitigations undertaken prior to construction of the Rafferty and Alameda dam project in southeastern Saskatchewan (Magee 1997), few large scale research projects have been undertaken on the Canadian Northeastern Plains. The limited number of archaeological studies, and the even more limited number of detailed analyses of site faunal assemblages has perpetuated the situation where faunal analysis from one or a few key sites is used as evidence of a cultural subsistence adaptation.

Furthermore, these results only provide evidence of two subsistence choices from sites with foetal bison elements. Sites that do not contain foetal bison bone and likely represent occupation during other seasons do not seem to be as prolific in the archaeological literature, at least on the Northeastern Plains. As Hamilton et al. (2007) observed, Plains Blackduck sites with sparse and scattered faunal remains and low quantities of material culture reflect differential land use and subsistence choices. Foetal bison elements for the most part have not been recovered from these sites, and although seasonality is currently unknown, it has been tentatively suggested that they represent warm season occupations (Hamilton et al. 2007). A similar situation exists for the western cluster Vickers focus sites where large sites with dense deposits contain foetal bison elements. Other Vickers focus sites in the area such as the Atkinson East site contained sparse, widely scattered faunal remains and minimal amounts of material culture. The concern here is that these possible warm season sites, because they do not contain *significant* archaeological resources, are undervalued by archaeological resource managers and are not as useful to academic archaeologists. For these reasons, these site types are not being adequately excavated and examined.

Summary

Establishing the site seasonality of these six sites has enabled a valid comparison of two subsistence choices. The occupants of the two Blackduck sites exhibited variability between sites both in terms of species diversity and intensity of bison processing. The Lovstrom site inhabitants chose to incorporate fewer animals into their diet than did the occupants of the Hokanson site. The Lovstrom site inhabitants were processing bison to a lesser extent than observed in the Hokanson sample. However, the cause of this variability may be due to differences in seasonal occupation. While the interpreted seasonality difference in a westernized seasonal paradigm is slight, a difference of a month or two, this difference likely would have been significant for the site occupants. When compared with the Vickers focus and Mortlach sites, there is an obvious difference in the species diversity and intensity of bison processing choices being made by the inhabitants of the Blackduck sites. It is unlikely that these observed differences were a factor of seasonality. The subsistence choices of the Vickers focus and Mortlach site inhabitants are all quite similar. The increased species diversity calculated for the Sanderson site may be a result of an earlier initial occupation of this site. All Vickers and Mortlach site inhabitants were intensively processing bison for both marrow and grease. Without a re-analysis of all site assemblages, it is difficult to interpret whether the grease processing occurred immediately after marrow extraction or sometime later. The Twin Fawns sample assemblage suggests that lower limb elements were stored and processed at a later date. The significance of these results indicates that archaeological subsistence strategy classifications may not adequately describe past practices. These site results represent only a portion of the entire subsistence strategy because warm season sites may be undervalued due to their archaeological signature.

CHAPTER 08: CONCLUSIONS AND RECOMMENDATIONS

Introduction

The main purpose of this dissertation was to assess subsistence variability inferred from the archaeological record for three archaeological cultures living on the Canadian Northeastern Plains during the Late Precontact time period. To achieve this goal, three separate research areas were investigated, and the results from each were synthesized in Chapter Seven in an attempt to fully comprehend the significance of subsistence variability. Inherently important was ensuring that the season of site occupation could be precisely estimated because seasonal resource availability has the potential to greatly influence subsistence choices. A secondary goal of the research was to relate this subsistence variability significance to current archaeological resource management practices in Manitoba and to contribute a practical and easily applied method of establishing site seasonality that does not require a comparative collection. The three research areas and secondary goal represent the four objectives of this dissertation. The following section presents the results of each objective and how they contribute to the main goal of the dissertation.

Satisfaction of Objectives

Objective 1

Compare animal food subsistence choices that have been inferred to exhibit variability from Plains Blackduck complex, Vickers focus and Mortlach complex sites located on the Canadian Northeastern Plains.

Before comparing subsistence choices, it was necessary to ensure site comparability. This was achieved by selecting two Plains Blackduck complex (Hokanson and Lovstrom), two Vickers focus (Jackson and Vera) and two Mortlach complex sites (Sanderson and Twin Fawns) located on the Canadian Northeastern Plains. All sites were situated within areas of analogous biodiversity as determined by Wiseman and Graham (2007). Recovery methods, cultural affiliation and site activity areas were reported for each site. Processing activities have been interpreted for each site, and a sample faunal assemblage was selected from each for further study.

The Jackson, Vera and Sanderson site faunal assemblages had previously been analyzed and reported while the Twin Fawns material and been analyzed by the author but not published (Magee 1997; Playford 2001a, 2010; Playford and Nicholson 2006). The Hokanson and Lovstrom assemblages were catalogued by the author following the same methodology employed for the other sites, and the results of this analysis was used to quantify subsistence.

Two animal food subsistence choices, prey selection and intensity of bison processing, were selected for quantification as a means of assessing subsistence variability. Prey selection was quantified by comparing the observed species richness and the calculated Shannon diversity index for each assemblage. Bison processing intensity was quantified by application of established economic utility indices used to evaluate marrow and grease extraction, and by calculating bison element fragmentation rates.

After accounting for differing recovery methods, the results indicate that bison represent the primary animal food resource exploited by the inhabitants of all six sites. The Mortlach complex Sanderson site exhibits the highest species diversity due to the presence of other ungulates, canids, medium mammal fur-bearers, migratory waterfowl and small mammals. It is unknown whether the recovered fish remains in the faunal assemblage sample represent utilization by the site inhabitants or were introduced into the site during the historic time period. Of the remaining five sites, all except the Plains Blackduck Lovstrom site have comparable levels of species diversity. The four comparable sites had relatively high numbers of small mammals that appear to have been used as a food resource and include the identification of amphibians and/or reptiles, which may or may not have been used as food. The Lovstrom site had the lowest species diversity because no other ungulates and only a few birds as well as a few medium, small and micro mammals were recovered.

The economic bison utility indices suggest that all site inhabitants were actively procuring within-bone nutrients such as marrow and grease. The intensity of this behaviour, however, varied. The Jackson, Vera and Sanderson site inhabitants were processing bison the most intensively. This is reflected in the highly fragmented nature of the bison elements, and the fragmented nature of the low ranking grease and marrow elements like carpals, tarsals and phalanges, which is interpreted here as a result of food utilization. The Twin Fawns and Hokanson site inhabitants were also processing bison for grease and marrow but were not utilizing as many low ranked elements as observed in the Jackson, Vera and Sanderson site faunal assemblage samples. The Lovstrom site inhabitants were processing bison the least intensively. Although still highly fragmented, bison elements from this site were the most complete of the six study sites, and low ranked elements such as carpals, tarsals as well as the first and second phalanx were recovered whole.

Objective 2

Develop a new measure of establishing site seasonality involving consideration of foetal bison osteological development and apply it to the foetal bison assemblage of each site to determine site seasonality.

The presence of foetal bison elements from archaeological assemblages have repeatedly been used to estimate season of site occupation. This is based on the assumption that bison have a seasonally restricted rut in the fall, and subsequent birth schedule in the spring, so the presence of foetal elements in a site would indicate a season of occupation sometime between fall and spring, most likely winter. Early studies of foetal bison growth and development undertaken by Wilson (1974), McKee (1985) and Landals et al. (2004) identified the potential for foetal bison to provide precise estimates of site seasonality.

Walde (2006c) questioned the validity of site seasonality estimates based on the presence of foetal bison because he believed bison parturition is not significantly seasonally restricted. An extensive review of both the ethnographic literature and modern herd studies indicate that over 80 percent of bison calves are born within a two month period between April 15th and June 15th. This is considered here to be seasonally restricted and a method of estimating site seasonality was created based on a modern comparative sample.

Modern foetal bison specimens of known collection date were processed following standard zooarchaeological methods. The gestational age of each specimen was determined by assuming a peak rut date of August 19th and a 270-day gestation length based on the aforementioned literature review. Measurements taken on the appendicular long bone elements were plotted against gestational age and a series of linear regression equations were created. These regression equations constitute the FODS (foetal osteological development sequence) which can be applied to elements of unknown age to estimate day of collection. The FODS was tested using four modern comparative specimens. The results of this test indicate that the maximum diaphyseal length of the scapula, ulna, femur, tibia and metatarsal were the most reliable indicators of gestational age. The foetal bison assemblages from each site were analyzed and when possible, elements were measured to estimate site seasonality. Using only the FODS, seasonality for four of the six sites was estimated. The Lovstrom site may have been occupied as early as October but was most likely occupied from January to March. The Jackson site foetal bison elements indicate an occupation between December and March. The Vera site was likely occupied between January and February while the Sanderson site appears to have been occupied between November and February. Foetal remains from the Hokanson and Twin Fawns site did not include measureable elements, so site seasonality was estimated based on a comparison of the foetal assemblages from these sites with the modern specimens. These results indicate that the Hokanson site was likely occupied in April and May, while the Twin Fawns site foetal elements, corresponding closely with modern specimens collected, between February and March. The foetal bison faunal assemblages from all sites were compared with the modern samples, and based on these results the Vera site occupation was extended into March.

Objective 3

Explore Aboriginal concepts of seasonality and identify significant seasonal socio-economic activities important to Plains and Woodland adapted people to better understand subsistence variability.

A literature review emphasized the different worldviews held by some First Nation people, and the differing concepts of seasonality were especially relevant to this study. Aboriginal people have identified anywhere between two and six seasons but archaeologists have usually interpreted site inhabitant behaviours based on the westernized four season paradigm. While this model classifies seasons based on astronomical or meteorological events, Aboriginal people identify seasonal transition most often by changes in the biophysical environment. An examination of language families of Plains-adapted and Woodland-adapted people identified several key social, political and economic events in the use of their moon-names. Several of these events related to bison parturition, such as the month the foetal bison gets large (December), the month the foetal calf develops a red coat (February), and the month the calves are born (March/May). Other significant moon-names include the month when the birds fly south (October), and the bone month or the month the wife cracks bone for marrow (February).

The results of Objectives One and Two were incorporated within this seasonal concept to better explain the observed subsistence variability. The monthly seasonality estimates of each site were correlated with significant social or economic activities identified in the moon-names. The subsistence results of Objective One were re-examined, and all sites except Hokanson were occupied over the coldest months of the year. The Sanderson site was abandoned about the time when the foetal bison calf develops its red coat whereas Lovstrom, Jackson, Vera and Twin Fawn continued to be occupied during this time. The recovery of foetal bison elements from all sites attests to the importance of this event. The high species diversity observed for the Sanderson site faunal assemblage was likely a factor of the site being initially occupied earlier than the others, during the time when the birds fly south. The relatively high proportion of canid materials in this assemblage may be related to fat-seeking behaviour. It could also be a function of the site occupation during a time of year when ceremonial activities, which often included the incorporation of dog meat, were performed. The low species diversity calculated for the Lovstrom site faunal assemblage could not be explained within this Aboriginal seasonality model and is most likely a factor of another, as of yet undetermined variable.

The high level of bison processing intensity inferred for the Jackson, Vera and Sanderson sites are a rational outcome of these sites being occupied during the time of year identified as the bone month, or the month the wife cracks bones for marrow. Accessing within-bone nutrients is considered to be fat-seeking behaviour and may be a subsistence choice to protect against protein starvation, which can occur when lean meat comprises more than 40 percent of the diet. However, other variables may be responsible for this fat-seeking behaviour. Large ungulates metabolize fat in a known and predictable order and animals are most fat-depleted during the coldest months of the year. Fat in the distal limb elements is among the last to be metabolized. The decision to extract marrow and grease from these elements may reflect prey condition although the presence of fragmented high ranked elements within these assemblages suggests this is not the case. Cultural values as expressed in the ethnohistorical literature could also account for the selection and processing of low ranking marrow and grease bison elements by these site inhabitants. The production of pemmican, which usually occurs when there is a surplus of bison meat, necessitates bone grease production and could be another reason why these site inhabitants were processing bison so intensively. Although pemmican production cannot be disregarded, this activity is usually identified in the ethnohistorical record as occurring in late summer or early fall. The month of June is identified by the moon-name of making fat which most likely relates to this event.

The Hokanson and Twin Fawns site inhabitants were also processing bison, just not as intensively as seen in the Jackson, Vera and Sanderson assemblages. Because the Twin Fawns site is inferred to be occupied during the same cold month time period, season of site occupation cannot explain the observed variability. The relatively small sample size of the Twin Fawns assemblage may be a factor influencing the observed variability. The Hokanson site, however, is occupied during a different seasonally significant period. Although the seasonality estimate for this site is tentative, it appears to have been occupied after the coldest part of the year, after the bone month and at the beginning of the bison calving period when grass was starting to appear. The Lovstrom site occupation, with the lowest bison processing intensity of the six study sites, spanned roughly the same season as the Jackson, Vera, Sanderson and Twin Fawns occupations. This suggests that the observed variability in the Lovstrom site material is not a function of seasonality.

Contributions to the Literature

The subsistence strategies of archaeological cultures are comprised of a series of plant and animal food subsistence choices. The cause of perceived subsistence variability of these choices interpreted for Plains Blackduck complex, Vickers focus and Mortlach complex sites on the Canadian Northeastern Plains have been thought to represent differing socio-economic orientations for the various groups, although the variability could also be a reflection of seasonal land use patterns. By treating seasonality as a constant rather than a variable, it was possible to undertake intra and inter-culture comparisons of two animal food subsistence choices executed by the inhabitants of two Plains Blackduck complex, two Vickers focus and two Mortlach complex sites. To make seasonality a constant, a new method of precisely estimating site seasonality using foetal bison elements was developed and applied to the archaeological foetal specimens.

The results conclude that bison was the primary animal food source being utilized by all site inhabitants. However, the Mortlach sites, especially the Sanderson site, had the highest level of species diversity. One of the Blackduck sites had the lowest calculated species diversity and the other sites had comparable levels of species diversity. The animal food subsistence choice of bison processing intensity was more difficult to interpret because several factors other than seasonality can influence these decisions. Also, processing intensity has never been explicitly defined or quantified. All site inhabitants were processing for within-bone nutrients such as marrow and grease, although the inferred intensity did vary. The subsistence variability observed for all six sites is more a matter of degree than kind but some of the variability could be accounted for when sites were placed within an Aboriginal concept of seasonality. Other variability, however, does not seem to be a function of seasonality.

These conclusions are important because it raises the question of whether subsistence strategies are as culturally distinct as previously thought, and whether they should be employed at the highest level of archaeological taxonomy (see Table 2-2). Although there was inter-culture variability in terms of the two quantified subsistence choices examined, the Lovstrom site results were the only ones that were considerably different from all other sites for both subsistence choices examined.

Another important outcome of the results was the realization that bison processing *intensity* has never been explicitly defined in the literature. While the term has often been used, and the concept easily understood, attempting to identify *differing* intensity levels of bison processing in the archaeological record and identifying exactly what the intensity represents was not a simple exercise. Equating highly fragmented assemblages as being intensively processed and as evidence of nutritional stress is far too simplistic and does not take into account all the potential variables influencing the decision to process these nutrients.

Finally, these results demonstrate that the very concept and definition of subsistence strategies need to be revisited by archaeologists. The current terminology is inconsistent and often relies on outdated anthropological models usually derived from modern hunting and gathering people, whose situation and lifestyle may bear little or no resemblance to that of past societies. Terms such as hunter/gatherer or forager are also used to imply socio-political organization and settlement strategies. It is recognized that subsistence, settlement and socio-political organization are interconnected and can be indistinctly linked to the biophysical environment, but it is necessary to isolate subsistence systems for analysis. The individual component parts of a subsistence strategy, or what has been termed here as subsistence choices, must be considered. On the Canadian Northeastern Plains during the Late Precontact time period this includes not only wild plant and animal food, but also the inclusion of domestic plants. A subsistence strategy for an archaeological culture can only be reconstructed when all the subsistence choices have been analyzed for a minimum of an entire seasonal year. The subsistence choices executed by an archaeological culture at several sites spanning all seasons would comprise that culture's strategy.

Objective 4

Provide consulting archaeologists with an accessible, easily applied tool to establish season of site occupation and incorporate a better understanding of site subsistence variability into the criteria for assessing archaeological potential currently being employed by archaeological resource managers.

The fourth objective of this dissertation stems from the desire to bridge the gap between academic and applied archaeology. The deliberate decision to develop the FODS as a series of linear regression equations rather than as a comparative collection was made so that it could be quickly and easily applied by academic, but especially by applied archaeologists. Recovered foetal bison bone can easily be measured (in the field) and an estimate of site seasonality can immediately be discerned. This does not require access to a modern comparative sample which is quite rare and not easily accessible. This is considered to be one of the major contributions of this dissertation to the literature.

With the creation and application of the FODS, Northern Plains archaeologists will be able to estimate the time of year when sites were occupied only if they contain foetal bison elements. There appears to be an overrepresentation of winter sites in the archaeological literature for Late Precontact sites on the Canadian Northeastern Plains. This may be a result of precontact land use and subsistence patterns where people were remaining sedentary during the coldest months of the year. This results in large accumulations of faunal remains and dense material culture deposits. These site types are easily visible in the archaeological record and are chosen for study because they are more interpretable and usually contain diagnostic artifact classes. The concern here is that warm season sites as tentatively proposed by Hamilton et al. (2007) do not contain the *significant* resources identified by the

Manitoba Historic Resources Branch (HRB) as necessary to warrant a heritage resource impact assessment (HRIA). Or, if an HRIA is required, the significance ranking employed by HRB results in undersampling of these sites because they can be small, ephemeral and have limited quantities of material culture. To fully understand past subsistence strategies and related land use patterns, it will be necessary to ensure that warm season sites are properly documented in the archaeological record. Because consulting archaeology represents the vast majority of archaeological excavations being undertaken in Canada, archaeological resource managers should begin to rank and assess site mitigation priority not only on the significance of the site or the materials recovered, but also on the information that sites can impart. A better understanding of the entire seasonal land use by precontact peoples will allow for better predictive capabilities and which should result in reduced impacts to archaeological resources.

Limitations of the Study

While the three primary objectives and the one supplementary objective of this dissertation were achieved, there were limitations of the study. The first limitation was the small sample size of modern bison to create the FODS. A second limitation of the study was the small sample sizes of the Hokanson, Lovstrom and Sanderson foetal bison elements. There was a lack of measurable foetal bison elements in the Twin Fawns sample, which necessitated that site seasonality be based on comparison of size and development of the modern comparative sample.

Recommendations

The first recommendation resulting from this dissertation is to expand the sample size of the Blackduck, Vickers and Mortlach sites. Two sites of each culture are insufficient to make any substantial statements about the overall subsistence strategies of these individual groups. Most imperative is to include sites occupied during other seasons. It is also important to include sites from across the distributional range of each culture. Without having a representative sample of sites, it is impossible to determine if the subsistence patterns observed at these sites are representative of each culture or are a reflection of geographical location.

To fully understand subsistence, it is also necessary to include plant food resources in subsistence strategy reconstructions. This type of research is currently being undertaken through an examination of cooking residue recovered from pottery vessels (Boyd et al. 2006a, 2006b, 2008; Boyd and Surette 2010; Lints 2012; Surette 2005). The results of the botanical studies need to be incorporated with the animal food resource utilization to provide a holistic picture of subsistence.

A substantive comparison of the subsistence strategies employed during the Late Precontact time period with other time periods should be undertaken once adequate quantified faunal analysis has been undertaken on the necessary sites. Similarly, other bison subsistence choices such as procurement and butchery need to be quantified and these decision choices compared between cultures.

The FODS is in need of refinement. Testing of the FODS indicated that several of the measurements, notably the minimum midshaft diameter of the humerus, were unreliable to estimate gestational age. Additional modern foetal bison specimens should result in a refinement of the linear regression equations. Of particular importance is the acquisition of young gestational specimens. It would also be useful to create a similar comparative collection from other subareas of the Plains. These collections could then be compared to determine the effect of geographic location of foetal bison growth and development.

The final recommendation is for archaeological (and all cultural/heritage) resource managers to include deductive models of site prediction to better assess archaeological potential.

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APPENDIX 01: RADIOCARBON DATES FOR THESIS SITES

Site	**Sample**	**RC Date**	**Sigma**	**AD Range**			
Lab#				1 Sigma	P	2 Sigma	P
HOKANSON DiLv-29							
TO-9243	BPtp6-1	1050	50	901-920 954-958 961-1025	0.157 0.028 0.816	883-1049 1085-1124 1137-1150	0.942 0.045 0.013
TO-9769	Hok2-5-25	1070	110	777-792 803-843 858-1043 1103-1118	0.042 0.11 0.804 0.045	692-748 762-1187	0.045 0.955
TO-9770	Hok4-11A-9	1370	80	597-716 743-766	0.87 0.13	477-482 536-783 786-878	0.003 0.93 0.067
TO-9771	Hok4-12A-2	1080	50	898-924 945-1015	.262 0.738	778-791 806-819 822-842 861-1032	0.014 0.01 0.016 0.961
TO-9772	Hok5-6-29	1160	50	776-794 799-900 922-948	0.123 0.698 0.179	721-740 767-989 777-792	0.026 0.974 0.038
TO-9773	Hok7-4-13	1110	50	886-991	1	802-847 854-1018	0.088 0.874
TO-9774	Hok11-6-62	920	50	1040-1109 1115-1160	0.611 0.389	1023-1214	1
TO-9775	Hok13-6-36	960	50	1022-1053 1079-1152	0.305 0.695	990-1186	1
TO-9658	Hok-RC-1	2180	110	BC 374-111	1	BC 476-444 BC 431-AD 64	0.01 0.99
TO-11675	HKRC02 19:31-4-44	1160	50	776-794 799-900 922-948	0.123 0.698 0.179	721-740 767-989	0.026 0.974
TO11676	HKRC02 27-6-10	1190	50	769-894 931-937	0.975 0.025	692-748 762-969	0.12 0.88
β-200613	HKRC02 27-6-10	960	40	1023-1051 1082-1128 1134-1151	0315 0.505 0.18	998-1004 1012-1164	0.0008 0.992
β-202929		920	50	1040-1109 1115-1160	0.611 0.389	1023-1214	1
β-202930		900	50	1044-1100 1119-1189	0.459 0.541	1024-1244	1
β202928		680	50	1273-1311 1359-1387	0.599 0.401	1259-1399	1
LOVSTROM DjLx-1							
S-2951	Block B	705	75	1228-1213 1245-1317 1353-1390	0.017 0.677 0.306	1184-1409	1
S-2953	Block B	675	80	1266-1325 1344-1394	0.548 0.452	1213-1423	1
S-2699	TU5	1215	320	544-1158	1	140-196 208-1323 1347-1393	0.012 0.977 0.012
S-2700	TU 8	1280	190	604-971	1	397-1156	1
S3029	Block C	850	150	1033-1275	1	891-1407	1

Site	Sample	RC Date	Sigma	AD Range			
Lab#				1 Sigma	P	2 Sigma	P
LOVSTROM DjLx-1 cont'd							
S-2823	TU 22	230	90	1520-1592 1619-1693 1727-1812 191-1950	0.228 0.301 0.351 0.12	1483-1892 1907-1950	0.899 0.101
S-2824	TU 22	775	90	1157-1298 1372-1378	0.982 0.018	1039-1320 1349-1391	0.924 0.076
S-3034	Block E	715	110	1211-1328 1341-1395	0.704 0.296	1045-1094 1120-1141 1147-1429	0.049 0.018 0.932
S-3033	Block E	465	105	1321-1348 1392-1521 1576-1584 1590-1623	0.109 0.728 0.025 0.139	1297-1644	1
S-2952	Block E	675	70	1270-1321 1349-1392	0.551 0.449	1224-1410	1
SFU*	Block E	380	50	1054-1078 1153-1246	0.161 0.839	1041-1107 1116-1262	0.227 0.773
SFU*	Block E	380	50	1447-1521 1576-1584 1590-1623	0.674 0.047 0.278	1441-1533 1536-1636	0.545 0.455
S-3031	Block H	780	110	1052-1080 1152-1301 1368-1382	0.095 0.857 0.048	1027-1330 1339-1397	0.898 0.102
S-3032	Block H	405	110	1426-1528 1544-1634	0.565 0.435	1299-1370 1380-1680 1739-1742 1763-1801 1938-1950	0.061 0.906 0.001 0.026 0.007
JACKSON DiMe-17							
β-65952		620	65	1295-1329 1340-1396	0.382 0.618	1276-1422	1
β-82795	bison kill	330	60	1493-1602 1613-1637	0.82 0.18	1446-1661	1
VERA DiMe-25							
β-106109		340	60	1484-1528 1544-1634	0.338 0.662	1445-1653	1
β-111141		250	50	1523-1572 1630-1677 1765-1773 1776-1800 1940-1950	0.282 0.434 0.033 0.19 0.061	1486-1604 1607-1689 1730-1809 1926-1950	0.318 0.366 0.252 0.063
SANDERSON DhMs-12							
S-2968	Level 1	310	75	1487-1604 1607-1649	0.74 0.25	1439-1682 1737-1757 1761-1804 1936-1950	0.913 0.014 0.057 0.015
TWIN FAWNS DiMe-23							
β-9611	bison bone AMS	150	60	1669-1698 1722-1781 1798-1816 1834-1878 1916-1946	0.165 0.329 0.105 0.232 0.169	1663-1895 1903-1950	0.829 0.171

* these two SFU samples do not have samples provided; were some of the last samples run at the SFU laboratory and dates are suspect.

Calib Rev 7.0.1 Radiocarbon Calibration Program (Stuiver and Reimer 1993)

APPENDIX 02: ANIMAL UNIT CALCULATION BY LANDMARK

Appendix 02-Table 1		Hokanson					Lovstrom					Jackson				
		A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU
Cranium					4.0	66.7				1.5	27.3				4.0	57.1
foramen magnum																
basioccipital	1*												1	1		
articular tubercle	2															
tympanic bulla																
Petrous	3	2	1	1				1					5	3		
auditory meatus	4												2	3		
jugular process				1												
occipital condyle	5		2	1				1					2	1		
Parietal				1												
Frontal	6			1												
temporal													1	1		
horn core	7	2	1	2									1			
zygomatic	8			3												
Lacrimal																
nasal		1												1		
palatine	9															
maxilla	10												1	1		
premaxilla	11		1					1	1							
P^2	12		2	3					1				4	2		
P^3	13			3				1					2	2		
P^4	14		1	3									1	2		
M^1	15		3	5					2				5	2		
M^2	16			3				1	1				3	2		
M^3	17		2	3									2	2		
Mandible					5.0	83.3				2.5	45.5				7.0	100
coronoid process	1		1	2					1				4	4		
condylar process	2		1	4				1	2				5	6		
ascending ramus	3			1					2					1		
mandibular foramen	4								2					1		
angular process	5		1	1												
body	6	1	1													
diastema	7			1				2	1							
mental foramen	8			1				2	1					1		
mandibular symphysis	9		2	1				3	1				1	1		
incisor/canine	10	3	4	3				5	1				11	5		
P$_2$	11			6				1					3	2		
P$_3$	12			2				1					3	1		
P$_4$	13			1				1					4	1		
M$_1$	14			1				1	1				7	3		
M$_2$	15		2					1	1				8	4		
M$_3$	16		4	1									6	3		
Hyoid	1		1	1	1.0	16.6							3	2	2.5	35.7

Appendix 02-Table 1		Hokanson					Lovstrom					Jackson				
		A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU
Sternum	1															
Rib					0.3	5.0				0.5	9.1				1.0	14.3
head	1		3	3				8	5				5	8		
tubercle			2	5				8	6					6		
body		8	3	4				2	3				14	13		
sternal end																
Atlas															1.0	14.3
alar foramen												1				
cranial articular surface	1											2				
caudal articular surface	2											2				
dorsal tubercle	3											1				
ventral arch	4											1				
transverse process	5											1				
Axis					1.0	16.7									3.0	42.9
dens	1											1				
cranial articular surface	2											1				
caudal articular surface	3											1				
spinous process	4	1										1				
vertebral arch	5															
transverse process																
centrum	6											3				
Cervical					0.4	6.7				0.1	1.8				1.4	20.0
cranial articular surface	1	5					1					7				
caudal articular surface	2	6					1					7				
neural arch	3	2					1					7				
spinous process	4	3										4				
transverse process	5	4										4				
centrum	6	1					1					10				
Thoracic					1.4	11.7				0.5	9.0				1.8	25.7
cranial art surface	1						4					5				
caudal art surface	2						4					8				
spinous process	3	2					5					25				
transverse process	4	19					9					7				
centrum	5	2					7					10				
Lumbar					1.0	16.7				0.6	10.9				0.6	8.6
cranial art surface	1											1				
caudal art surface	2															
spinous process	3											1				
transverse process	4	10					5					2				
centrum	5	1														
Sacrum	1														1.0	14.3
cranial art surface																
wings																
medial crest												1				
lateral crest																

Appendix 02-Table 1		Hokanson					Lovstrom					Jackson				
		A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU
Caudal	1						2			0.1	1.8	2			0.1	1.4
Scapula					3.5	58.3				0.5	9.0				3.0	42.9
glenoid cavity	1		2	3									5	1		
corocoid process	2		2	2									2			
supraglenoid tubercle			2	2												
acromion	3		2	2												
acromion spine	4		2	5									1			
neck	5		2	2					1				4			
supraspinous fossa	6		1	1										1		
infraspinous fossa (blade)	7													1		
proximal border			1													
Humerus					4.0	66.7				2.5	45.5				2.5	35.7
head	1			1												
lateral tubercle	2		1													
medial tubercle	3															
proximal shaft	4		2					1					3			
deltoid tuberosity	5		4	1				3	1							
teres major tuberosity	6		1					2								
teres minor tuberosity	7												3	1		
posterior lat foramen	8		1	1				1	2							
distal shaft				2				1	2					2		
olecranon fossa	9			3				1	1					1		
radial fossa	10		2	2				1	1					1		
medial epicondyle	11			3				1	2					2		
lateral epicondyle	12			3				1	2					1		
medial condyle	13			3				1	1				1	3		
lateral condyle	14			4				2	1							
Radius					3.0	50.0				4.0	72.7		4	3	4.0	57.1
lateral fossa	1		1	3				4	3				4	4		
medial fossa	2		2	4				4	2				4	3		
radial tuberosity	3		2	3				4	3				3	4		
medial tuberosity			1	4				5	3				1	1		
posterior lateral foramen	4		2	4				1	2				1			
anterior shaft	5		1						1					1		
posterior shaft	6		2	3									1			
internal carpal facet	7		1	1									1			
radial carpal facet	8		1	1												
Ulna					4.0	66.7				5.5	100		2	1	3.0	42.9
olecranon	1		1	4					1				2	1		
olecranon tuberosity	2		1	5				3					2	3		
anconeal process	3		3	3				8	1				2	4		
semilunar notch	4		3	3				8	2				2	2		
radial articular surface			2	4				9	1							
shaft	5			2				5	1				2	4		
styloid process	6		2	1					1							

Appendix 02-Table 1		Hokanson					Lovstrom					Jackson				
		A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU	A/I	L	R	MAU	% MAU
Radial Carpal	1		1	4	2.5	41.7		2	2	2.0	36.4		2	4	3.0	42.9
Central Carpal	1		2	2	2.0	33.3			3	1.5	27.3		5	5	5.0	71.4
Ulnar Carpal	1		1	2	1.5	25.0		7	1	4.0	72.4		4	4	4.0	57.1
2/3 Carpal	1		2	4	3.0	50.0		2	2	2.0	36.4		2	2	2.0	28.6
4th Carpal	1		1	3	2.0	33.3			1	0.5	9.1		4	2	3.0	42.9
Accessory Carpal	1		1	3	2.0	33.3		1	1	1.0	18.2		3		1.5	21.4
Metacarpal					1.0	16.7				3.0	54.5				3.5	50.0
2/3 carpal facet	1			1				3	2				2	3		
4th carpal facet	2			1				3	2				2	2		
proximal anterior foramen	3							3	2				1	2		
proximal posterior foramen	4							2	1					2		
anterior shaft	5							1								
posterior shaft	6															
distal anterior foramen	7		1	1				4	2				3	1		
distal posterior foramen	8		1	1				4	2				4	1		
medial condyle	9		1	1				4	2				4	2		
lateral condyle	10		1	1				4	2				4	2		
5th Metacarpal	1			1	0.5	8.3		1	1	1.0	18.2		1	1	1.0	14.3
Innominate					2.0	33.3				0.5	9.1				2.5	35.7
coxal tuber																
iliac crest																
ilium blade	1								1							
ilium shaft	2													1		
major sciatic notch																
ischiatic spine																
minor sciatic notch	3															
ischium (blade)	4		1	2												
ischiatic tuberosity	5		1	1												
pubis (shaft)	6		2	1					1							
pubic symphysis	7		2	1												
pubis acetabulum	8		2	1					1					2		
ischium acetabulum	9		1	2					1				2	3		
ilium acetabulum	10		2	1					1				2	1		

Appendix 02-Table 1		**Hokanson**					**Lovstrom**					**Jackson**				
		A/I	**L**	**R**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**
Femur					2.0	33.3				0.5	9.1				1.5	21.4
head	1		1						1				1	1		
greater trocanter	2		1													
trochanteric fossa																
lesser trocanter	3		2	2												
intertrochanteric crest																
anterior shaft	4		2										1	1		
posterior medial foramen	5		1	2					1				1			
medial supraglenoid tubercle			1	1												
supracondylar fossa	6			1												
lateral supraglenoid tubercle									1				2			
lateral epicondyle																
medial epicondyle	7															
lateral condyle	8								1							
medial condyle	9															
trochlea	10															
Patella	1		2		1.0	16.7		3	3	3.0	54.5		2	1	1.5	21.4
Tibia					6.0	100				4.0	72.7				2.0	28.6
medial condyle	1							1								
lateral condyle	2		1					1								
tibial tuberosity	3							1					1	1		
anterior (tibial) crest	4		7	3				2	3					2		
posterior lateral foramen	5		6	1				4	3				2	2		
proximal posterior shaft	6		1						1					1		
distal anterior shaft	7		4	3				1	4					1		
distal posterior shaft	8		3	4				1	4							
lateral malleolus groove	9		3	5				2	3					1		
medial malleolus	10		3	5												
Lateral Malleous	1		5	3	4.0	66.7			4	2.0	36.4		4	2	3.0	42.9
Astragalus					2.0	33.3				2.5	45.5				5.5	78.6
proximal condyle	1		2	2				4	1				6	5		
distal condyle	2		2	2				4	1				5	3		
Calcaneous					1.5	25.0				2.0	36.4				3.5	50.0
calcaneal tuber	1			1				2	1				3	2		
body	2		1	1				3	1				4	2		
C/4 tarsal facet	3		1	1				3	1				3	3		
sustentaculum	4		2	1				3	1				3	3		
C/4 Tarsal	1		2	5	3.5	58.3		5	2	3.5	63.6		4	6	5.0	71.4
2/3 Tarsal	1		4		2.0	33.3		3		1.5	27.3		3	5	4.0	57.1
1st Tarsal	1		2	2	2.0	33.3		2	1	1.5	27.3		3	4	3.5	50.0

Appendix 02-Table 1		**Hokanson**					**Lovstrom**					**Jackson**				
		A/I	**L**	**R**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**
Metatarsal					2.5	41.7				2.5	45.5				5.5	78.6
C/4 tarsal facet	1		1	4				2	1				2	5		
2/3 tarsal facet	2		1	4				2	1				3	6		
1st tarsal facet				4				3	2				3	3		
proximal anterior foramen	3		1	4				2	1				2	8		
proximal posterior foramen	4			1				3	2				2	4		
anterior shaft	5							1					1	3		
posterior shaft	6		1					2					1	3		
distal anterior foramen	7		1	1				2					1	3		
distal posterior foramen	8			1				2					2	2		
medial condyle	9			1				2					2	2		
lateral condyle	10		1	1				2					2	2		
2nd Metatarsal	1														0.5	7.1
1st Phalanx					2.0	33.3				2.0	36.4				3.0	42.9
proximal	1	16					16					24				
distal	2	15					16					18				
2nd Phalanx					0.8	13.3				2.4	43.6				2.5	35.7
proximal	1	4					19					20				
distal	2	6					19					18				
3rd Phalanx					1.1	18.3									2.9	41.4
proximal	1	8					21			2.6	47.3	23				
distal	2	9					12					12				
Lateral Sesamoid	1	5			0.6	10.0	7			0.9	16.4	15			1.9	27.1
Medial Sesamoid	1	4			0.5	8.3	10			1.3	23.6	23			3.0	42.9
Distal Sesamoid	1	3			0.4	6.7	12			1.5	27.3	15			1.9	27.1

Appendix 02-Table 2		**Vera**					**Sanderson**			**Twin Fawns**				
		A/I	**L**	**R**	**MAU**	**% MAU**	**MNE**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**
Cranium					2.5	35.7	15	7.5	100				2.5	41.7
foramen magnum												1		
basioccipital	1											1		
articular tubercle	2						1							
tympanic bulla												1		
petrous	3		2	3			5				2	1		
auditory meatus	4						1			2				
jugular process														
occipital condyle	5			1								1		
parietal														
frontal	6						1				1	1		
temporal														
horn core	7									1				
zygomatic	8										1	1		
lacrimal														
nasal										1				
palatine	9													
maxilla	10													
premaxilla	11			1			5				2	2		
P^2	12		2	3			8				2	1		
P^3	13			3			1				3	1		
P^4	14		2	3							2			
M^1	15			1			15							
M^2	16		1	1			4				2	2		
M^3	17		1	1							1			
Mandible					5.0	71.4	14	7.0	93.3				3.0	50.0
coronoid process	1		1	2			14			1	1	3		
condylar process	2		3	5			5			2	2	2		
ascending ramus	3			1								1		
mandibular foramen	4			2								1		
angular process	5			2			1				1			
body	6									1		1		
diastema	7											1		
mental foramen	8			1			1				1	1		
mandibular symphysis	9		3	2			10				1	1		
incisor/canine	10		2	2			24			1	1	1		
P_2	11		3				11				2	1		
P_3	12		3	1			5				3	3		
P_4	13		3				0			1	2	1		
M_1	14		2	1			13				3	2		
M_2	15		2	1			1				1	1		
M_3	16		5	1			10				2	1		
Hyoid	1				0.5	7.1	2	1.0	13.3				1.0	16.7

Appendix 02-Table 2		Vera					Sanderson			Twin Fawns				
		A/I	L	R	MAU	% MAU	MNE	MAU	% MAU	A/I	L	R	MAU	% MAU
Sternum	1												1.0	16.7
Rib					0.1	1.4	43	1.6	21.3				0.3	5.0
head	1									1		1		
tubercle										2		4		
body										8	1			
sternal end										3				
Atlas					2.0	28.6	1	1	13.3					
alar foramen		2												
cranial art surface	1	1												
caudal art surface	2	1												
dorsal tubercle	3						1	1	13.3					
ventral arch	4													
transverse process	5													
Axis					2.0	28.6	2	2	26.7					
dens	1	2					1							
cranial art surface	2	1					4							
caudal art surface	3	1												
spinous process	4													
vertebral arch	5													
transverse process														
centrum	6	1					2							
Cervical					0.1	1.4	6	0.9	12.0				0.3	0.5
cranial art surface	1						6			1				
caudal art surface	2						7							
neural arch	3						4							
spinous process	4	1												
transverse process	5						3							
centrum	6						5			2				
Thoracic					0.1	1.4	10	0.8	10.7				0.5	8.3
cranial art surface	1						5							
caudal art surface	2	1					10			6				
spinous process	3	1					3			7				
transverse process	4						13			1				
centrum	5						1							
Lumbar					0.2	2.9	17	2.8	37.3				2.0	33.3
cranial art surface	1						8							
caudal art surface	2						17			1				
spinous process	3						2							
transverse process	4	2					2			19				
centrum	5						8			1				
Sacrum	1						6	6	80.0				1.0	16.7
cranial art surface														
wings														
medial crest														
lateral crest														

Appendix 02-Table 2		Vera					Sanderson			Twin Fawns				
		A/I	L	R	MAU	% MAU	MNE	MAU	% MAU	A/I	L	R	MAU	% MAU
Caudal	1				0.4	5.7	3	0.2	2.0	4			0.2	3.3
Scapula					2.0	28.5	3	1.5	20.0				1.0	16.7
glenoid cavity	1		3	1						1		1		
corocoid process	2													
supraglenoid tubercle														
acromion	3													
acromion spine	4													
neck	5		1	1								1		
supraspinous fossa	6													
infraspinal fossa	7													
proximal border												1		
Humerus					3.0	42.9	8	4	53.3				2.0	33.3
head	1													
lateral tubercle	2													
medial tubercle	3													
proximal shaft	4													
deltoid tuberosity	5		2	1							2	2		
teres major tuberosity	6			1							1	1		
teres minor tuberosity	7													
posterior lat foramen	8		4	1							2	2		
distal shaft												1		
olecranon fossa	9			1								1		
radial fossa	10		1	2							1	2		
medial epicondyle	11			2								2		
lateral epicondyle	12			1								2		
medial condyle	13			2								2		
lateral condyle	14											1		
Radius					7.0	100	13	6.5	86.7				1.0	16.7
lateral fossa	1		6	4										
medial fossa	2		6	7										
radial tuberosity	3		7	5										
medial tuberosity			6	5								1		
post lateral foramen	4		1	3							1			
anterior shaft	5		1								1			
posterior shaft	6													
internal carpal facet	7		1											
radial carpal facet	8		2	1										
Ulna					5.0	71.4	6	3	40.0				2.0	33.3
olecranon	1			2								2		
olecranon tuberosity	2		1	1								2		
anconeal process	3											2		
semilunar notch	4		1	2							1	3		
radial art surface			1	4							1	1		
shaft	5		4	6							1	1		
styloid process	6		4											

Appendix 02-Table 2		Vera					Sanderson			Twin Fawns				
		A/I	L	R	MAU	% MAU	MNE	MAU	% MAU	A/I	L	R	MAU	% MAU
Radial Carpal	1		8	1	4.5	64.3	10	5	66.7				0.5	8.3
Central Carpal	1		8	2	5.0	71.4	11	5.5	73.3					
Ulnar Carpal	1		4	1	2.5	35.7	10	5	66.7		2	1	1.5	25.0
2/3 Carpal	1		8	3	5.5	78.6	9	4.5	60.0			1	0.5	8.3
4th Carpal	1		6	1	3.5	50.0	7	3.5	46.7					
Accessory Carpal	1		5	1	3.0	42.9	4	2	26.7		1		0.5	8.3
Metacarpal					3.0	42.9	6	3	40.0				1.0	16.7
2/3 carpal facet	1		4	1								1	0.5	8.3
4th carpal facet	2		2	1										
proximal anterior foramen	3		4	2								1		
proximal posterior foramen	4			1										
anterior shaft	5													
posterior shaft	6													
distal anterior foramen	7		1	1							1			
distal posterior foramen	8		2	1						1	1			
medial condyle	9		3	1										
lateral condyle	10		2	1										
5th Metacarpal	1		3	2	2.5	35.7	3	1.5	20.0				0.0	0.0
Innominate					1.0	14.3	6	3	40.0				1.0	16.7
coxal tuber														
iliac crest														
ilium blade	1						2	1	13.3					
ilium shaft	2		1											
major sciatic notch														
ischiatic spine										1				
minor sciatic notch	3													
ischium (blade)	4										1	1		
ischiatic tuberosity	5													
pubis (shaft)	6													
pubic symphysis	7													
pubis acetabulum	8		1											
ischium acetabulum	9		2									1		
ilium acetabulum	10		2											

Appendix 02-Table 2		Vera					Sanderson			Twin Fawns				
		A/I	L	R	MAU	% MAU	MNE	MAU	% MAU	A/I	L	R	MAU	% MAU
Femur					0.5	7.1	11	5.5	73.3				3.0	50.0
head	1													
greater trocanter	2													
trochanteric fossa														
lesser trocanter	3													
anterior shaft	4													
posterior medial foramen	5	1												
medial supraglenoid tubercle												5		
supracondylar fossa	6										1	1		
lateral supraglenoid tubercle											1			
lateral epicondyle														
medial epicondyle	7													
lateral condyle	8											1		
medial condyle	9													
trochlea	10													
Patella	1	1	6		3.5	50.0	3	1.5	20.0		1	2	1.5	25.0
Tibia					2.0	28.6	15	7.5	100					
medial condyle	1						2	1						
lateral condyle	2		1				4	2						
intercondylar eminence														
tibial tuberosity	3		1								2			
anterior (tibial) crest	4		1								2	1		
posterior lateral foramen	5		1	1							6	6		
proximal posterior shaft	6									1	2			
distal anterior shaft	7			1										
distal posterior shaft	8			1						1	2			
lateral malleolus groove	9		1	3							1	1		
medial malleolus	10			1						1		2		
Lateral Malleous	1		2	4	3.0	42.9	11	5.5	73.3			1	0.5	8.3
Astragalus					7.0	100	6	3	40.0				0.5	8.3
proximal condyle	1		7	7								1		
distal condyle	2		7	7								1		
Calcaneous					4.5	64.3	5	2.5	33.3				2.0	33.3
calcanean tuber	1		4	2							2	2		
body	2		4	2							2	2		
C/4 tarsal facet	3		5	4							2	2		
sustentaculum	4		5	1							2	2		
C/4 Tarsal	1		4	3	3.5	50.0	15	7.5	100		2	2	2.0	33.3
2/3 Tarsal	1		8	3	5.5	78.6	13	6.5	86.7		1	3	2.0	33.3
1st Tarsal	1		5		2.5	35.8	2	1	13.3	7			3.5	58.3

Appendix 02-Table 2		**Vera**					**Sanderson**			**Twin Fawns**				
		A/I	**L**	**R**	**MAU**	**% MAU**	**MNE**	**MAU**	**% MAU**	**A/I**	**L**	**R**	**MAU**	**% MAU**
Metatarsal					4.0	57.1	4	2	26.7				2.0	33.3
C/4 tarsal facet	1		4				4	2				2		
2/3 tarsal facet	2		4	2			3	1.5						
1st tarsal facet			6									1		
proximal anterior foramen	3		2	1			2	1						
proximal posterior foramen	4		6	1							1	1		
anterior shaft	5		2	1			2	1		1				
posterior shaft	6		1				2	1			2			
distal anterior foramen	7		1	1							1	2		
distal posterior foramen	8		1									2		
medial condyle	9		1	1			1	0.5			1	2		
lateral condyle	10		1	1			1	0.5			1	2		
2nd Metatarsal	1		3	2	2.5	35.8	3	1.5	20.0		1	1	1.0	16.7
1st Phalanx					1.5	21.4	21	2.6	34.7				3.4	56.7
proximal	1	12					21			27				
distal	2	11					21			20				
2nd Phalanx					1.9	27.1	35	4.3	57.3				2.8	46.7
proximal	1	15					35			20				
distal	2	14					35			22				
3rd Phalanx					1.3	18.6	9	1.1	14.7				2.8	46.7
proximal	1	10					9			22				
distal	2	4					9			9				
Lateral Sesamoid	1	24			3.0	42.9	26	3.3	43.3	12			1.5	25.0
Medial Sesamoid	1	9			1.1	14.7	24	3	40.0	12			1.5	25.0
Distal Sesamoid	1	17			2.1	30.0	12	1.5	20.0	26			3.0	50.0

APPENDIX 03: MODERN FOETAL BISON ELEMENT MEASUREMENTS

ID	Collection Date	AGE (days)	SCAPULA			HUMERUS		RADIUS	
		Aug 19 as Day 1	Max M-L Length	Min A-P Neck Width	Max A-P Head Width	Max Diaphyseal Length	Min midshaft Diameter	Max Diaphyseal Length	Min midshaft Diameter
B6E	Dec 15	119	21.15	3.60	5.72	15.32	3.33	16.31	1.89
B6F	Jan 08	143	41.25	6.63	8.69	28.78	5.84	30.82	3.40
B6L	Jan 15	150	71.32	12.51	15.67	54.35	11.63	56.86	7.44
B6H	Feb 12	178	66.22	10.79	13.32	47.76	9.94	51.07	6.35
B6I	Feb 12	178	87.71	13.19	18.14	68.65	12.43	72.77	9.14
B6O	Feb 26	192	93.94	15.05	20.93	74.74	14.41	76.43	10.00
B6N	Feb 26	192	125.27	19.37	28.44	102.20	16.42	101.43	12.01
B6P	Mar 05	199	110.36	16.81	24.84	89.38	15.97	91.33	11.12
B6V	Mar 05	199	114.18	18.27	27.54	90.34	17.35	93.17	12.25
B6Q	Mar 05	199	119.32	19.10	28.92	99.02	18.23	99.77	11.72
B6U	Apr 20	245	169.71	25.92	40.92	137.25	23.67	134.24	15.97
B6J	May 14	269	143.17	21.10	32.43	121.32	19.09	119.13	12.98
B6K	May 19	274	152.92	21.24	33.28	126.92	20.08	127.62	12.76
B6T	June 15	301	L border broken	27.64	45.10	156.73	25.61	143.35	15.46

ID	Collection Date	AGE (days)	ULNA	METACARPAL		FEMUR		TIBIA		METATARSAL	
		Aug 19 as Day 1	Max Diaphyseal Length	Max Diaphyseal Length	Min midshaft Diameter	Max Diaphyseal Length	Min midshaft Diameter	Max Diaphyseal Length	Min midshaft Diameter	Max Diaphyseal Length	Min midshaft Diameter
B6E	Dec 15	119	broken	unfused	unfused	16.04	2.94	19.13	2.71	unfused	Unfused
B6F	Jan 08	143	65.76	unfused	unfused	32.12	5.06	37.04	4.30	unfused	Unfused
B6L	Jan 15	150	65.10	unfused	unfused	60.73	10.35	68.70	10.24	59.20	8.70
B6H	Feb 12	178	58.42	38.23	6.28	53.04	9.34	59.43	9.59	48.26	7.12
B6I	Feb 12	178	82.44	unfused	unfused	76.80	11.85	88.26	12.44	77.44	10.39
B6O	Feb 26	192	87.96	67.29	10.93	85.71	14.27	94.30	15.16	83.67	12.73
B6N	Feb 26	192	122.19	unfused	unfused	115.03	16.63	127.29	16.33	115.61	15.02
B6P	Mar 05	199	106.76	86.28	13.57	99.19	15.53	113.22	15.94	105.26	14.51
B6V	Mar 05	199	broken	unfused	unfused	103.06	16.58	116.63	16.26	104.51	14.70
B6Q	Mar 05	199	110.50	90.66	14.12	110.20	16.19	123.59	15.81	111.92	13.88
B6U	Apr 20	245	170.11	118.91	15.35	151.87	21.67	168.51	20.81	147.09	18.84
B6J	May 14	269	146.22	112.83	14.55	137.96	18.84	152.29	17.41	136.29	16.33
B6K	May 19	274	156.73	117.22	15.63	143.15	19.36	166.74	17.97	142.61	17.53
B6T	June 15	301	broken	128.31	16.37	174.56	24.90	181.91	19.23	157.06	19.02

APPENDIX 04: FODS TEST SPECIMENS

ID	Age in days	Day Range	Scapula						Humerus				Radius				Ulna	
			max M-L length	day	min A-P neck width	day	max A-P head width	day	max length	day	mmd	day	max length	day	mmd	day	max length	day
US01L	60	30-90	9.61	80	2.83	31	2.56	**29**	6.74	73	1.41	**20**	6.92	62	0.90	**17**	fragile	-
US01R	60	30-90	9.32	79	3.66	38	2.99	31	6.27	73	1.51	**17**	6.91	62	0.90	**17**	fragile	-
US02L	60	30-90	9.77	80	2.73	31	2.81	30	6.63	73	1.46	**20**	7.48	63	0.91	**17**	fragile	-
US02R	60	30-90	9.63	80	2.03	**25**	2.68	30	6.78	73	1.57	**21**	7.16	63	0.93	**17**	fragile	-
US03L	135	105-165	77.74	158	13.55	122	18.92	110	62.23	148	11.43	112	65.46	148	8.54	128	fragile	-
US03R	135	105-165	77.54	158	14.60	131	18.75	109	61.87	147	12.25	119	64.48	146	8.23	123	75.91	150
US04L	210	180-240	109.12	193	21.63	191	30.88	**169**	85.54	**179**	16.63	**159**	91.64	186	12.61	187	111.98	195
US04R	210	180-240	109.07	193	21.42	189	29.85	**164**	86.56	181	17.39	**166**	90.29	184	12.14	180	112.23	195
US05L	277	247-307	broken	-	24.54	**216**	38.34	**205**	136.35	**244**	20.74	**197**	128.21	**239**	14.80	**219**	164.62	261
US05R	277	247-307	broken	-	25.92	**227**	36.00	**194**	135.56	**246**	20.47	**195**	131.11	**243**	14.41	**213**	165.60	262
US06L	291	261-321	169.95	264	25.62	**225**	42.04	**224**	141.59	**254**	19.34	**184**	138.75	**255**	15.85	**234**	174.64	273
US06R	291	261-321	170.34	264	24.73	**218**	42.02	**224**	141.15	**254**	19.82	**189**	138.24	**254**	15.25	**225**	175.94	275
US07L	300	270-330	191.32	288	28.63	**250**	46.00	**243**	162.66	283	20.13	**191**	171.73	303	14.80	**219**	197.02	301
US07R	300	270-330	192.89	289	28.17	**247**	45.93	**243**	162.16	282	20.45	**194**	169.68	300	14.60	**215**	197.84	302

ID	**Age in Days**	**Day Range**	**Metacarpal**				**Femur**				**Tibia**				**Metatarsal**			
			max length	day	mmd	day	max length	day	mmd	day	max length	day	mmd	day	max length	day	mmd	day
US01L	60	30-90	unfused	-	-	-	6.59	80	1.44	21	7.67	83	1.24	**18**	unfused	-	-	-
US01R	60	30-90	unfused	-	-	-	6.55	80	1.49	21	7.73	83	1.23	**18**	unfused	-	-	-
US02L	60	30-90	unfused	-	-	-	7.01	81	1.31	19	8.07	83	1.33	**20**	unfused	-	-	-
US02R	60	30-90	unfused	-	-	**-**	6.40	80	1.44	21	7.79	83	1.39	**20**	unfused	-	-	-
US03L	135	105-165	unfused	-	-	-	75.01	162	12.47	120	81.75	165	13.52	159	unfused	-	-	-
US03R	135	105-165	unfused	-	-	-	73.90	160	12.22	121	82.54	**166**	12.23	144	unfused	-	-	-
US04L	210	180-240	90.31	195	14.22	**255**	105.56	199	16.39	159	111.99	199	15.66	183	104.40	192	14.02	203
US04R	210	180-240	90.10	195	14.08	**252**	107.33	201	17.29	167	112.56	199	15.69	184	104.38	192	14.12	203
US05L	277	247-307	115.61	**237**	16.53	297	150.35	252	21.00	201	175.71	269	18.84	**220**	149.52	259	18.51	267
US05R	277	247-307	115.56	**237**	16.61	298	151.96	253	21.64	**207**	175.33	269	18.78	**219**	150.65	260	18.69	270
US06L	291	261-321	120.48	**245**	17.41	313	163.88	269	20.34	**195**	182.52	277	19.53	**228**	152.16	263	18.95	274
US06R	291	261-321	120.94	**246**	17.03	305	165.36	270	21.28	**204**	183.11	278	19.77	**230**	152.91	264	19.11	276
US07L	300	270-330	140.77	279	16.17	290	224.63	**341**	20.95	**201**	226.73	326	19.64	**229**	174.76	296	17.82	**257**
US07R	300	270-330	140.47	279	16.40	294	193.73	304	22.08	**212**	200.21	297	19.51	**227**	176.11	298	18.19	**263**

mmd=minimum midshaft diameter