SAND DUNE ENVIRONMENTS IN FIRST NATIONS LIFEWAYS: HOLISTIC INTERPRETATION FOR THE MIDDLE AND LATE PRECONTACT PERIODS ON THE NORTHERN PLAINS

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Abstract

Over the past forty years, archaeologists have identified hundreds of Middle and Late Precontact archaeological sites in sand dune areas across the Northern Plains. Varying from isolated finds to complex multi-component sites, they represent a set of complex and integrated behaviours that to date have not been examined in a holistic manner across both time and space. This work uses the concepts of Island Theory, Historical Ecology, and Possibilism to examine the environmental, social, and spiritual/cultural roles that sand dune locations played in the lifeways of Northern Plains groups during the Middle and Late Precontact periods. This theoretical basis allows for the development of a holistic interpretation of First Nations behaviour in relation to dune environments, creating an interpretive narrative that better accounts for social, economic, political, and environmental behaviour than do previous investigations. Further, the concept of human agency as a factor in influencing the environmental conditions and physical attributes to create anthropogenic landscapes is examined.

This work presents a synthesis of past work completed within dune environments, including a reassessment of past radiocarbon dates obtained from Northern Plains dune sites, as well as the history of dune usage across the study area as both resource bases and as sacred landscapes. These data are analysed along with the results of field surveys and testing programs to determine if landscape usage observed at sand dunes varies from the surrounding grasslands, as well as with palaeoenvironmental and geoarchaeological data to determine what role environmental variation played in the usage of sand dune environments. What emerges from this analysis indicates that in the Precontact era Indigenous people viewed and exploited dune environments differently than the environments that surround them. Patterns of seasonal usage, and in some cases cultural contact, are present within the archaeological record. This pattern varies, based upon the cultural group in question, and is influenced by such factors as regional climate variation, dune stabilization and hydrology, the diverse resource base that is present within dune environments, traditional subsistence practices, and the spiritual beliefs associated with aeolian environments on the Northern Plains for specific groups. Further evidence indicates that these practices impacted dune environments, transforming them in part into anthropogenic landscapes.

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Numerous organizations were also instrumental in seeing this work, and my program, through to completion. A great deal of thanks is given to the Department of Interdisciplinary Studies in taking a bit of a chance and allowing me to complete this work. To obtain the data needed for this research, provincial regulatory agencies allowed me generous access to all of their resources; for this I thank the staffs of the Archaeological Survey of Alberta, the Heritage Conservation Branch for Saskatchewan, and the Historic Resources Branch for Manitoba. Equally supportive were the past and present staff members of the Saskatchewan Archaeological Society, who provided me with information, support, encouragement, and access to far too many books – thank you Tomasin, Talina, and Belinda!

Finally, and most importantly, my thanks have to be given to those closest to me who supported me through what turned out to be a long and winding journey. To my parents and family, thank you for supporting and caring for me as I continued to be (and still are!) that strange kid who would dig up the garden looking for artifacts, and surprising everyone when I would walk into the house with a box of broken glass and literally what a dog chewed on and dragged into the yard. Lastly, but not least in any way, is Karin. You are my better half, my partner in crime, and constant person who without I would not be me. You have seen be at my best and my worst through this process, and have always been there - without you, I would not have been able to see this through. Words cannot express what you, and everyone else, mean to me for helping see me through to the end!

This work is dedicated to the memory of my father, Michael, who taught me the importance of hard work and education, and who always enjoyed going to a museum with an overeager kid!

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List of Abbreviations

AD - Anno Domini

BGS - Brock University Earth Sciences Radiocarbon Laboratory

BP - Before Present

CARD - Canadian Archaeological Radiocarbon Database

CRM - Cultural Resource Management

DBS - Depth Below Surface

FBR - Fire-Broken Rock

GIS - Geographic Information Systems

GSC - Geological Survey of Canada Radiocarbon Laboratory

HCl - Hydrochloric Acid

M - Molar Concentration (mol/L)

MNI - Minimum Number of Individuals

NWMP - North West Mounted Police

PAA - Provincial Archives of Alberta

PAM - Provincial Archives of Manitoba

S - Saskatchewan Research Council (SRC) Radiocarbon Laboratory

SCAPE - The Study of Cultural Adaptations in the Prairie Ecozone

Chapter 1

Introduction and Research Methods

1.1 Introduction and Focus of Study

Found throughout the Northern Plains regions of Saskatchewan, Alberta, and Manitoba, sand dunes are distinct geographic features that vary in both geomorphological form (e.g., sand hills, sand sheets, minor dunes, deflation hollows) and size. Covering an area of almost 9000 km^2 within these three provinces, these regions possess archaeological evidence suggesting that First Nations groups have utilized them for approximately 10 000 years (see Epp and Johnson 1980). Further, historical and ethnographic sources indicate that dune areas were treated as being distinct environments by First Nations groups, with oral and written accounts distinguishing between these aeolian environments and the grasslands surrounding them. In spite of the abundant evidence for human usage of these environments prior to European contact, and the written and oral records that exist pertaining to this usage, few academic efforts have been made to determine if there is a larger pattern to First Nations habitation of these environments, and if these patterns of behavior altered as drought impacted dune areas. Previously, studies of dune site habitation patterns (see Epp 1984; Epp and Johnson 1980; Hamilton and Nicholson 1999; Hanna 2007; Neal 2006) have focused primarily on one site and the time period represented by the particular diagnostic material it contains. Furthermore, any conclusions drawn on dune usage are based on comparisons with sites that are either well known from easily accessible theses and monographs or have been recently excavated. Frequently, these analyses of Northern Plains sites include data from outside of the region, most commonly the McIntosh site, a well-documented Central Plains settlement located in the Great Sand Hills in Nebraska (see Hanna 2007; Koch 1995; Neal 2006). This usage of site data from outside of the Northern Plains in the construction of a regional model of landscape usage is problematic and is addressed later in this work.

In addition, within the broader context of regional reconstructions and theorization of past human behavior, migration, and resource use, little or no mention is made of sand dunes. This omission comes despite the substantial geographical area that these landscapes cover on the Northern Plains. Rather, the focus for analysis has been placed upon broad-based ecological and ecoregion data (see Malainey and Sheriff 1996; Peck 2001; Vickers and Peck 2004) that do not consider the role that smaller environments, such as dunes and river valleys, play in influencing human behavior. These perspectives, while technically accurate, should be questioned with regards to how accurately they describe and explain human behaviour within discrete bounded landscapes contained within the larger grasslands ecoregion.

The goal of this thesis is to examine the present state of knowledge on sand dunes and their usage by Precontact groups on the Northern Plains. To accomplish this, a holistic, multidisciplinary approach is adopted that takes into consideration both the unique nature of these landscape features and the ways in which they were perceived and utilized by societies over the past 6000 years. Major subject areas that are examined, as reflected in their individual chapters, include the geomorphological aspects of Northern Plains sand dunes, the First Nations oral and ethnographic histories as they relate to mention of dune features, and the archaeology of sites found within sand dunes. Due to the broad temporal and cultural bounds of this thesis, its ultimate goal is not to provide a final, definitive conclusion on the role that sand dunes played in the lifeways of groups over the past six millennia. Within the context of a single thesis, this would be impossible given the temporal frame examined, the geographic scale of the study region, and the diverse behaviours and potentially fluctuating identities of the cultural groups present during the study period. Rather, it will bring to the forefront the unique and previously overshadowed role that dunes played in the lives of Precontact groups. While this analysis seeks to determine cultural patterns over time and space, it should be viewed in the context of being a synthesis and critique of work conducted over the past fifty years in these regions, as well as a starting point for conducting future topic-specific work. Over the course of this holistic examination, both interpretations on human usage and perception are given, as well as commentary on past analytical work where it is felt that reconsiderations and changes in methodology are required in order to better meet the needs of landscape-specific research in the future.

With this overall goal in mind, the research in this thesis is focused around five major questions:

- How do sand dunes differ from the surrounding dominant grasslands environments, and do these differences require dunes to be viewed as separate landscapes?
- What are historic and ethnographic First Nations perceptions and utilizations of dune environments, and how does taking such factors into account inform our understanding of the archaeological record found within sand dunes?

- Can any unique patterns of human behaviour be detected in dune environments through archaeological and ethnographic records? If so, are these behaviours part of a general pattern across time and space, or are they region- or culture-specific?
- Can the physical conditions present within sand dunes impact the integrity and visibility of archaeological sites, and do these conditions present unique problems for the isotopic dating of faunal materials found within them and any interpretations drawn on human occupations?
- Given the evidence presented in this work, to what extent can it be determined that First Nations groups impacted or altered sand dune environments through their activities?

1.2 Proposed Study Area Boundaries

To obtain a relevant dataset capable of examining the questions posed in this research, the study area for this dissertation focuses on sand dunes within the grasslands region of the Northern Plains of Canada, specifically Alberta, Saskatchewan and Manitoba, as listed in Wolfe (2001).

I am not alone in seeing value in distinguishing the grasslands as a distinct ecological study area. This same criterion was used by the palaeoenvironmental component of the SCAPE (Study of Cultural Adaptations in the Canadian Prairie Ecozone) project, a multi-disciplinary, multi-year research project initiated by Brandon University to examine the interaction between First Nations groups on the Northern Plains and their environment over the past 9000 years (see Nicholson and Wiseman 2006). In order to reconstruct an accurate portrait of regions that are identified as part of the Northern Plains, environmental records from the northern and alpine regions of the Prairie provinces were excluded, as the vegetation of these areas differed dramatically from that of study area in species composition (Beaudoin and Panas 2002:4-5). Similar problems arise with the work proposed here, as the usage of dunes surrounded by forest or montane ecosystems differs from that found in a grasslands environment (see Beaudoin and King 1994; Luckman and Kavanagh 2000; Thorpe and Godwin 2013).

It is for these same reasons that this work will depart from others completed in the past that included sites from the Nebraska Sand Hills. While work in this area has been well documented over the past 20 years, its inclusion in a study of Northern Plains dune occupations can be viewed as problematic, given different cultural and environmental histories. The occupation and use of an area such as the Nebraska Sand Hills is an important topic in Plains archaeology that has been explored at length by a number of authors (see Koch 1995; Koch and Bozell 2003; Roper 1989). Although the availability of a large, established body of literature does make the inclusion of this region in a larger study of dune regions across the Plains attractive, its use as a data source in a comparative analysis with Northern Plains dune sites can be seen as contentious. This is due to the contrasting cultural and environmental histories that exist between the southern portions of the Prairie provinces and Nebraska, located in what can be considered to be the southern edge of the Midwestern United States, and those of the Northern Plains. While continuities do exist between dunes on the Northern Plains and the Great Sand Hills of Nebraska, groups living in the latter would be occupying a dune area of over 50,000 km^2, more than five times the size of all dunes present within the study area (Ahlbrandt and Fryberger 1980:1). The substantial size of this dune field and its loction on top of the immense Ogalalla Aquifer allow it to function as a major influence in regional hydrology and geomorphology that is not seen in the smaller dunes within the study area. (Loope and Swinehart 2000:7). Due to the relationship between the aquifer and the Great Sand Hills, the region possesses unique hydrologic features not seen within the dunes in this study. These features include serving as the origin for river systems within the region, including the Snake River, Middle and North Loup Rivers, and Dismal River, as well as supporting extensive lake and wetland regions (Loope and Swinehart 2000:8-12). Further differences are observed when examining the vegetation of the Great Sand Hills, which is influenced by its size, wide variations in topography, landscape history, and physical location. Found within the Central Plains region, but in close proximity to other ecozones due to its substantial size, the Nebraska Great Sand Hills is influenced by eastern and western forest populations that do not impact the dunes found in this study. This is witnessed within stream valleys, which are populated by a mix of deciduous eastern species and western pine forests (Cowles 1914:534). This history of forest populations can be traced back to the Late Pleistocene, when the region was dominated by boreal forest species, while the study area for this research was still glaciated and the dunes examined remained to be formed (Bradbury 1980:29; Watts and Wright Jr. 1966:209).

From the standpoint of cultural impacts, the inclusion of the Great Sand Hills would also serve as a point of discontinuity in this present study. As the cultures that would impact, and influence Nebraska groups as opposed to those on the Northern Plains differ (the Southwestern and Southern United States in comparison with the Boreal Forest and Eastern Woodlands of

Canada), the inclusion of the Nebraska Great Sand Hills into a comparative examination of Northern Plains dune sites would offer little insight into regional behaviour found within Canada. Furthermore, archaeological and historical evidence, as well as oral traditions, show that none of the cultural groups that occupied the Nebraska Sand Hills were also present on the Northern Plains in southern Alberta, Saskatchewan, and Manitoba. Groups most commonly associated with the Nebraska Sand Hills are the Brulé and Oglala bands of the Lakota, with evidence for bison hunting by nomadic groups like the Cheyenne, Kiowa, Arapaho, and Crow, as well as by more sedentary agricultural groups such as the Pawnee, Arikara, Plains Apache, Omaha, and Ponca (Koch 1999:5). Furthermore, the archaeological classifications for the region differ from those found on the Northern Plains, with period divisions (Paleoindian, Archaic, Woodland, and Central Plains Tradition) being made in part by the introduction of agriculture to the region and the resulting semi-sedentary residential patterns (Koch and Bozell 2003:177-179). Due to these differences in cultural and environmental histories between the Sand Hills of Nebraska and the study area examined in this research, any comparisons with Northern Plains groups would not produce a grounded insight into the patterns of behaviour we witness in the prairie provinces.

As such, the boundaries adopted for the Canadian provinces in the palaeoenvironmental component of SCAPE have been applied for this dissertation; these boundaries extend northward from the Canada-United States border, and east-west from the foothills in Alberta to central Manitoba. Using these parameters, 68 sand dune fields and numerous undifferentiated aeolian deposits (e.g., minor dunes, sand sheets, loess, or deflation planes) were initially considered for this study (Wolfe 2001). However, a more restricted group of complexes was selected based upon the amount and quality of available archaeological and environmental data available for any specific dune area.

1.3 Proposed Time Periods of Study and Definitions of Chronology

As with the physical study boundaries, it is necessary to define the temporal boundaries for this study as well. Given the holistic nature of this research it is necessary to utilize time scales from both archaeology and geology. In addition, within the latter of these fields of study further definitions of time periods are present, due to differences in how these periods are classified. Under a chronostratigraphic system, boundaries between time intervals are defined on the basis of major events beginning or ending, such as the end of the last glacial period. Within the time

Table 1.1 – Holocene Time Intervals

(*after Mangerud et al. 1974*)

Interval	Time Span
Preboreal	10 300 – 9000 BP
Boreal	9000 – 7500 BP
Atlantic	7500 – 5000 BP
Subboreal	5000 – 2500 BP
Subatlantic	2500 BP – Present

frame for this study, it falls within the Holocene geological epoch, which is broken down into a further five time intervals, as seen in Table 1.1 (Mangerud et al. 1974:119-122).

A second period of time that is referenced within the archaeological literature is the Altithermal, or the Holocene Climatic Optimum. This period, first defined by Antevs (1955) as lasting from 7500 to 4000 BP, is marked by an increase in temperatures and a decrease in both atmospheric moisture and precipitation (Antevs 1955:324). The impact that this climatic episode had on the study region is illustrated through the analysis of the lake core pollen record from across the Northern Plains as compiled by Laird et al. (2007). Particular emphasis is placed upon Oro Lake, one of the few lakes in the region with an uninterrupted limnological record for the past 10 000 years (Last and Vance 2002:162). These records indicate that conditions on the Northern Plains were warmer and more arid than present following deglaciation, occurring between 9300 and 7400 BP. This period is followed by the Altithermal, between approximately 7400 and 4000 BP, which experienced more aridity than any other period during the Holocene. Following this period is one of gradually cooler, wetter conditions, with a climate similar to that of today becoming more established since approximately 2000 years ago (Laird et al.2007:3340-3341; Lance and Vast 2002:178-181).

Two further climate-based time periods are mentioned prominently in archaeological literature that are typically linked with cultural expansion and fluorescence. The first of these is the Roman Warm Period, lasting from approximately 2500 to 1600 BP (Wang et al. 2012:110). Walker (2016) warm and moist period in the Northern Hemisphere with the expansion of Besant bison hunting on the Northern Plains (Walker 2016:136-137). The second of these intervals is the Medieval Warm Period, lasting from 1000 to 700 BP. This global climatic pattern saw the rise in mean air temperatures coupled with an increase in precipitation in the Northern Hemisphere (Mann et al. 2009:1257). This change in climate is seen as having a large influence on Northern Plains populations within the study area, specifically with subsistence and migration patterns. With environmental conditions allowing for more regions to be used for horticultural practices, corn farming is recorded to have spread westward from the Eastern Woodlands of Minnesota. It is from this region that the Blackduck archaeological culture emerges, spreading out along both shores of Lake Superior to eventually settle in the Interlake region of Manitoba (Meyer and Hamilton 1994:112). Further west, Plains groups did not adopt these horticultural practices due to the almost industrial exploitation of immense bison herds through jumps and pounding activities, although trading for horticultural products with southern groups did occur. Developing the social structures needed to organize the large numbers of individuals for these hunts and semi-sedentary habitation practices, they were able to easily meet their dietary needs (Boyd 1998:311; Walde 2006a:298-305).

The final climate-based time period that is featured in archaeological literature is the Scandic, which lasted from 1700 to 1300 BP on the Great Plains. Defined in Bryson and Wendland (1967), it is marked by an increase in air temperatures and a decrease in precipitation, emulating conditions similar to that found in the Atlantic period. It is also speculated that this period saw the increased reoccurrence of drought episodes, which impacted both faunal and human populations (Bryson and Wendland 1967:280; Duke 1988:268-269; O'Brien and Wood 1998:230; Reeves 1969:17-18).

From an archaeological viewpoint, time periods are delineated on the basis of major technological changes in hunting practices, which are further subdivided into phases and complexes based upon the presence of diagnostic projectile points and pottery. As the periods of archaeological site occupation by different groups vary over both time and space, the different provinces examined in this study will have slight variations in their cultural occupations, although substantial continuity exists between them. In addition, under the Saskatchewan system of classification, Besant is considered to be part of the Late Precontact Period, while in Alberta it is grouped into the Middle Precontact Period. This stems from the Besant phase, which relied upon atlatl technology, spanning the period when bow and arrow technology was introduced to Western Canada. For the purposes of this study, the Besant phase is being considered to be part

Table 1.2 – Cultural Periods Within Study Area

(*adapted from Dyck 1983, Peck 2011, and Saskatchewan Archaeological Society 2010*)

<table>
<tr><th>Alberta Period</th><th>Alberta Phase/Complex</th><th>Saskatchewan Period</th><th>Saskatchewan Phase/Complex</th></tr>
<tr><td rowspan="4">Late Precontact 1250 to 250 BP</td><td rowspan="2">Old Women’s 1100 to 250 BP</td><td rowspan="4">Late Precontact 2000 to 170 BP</td><td>Mortlach 450 to 250 BP</td></tr>
<tr><td>Old Women’s 1200 to 500 BP</td></tr>
<tr><td rowspan="2">Avonlea 1350 to 1100 BP</td><td>Avonlea 1800 to 1150 BP</td></tr>
<tr><td>Besant 2000 to 1150 BP</td></tr>
<tr><td rowspan="5">Middle Precontact 7500 to 1350 BP</td><td>Besant 2100 to 1350 BP</td><td rowspan="5">Middle Precontact 7700 to 2000 BP</td><td rowspan="2">Pelican Lake 3300 to 1850 BP</td></tr>
<tr><td>Pelican Lake 3600 to 2100 BP</td></tr>
<tr><td>McKean 4200 to 3500 BP</td><td>McKean 4100 to 3100 BP</td></tr>
<tr><td>Oxbow 4500 to 4100 BP</td><td>Oxbow 4700 to 3800 BP</td></tr>
<tr><td>Mummy Cave 7500 to 4500 BP</td><td>Mummy Cave 7500 to 5000 BP</td></tr>
<tr><td rowspan="6">Early Precontact 11 050 to 7500 BP</td><td>Plains/Mountains 8500 to 7500 BP</td><td rowspan="6">Early Precontact 11 200 to 7500 BP</td><td>Lanceolate 8800 to 7500 BP</td></tr>
<tr><td rowspan="2">Cody 9000 to 8500 BP</td><td>Cody 9500 to 8400 BP</td></tr>
<tr><td>Alberta 9500 to 9000 BP</td></tr>
<tr><td>Agate Basin 10 200 to 9000 BP</td><td>Agate Basin/Hell Gap 10 500 to 9500 BP</td></tr>
<tr><td>Folsom 10 900 to 10 000 BP</td><td>Folsom 11 000 to 10 500 BP</td></tr>
<tr><td>Clovis 11 505 to 10 800 BP</td><td>Clovis 11 200 to 10 900 BP</td></tr>
</table>

of the Middle Precontact Period, along with other phases that used a similar technology. Despite this discrepancy, these two chronologies generally create distinctions between major periods based upon technology, with the Early Precontact Period marked by the use of the spear as the primary weapon for hunting, the Middle Precontact Period sees the introduction of atlatl and dartpoint, and the adoption of bow and arrow technology marks the transition to Late Precontact Period (see Dyck 1983; Peck 2011; Vickers 1986). Chronologies established for both Alberta and Saskatchewan are presented in Table 1.2.

The selection of the Middle and Late Precontact periods as the temporal focus for this work, with the exclusion of Early Precontact sites, is based on environmental factors. Examining the history of deglaciation across the study area, it is apparent that not all regions were free of ice or meltwater at the same time. As dune environments on the Northern Plains are derived largely from the remnants of glaciolacustrine or glaciofluvial features, some areas were still underwater while others were dried out and capable of supporting human activity. Further, during deglaciation marked differences in climate conditions existed between the east and west portions of the study area due to the differential retreat of the Laurentide and Cordilleran Ice Sheets (Laird et al. 2007:3335-3336). To ensure that the absence of Early Precontact sites, due to dune landscapes not yet being inhabitable, is not interpreted as being the result of cultural behavior this time period has been excluded from this study.

1.4 Methods

To complete a comprehensive historical and environmental survey of sand dune environments, as well as an assessment of present archaeological management policies currently enforced across the Northern Plains, a variety of different information sources were consulted. To obtain archaeological site information from across Alberta, Saskatchewan, and Manitoba, publicly available sources such as journal articles, monographs, academic theses, and conference presentations were referenced to create the dataset used in this work. In addition, gray literature[1] archaeological data sources were accessed at the different permit report repositories for each province (the Archaeological Survey Section in Alberta, the Heritage Conservation Branch in Saskatchewan, and the Historic Resources Branch in Manitoba), which provided information on sites that have not been published in either journals or monographs. Geographic parameters for sand dunes examined in this search were defined by Wolfe (2001) and were restricted to the SCAPE project study boundaries as defined previously. While this search produced records for hundreds of sites (see Panas 2005), only a few were selected for inclusion in this study. Criteria

[1] Within this context, grey literature is considered to be any unpublished reports or manuscripts that have been submitted to governmental agencies or educational institutions to meet with permitting or reporting obligations.

for selection were based predominantly on the presence of some type of diagnostic information, in the form of either projectile points or pottery. Without this basic information, it was impossible to place any site within either the temporal or cultural context required for this work. Other types of information, such as radiocarbon dates, seasonality studies, and determinations of site usage, while important to the conclusions drawn here, were seen as of secondary importance. One exception to this methodology was made for the Great Sand Hills, which did not contain any sites that were excavated or studied in detail. This inclusion of the region in this study is not seen as a deviation from the above methodology due to the large cultural role that the Great Sand Hills was found to play in the lifeways of Northern Plains groups, in addition to the focus that the region has received from recent geographical and ecological studies (see Peters et al. 2006). Although not subject to large-scale excavations, due in part to the region's increased affinity for the dunes to activate (see chapter three), the role that the region played in the cultural and spiritual lifeways of First Nations groups was viewed as being important for this study to take into consideration. As such, the area was included in this research. Analysis of the data consisted of comparing contemporaneous sites on the basis of their cultural affiliation, usage, time period exploited, seasonality, and location to detect any trends or patterns as to who occupied these regions and to how and when these sites were used.

Another factor used in determining which sites would be included in this study is their proximity to major water sources, such as rivers. Some dune areas within the study area, such as the Elbow Sand Hills, are either directly bordered by or transected by large watercourses. As rivers and river valleys can be considered to be ecological and geographic islands in their own right (see Evans et al. 2007; Kornfeld and Osborn 2003), any archaeological occupations found within dunes that contain major water features may be the result of behaviour that is more focused on the usage of water resources, as opposed to those contained within dunes. For this reason, some major sites located on current or past river terraces, such as the Norby site (Zurburg 1991:6), have been excluded from this study, while others that are within dunes that are located near major water resources, but those dunes themselves do not contain rivers, are included.

Historical information was obtained from various sources depending on the specific topic to be examined. To create the best reconstruction of Indigenous perspectives and landscape usage, ethnographic and historical sources were consulted to assemble a narrative of First Nation's perceptions and usage of sand dune environments and the resources that are found within them. It is acknowledged that this reconstruction can be influenced by the largely settler origins of many of these written sources. Historical data were also employed in part in creating an accurate environmental and geological assessment of dune areas, and how these regions function as an ecosystem in comparison with the surrounding grasslands environments. Through the use of firsthand accounts, in addition to surveyors' records and reports created immediately following the relocation of First Nations groups to reserves, a depiction of the pre-EuroCanadian settlement ecology was drafted. This approach to environmental reconstruction has been utilized in the past with a great deal of success (see Archibold and Wilson 1980; Tracie 1992; and Vickers and Peck 2004). Historical climate records were also examined, as well as modern syntheses of climate fluctuations, to determine if large-scale shifts in environmental factors such as temperature and precipitation could impact the geomorphology and resource base in dune environments, which in turn could lead to a change in human behavior.

In addition to historical environmental data, modern studies and surveys conducted within sand dunes on the Northern Plains were examined to provide an accurate description of how these environments were created, what factors sustain them, and what unique physical and biological resources are found within them. This line of inquiry incorporated aspects of physical geography, hydrology, and formation processes to determine how these regions respond uniquely to environmental factors in comparison with the dominant surrounding grasslands. Also included in this section is a survey of studies on the history of dune activation and drought found within both the study area and the Northern Plains as a whole.

To explore the questions outlined above, this dissertation examines a number of diverse topics. Chapter two establishes a theoretical foundation for the examination of sand dune environments as distinct localities from both a natural and social perspective. Chapter three provides a review of research on sand dune ecology, as well as examines differences between dune and grassland environments. Chapter four provides a literature review of historical and ethnographic information on First Nations perceptions and usages of sand dunes, including spiritual beliefs surrounding the landscapes and traditional plant usage for species found within arid environments on the Northern Plains. Chapter five summarizes past archaeological research performed on dune sites and environments on the Northern Plains and their relevance to this work. Chapter six examines the issues surrounding the absolute dating of materials from a dune site, as well as visibility concerns for archaeological sites within this environment. Chapter seven provides an examination of the archaeological dataset that is used in the comparative analysis of dune sites on the Northern Plains. The sites used in this analysis are listed, as well as all information known about them pertaining to seasonality, dating, usage, and cultural affiliation. Chapter eight contains an analysis of radiocarbon date ranges obtained from dune sites, as well as an archaeological comparative analysis that incorporates all this data to determine how dune areas were used during the Middle and Late Precontact periods. Chapter nine compares the datasets derived from the archaeological analysis and from the examination of First Nations perspectives on dune areas and compares it to the management criteria as set by each individual province. In performing this analysis, the questions posed in this introductory chapter will be addressed, with recommendations being made on deficiencies, if any, present within how heritage resources and landscapes are currently viewed and analyzed.

As a final note, it should be expressed that that this work is not being constructed with the goal of providing the final, definitive assessment on human sand dune usage over the past 6000 years. Although using all current documentary resources in constructing this assessment, it is recognized that the scale of this project is such that the reconstruction of a culture-specific pattern of usage for each group and the role that dunes played in their lifeways in relation to other environments across the Northern Plains is not feasible within the context of this project. Rather, this work stands as an assessment of the conclusions currently drawn on what is known about these regions and how they were used by human societies. The results of this research are a starting point to raise further questions and encourage future studies that examine, on a smaller group- or complex-level basis, the larger role that sand dune environments played in the lifeways of past human groups on the Northern Plains as they travelled across the landscape on a seasonal basis.

Chapter 2

Theoretical Constructs of Landscape Usage and Alteration on the Northern Plains

2.1 Introduction

The examination of human behaviour as it relates to landscape, on both a large- and small-scale, is not a new practice within the social sciences. Over the past fifty years, numerous studies have attempted to better define the relationship between human hunter-gatherer cultures and the environments within which they live (see Binford 1980; Jochim 1976; and Kelly 1983, 1995). As a holistic dataset is being utilized in this study to interpret both human behaviours over space and time within dunes and the unique physical properties of dunes themselves, theoretical perspectives of Island Theory and Historical Ecology are employed to place into context the complex relationship between human cultures and the landscapes that they live in.

2.2 Structure of Island Theory

Within a social science context, Island Theory is the application of concepts rooted in biogeographical theory to the question of how humans perceive and utilize different environments. This theoretical perspective can trace its origins to the work of Charles Darwin and his research in the Galapagos Islands during the 1830s. As a distinct field of study in the biological sciences, Robert MacArthur and Edward Wilson defined it in their work, *The Theory of Island Biogeography* (MacArthur and Wilson 1967). Since this time, Island Theory has been successfully applied to questions pertaining to both the natural and social science aspects of archaeology.

The concept within Island Theory that has relevance for this work is that within any uniform regional community of biota, or biome, there exists isolated areas (i.e., “islands”) that, on the basis of their physiography, are punctuated with plant life, animals, natural resources, and a geology that differs from the surrounding dominant environment. As these areas are seen as isolated from the influences of the larger environment and are placed under different natural controls particular to that island, individual species within them can react in different manners depending upon the environmental conditions that are presented to them. Due to the fact that a large number of islands of varying physiography can exist within one dominant environment, with the plant and animal species found on them originating from the dominant surrounding environment, they were seen as natural laboratories where species evolution and equilibrium could be witnessed on a small scale (Dewar 1997:482; MacArthur and Wilson 1967:3; Osborn and Kornfeld 2003:4; Pianka 2000:413). Islands were also seen as attractive study areas, due to their smaller size in comparison with the large expanses covered by the dominant biomes (MacArthur and Wilson 1967:3). By examining island ecosystems, it is easier for researchers to define boundaries for the biomes, as well as to determine the characteristics of the area, with respect to geology, plant life, soil conditions, climate, and animal populations (Osborn and Kornfeld 2003:5).

Traditionally, the concept of an island has been restricted solely to land masses surrounded by bodies of water however, within the confines of Island Theory there is room for areas that are surrounded by distinct ecological terrestrial zones. These present the same kind of conditions and restrictions to plant and animal life as found on water-locked landmasses. From a literal point of view, islands exist to living organisms as an environment that is surrounded by another environment that is different and, in some cases, relatively inhospitable. In this way, sand dunes, small stands of trees on the open plain, mountains, or landmasses surrounded by water can all be islands (Pianka 2000:414).

One distinction that should be made before continuing is the usage of the terms "islands" and "patches" in ecological studies, as the definition of a particular biome depends upon the scale at which one views them. Depending on the type of organism, what may be an island to one is a patch to another, with islands considered to contain a greater diversity of plant and animal life and to be more isolated (Kotliar and Wiens 1990:253; Osborn and Kornfeld 2003:10-11). In comparison, islands and patches can be seen to possess a similar range of organic life, as some patches can contain smaller, less complex, and less diverse patches themselves (Kotliar and Wiens 1990:253). Despite these similarities, islands possess such distinct features as abrupt boundaries and an isolated geographic location from other similar environments. Given these criteria, they further contend that many of the anomalous environments found within the Great Plains, including sand dunes, fit the definition for an island (Osborn and Kornfeld 2003:10-11).

Island Theory has been successfully applied in the social sciences to questions concerning human behaviour at locations around the globe. Research over the past two decades has seen work conducted from Europe, to islands in the Pacific Ocean, Australia, Madagascar and, as discussed below, North America (see Amorosi et al. 1997; Boyd 2000a; Burney 1997; Corbett et al.1997; Dewar 1997; Kornfeld and Osborn 2003; and Veth 1993).

2.3 Previous Research Using Island Theory on the Northern Plains

Usage of Island Theor*y* in the study of Northern Plains groups is not without precedent and has been applied to numerous sites within the region. In the Great Sand Hills of Nebraska, Koch and Bozell (2003) use this theoretical approach to show the habitation and resource potential of a dune environment for groups subsisting largely by means of a hunter-gatherer economy. Undertaken as a preliminary study of the region, they do not draw any conclusions about the usage of the Sand Hills area by hunter-gatherer groups. The work however, serves as a template for the background research that is required in order to reasonably begin an assessment of an area using Island Theory. In their introduction, Koch and Bozell state that, one of the goals of archaeology is to obtain a richer understanding of past human environmental adaptation, and as such we must "… define the relationship among people, landscapes, flora and fauna in all ecosystems that humans used and lived in" (Koch and Bozell 2003:167). To do so, they break their discussion into four major sections, examining the cultural and natural history of their study region. The first of these sections provides an overview of the formation history of the Nebraska Sand Hills, highlighting known periods of aridity and dune activation for the region, while the second offers a history of the formal archaeological investigations conducted within the Sand Hills. The third section details the unique environment of the Sand Hills, with a comprehensive summary of the climate, groundwater, soils, vegetation, fauna, streams, lakes, and wetlands. Lastly, the fourth section examines the culture history of the area, beginning with the first Paleoindian evidence for occupation at 8000-12 000 BP, and concluding with European settlement in the 19th Century (Koch and Bozell 2003:177-183).

In addition to providing the framework for the type of preliminary research one requires when approaching the subject of dune environment usage under the umbrella of Island Theory, Koch and Bozell (2003) also highlight three areas that they feel must be addressed to allow for research within the Great Sand Hills, and other dune environments, to reach their potential. The first of these is the implementation of extensive sample survey programs within dune environments. Owing to reduced numbers of impact assessments and research programs conducted within sand dune landscapes, little is known of these areas compared with adjacent grassland regions. Second, excavations within dune environments should employ modern recovery techniques to obtain faunal and floral remains from archaeological sites. These artifacts would aid in the reconstruction of past environments in the area and provide researchers with important data on the relationship that existed between dune environments and the people that lived within them. Lastly, they advocate the detailed examination of lakes and wetlands within dune environments. In particular, they stress the need for examining the water chemistry of lakes, in relation to their ability to support a variety of plant and animal species. Using GIS technology, they feel that, based upon the location of water-based resources, it would be possible to create predictive models of where sites would be located in relation to bodies of water (Koch and Bozell 2003:183-184).

Within the construct of Canadian Plains archaeology, the idea of selective usage of dune landscapes was indirectly proposed by Epp (1984) in his analysis of "edge areas", or areas along the edge of unique ecological zones or geographic features (e.g., valley edges, hills, sand dunes, etc.). Epp contends that the informal borders between these regions are subject to what ecologists have dubbed the "edge effect", where the transition zone (ecotone) between major ecosystems contain not only plant and animal species found in each overlapping ecosystem, but species that are unique solely to the ecotone itself (Odum 1971:275). As such, these ecotones possess ecological resources sufficiently significant to influence the settlement of hunter-gatherers on the Northern Plains (Epp 1984:332). As part of the dataset for his study, he includes three major sand dune fields that are also part of this study: the Dunfermline Sand Hills, the Harris Sand Hills, and the Great Sand Hills in Saskatchewan (Epp 1984:326). Based upon his survey of sites from boreal forest, aspen parkland and plains grassland regions of Saskatchewan, he concludes that ecotone boundaries within these areas contained more environmental attractants than those found within the centers of the regions themselves; as such, these boundaries were also found to contain more sites (Epp 1984:332).

While having a direct bearing on the examination of dune environments in Western Canada, Epp is not the first Canadian researcher to recognize the role that environmental edges plays in human settlement patterns and adaptation. During the 1970s, Hickey examined the role that ecological edges play in the interaction between forest and tundra peoples of northern Canada. Specifically, he highlighted the fact that these ecotones, due to their rich and varied resource base, can act as contact zones between diverse cultural groups, allowing for an increased chance for technological innovation and the transmission of “outside” ideas and practices (Hickey 1974:89). Further evidence for ecological edge regions acting as meeting areas is presented by Meyer et al. (2008), who examined Cree aggregation areas along the Saskatchewan River. Assembling during the late winter to early spring at historically identified traditional encampments like *Pasquatinow*, *Opaskweyaw* (The Pas), *Nipowiwinihk* (Nipawin), and *Pehonan* (Fort à la Corne), groups exploited the seasonal fish weirs in the river (Meyer et al. 2008:65).

Island Theory was also employed by Hamilton and Nicholson (1999) in their examination of Vickers Focus sites located within what they deem as the *Makotchi-Ded-Dontipi* locality in southwestern Manitoba near the Saskatchewan border. This locality consists of a number of sites located in the Lauder Sandhills in association with wetlands that are removed from primary river systems. Nicholson and others theorized that Vickers Focus represents the migration of Plains Village/Mississippian groups into southern Manitoba. These groups moved onto the Eastern Plains from the Eastern Woodlands during the Medieval Warm Period, then northward following major river systems with the onset of hotter, drier conditions, circa AD 1250. It is postulated by Nicholson and Hamilton (1997b) that Vickers Focus peoples journeyed westward using the Pembina River valley into the Tiger Hills, where they established a Plains Village society with a subsistence based on small-scale horticulture and foraging roughly 650 years ago (Nicholson and Hamilton 1997b:31-32; Nicholson et al. 2006:325; Playford 2015:62-63). Their departure from the Tiger Hills to the *Makotchi-Ded-Dontipi* locality began during the Little Ice Age, when average temperatures dropped to the lowest seen over the past 1000 years. It is postulated by Nicholson and Hamilton that this climatic shift severely impacted the subsistence base of Vickers Focus groups with a shorter growing season and unseasonable killing frosts. While this shortfall may have been offset by intensive foraging activities, local resources would also have been rapidly exhausted due to the sedentary residence patterns that were required with a horticultural subsistence pattern. Faced with starvation, Vickers Focus groups in the Tiger Hills migrated to another biodiversity-rich area that was capable of supporting their population. To prevent a similar resource collapse, they also shifted their subsistence pattern to one based upon warm season foraging and cold season bison hunting (Hamilton and Nicholson 1999:20; Nicholson et al. 2006:329-31). Based upon the artifact assemblages found at the sites, as well as the environmental context of the sites, Hamilton and Nicholson (1999:22) conclude that the dune locality acted as an ecological island and refuge for Vickers Focus peoples as they shifted their subsistence pattern from one of sedentary horticultural practices (Eastern Woodlands pattern) to one of a mobile hunter-gatherer economy (Plains Woodlands pattern).

Southwestern Manitoba is also the focus of research by Boyd (2000a), who performed a study on the Late Quaternary geoarchaeology of the Lauder Sandhills. While concentrating primarily on the ecological history of the area, Boyd examined the concept of islands and how it applies to the examination of a sand dune environment. Through a detailed analysis of the Lauder Sandhills area, he concludes that the area contains a greater diversity of plant species than that found in surrounding grasslands, due to a combination of the sandy substrate in the area, a higher water table, and a rolling terrain maintained through sand dune development (Boyd 2000a:20-22). Additionally, he observes that the aquifer under the Sandhills that provides the higher water table may also be able to mitigate a drought better than the surrounding grasslands, which are supported almost entirely by precipitation (Boyd 2000a:30). Given these factors and their resulting outcomes, the Lauder Sand Hills can be viewed as an ecological island.

Also bearing upon this thesis is a work examining the relationship between winter site locations and resources by Vickers and Peck (2004). After reviewing historic accounts and township surveys they conclude that one of the key factors in determining the location of wintering sites on the Northern Plains is wood, rather than bison, as is usually thought (Vickers and Peck 2004:99). Based in part on the work found in Peck's doctoral dissertation (see Peck 2001), this paper begins to refine the question of why sites are located where they are. For wintering sites, Vickers and Peck feel that the presence of wood, used for fuel and in the construction of pounds, played a larger role in determining where groups camped than the proximity of bison herds (Vickers and Peck 2004:116-117). While not specifically examining sand dune localities, or adopting an island theory perspective, this paper does present the concept that specific environmental and landscape conditions do play a role in human settlement behaviour.

In a similar fashion, Brumley (1983) used ecological and geographical criteria in the creation of an interpretation model for stone circle sites within the Suffield Military Reserve, located in southeastern Alberta. Examining stone circle distribution within the area, as well as cultural and environmental factors, he developed five "utilization zones" for the Reserve. Marked by distinctive usage patterns, one of these zones is the sandhills, which consist of the

Middle Sand Hills and a second unnamed dune area. This zone is marked as being devoid of usable lithic resources, although some can be found along the dune margins with other ecoregions, as well as a rugged terrain that the author lends itself to a wide range of individual and communal hunting practices (Brumley 1983:190). Noted natural resources consist of water sources, in the form of springs and seasonal lakes, as well as abundant floral resources, including chokecherry and sagebrush. It is hypothesized by Brumley (1983:191) that this presence of both water and plant diversity allowed the zone to support bison populations on a year-round basis, resulting in a likewise continued and year-round exploitation by human populations. Also noted within these regions was the absence of stone circle features due a lack of larger stones and cobbles within the zone. Due to the loose soil conditions however, it is postulated that lodge bases were anchored down using wood stakes (Brumley 1983:177).

2.4 Cultural Islands on the Plains

While based within a theoretical body originating from the biological sciences, Island Theory has been adapted within the social sciences such that it is used to explain factors beyond that of physical environmental conditions and resource diversity. In addition to possessing these attributes, geographic locations also possess cultural aspects as well that can make them unique (see Basso 1996). Of these, one of the most prominent and culturally sensitive cultural islands to be found on the landscape is sacred spaces.

This concept of sacred cultural islands on the Northern Plains is the focus of research by Sundstrom (2003). Citing Deloria (2003), she contends that First Nations religious interpretations of place differ from those found in Western belief systems due to their basis on spatial, rather than temporal, dimensions. By temporal, it is meant that Western religions focus on historical events that are placed within a religious framework. This difference in focus results in a greater emphasis placed upon religious teachings themselves, and not necessarily the locations where specific events occurred. Under this ideology, belief is still possible without any loss of meaning if the individual is removed from a specific location, provided belief is invested in the reality and historical accuracy of religious events. This differs from First Nation's belief systems, where practices and ideologies are not divorced from geographic locations, but instead are based upon identification with specific areas that are in turn removed from any historical contexts (Sundstrom 2003:260). The spiritual relationship that exists between a First Nations individual and the natural world is not one that conforms to a universal religious doctrine, but instead is based upon personal revelations and interpretations associated with specific geographic locations (Deloria 2003:66-67). Although viewed as being distinct from the surrounding landscape, sacred sites are not viewed as being separate or isolated from their surrounding landscape. With no major barriers surrounding them, such as water or hostile environments, it is easier for individuals to physically reach these sacred locations, although personal sacrifice, such as fasting or special preparations, may be required before an individual can enter them (Sundstrom 2003:259).

Criteria used for defining which landscapes are sacred vary, with many areas viewed as possessing an inherent sacredness due to perceived natural attributes or mysterious nature. Areas such as these include springs, caves, mountain peaks, cliffs, fossil find sites and areas where lightning has struck. Desert patches also fall into this category and were believed by some groups to provide access to a deeper earth realm (Schlesier 1987:6; Sundstrom 2003:261-262). These natural features (by Western standards), in addition to possessing sacred power, can also act as important landmarks for orientation, due to their prominence on the landscape (Sundstrom 2003:275). Other types of areas that possess sacredness are those that acquire it through cultural or historical association. At these locations, sacredness is obtained through an association with the past, sacred ceremonies or with the spirit world. Unlike natural features, these areas can be constructed or created by humans, although they can still possess the same spiritual power found in natural locations. Types of these sites include stone circles or alignments, rock art sites, cairns, ceremonial sites, vision quest sites, earthworks, eagle pits, horn stacks, and burial sites (Sundstrom 2003:265-274). In addition, ceremonies can also take place at sacred locations that are natural in origin, such as buttes, rivers and lakes associated with specific bundle ceremonies. Lastly, legends also play a role in the sacredness of the landscape, with certain features associated with mythological events. What occurred at these areas varies, from associations with specific events such as being the site of creation to the formation of alliances, to general association with a legendary figure (Sundstrom 2003:280-283).

Recognition of an area's sacred properties on the Northern Plains was not restricted solely to the group who originated the belief systems. Rather, it has been witnessed that cultural groups who entered new areas adopted pre-existing perceptions of the sacred for specific geographic locations. This practice of recognition is witnessed when examining the cultural history of numerous sacred areas, such as the Black Hills, South Dakota; Pryor Gap, Montana; and Devil's Tower, Wyoming (Sundstrom 1996:187-188; Sundstrom 2003:283-284).

Often, sacred sites are associated with resource areas, including water sources, ochre and pigment outcrops, pipestone sources, fossil outcrops, and hunting grounds. How aspects of the sacred were expressed and reinforced in areas that served utilitarian aspects of life varied according to the nature of the areas themselves. Physical signs, such as rock art and effigies, are frequently found in association with water sources and pipestone quarries, while social taboos existed to enforce belief systems in traditional hunting grounds. As these areas also tended to have a large number of game animals, these restrictions also served to prevent overhunting, in addition to providing legitimacy for a group using a particular tract of land and the resources found there (Sundstrom 2003:285-287).

Less frequently associated with spiritual power are resources such as wood, although where it is found on the landscape can alter how it is perceived by a society. Gathered within areas of spiritual power, wood was seen to have more medicine, and as such was desired as raw material for hunting implements or pipe stems (Sundstrom 2003:288).

While the locations of resources and sacred sites do correlate to a certain degree, it should be noted that this is not the case for all areas of spiritual power. As mentioned previously, the recognition of one group's spiritual connection to the landscape by another can serve as a boundary marker and can assist in establishing territorial boundaries and home territories for neighbouring groups. As such, spiritual power can be mapped onto a landscape that does not have a desirable resource base but is important due to its proximity to other groups. In addition, ceremonial locations can be selected on the basis of religious or personal value, rather than the economic decision, where a large resource base is not required. Examples of these locations include vision quest sites, which are chosen by an individual undergoing the ritual, and smaller ceremonial sites that do not require the resources to support a large population that would participate in a larger ceremony, such as a Sun Dance (Sundstrom 2003:288).

Although playing a large role in the belief systems and lifeways of Northern Plains groups, some sacred sites are difficult to detect within the archaeological record. While sites containing such features as rock art and cairns can be related to religious practices, others that contain only artifacts may not unless the items can be placed within a social context through ethnography or oral history, as many of the items found *in situ* as offerings are also found in other types of sites. The range of objects left at sacred sites is large, and includes arrowheads, pipes, knives, coins, beads, bracelets, pendants, shell, and elk teeth. Other items, such as hides, tobacco, and cloth, would deteriorate, and as such would not survive in the archaeological record (Sundstrom 2003:284-285).

2.5 Structure of Historical Ecology and Niche Construction

Complementing the holistic perspective found within Island Theory is Historical Ecology, a school of thought that also has its origins within the biological sciences. Where Historical Ecology and Island Theory differ are in the perceptions that the former concept has towards the ideas of history, disturbance, and the role of human agency. Within Island Theory, each individual location is defined as not only being unique, based upon its physical attributes and the response of human cultures to these attributes, but also isolated from other areas based upon these differences. Further, the role of humans within this construct is seen as largely a responsive and reactionary one, where groups react solely to the physical conditions and attributes of a place, which are there as a result of "natural" processes. Although physical resources and cultural meaning are present in a location, humans are seen as not playing a large role in why these attributes are present.

Within Historical Ecology, humans play a central role within the physical and cultural attributes found at particular locations, as they are viewed as being active agents within the ecosystems within which they live (Crumley 2017:S65). With regards to the geographic scale being examined, Historical Ecology can adopt a larger view than that found in Island Theory, with an expanded view of landscape to explain the holistic datasets that are employed (Balée 2006:76). As well, it alters past definitions of ecology by acknowledging that human beings are a part of the ecological systems within which they live, and that the concept of history transcends the written record to also include the history of both environmental systems and the social and physical past of humans themselves. In this way, it is capable of examining the transformation of landscape through records originating from both the natural and social sciences (Crumley 2015:2). As a theoretical approach, it is seen as an effort to develop a collaboration between fields within the social sciences (anthropology and geography) and hybrid fields based in the natural sciences (such as environmental history, environmental sociology, human ecology, and landscape ecology) to better define the relationship between human communities and their environment (Crumley 1998:xii; Szabó 2015:999-1000).

The foundations of Historical Ecology are difficult to determine, due its interdisciplinary focus. The earliest attempts to examine the concepts of humans playing a role in environment construction can be traced to studies in the 18th century (Szabó 2015:999). Over the past fifty years, numerous studies have been conducted within the fields of history, ecology, geography, and anthropology that acknowledge the integrated relationship between human culture and the environments within which they inhabit (Szabó 2015:998). As such, interpretations of the development of the theory also vary, with perspectives offered on its origins from the fields of environmental history (McNeill 2003; White 1985), historical geography (Merrens 1965), palaeoecology (Ferguson 2000), and landscape archaeology (Darvill 2008) over the past fifty years (Szabó 2015:998).

At the core of Historical Ecology are four postulates that allow for the interpretation of cultural processes and beliefs as reflected within landscapes. First, humans have impacted almost all environments on the planet, although debate exists as to if this impact is present prior to the advent of agriculture. Second, human beings are not genetically predisposed to altering the species diversity within a particular landscape, either through increasing or decreasing the biodiversity present. Third, not all human cultures will alter landscapes to the same degree or in the same manner. As well, it should not be assumed that a landscape that has undergone slight or no cultural alteration has a lesser species diversity than one that has been largely engineered through human intervention. Finally, humans interact with the environment in a number of diverse ecological and historical contexts, which can be studied from an integrative perspective (Balée 2006:76). While largely recognizing these postulates, practitioners of Historical Ecology also recognize that each study is unique through the specific physical conditions of the study area, the nature and type of research questions asked, and the quality and availability of the material record that is available to them. Further, the definition of scale is significant in the application of Historical Ecology, as diversity within any research can be defined by the parameters of the study area that is selected. If an improper scale is established for a particular set of research questions, critical evidence may be absent or missed (Crumley 2017:S67).

Through this process of anthropogenic alteration, landscapes can be seen to undergo the process of construction, as outlined in Niche Construction Theory (NCT). Within this concept, humans and other organisms modify their own and other organism's environments through their activities, choices, and metabolism (Odling-Smee and Laland 2011:220). Like the other theoretical perspectives discusses previously, NCT finds its origins within the biological and evolutionary sciences. First proposed in the 1980s by Lewontin (1982, 1983), it has since been adopted into multidisciplinary studies, including those within the social sciences (Odling-Smee and Laland 2011:220).

Within NCT, it is recognized that the creation of organism-generated space is a mechanism that is an evolutionary process as much as natural selection. While the ability of an organism to construct a niche is bounded by the constraints of natural selection, or the natural boundaries of the environment that they are living in and their own biology, there is no predetermined manner in which an organism reshapes their environment. This reconstruction typically occurs to the benefit of the organism and its biology, although cases have been recorded where a niche is created that is detrimental to the creator (Odling-Smee and Laland 2011:221).

2.6 Previous Research Using Historical Ecology on the Northern Plains

Much of the work conducted on Northern Plains groups under these theoretical perspectives has been conducted by Gerald and Joy Oetelaar in their examinations of Blackfoot (*Niitsitapi*) migrations and landscape usage in southern Alberta. Within their work, they document *Niitsitapi* beliefs on the role of humans within the creation and maintenance of landscape, where the role of humans is no different from that of streams, trees, or mountains. As well, humans are responsible for helping maintain balance within nature through rituals, ceremonial behaviour, and proper daily social conduct. Failure in this regard would result in damage to the health and well being of themselves and the floral and faunal species that make up their environment. These practices are guided by ancestral beings and mythical heroes who travelled across and created the landscapes and resources that the *Niitsitapi* now employ and use. Resources are found at these important locations as a result of the spiritual energy that is present due to the visitation of their ancestors and heroes. By travelling the same routes as their ancestors and remembering the stories and repeating the rituals associated with each location, the *Niitsitapi* are not only using resources placed at these spots but ensuring the continuation of these resources at these particular locations as well as renewing their cultural identity and relationship with the landscape (Oetelaar and Oetelaar 2007:66-67; Oetelaar and Oetelaar 2008; Oetelaar 2016:46-47).

Within the context of landscape management and NCT, the impacts that these cultural and ritualistic practices have upon the landscape are examined at a number of different locations on the Northern Plains that were utilized by the *Niitsitapi*. In examining the location of cottonwood and aspen groves, they conclude that their regular spacing every 14 to 16 km at locations associated with such culturally significant areas as springs, river crossings, and trails. This spacing is felt to be due to strategic low-intensity burnings in these areas by the *Niitsitapi* to away clear dead plant debris and remove undergrowth in order to protect the overhead tree canopy from uncontrolled grass fires. These measures were enacted not just to protect the shade-providing canopy and wood resources, but the bodies of their ancestors placed on platform burials within the groves who served as mediators between the living and celestial beings (Oetelaar and Oetelaar 2007:74; Oetelaar and Oetlaar 2008). The practice of spring controlled burning also contributed to the ecological health of the region through increasing the photosynthetic rates and tiller production for the region, as well as to increase and maintain the species composition, richness, and diversity for the burned areas (Oetelaar and Oetelaar 2207:81-82). Fire also played a role in the anthropogenic control of traditional *Niitsitapi* territorial usage within the foothills and Rocky Mountains. Using historical evidence, as well as ethnographic accounts of anthropogenic burning practices, they contend that intentional burning took place within low mountain valleys to extend the limits of grasslands and create open plains to attract and control bison herds for hunting purposes (Oetelaar and Oetelaar 2007:79; Oetelaar and Oetelaar 2008).

Also examined is the presence of montane plant species within the Cypress Hills area of southeastern Alberta. Early research on this topic concluded that these populations represent relict species left over from an early postglacial forest within the region (see Thompson and Kuijt 1976). Further investigations however, have shown that there is no evidence to support the presence of a forest in the Cypress Hills during this time period (see Yansa 2006, 2007). To explain this phenomenon, Oetelaar and Oetelaar postulate that the presence of non-native plants to the Cypress Hills can be attributed to *Niitsitapi* cultural practices with regards to mobility and traditional plant gathering. When collecting plants, in particular for medicinal or ceremonial purposes, it is necessary to dispose of any unused portions in a respectful manner, along with suitable offerings. Due to the viability of the roots and seeds that can be transplanted into new environments such as the Cypress Hills, which are a location within traditional *Niitsitapi* migrations, it is possible to create and manage new communities of culturally important species (Oetelaar and Oetelaar 2007:77-81; Oetelaar and Oetelaar 2008). This practice, observed in the Plateau region of British Columbia, is suspected by Oetelaar and Oetelaar of occurring with Northern Plains groups as well (Peacock 1998:43).

2.7 Possibilism and the Role of Human Agency

Lastly, as this study is examining usage and perception of a specific landscape feature over space, time, and across different cultural communities, it is necessary to accommodate for the aspect of cultural differences in the results found. Simply put, because a landscape has particular attributes, features, and resources present, it does not predispose all groups within the region to perceive or use these areas in the same manner. For this reason, it is necessary to employ the concept of Possibilism within the analysis. This school of thought arose from opposition to Environmental Determinism, which proposes that individual and societal characteristics can be explained and predicted to form based upon one or more definable factors within the natural environment. This external influence has the capacity to impact all aspects of human society and life, including culture, civilization, resource, anatomy, behaviour, politics and group organization, knowledge, health, and religion (Fekadu 2014:133). In contrast, Possibilism proposes that the physical environment, rather than restricting human behaviour to only one course of actions, instead offers a range of possible choices to and responses by individuals. Taking into consideration the aspect of human agency as a factor in behaviour and refuting the idea that the constraints of the physical world are solely responsible for all aspects of human culture, Possibilism contends that humans create our own situations through socialization, information circulation, and the power of thought (Fekadu 2014:136). Within the context of this study, human responses and interaction with sand dune environments should not be seen as a given across all groups for all time periods, as their behaviours will be determined at least in part by their own histories, beliefs and perceptions. As such, it must be considered that each culture may differ in their practices and perceptions with relation to sand dune landscapes across the Northern Plains. However, these behavioral choices will be bounded by limits placed by the physical aspects of the environment (Jones 1956:369).

2.8 Summary

Due to the diverse nature of the datasets used in this study, the theoretical perspectives discussed, this focus on multiple concepts will provide the best opportunity for supplying proper context for the conclusions presented for this research. These perspectives allow for the utilization of information sources from both the natural and social sciences and examine the role that human culture has in the transformation of landscapes thought to be pristine. Within chapters three, four, and seven, these methodologies are applied in order to determine if sand dunes can be viewed as unique environmental areas, and what roles sand dunes played within the lifeways of present and past human populations who utilized these geographical areas. Additionally, using the principles of Historical Ecology, the limitations of the available dataset for a study such as this will be recognized and acknowledged. From an analysis using these standpoints, it is possible to place Northern Plains sand dune environments into a context that takes into consideration environmental factors, the role of human culture in influencing the holistic database examined, and variations observed in behavior between groups and over time.

Chapter 3

Sand Dune Environments

3.1 Introduction

In order to engage in any meaningful dialogue on the role that dune environments played in the lifeways of First Nations groups, it is necessary to define what these areas are from a geographic perspective. Within a literal sense, sand dunes are defined as "a shifting mound or ridge of sand formed by the wind", according to the Canadian Oxford Dictionary (Barber 1998:1280). This basic characterization of arid environments on the Northern Plains does not adequately describe the unique landforms found within these regions, nor the forces that are in play in forming, altering, and maintaining them. Contrary to the basic descriptions provided on sand dunes and sand dune areas in many of the archaeological site reports and academic theses cited in this study, they are complex areas that require a depth of understanding on their formation and mechanics prior to drawing any conclusions on human behaviour within them. The purpose of this chapter is to provide an overview of dune formation and mechanics, and the natural resources found within them.

3.2 Dune Formation in Western Canada

For sand dunes to form in any geographic area, three major factors, first identified by Hack (1941), must be present. The first of these factors is a source of sand to supply the dune features. Within the current study area, all of the sand dunes derive materials from either glaciofluvial or deltaic deposits that resulted from the retreat of the Laurentide ice sheet (Lemmen et al. 1998:38; Muhs and Wolfe 1999:187).

The second factor needed in dune formation is a wind regime capable of suspending sand particles and transporting them over space. Classification of wind regimes within a given area is possible through an examination of sand roses, or the graphic representation of models that show the amount of sand that a particular wind regime is capable of moving, the directions that the material will be transported, and how far the transported material may travel. Values for these graphs are based upon calculations using the sum of all sand-moving winds in an area, the vector sums of each of these individual winds, and the net direction of sand movement present in a particular dune area. Based upon these calculations, Wolfe (1997) concluded that the winds present on the Northern Plains not only possess sufficient energy to facilitate the formation of sand dune features but are also home to some of the strongest winds on the North American Plains due to regional climate patterns (Fryberger and Dean 1979:145-148; Muhs and Wolfe 1999:186; Wolfe 1997:424-425).

The third environmental factor required for dune formation is a lack of vegetation within an area, although in the case of parabolic dunes some vegetation is required to create the landform. The role that vegetation plays in the formation, and by extension activation and stabilization of dune features, is not connected to just the physical presence of the plants in an area but to the role that they play in moisture retention. In a physical sense, vegetation acts to suppress the movement of sand across the landscape by trapping moving particles of soil by reducing the velocity of the wind above the ground surface to create a dead air zone, preventing sand particle entrainment and transport. As well, more fine-grained particles are prevented from becoming airborne when some vegetation is present. This protection occurs, although in varying degrees, in all sand dune environments, including those where vegetation cover is very sparse (Muhs and Wolfe 1999:188; Wolfe and Nickling 1993:50-52; Wolfe and Nickling 1997:8). The degree of protection offered by vegetation varies, based upon how closely together plants are situated, with increased ground cover occurring in areas of dense vegetation, and the height of the vegetation, with taller plants offering more protection (Townley-Smith 1980b:69). In addition, vegetation also acts to increase the amount of moisture present within dune features by providing shade, which in turn decreases the amount of direct evaporation on the ground surface. Detritus from plants also serves to increase the organic content of soils, which increases their capacity to retain water as well as increase the water availability to surrounding vegetation (Hudson 1994:193). The presence of moisture is important in the formation of sand dunes, as even in small quantities such as those found in condensation, it creates capillary forces between interparticle contacts, which in turn increases the cohesion of the sand and silt particles (Koenig 2008:4; Muhs and Wolfe 1999:188; Sloss et al. 2012:21). Even in cases where surface vegetation is minimal or absent, such as in areas that have experienced fires, the presence of plant roots act as a deterrent to erosional processes and the activation of sand dunes through increasing soil cohesion and increasing soil resistance to erosion. To survive within a drier environment, the most successful plant species that populate dune environments on the Plains typically exhibit deep root growth in order to anchor the plant and to access deeper moisture and to store proteins and sugars that will sustain it during periods of drought and the winter months. This root growth can be extensive, as seen with Blue grama grass (*Bouteloua gracilis*), a species that is found within the study area, having a subsurface structure that can extend up to two metres despite the fact that only a few inches of the plant is visible on the surface. These extensive root systems not only serve to establish Plains vegetation and allow them to survive drought conditions, but they also act as physical traps for sediments and as the means to moisten and bind together surface sands that may otherwise be more inclined to erosion (Courtwright 2011:17; Thomas and Redsteer 2016:401).

3.3 Dune Features

The aeolian environments examined in this work are comprised of a number of different geomorphic features, including several different types of sand dunes. The size and shape of each of these features are the result of the climate history of a region as well as the physical characteristics of a region itself, such as vegetation coverage, the amount of sediment present, grain-size distribution, wind energy, direction, and the presence of topographic obstacles (Trenhaile 201:409). A general overview of the major types of aeolian landforms noted as occurring either within or in close proximity to archaeological sites examined in this study is presented below (Figure 3.1).

The most commonly observed aeolian landforms on the Northern Plains are blowouts and parabolic dunes. These two features are linked, as blowouts are required for parabolic dunes to form. Blowouts are depressions in the sand that are caused by the deflation of sediments by the wind. They are formed when sand is removed from one localized spot through the process of deflation. Found upwind of dunes and other blowout features, these depressions can be indicative of a wide range of available sediment supply, vegetation cover, and water table depth (Lemmen et al. 1998:30).

The prevalence of parabolic dunes on the Northern Plains is due to the wide range of environmental conditions in which different subtypes of parabolic dunes can form. In general, these dunes are parabolic in shape, with the wings of the arch pointing upwind and the convex end downwind. They can form in areas of low to high sediment supply and are indicative of a semiarid or subhumid climate. These features originate when the edges of a transverse ridge, a

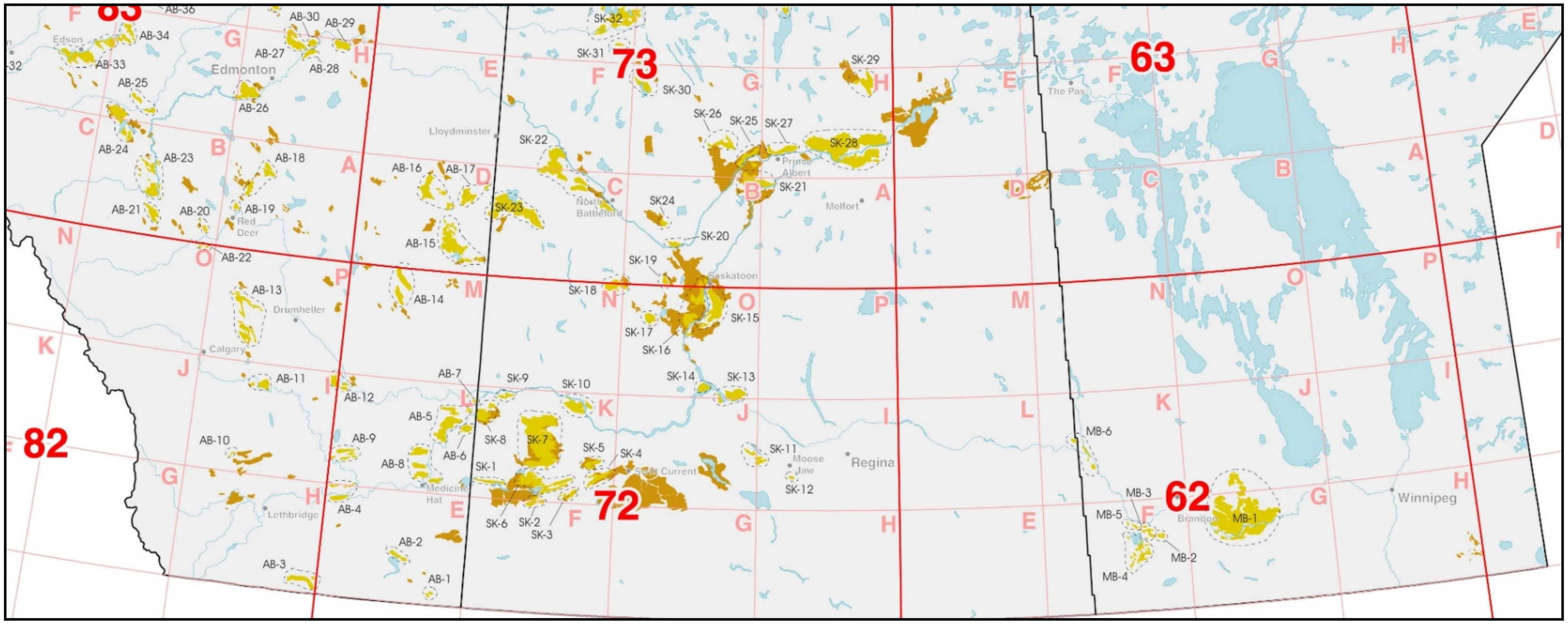

Figure 3.1 – Sand Dunes (in yellow) Found Within the Study Area

(from Wolfe 2001)

Table 3.1 – Map Legend of Sand Dunes Found Within the Study Area

(*from Wolfe 2001*)

Map Label	Sand Hills Name	Map Label	Sand Hills Name
AB-1	Dominion	SK-3	Carmichael
AB-2	Pakowki Lake	SK-4	Seward
AB-3	Milk River	SK-5	Antelope
AB-4	Grassy Lake	SK-6	Big Stick-Crane Lake
AB-5	Middle Sand Hills	SK-7	Great Sand Hills
AB-6	Hildas	SK-8	Burstall
AB-7	Empress Meander	SK-9	Westerham
AB-8	Bowmanton	SK-10	Cramersburg
AB-9	Rolling Hills Lake	SK-11	Pelican Lake
AB-10	Clear Lake	SK-12	Airfield
AB-11	Gleichen	SK-13	Elbow
AB-12	Dutchess	SK-14	Birsay
AB-13	Rosebud River	SK-15	Dundurn
AB-14	Sounding Creek	SK-16	Pike Lake
AB-15	Sounding Lake	SK-17	Harris
AB-16	Buffalo Park	SK-18	Richmond
AB-17	Edgerton	SK-19	Kinley
AB-18	Battle River	SK-20	Borden
AB-19	Blackfald	SK-21	Duck Lake
AB-20	Markerville	SK-22	North Battleford
AB-21	Chedderville	SK-23	Manitou Lake
AB-22	Bowden	SK-24	Fielding
AB-23	Rocky Mountain House	SK-25	Holbein
AB-24	Brazeau	SK-26	Canwood
AB-25	Lodgepole	SK-27	Nisbet Forest
AB-26	Stony Plain	SK-28	Fort á la Corne
AB-27	East Gate	MB-1	Brandon
AB-28	Beaverhill Creek	MB-2	Souris
AB-29	Ukalta	MB-3	Oak Lake
AB-30	Redwater River	MB-4	Lauder
SK-1	Tunstall	MB-5	Routledge
SK-2	Piapot	MB-6	St. Lazere

straight dune with an axis that is normal to the prevailing winds, are anchored by vegetation. The curved parabolic dune shape is then formed as wind deflates the unvegetated central portion of the dune into a blowout and deposits the material downwind (Trenhaile 2016:410). Parabolic dunes have been observed to occur in large groups, with all of their axes parallel to the dune forming wind (David 1977:25; Lemmen et al. 1998:30).

Specific subtypes of parabolic dunes however, can be indicators of conditions that differ from the above general description. Open parabolic dunes, where the two wings are not connected at the upwind end, are found in areas of limited sand supply, with absent to very low vegetation cover, and a deep-water table (Lemmen et al. 1998:30). Closed parabolic dunes, where the two wings are joined by a semi-circular ridge at their upwind end, are indicative of a formerly humid climate, and are found in association with a moderate to high amount of vegetation cover and a moderate to high sediment supply. They are the result of either a newly created or reactivated blowout where material from a destabilized area is blown out of the deflation hollow to be deposited on along its edges, forming a parabolic dune (David 1977:23; Lemmen et al. 1998:30). The process by which a blowout is transformed into a parabolic dune, and the role that vegetation plays in this process, has been described above.

The third type of aeolian feature seen in Western Canada are transverse dunes, or ridges. While taking on various forms, depending upon the environmental conditions in which they form, ridges in general are defined as windblown linear sand features perpendicular to the direction of the wind, formed by the erosion of aeolian features on the upwind side and the deposition of material on the downwind side. They can form in conditions where the sediment supply is moderate and vegetation cover is high (David 1977:29; Lemmen et al. 1998:31). A rarer type of dune ridge that appears in a number of archaeological sites examined in this study is the North Battleford-type ridges. These unusual dune ridges are defined as a linear, elongate ridge with a sinuous crest-line. They are formed by the deflation of a former parabolic dune along its southern wing and possess a strongly asymmetrical transverse profile. These features consistently lie parallel to each other (David 1977:29). David (1977:97) also notes that in order for this type of dune ridge to form the south facing inner slope of a dune's northern wing must become active from winds moving to the north, while the north facing slope of the northern wing must be covered by dense vegetation, consisting of trees and shrubs.

A fourth type aeolian landform observed on the Northern Plains are sand sheets which are accumulations of windblown sand of various depths, but which lack any substantial topographic relief (David 1977:31). Situated around and in between sand dunes, they form within areas characterized by a limited sediment supply, a high-water table, a vegetation cover that increases with distance from the main source of sediment, periodic flooding, and surface cementation of sand particles. This cementation is caused by the introduction of cementing agents as gypsum, anhydrite, or halite, and through colonization by lichen or fungus that can bind the surface together. Introduced through groundwater, flooding, surface runoff, wind, or the localized growth of lichen or fungi, the process of cementation limits the amount of sand available for transport through increasing the threshold velocity required to entrain sand particles (Evans 2006:86; Laity 2008:196; Lemmen et al. 1998:31; Schulten 1985: 1657; Trenhaile 2016:407). The high-water table that is typically found associated with these features can result in the formation of stable soil horizons due to the degree of moisture present, and in some cases flooding when there is sufficient moisture to cause the water table to rise above the ground surface (Pye and Tsoar 1990:249).

3.4 Dune Activation and Stabilization

The processes of dune activation and stabilization are influenced by the regional wind regime and vegetation cover. For the former, activation cannot take place if the wind regimes are incapable of entraining and transporting sand particles across the landscape. The vegetation cover present in a dune environment suppresses entrainment and transport of sand. Although these two factors play major roles in how dunes are formed and transformed, other aspects of the environment also play a role in dune dynamics.

The first of these factors is the nature of the sediments. Due to their lighter texture and high infiltration capacity, sand and sandy soils allow for a quicker saturation of deeper sediments by surface water than occurs in denser soils. As a result, less moisture is lost due to surface evaporation, although this can also lead to an increased chance of activation as moisture is drawn away from the surface. The amount of water retention on the surface of dunes is found to fluctuate with the seasons, with the least amount seen during the summer months, increasing to 2.5% moisture in February. In addition, the colour of the soil plays a role in moisture retention, due to the lighter-coloured sediments found in dune areas being formed predominantly from quartz. This lighter colour allows for a decrease in the amount of solar energy absorbed at the surface, which again causes a decrease in the amount of moisture lost through evaporation (Krinsley and Smalley 1972:286-287; Townley-Smith 1980a:28; Tsoar 2013:417).

Also playing a role in the activation of dune features is the passage of the seasons, as each season will provide environmental variability that will influence if, and to what degree, sand will be transported across the landscape. Based upon observations taken from the Great Sand Hills over a three-year period, Wolfe and Lemmen (1999) conclude that the season with the greatest potential for dune activation is fall, due to a number of factors acting in concert. These consist of surface moisture being at a minimum, the ground surface not yet being frozen, and the vegetation cover entering a dormant stage, leading to an increase in surface exposure due to the loss of leafy foliage, although sand entrainment still occurs, as leafless shrubs, trees and stems are still present on the surface. It should be noted however, that this dormancy does not imply that the plants are dead or have lost any of their substantial subsurface root networks that will sustain them over the colder seasons. Further, this dormancy does not impede vegetation to continue to act as a barrier to sand entrainment. Winter months were also witness to dune activation to a lesser extent then that seen in the fall, despite the presence of interstitial ice, as winds were strong enough to transport unfrozen sand. The spring, while having the highest potential for sand transport due to high winds, also displayed activation rates lower than that seen in the fall, due to variable wind direction and increased moisture from melting snow and rainfall that saturate and bind surface material. The summer months were also seen to have decreased activation potential, a result of winds that are both directionally variable and weaker, which reduce their capacity to carry sediments (Wolfe and Lemmen 1999:207). These results differ slightly from those presented by David (1993), who states that the season displaying the greatest dune migration rates is the late winter to early spring, with minimal activation occurring during the summer and early winter (David 1993:66-69). Wolfe and Lemmen (1999:207) state that David's results are correct for periods when there is limited snowfall during the winter and rain in the spring. This claim can be viewed as sound, as David, in his descriptions of long-term dune monitoring in the Great Sand Hills, states that dune advance is minimal if sloughs in the area are full of water, indicating that the water table has risen and is impacting surface sediments through increasing the cohesion between the sand particles. David also noted that dune movement increases the drier it is during the late winter to early spring (David 1993:66-68).

A third factor, of particular importance to archaeologists, that is believed to cause dune activation are human activities. Specifically, David (1993) notes that archaeological material has been observed on the surface of active deflated areas that are believed to have become unstable during a dry period in the 1880s. This limited drought in the late 19th Century would have contributed to some of the destabilization that was witnessed. The degree and extent of the dune activation has led some researchers to suggest that the activities represented by the artifact assemblages, such as hunting, have increased the likelihood of dune activation (David 1993:63-64). These practices include intensive human activity within a restricted area, the removal of plants and trees for food, fuel, and building materials, anthropogenic burning, and trampling from the concentration of hoofed animals (bison) within a confined space such as a pound or bison trap (Wolfe et al. 2007:187).

As well, it should be noted that the size of dunes themselves influences how often activation takes place. For dunes that measure between six and eight metres in height, a history of activation is seen during any period of dryness (David 1971:297, 1993:64-65). This same behaviour is not seen in smaller dunes where activation occurred only during periods of major climatic change. It is suspected that this difference in activation potential is due to the greater access that the root systems for plants have to groundwater on smaller dunes, as plants located on higher dunes would be more easily deprived of water as the groundwater table lowers as a result of climatic fluctuations (David 1993:65).

Lastly, the factor of fire and its relation to dune mobility must be examined. Although viewed historically by the first European explorers to the Northern Plains as a highly destructive force that consumed valuable wood resources and drove away game animals, fire also plays a role in maintaining the ecological health of the region and in providing an abundant resource base for the humans living there (Rannie 2001:18-19). From a soil chemistry perspective, the regular burning of Prairie grasslands served to remove dead plant debris and release nutrients back into the soil, thus allowing for new growth to occur. From the standpoint of species competition and diversity, fire served to increase the number of grass species on the Prairie, making for much richer forage for animals, and to limit the growth of tree populations (Courtwright 201:19; Pyne 2007:32).

Despite the dramatic impact that fire has upon the Prairie landscape, the role that it plays in the activation of sand dunes can be viewed as negligible. While it has the ability to eradicate any vegetation that acts as a stabilizing factor in a dune environment (Filion 1984:543), how it affects dunes depends not on the amount of burning that takes place above ground, but the amount of burning that takes place below ground. Dunes can remain stable provided both the root systems of the burned plants survive in an area that contains sufficient moisture for them to foster new growth. This phenomenon was observed to occur in the Great Sand Hills between the years 1967 and 1969, where fires resulting from lightning strikes failed to cause any dune activation (David 1993:65). This stabilization is attributed in part to the extensive root systems associated with Prairie adapted grass species. The impact that fire has upon tree species in dune environments can also be seen as negligible, due to the root systems and regeneration cycles that Plains-adapted species possess. Quaking aspen (*Populus tremuloides)*, one of the dominant tree species within dune environments, is known to rapidly colonize areas following fires or other disturbances due to their adaptation to fire that allows them to be extremely competitive with regards to colonizing burned areas (Howard 1996). In examining this response to fire, Brown and DeByle (1987) found that burning acted as a stimulus for sucker production within an area. New growth of aspen was seen to peak in the first year following a fire and decreased gradually over time. Further, fire intensity was found not to play a substantial role in the number and density of new sucker growth, although a slight decrease is witnessed in the case of high-intensity fires. Optimum growing conditions and sucker spread for aspen were seen with moderate-intensity fires, where the flame height was approximately 45 cm. With regards to the impact of fire on standing trees, it was seen that trees damaged in low- to moderate-severity burns survived for up to four years, with most dying off by the second-year post-burn. Within that time period, however, new growth was able to re-establish aspen populations and eventually result in stands of mature stems (Brown and DeByle 1987:1108). While fed upon by bison, deer, and other Plains species, this impact was not found to stop aspen regeneration and the creation of stable stands, due to the large supply of new forage, in the form of grasses and shrubs, in addition aspen suckers (Bartos, Tshireletso, and Malechek 2014:406; Howard 1996). The presence of bison did serve to curtail this growth, however, and encourage the expansion of grassland ranges. This process has been noted historically in Elk Island National Park in Alberta, where historical records note the area consisting mostly of grasses, with isolated patches of aspen. With the extirpation of bison from the area and the elimination of traditional burning practices, aspen populations greatly expanded through the region. With the reintroduction of bison herds with the establishment of the park in 1913, aspen populations were seen to decrease. Since this time, aspen groves have seen to expand and contract in the park, fluctuating whenever bison herds are culled due to overpopulation (Campbell et al. 1994:360-362; Howard 1996).

With regards to growth rates, aspen suckers have been observed to grow between 6 and 24 inches high within their first year, with a closed aspen canopy being present within four years (Howard 1996). As such, tree cover within dunes would still be maintained, contributing to the stabilization of these landscapes. These case studies exemplify the negligible impact that fire can have on the activation of dunes, given the previously noted tendency for larger dune areas like the Great Sand Hills to activate. Although possessing this attribute, we can conclude that fire is not a large factor in causing activation, even in those areas that are more prone to do so.

3.5 History of Activation within the Study Area

As a result of the variability of dune dynamics in response to environmental change, it is difficult to develop a general model of dune activation and stability on the Northern Plains (Muhs and Wolfe 1999:191). Based upon the evidence from a number of dune studies across Alberta, Saskatchewan, and Manitoba, it is possible though to examine trends in dune dynamics across the Northern Plains in relation to Holocene environmental change.

Almost no intact dune deposits formed between 8000 and 5600 BP are known on the Northern Plains, a period encompassing the Altithermal, due to either dune activity during this climatic episode or to dune activation during the late Holocene that reworked earlier deposits (Wolfe et al. 2002:224-225). One exception is the Flintstone Hill exposure on the Souris River, which provides an almost continuous record of landscape change since deglaciation. This stratigraphic section provides evidence of dune activation between 7600 and 6100 BP, followed by wetter, then drier conditions (Boyd 2000b:32; Wolfe et al. 2002:225). These findings are mirrored by climatic evidence from Ingebright Lake in southwestern Saskatchewan (Boyd 2000b:33-34; Shang and Last 1999:107; Wolfe et al. 2002:225). Dune stability is evident in the region between 4600 and 3500 BP through the presence of dated paleosols, followed by successive periods or aridity (assessed by optically-stimulated dated quartz feldspar grains within the sand matrix) and stability (assessed by the carbon-14 dating of paleosols) throughout the late Holocene (Wolfe et al. 2002:225). Of particular interest is the interval between 1000 and 600 BP, which corresponds with the Medieval Warm Period. During this time, dune stability decreases, as indicated by the domination of aeolian deposits from this time period within dune chronologies as areas went through cycles of activation, deposition and paleosol formation. In addition to constructing these chronologies, these activities also resulted in the reworking of earlier dune deposits (Vance et al. 1995:139-140; Wolfe et al. 2002:226).

Evidence of dune activation and stabilization trends are present within several dune fields across Western Canada, although for some of the areas examined in this work activation has led to erosion of the materials, representing periods of time immediately following deglaciation (David 1993:80). The first of these areas is the Brandon Sand Hills, located east of Brandon, Manitoba. Consisting of deposits originating from the Assiniboine delta of Glacial Lake Agassiz, an activation history was constructed from sediments and paleosols exposed in the Brookdale Road Section in the northwest portion of the Sand Hills (David 1971:293; David 1977:63). Using radiocarbon dating on humus extracted from five paleosols, a chronology of stabilization and activation was constructed for the area, with stability and soil formation occurring at 3680 ± 180 BP, 2150 ± 150 BP, 1510 ± 150 BP, 920 ± 140 BP, and 430 ± 130 BP (David 1971:297). Activation that occurred between these periods is thought to be the result of a moisture deficit resulting from a shift in local climates, with stability returning when conditions became moister (David 1971:299; Wolfe et al. 1995:133). It should be noted however, that radiocarbon dates obtained from dune sites have the potential to provide erroneous results due to environmental factors, a topic that will be discussed in chapter six.

A second region that was studied for evidence of activation and stabilization is southwestern Saskatchewan. Using both aerial photographs and optically stimulated luminescence dating quartz feldspar grains within the sand matrix, Wolfe et al. (1995) examined a number of dune fields within the region, including the Great Sand Hills, the Burstall Sand Hills, the Seward Sand Hills, the Tunstall Sand Hills and the Bigstick Sand Hills, for evidence of activation and stability during the Late Holocene. While finding variations in stability, witnessed through the presence of both paleosols and interdune sands, each of the sand hills display a trend towards activation over the past 200 years at levels equal to or greater than those seen today, with signs of increased stabilization over the past 50 years. These conclusions are drawn from visible signs of activation and stabilization observed from historic aerial photographs (reflected through changes in the amount of bare unvegetated sand in the photos over time) and in paleosol formation. Further evidence for stability occurs between 200- and 600-years BP, coinciding with both the Little Ice Age and with evidence for increased moisture being present within the region (Hughenholtz and Wolfe 2005:145; Vance et al. 1993:118; Wolfe et al. 2002: 226). Prior to this period, dates are difficult to obtain owing to dune activity in the region exposing deposits to sunlight; this exposure would invalidate any results obtained from optically stimulated luminescence dating. In an examination of drought and dune activation on the southern prairies of Saskatchewan and Manitoba, Vance et al. (1995) and Wolfe et al. (2002) concluded that paleosol development occurred at 2700 BP, 2100 BP, and sometime after 1400 BP. A period of stability at 2600 BP corresponds to archaeological deposits discovered at the Burstall Sand Hills, consisting of *in situ* bison bone radiocarbon dated to 2620 ± 140 BP and a Pelican Lake-type projectile point, dated to approximately 2000 BP. Dates from these materials contradict those obtained from the optically stimulated luminescence dating of the surrounding undisturbed sediment matrix, that suggest that the mineral grains in the dune deposits ware last exposed to sunlight between 4150 ± 215 years BP and 5400 ± 600 years BP (Wolfe et al. 1995:138-139).

Gilliland (2007) examined dune stability in the Sounding Lake Sand Hills in her analysis of paleosols associated with archaeological material at FaOm-22. This study examined the profiles and soil chemistry at five locations within a 500 m^2 area at FaOm-22 to determine the geoarchaeological history of the area, as well as the role that human occupations had in the development of the area's soil chemistry. She concluded that soil formation took place in the region by at least 2400 BP, with subsequent periods of stability occurring at 1100 BP and 270 BP. The modern soil present is estimated to have formed by approximately 200 BP (Gilliland 2007:157-158). Based upon differences in phosphorous and microbial phospholipid fatty acid (PLFA) levels present within paleosols associated with archaeological materials, as compared to areas with no archaeological material, she further concludes that unspecified anthropogenic factors caused the introduction of these materials that played a role in the formation and alteration of soils at FaOm-22 (Gilliland 2007:138-147). Although no specific reason is given for these increased levels of phosphorous and microbial phospholipid fatty acid in the original research, this topic is addressed in section 3.5.1 of this work in the context of anthropogenic factors present in sand dune sites.

Finally, an overall summary of dune dynamics for southern Alberta, Saskatchewan, and Manitoba is presented by Wolfe et al. (2002) through the examination of seven dune areas, including the Lauder Sand Hills and the Brookdale Road Section in the Brandon Sand Hills, both mentioned previously (Figure 3.2). Their findings from these regions have established the sequence of dune activation and stabilization that that is largely used in the creation of this

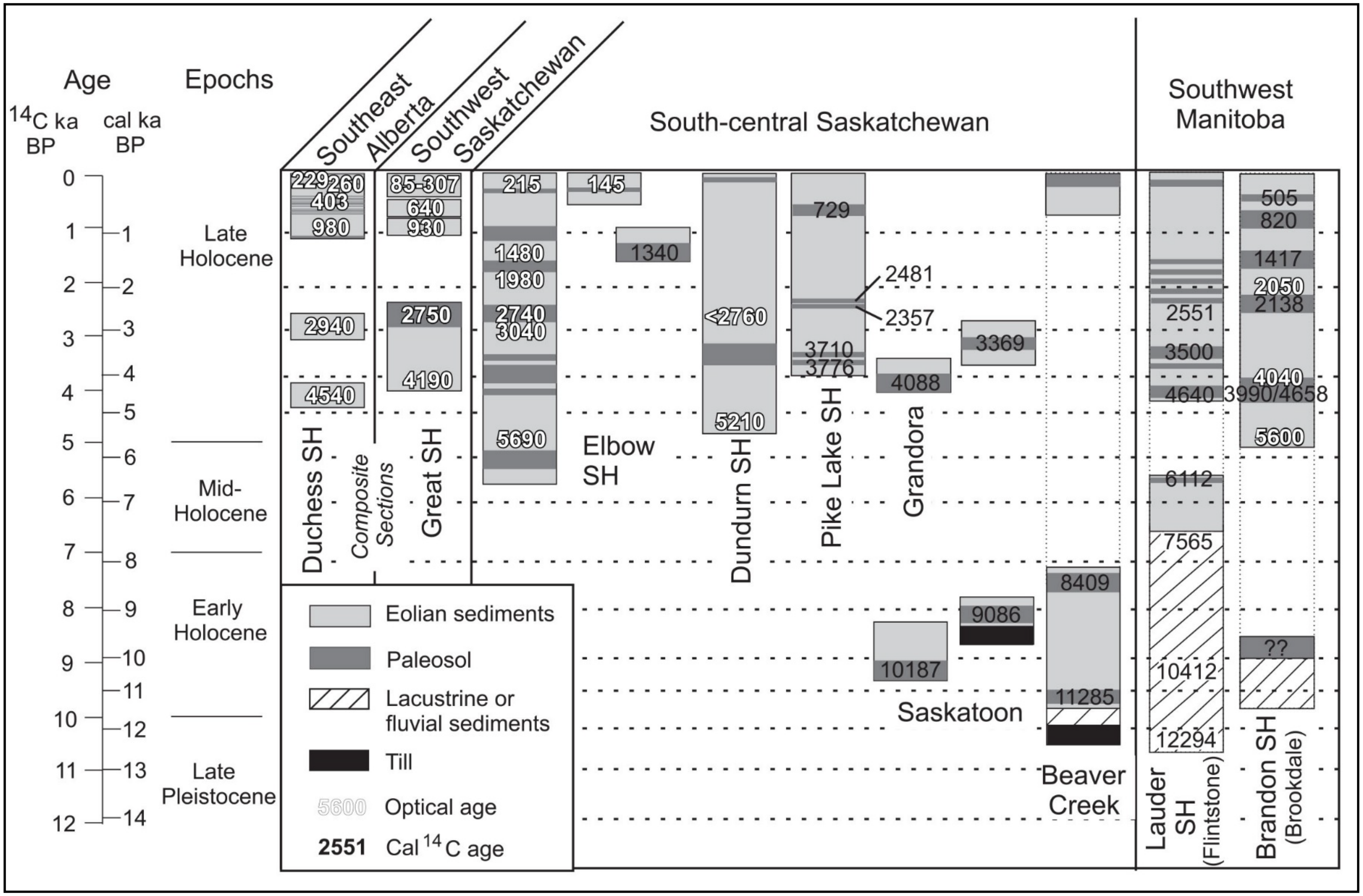

Figure 3.2 - Dune Activation History for the Northern Plains

(*from Wolfe et al. 2002:224*)

section (Wolfe et al. 2002:225-226).

3.5.1 Dune Soil Formation and Anthropogenic Factors

Within Northern Plains sand dunes, soil formation requires the decomposition of organic matter on the surface of a specific area (Trenhaile 2016:127; Wanek 1964:9). As such, prior to any soil formation taking place a particular location must have sufficient stability to facilitate vegetation growth. The process of soil formation within Plains dune environments was examined by Hopkins and Running (2000), who found that moisture fluctuations did not have an adverse impact upon soil formation as commonly thought. Previously, archaeologists and other researchers have made broad assumptions that with more arid conditions plant life, and thus soil formation and dune stability, was eliminated. Examining the Cheyenne Delta, the largest dune area in North Dakota, it was found that plant life within dune formations is highly adaptable, with the migration of plant species occurring in response to varying levels of surficial water (Hopkins and Running 2000:58-59). As such it is possible for a dune to undergo drought conditions but still be stabilized due to the presence of drought-resistant plants with deeper root systems. They conclude that dune destabilization has always been a part of dune ecosystems, and that the native species that inhabit these features are adapted to surviving under conditions of decreased moisture and sand/soil erosion. Further, they acknowledge that dune regions may be more resilient than previously assumed when placed under moisture stress and may act as both refugia and seed banks for the Plains when drought conditions do occur over extended periods of time (Hopkins and Running 2000:62).

Connected with this question of dune stability and soil formation are the contradictory claims made in previous sections of this work on the role of human occupation and activities in the stabilization or destabilization of dune areas. Within their assessments of sand dune fields, David (1993) and Wolfe et al. (2007) contend that human activities act as destabilizing agents within dunes. These agents take the form of plant collection, which would reduce vegetation cover, as well as intensive activities such as hunting, camping, and pounding bison, which would increase the chance of surface disruption. Studies on the impact of larger bison herds within regions experiencing a moisture deficit have found that animal grazing and trampling can contribute to denudation and the exposure of underlying soils (Forman et al. 2001:24). Following the criteria established by Hack (1941), it is also conceivable that human gathering, hunting, and camping activities could reduce or eliminate vegetation cover over a limited area, through intentional plant gathering activities and longer-term occupations, to the point where dune activation is possible. In contrast, Gilliland (2007) presents soil chemistry evidence that suggests, contrary to David (1993) and Wolfe et al. (2007), that human activities can act to promote soil development at bison processing sites through the introduction of phosphorous and organic materials into dune environments, although she does not specifically identify any agents that would do so.

To resolve this contradiction, the results provided by Gilliland were examined further to determine which human activities could produce these chemical results. From this research, the taphonomic processes that take place between decomposing animal material and the surrounding environment are seen to be the most obvious explanation, given the cultural usage of the site. Dead animals are a valuable resource for the environment, as they are rich in nutrients and are, by weight, 50% to 80% water (Carter et al. 2007:126). Following the discard of butchered remains, hide, viscera, and any faecal matter, bodily and cadaveric fluids are released into the immediate environment. The pooling of these fluids forms a cadaver decomposition island (CDI), a highly concentrated soil region of high fertility that is created from the absorption of carbon and nutrients from the decaying remains (Carter et al. 2007:12). The dimensions of a CDI vary, dependent upon the size of the animal, the number of animals or material present, the extent of the maggot mass that forms on the cadaver and the path of maggot migration, and the soil texture. For large ungulates (e.g., bison, *Bos bison;* and deer, *Odocoileus virginianus*) within a Plains environment, the CDI can extend to as much as two metres away. Initially, areas impacted by this CDI are devoid of vegetation, but within one year are colonized by a variety of floral species. The size of this barren patch varies upon the size of the carcass, as well as the season that the animal died in, with fall and winter kills displaying the least impact, if any, on the surrounding vegetation (Towne 2000:234).

As a result of advanced decomposition, increased levels of soil moisture, carbon content, microbial activity, nematode abundance, and nutrients are observed within a CDI (Carter et al. 2007:12). Further, additional organic material can be added following the initial deposition of the material, with remains, pupa, and casings being left by insects, and faecal matter being left by scavengers. These conditions result in an increase in both vegetation growth and diversity within the immediate area of the remains, which can in turn attract grazing animals, who will continue to contribute to the organic content of the island through fecal matter and, at times, by their own remains as predators engage in kills near preferred herbivore feeding areas (Carter et al. 2007:19). Furthermore, areas outside of the initial disposal area can also be impacted, as scavengers will drag portions of carcasses across the landscape, resulting in the creation of secondary CDI (Towne 2000:236). These increases in vegetation, moisture, and nutrient content will in turn act as very localized stabilizing agencies for dune sand, with the area impacted extending beyond the immediate range of where the cadaver is located due to both the saturation of the ground surface by cadaveric fluids and by the transport of carcasses and carcass portions (Carter et al. 2007:20; Towne 2000:237).

These results offer an explanation of the results obtained by Gilliland (2007) on the soil chemistry of specific locations at FaOm-22. The elevated nutrient levels and variations in the microbial communities detected in soils found in association with cultural material are also well noted in cadaver studies, resulting from the addition of carbon and nutrients that result from animal decomposition as an agent of soil formation. Prominent among these findings is the increased presence of phosphorous, one of the key indicators of an anthropogenic soil at FaOm-22 outlined by Gilliland. Studies on large ungulate decomposition on the Plains have found that phosphorous levels remain high at carcass sites for years following initial deposition, when compared with samples taken from areas not impacted by a CDI (Towne 2000:234). Furthermore, these increased phosphorous levels cannot be seen solely as a function of natural plant decay from the surrounding environment, as decomposing floral material releases a fraction of the phosphorous as found in either biological remains or in faecal matter (Carter et al. 2007:16). In all likelihood, the areas tested represent specific locations where either kill activities took place or butchered remains were redeposited. This conclusion is supported by historical observations from Hind (1859), who observed the construction of a new bison pound in the Elbow Sand Hills after the previous structure was abandoned due to the amount of bison remains within it and the overpowering stench of the site (Hind 1859:55).

From these bodies of evidence, it can be concluded that within Northern Plains sand dune environments human behaviour can act as both an agent of activation and stabilization, depending upon the specific activity itself. In some instances, outlined by David (1993) and Wolfe et al. (2007), human hunting and processing activities can result in the loss of trees and vegetation, as well as destabilize surface soils in dunes through trampling by both humans and bison herds. These same activities, however, also have the potential to influence the stabilization of specific locations through the addition of nutrients and microorganisms through the large-scale deposition of carcasses and discarded bison soft tissue elements in secondary butchering locations. Furthermore, the primary kill area itself would also exhibit a greater degree of stabilization due to the discard of the larger bison carcasses themselves, which would provide both ground cover and moisture.

3.6 Dune Flora and Fauna

Throughout the study area, numerous floral and faunal inventories have been constructed that detail the species diversity found within dune areas. Based upon this research, it is possible to determine not only the degree of plant and animal diversity within these environments, but the resource base available to First Nations groups that may have used these areas. First among these is the Great Sand Hills, which was documented by Townley-Smith (1980b) with respect to the vegetation and associated habitats and Epp and Waker (1980), who studied the fauna.

To obtain the dataset required for his study, Townley-Smith conducted terrestrial surveys and sample collecting within nine survey blocks within the Great Sand Hills, each block measuring four square miles. As there were limitations of both time and resources, he restricted his examination and collecting to vascular plants only, including ferns, fern allies, gymnosperms and angiosperms, although he also briefly mentions terrestrial algae, mosses, fungi and lichens (Townley-Smith 1980b:30-31). In addition, earlier works on the region were consulted (see Hulett 1962 and Hulett et al. 1966) to ensure that the inventory was complete as possible. In all there were 209 different plant species identified within 11 different habitats that he identified on the basis of landform and topography: low stabilized dunes, high south-facing dunes, high north-facing dunes, upland sand flats, intermediate sand flats, moist saline sand flats, active erosion areas, recently active erosion areas, active deposition areas, aspen understory, and disturbed areas. Criteria for defining these habitats, however, are not clearly stated. Rather, distinctions are made on the broad categories of dune height (greater than or less than 3m, or of variable height in some cases), slope steepness (present or absent), the frequency of sand hills/dunes (low, intermediate, and high), and unspecified microenvironmental differences that can cause variations in vegetation (Townley-Smith 1980b:19-47). Based upon these results, Townley-Smith concluded that the Great Sand Hills differs greatly from that of the surrounding grasslands, most notably the scarcity of trees in the latter, due in part to the variety of the 11 habitats he identified as being present within the dune environment (Townley-Smith 1980b:73). In their investigation of the vertebrate fauna within the Great Sand Hills, Epp and Waker (1980) employed the same study blocks utilized in the vegetation study. As with the vegetation study, other sources documenting animal life within the region were included with the study (see Elliott 1966 and Vermeer 1970). Although as thorough in their examination of fauna within the study area, there are two notable omissions from this study of vertebrate life in the Great Sand Hills. First, limited resources restricted field examinations solely to an inventory of terrestrial vertebrates and did not include any of the potential fish resources in the area. Secondly, although they were sought out during field studies, no reptiles were found, and are absent from the study. As such, only amphibians, birds and mammals were documented (Epp and Waker 1980:75). Of these three, the greatest diversity is found among birds, with 73 species recorded. Following birds are mammals, which are represented by 19 species, and five species of amphibians. No dominant species were listed in these inventories. Based upon the results, Epp and Waker concluded that the Great Sand Hills represent an anomalous environment in comparison with the surrounding grasslands biome. While containing species that are suited for a grassland's environment, dunes also support animal species more commonly found in not only arid environments, as well as those from wetland, parkland, and river valley environments (Epp and Waker 1980:84).

An ecological inventory of the Lauder Sandhills was also conducted by Boyd (2000a) as part of his research into the *Makotchi-Ded Dontipi* locale, located in the western end of the Sandhills (Boyd 2000a:2). Using information from both his own field studies and other works (see Hohn and Parsons 1993), he concluded that five different habitats exist in the Sandhills: aspen forest (*Populus tremuloides*, *Symphoricarpos occidentalis*, *Prunus virginiana*, and *Amelanchier alnifolia* defining species), forest/grassland transition areas (*Populus tremuloides*, *Prunus virginiana*, *Juniperus horizontalis*, and *Juniper communis* defining species), grassland (*Bromus inermis* and *Festuca* spp. common defining), sandhills proper (*Juniperus horizontalis*, *Coryphantha vivipara*, *Opuntia polyacantha*, *Bouteloua* sp., and *Andropogon hallii* defining species), and wetlands (*Urtica dioica*, *Salix bebbiana*, *Caltha palustris*, *Petasites sagittatus*, and *Typha angustifolia* defining species). These habitats were found to contain a total of 83 distinct species, of which only five are introduced (Boyd 2000a:14-20). While comprehensive in scope, Boyd does note that this ecological survey is not an entirely accurate portrait of past environments but is also the result of modern ecological influences (Boyd 2000a:10). Based upon these results, Boyd concludes that the Lauder Sandhills function as an ecological island, due to the glaciolacustrine deposits supporting a number of plant species (*Andropogon hallii*, *Calamovilfa longifolia*, *Chenopodium leptophyllum*, *Rumex venosus*, *Salix interior*, and *Solidago nemoralis*) that are not found in the surrounding Souris Basin (Boyd 2000a:22-23).

In addition, an intensive literature review of the flora and fauna of the Lauder Sandhills area was also conducted by Playford (2001) as part of her investigations into the faunal material found at the Jackson Site (DiMe-17). Using broadly-based source literature, she documented 498 unique plant species and 304 unique animal species as being present within the Lauder Sandhills region and Souris River (Playford 2001:164-185). No dominant species were listed as part of this study.

Lastly, a small-scale ecological inventory and analysis was conducted by Ramsay (1991) as part of her archaeological research at the Melhagen site in the Elbow Sand Hills, located near Elbow, SK. Conducting surveys along five transects at three metre intervals, she identified 28 different plant species, with another 13 located in the close vicinity of the survey transects (Ramsay 1991:8). Dominant species were identified as *Symphoricarpos occidentalis*, *Carex* sp., *Solidago missouriensis*, and various grass species (Ramsay 1991:233-234).

3.7 Summary

Originating from glaciofluvial deposits, dune environments in Western Canada can be viewed as distinctive landscapes in comparison with the surrounding grasslands region. During periods of drought, given the correct conditions, dunes and sand sheets can be created, destroyed or altered. Likewise, they can also remain highly stable and serve as host to a variety of plant and animal species, some of which are specific to dune environments. In short, they are not fragile, sparse landscapes, devoid of life and easily prone to activation. In addition, they are not similar to other depositional environments that are found on the Northern Plains and should not be analyzed or interpreted using the methodologies or perspectives used in other environmental regions.

Observed within the context of global climate patterns, it is possible to define a pattern to dune stabilization across the Northern Plains. Under certain conditions, dune environments have an increased tendency towards activation that is reflected physically within the dunes themselves. However, because of the variable nature of dune deposits, it is difficult to define a general pattern for activation and stability for dune areas on a small time scale. Given regional, and even local variations in hydrology, wind regimes, vegetation cover, and dune size, conditions that can cause activation in one region may have little or no effect in another. Although originating from the same processes that saw the disappearance of glaciolacustrine bodies of water at the beginning of the Holocene, Northern Plains sand dunes are not homogeneous with regards to landforms, structures, hydrology, and potential for activation. As such, it is difficult for archaeologists to employ the same approaches to examining dune occupations as they would to other regions of the Northern Plains. Each dune area should be examined on the basis of its own unique features due to the variations found between dunes on the Northern Plains.

By examining the topic of anthropogenic soil formation and sand dune activation, it can be concluded that humans can act towards both causing and preventing activation through their activities. In instances where both the vegetation and surface soil is damaged or removed, through trampling, repeated use, or intensive plant use, the chance for dune activation increases. Likewise, through depositional activities, as found with intensive butchering within pound features, stability is encouraged through the contribution of nutrients, moisture, and ground cover to a particular location. In this manner, it is possible for both types of actions to be found within a single site, depending upon what activities are taking place.

From this chapter, it is further demonstrated that sand dune areas from across the entire study area contain ample faunal and floral resources to sustain human populations. Key to this biodiversity is the presence of floral resources, which are essential to supporting any faunal species as well as for humans who would exploit both plants and animals to sustain themselves. Although containing sufficient diversity to be interpreted as ecological islands within the larger Northern Plains ecoregion, the mere presence of diverse species does not imply that all First Nations groups used some, or any, of these resources. Examinations of indigenous plant and animal use will be explored further in chapters four and six respectively.

Chapter 4

First Nations Ethnohistory of Sand Dune Landscapes

4.1 Introduction

To effectively approximate a First Nations understanding of dune environments, it is vital that the words, accounts, histories, and practices of these groups be included in any historical reconstruction. While providing a source of quantifiable data that can be readily replicated and tested, information sources from archaeology and geography cannot necessarily by themselves provide the context and information needed to properly understand cultural landscapes. As noted by Basso (1996), the landscape we all move through is a cultural one, to which significant narratives and histories are tied that defines cultural groups. These histories, in turn, are not solely rooted in physical and economic factors that are easily quantifiable and physically represented. This understanding of history, landscape, and systems can be misinterpreted when provided by members of outside groups who lack this cultural context, resulting in a lack of comprehension and understanding. How this lack of context can influence interpretation is exemplified by the varying perceptions surrounding the map provided to Peter Fidler in 1801 by Old Swan of the Siksika. Although used by Aaron Arrowsmith, the leading cartographer of the period, to update maps of the North American interior, the information obtained from Old Swan added confusion to European understandings of the Northern Plains. Lacking the cultural context within which the landscape information was understood and conveyed, users of the Arrowsmith, including Lewis and Clarke, were left confused (Binnema 2001:201-208). In order to fully understand the geographic narrative provided by Old Swan, one needed to understand the basic structure of Blackfoot maps, and the important role that river systems and *mistakis* (the front ranges of the Rocky Mountains) play in defining the landscape (Binnema 2001:218). He contends that, not only were any difficulties in understanding the map the result of European difficulties to comprehend Siksika conventions, but that the information that was relayed to Fidler was sufficient to navigate across the Northern Plains (Binnema 2001:211-213; Nordland 2004:156). With this perspective, it is evident that to fully comprehend the lifeways of First Nations groups, we must endeavor to understand and incorporate information from all sources and take the worldview of these groups themselves into consideration.

The purpose of this chapter is to examine, as much as possible with given sources, First Nations perceptions, histories, and usages surrounding sand dune landscapes in their own voice. This is accomplished through the use of written and recorded oral histories, both from First Nations and EuroCanadian sources, as well as with ethnobotanical datasets compiled from studies based upon these same accounts. Ideally, this work would have also collected current oral histories from groups whose ancestors lived in the region, but project constraints prevented this from occurring. It is felt however, that consultation with groups who occupied the study area would make an immeasurable contribution to the information presented here.

4.2 Cultural Identity and the Historical and Archaeological Records

Prior to conducting any examination of the histories of the groups who inhabited the study area, an examination of the context of these records is required. This concern stems not from a question of validity of the accounts provided by informants and written records, and if they are "correct" in their statements. Rather, it is rooted in concerns surrounding the fluidity of cultural identity for Plains groups prior to European contact, how this interpretation of identity is reflected within both modern written and oral histories, and how these factors can be interpreted within the archaeological record.

In examining this topic, McLeod (2000) feels that there is a trend with some academic and First Nations perceptions of Plains identity, where individuals and groups are classified into what he has described as a "pure, essentialized…identity". In doing so, he feels this simplification of tribal identity is not reflective of the multi-layered genealogies present within Northern Plains groups and can be misleading and limiting (McLeod 2000:438-439). As an example of this process, he cites his own personal experiences as a member of the James Smith Reserve in Saskatchewan and the modern emergence of a pan-Plains Cree identity across previously pluralistic, polylingual groups. He identifies this trend towards identification with a Plains Cree identity, and less with a Swampy or Woodlands Cree within the province, as stemming from a number of factors, ranging from popular culture to ones with historical and academic roots. First among these is the popularization of a Plains identity within mainstream media to meet a fascination that Western society has with the group. Secondly, within a historical context the Plains Cree language has had higher prestige among Cree dialects. This was witnessed during negotiations for Treaty Six, where Plains Cree leaders refused to listen to a

Swampy Cree translator. Third is the adoption of Plains Cree as the standard written dialect for all Cree groups, again stemming from the idea of the prestige associated with it. Fourth, McLeod (2000) cites the adoption of largely Plains Cree ceremonies in the Indigenous cultural revitalization movement that has occurred since 1970. As such, he feels that there is the tendency among participants to equate their own cultural identity with the Plains Cree practices they are conducting. Lastly, he contends that the contribution of academic writers, such as Mandelbaum (1979) and Milloy (1988), have contributed to and focused the notion of "Plains Cree" in their works, effectively essentializing the cultural identity within the literature (McLeod 2000:438-440).

Examples of this trend within *The Plains Cree* (1979) can be witnessed in a number of areas, beginning with what McLeod feels is the oversimplification of regional genealogies in the map of tribal distributions, where historical Plains Cree ranges, as well as reserves from 1936, are located. With the exception of a comment on how some territories were shared with other groups, no definitive mention of the cultural ambiguities that existed in the region is made. In reality, the occupants of some areas that were shared between the Plains Cree and other bands were hybridized and fused, such as the *Nêhiyâwi-pwâtak*, or Assiniboine. This map is also seen to include within it reserves, such as the Carry the Kettle Assiniboine Reserve, that are not Plains Cree. Conversely, the presence of other groups, such as the Assiniboine in the North Battleford area and the Saulteaux throughout the region, is not acknowledged (McLeod 2000:444). Further criticism of Mandelbaum is extended by Albers (1980) in her review of the reprint of *The Plains Cree*. In her critique, she feels that the work, while never outright stating that the Plains Cree are a self-contained group, does imply that this is the case.

Beginning in 1966 with the work of Morton Fried in examining his concerns with how tribes and tribal societies were viewed from a theoretical standpoint in the late 1960s (see Fried 1966, Helm 1968), and continuing on with later researchers, academics over the past fifty years have begun to recognize these inadequacies within past examinations of First Nations group identities and dynamics (Binnema 2004:11; Sharrock 1974:96-97). The primary concerns for Fried (1966:539) with past interpretations of the concept of tribe was that the validity of tribe as a level of sociopolitical integration is questionable and that a tribe, by non-specific definition, cannot be correlated completely with any historically well-documented sociocultural unit. As a part of this definition of tribe is the acceptance of the idea that a tribe is simultaneously an ethnic unit, a linguistic unit, a territorial co-residential unit, a cultural unit, and a societal unit. These units are discretely bounded, and infrequently contain the same population between them (Sharrock 1974:97).

To address these issues, a revised interpretation of social relations in the literature that took into consideration the complex nature of Northern Plains group dynamics and identity was needed. In his examination of contemporary Cree culture, McLeod (2000) states that group culture is multi-layered and open-ended, with narrative memory a continuing dialogue between past, present, and future. As part of this paradigm, genealogies are ambiguous entities and are part of what he views as a larger narrative irony, where a continual reshaping and cross-fertilization takes place within group worldview. On occasion, this reshaping occurs with the influence of Cree group members who were born and raised outside of the culture. As a result, contemporary Cree narrative memory can be seen to have emerged from interactions with Saulteaux, Dene, Assiniboine, and even English cultures (McLeod 2000:449-450). This perspective is mirrored in the critique of *The Plains Cree* offered by Albers (1980:218-219), who notes that qualitative evidence indicates that the Cree are not socially exclusive or culturally discrete, but instead possess a polyethnic system that have social relations and cultural institutions that cut across tribal ethnic lines.

A further interpretation of group cultural dynamics on the Northern Plains is presented by Binnema (2004) in his work *Common and Contested Ground*, which examines the interrelationship between cultural and environmental history on the Northern Plains prior to and after European contact. As a component of this analysis, Binnema examined both the nature of band and tribal constructions and how this social structure was reflected in historical and ethnographic literature. As with others, he emphasized the aspects of ambiguity and fluidity present within the concepts of ethnicity and group affiliation. Although perceived as being simple and unorganized, owing to the absence of formalized social structures witnessed in state societies, bands possess the same ability to meet all of their physical and social needs. This is done on a more informal basis, which allows them the flexibility to efficiently meet the rapidly changing circumstances found within their lifeways (Binnema 2004:11).

These adaptive concepts of informality and fluidity present within Northern Plains band societies are based around the structure of an extended family network, with members found both within the group that any one individual is currently living with, as well as with both other affiliated bands and with bands from other ethnic groups. Further, band political structure is based around non-hereditary chiefs, who hold power and influence both within and outside of the group through personal reputation and generosity, but not through any formalized power. As a result of this decentralized power structure, with kinship ties extending through multiple bands and with other ethnic groups, it was possible for an individual to easily relocate to another group on a short term or permanent basis when unresolvable political disagreements arose. This method of dispute mediation was not seen as either uncommon or extreme, but as cohesive as supporting communities were required in order to survive the challenges of the Northern Plains in a foraging society. Through the forging and maintenance of these social bonds, a larger support network is also forged that could be accessed during times of need, including periods of starvation or conflict with other groups. Due to this fluidity, the number of bands and their population numbers fluctuated over time, with individual groups separating, merging, and being absorbed on a continual basis (Binnema 2004:10-13). As well, the number of bands found within a particular tribe was not consistent across all tribes. Using historical accounts from the late 19th and early 20th centuries by George Grinnell, Robert Lowie, and Alfred Kroeber to examine the political structures of Plains groups, Smith (1924) provides counts for the number of tribes within the Blackfoot Confederacy, the Gros Ventre, and the Assiniboine. At the turn of the century, the Confederacy contained 35 tribes, split between the Piikani (23), the Siksika (5), and the Kainai (6), while the Gros Ventre were found to contain eight and the Assiniboine seventeen (Smith 1978:15-24).

Just as bands within one ethnic group were connected by common goals and kinship ties, so too were the multiple ethnic groups found across the Northern Plains. Interaction, congregation, and communal cooperation were common occurrences for the Cree, Assiniboine, and Blackfoot for the purposes of trade, hunting, waging war on mutual enemies, and forging and renewing friendships (Binnema 2004:14). In examining the social interactions of a Peigan band led by Sakatow in 1792-93, Binnema (2004:13) documents how the group peacefully camped with Blood, Siksika, Sarcee, and Cree bands. Through Peter Fidler's journals, he also documents how during this period the band also engaged in peace talks with neighbouring Shoshoni (Snake) and Kutenai bands. These efforts were successful, in part through the Peigan use of the visiting traders as a means to impress the Shoshoni delegation. This in turn led to offers from the Shoshoni to visit their settlements south of the Missouri River, as well as to participate in raiding parties with them against the Crow, located in what is now southern Montana and northern Wyoming. It should be noted that during this period of peaceful cohabitation and cooperation, other Shoshone bands were being raided for horses by Blood and Peigan bands, further illustrating the complicated nature of Northern Plains politics and group interaction (Binnema 2004:137-138).

These social relations frequently resulted in the establishment of inter-ethnic kinship ties through both marriage and the adoption of band members from other ethnic backgrounds. As observed by Daniel Harmon, a trader for the North West Company, intermarriage between neighbouring tribes on the Northern Plains occurred frequently (Lamb 1957:215). This inter-ethnicity is seen as a requirement for survival for Northern Plains bands, as it further expanded the social support network and diplomatic importance of any one band. It has been frequently documented in the historical record that individuals within leadership positions within a band were either of a mixed heritage or from another ethnic group altogether. Prominent examples in Plains history include Saukamappee (Young Man), a noted Peigan leader who was born into a Cree band, Old Star (a prominent Plains Assiniboine leader who was born a Kutenai), Jimmy Jock Bird (prominent with the Peigan despite his English-Cree background), Paskwa (Cree born leader of the Saulteaux), Piapot (Cree leader who lived in his youth with the Dakota), Poundmaker (Plains Cree leader whose biological father was Stoney and who was adopted by a Siksika leader), and Big Bear, a Cree leader who possessed a mixed Cree-Ojibwa heritage (Binnema 2004:201-202; Jackson 2003:3; Miller 1996:12). Having a mixed background offered individuals diplomatic and social advantages in normalizing relations with other bands and forging ties to meet common goals. This inclusion of individuals from another ethnic group within the power structure of a particular band is also seen on an occasional basis, with tribal councils allowing leaders from other neighbouring cultural communities to sit and make decisions alongside group members. This inclusion is due to regional interests that neighbouring groups had, which at times were more relevant than the opinions and positions of other bands within one cultural group, as these bands may be spread out over a wider geographic area. As such, the positions of outside leaders are of more relevance than those of leaders with whom you share cultural ties with (Albers and Kay 1995:52-53).

This inter-ethnicity is seen not only at the level of the individual but is also witnessed as occurring on a band level as well. Examining the topic of historical interethnic identity formation between the Cree and Assiniboine, Sharrock (1974) identifies three different forms of integration for the groups. These forms vary according to the intensity and quality of the documentable relationship between the two groups and the interactions between members of the Cree and Assiniboine. These forms vary from the Alliance, where a political alliance and bilingualism is noted, to the Intermarriage and Polyethnic Coresidence form, where marriages took place between the two ethnic groups and polyethnic coresidences formed, to the Fused Ethnicity form, where a fused hybrid ethnic unit is present, distinct from one found with either the Cree or Assiniboine. Sharrock (1974) identifies several cases of this fused ethnicity being noted in the historical records, with the presence of these groups being noted in the journals for Fort Vermillion, Fort Pelly, and the Qu'Appelle post (Sharrock 1974:103-112). Other Northern Plains groups recognized these groups as distinct from their parent ethnicities through the use of unique group names. Among the Cree, they were known as *Niopwatuk*, or the Young Dogs, while the Assiniboine referred to them as the *sahiyaiyeskabi* or *Cahi'aiyeskabin*, or the Cree-Talkers (Sharrock 1974:102-111; Sharrock and Kay 1995:71). A similar case of amalgamation can be seen historically with the Sarcee, a small Athapaskan speaking group, who at the turn of the 19th century was living with and allied to Cree, Blood, and Blackfoot (Henry and Thompson 1897:110). By 1815, the peaceful relations between these groups had ended, with the Cree and Assiniboine allied against the Blackfoot, Gros Ventre, and Sarcee. Following this period, observers commented on how the Sarcee differed culturally from the Blackfoot only in the area of language. During the previous period of peaceful relations however, Sarcee appearance and culture was seen to be identical to the Cree (Albers and Kay 1995:72; Henry and Thompson 1897:531-532).

This ethnic fluidity, and at times integration, impacts not only how we view past cultural identities within a modern light, but also how we view past territorial boundaries as well. Traditionally, Western scholars have interpreted Northern Plains ethnic boundaries in a similar fashion to those for European nation-states, with territories and the resources present on them being the domain of only a single group (Albers and Kay 1995:49-54). Within the historic and ethnographic records, ample evidence exists indicating that the practice of friendly or allied groups sharing territory was exceedingly common. In some cases, use of an area by one group required the invitation of another, as some type of boundary was established, while in others these boundaries were either ambiguous or non-existent. In both of these situations, a strong kinship tie was required before any joint usage took place. Groups made historic claims to specific geographic areas however these claims could be seen to overlap (Albers and Kay 1995:53-55). For all areas, and the resources that they contained, no idea of formal ownership existed. Rather, a concept of usufruct existed, where allied or kin-related groups could utilize the space, provided that it was not abused or destroyed, nor any resources wasted (Albers and Kay 1995:56).

This question of group fluidity, ethnic identity, and cohabitation can be a problematic one with regards to how it is represented within the archaeological record. In examining the Late Precontact period on the Northern Plains, Vickers (1994) examined the validity of assigning modern ethnic group identities to archaeological assemblages. Unlike other authors who have at least in part drawn parallels between archaeological phases and modern tribal groups and linguistic units (see Duke 1988 and Reeves 1983), he stipulated that this direct correlation is a difficult one to make. First, he pointed out that group classifications, such as "Blackfeet", are linguistic ones. As such, he questioned how meaningful this term is for examining past group identification due to changes in language over time. By extension, he then questioned at which point archaeologists can make the determination that the modern definition of a specific ethnic group is accurately reflecting the cultural ideals of the past community that created a specific assemblage. He concluded that before archaeology can begin to create these bridges between physical evidence of the past and modern groups, a greater consistency in reporting data, microstylistic studies of artifact classes, and quantitative studies of lithic raw material across a large section of the Plains is required (Daschuk 2009:3-4; Vickers 1994:31-33).

It should be noted that the practice of drawing conclusions on culture contact and spatial usage without relating past groups to modern ethnic identities has been conducted by some researchers. In examining the Old Women's Buffalo Jump in southern Alberta, Forbis (1962) concluded that the projectile point variability witnessed in the different horizons is reflective of various peoples, without making any distinction as to which ethnic group they were associated with (Forbis 1962:71). Further, within his examination of southwestern Manitoba, Syms (1977) concluded that sufficient physical evidence exists to postulate that up to fourteen different Plains and Boreal Forest groups occupied the region during the Late Woodland period (ca. 1170 BP to European contact). This conclusion is based upon the presence of diagnostic cultural material from both northern and southern Manitoba within fifteen separate components and horizons across the region. Included in this assemblage is material from the Snyder I occupation, which Syms feels is an expression of hybridized traits from the Boreal Forest and Northeastern Plains. He further concludes that the presence of these groups in the region was in part due to their symbiotic relationships with horticultural groups to the south (Albers and Kay 1995:69; Syms 1977:141-142).

As a result of these issues of cultural fluidity and interpretation, it is felt that distinctions must be made within the oral history datasets that are presented within this chapter. As shown previously, it is possible for the concept of identity, group affiliation, and concepts of cultural significance to change over both space and time. As such, it is extremely difficult to absolutely determine if each account was provided within the same historical or cultural context as the others. To alleviate this concern, each of the oral history accounts below are subdivided and examined on the basis of when they were recorded, with the division between historical and modern accounts being placed at the year 1950. This date has been selected, as it is felt that any accounts or histories recorded after this date have the possibility to be reflective of modern perceptions and opinions, while those before 1950 would be more reflective of a past generation no longer represented in the present population. In no way however, should this division be seen as a judgment on the accuracy or validity of the statements made. Rather, it is a recognition that, much like archaeological data, these qualitative accounts have their own contexts that must be taken into account, if possible, before any broad-based generalizations can be made regarding their equating with the archaeological record. A summary of the works used, the bibliography date given of when it was published or recorded, if they are primary or secondary source works, and the approximate date that the original source material was documented is provided in Table 4.1.

4.3 First Nations Groups Within the Study Area

Covering an expansive area through Alberta, Saskatchewan, and Manitoba, it is not surprising that the Northern Plains has been witness to migrations and population displacements both within Precontact periods and following the expansion of European groups into Western Canada. In current assessments of territorial occupation for the pre- and post-Contact periods, four modern groups are acknowledged as having been present within the defined study area: the Blackfoot Confederacy, the Gros Ventre, the Plains Cree, and the Assiniboine. Although sharing

Table 4.1 – Summary of Sources Consulted in Cultural Examination

Author	Bibliography Date	Primary/Secondary	Date of Source Material (ca.)	Group
Coming Day	1935	Primary	1935	Cree
Curtis	1970a	Primary	1907-1930	Assiniboine
Curtis	1970b	Primary	1907-1930	Blackfoot
Cuthand	1990	Primary	1990	Cree
Dawson and McConnell	1880s	Primary	1884	Blackfoot
DeMallie and Miller	2001	Secondary	Various	Assiniboine
Dempsey	1972	Secondary	Various	Blackfoot
Dempsey	1994	Primary	1950s	Blackfoot
Dempsey	2001	Secondary	Various	Blackfoot
Denig	1961	Primary	ca. 1854	Assiniboine
Denig	2000	Primary	ca. 1854	Assiniboine
Dusenberry	1962	Primary	1950s	Blackfoot
Ewers	1955	Secondary	Various	Assiniboine
Ewers	1958	Primary/Secondary	1950s	Assiniboine Blackfoot
Ewers	1968	Secondary	Various	Assiniboine
Fine Day	1934a	Primary	1934	Cree
First Rider	1970	Primary	1970	Blackfoot
Flannery	1957	Primary	1938-1948	Gros Ventre
Frantz and Russell	1995	Primary	1995	Blackfoot
Gambler	1968	Primary	1968	Blackfoot
Grinnell	1892	Primary	1890s	Blackfoot
Grinnell	1920	Primary	1920	Blackfoot
Handley	1973	Primary	ca. 1973	Assiniboine
Harper	1973	Primary	1973	Cree
Hind	1859	Primary	1859	Cree
Hungry-Wolf	2006	Primary	1911	Blackfoot
Jenish	1999	Secondary	Various	Blackfoot

Table 4.1 – Summary of Sources Consulted in Cultural Examination Continued

Author	Bibliography Date	Primary/Secondary	Date of Source Material (ca.)	Group
Kennedy	1961	Primary	ca. 1942	Assiniboine
Kidd	1986	Primary/Secondary	Various	Blackfoot
Kroeber	1908	Primary	1908	Gros Ventre
Lowie	1909	Primary	1907	Assiniboine
Lowie	1960	Primary	1907-1913	Assiniboine
Mandelbaum	1979	Primary	1936	Cree
Martin	1967	Primary	1967	Blackfoot
McMillan and Yellowhorn	2004	Secondary	Various	Blackfoot
McClintock	1968	Primary	1886	Blackfoot
Miller	1987	Primary	1976-early 1980s	Assiniboine
Montana Historical Society Press	2003a	Primary	2003	Assiniboine
Montana Historical Society Press	2003b	Primary	2003	Assiniboine
Osecap	1974	Primary	1974	Cree
Peters and Noble	2007	Primary	2000s	Various
Peters et al.	2006	Primary	2000s	Various
Rodnick	1938	Primary	1935	Assiniboine
Scribe	1997	Primary	1997	Cree
Siemens	1986	Primary	1983	Assiniboine
Snow	1977	Primary	1977	Assiniboine
Thompson	1962	Primary	1784-1812	Blackfoot

a common history of residing within the study area prior to Eurocanadian contact, the organization of each of these groups varies, depending upon their political structure and alliances. Defined by Bonnichsen and Baldwin (1978), groups can be seen to fall within two categories. The first of these, Autonomous Bands, is comprised of the Plains Cree and Assiniboine. These communities consist of populations of 30 to 50 individuals within an open political system where authority was invested in a leader within the community. In contrast are Integrated Bands, such as the Blackfoot and Gros Ventre, who have a more hierarchical leadership structure. Due to the establishment of political affiliations between Autonomous Bands, a higher level of leadership is required in the form of a tribal organization with a central chief, band leaders, and a policing group with responsibilities to this body of authority. This power structure comes into play whenever bands within this affiliation meet for hunting or ceremonial activities. Otherwise, individual groups operate in much the same manner as Autonomous Bands (Bonnichsen and Baldwin 1978:19-20).

4.3.1 The Blackfoot Confederacy

Using archaeological and historical literature, the Blackfoot Confederacy is seen as being the group that has shifted the least across the boundaries of this study area. This political and cultural alliance consists of three groups: the Kainai, the Pikani, and the Siksika (Blackfoot Gallery Committee 2001:2-3). Collectively, they are the *Nitsitapii*, or "the people". Based upon the oral accounts of Elders, the borders of the *Nitsitapii*, existing since time immemorial, are marked by significant geographic features: the North Saskatchewan River (*omaka-ty*) in the north, the Yellowstone River (*ponokasis-'ughty*) in the south, the Rocky Mountains (*mis-tõkis*) in the west, and the Great Sand Hills (*omaxi-spatchikway*) in the east. This definition is reinforced by primary historical documentation in the form of first-hand accounts and governmental reports, which themselves relied upon *Niitsitapi* accounts recorded at the time. Using these accounts, it is possible to further delineate the eastern boundaries of the *Niitsitapi* based upon geographic features, with the border marked by the Dirt Hills on the Missouri Coteau, the Elbow of the South Saskatchewan River, the Ear Hills, and the Neutral Hills. From a qualitative perspective, the territorial boundaries drawn from these historical and oral accounts are closely mirrored by those created by archaeological studies examining projectile points and pottery (Peck and Ives 2001), *iniskim* (Peck 2003), anthropomorphic boulder effigies (Vickers 2003; Vickers and Peck

2009), and rock art styles (Klassen 2003) that have been affiliated with Old Women's phase, believed to represent ancestral *Niitsitap*i groups (Oetelaar and Oetelaar 2006:376-381; Oetelaar and Oetelaar 2011:70-72). From linguistic evidence, it is suspected that this Algonkian-speaking group, including others such as the Gros Ventre and Cree, originated in southern Ontario in approximately 4000 BC before migrating into the Northern Plains in different periods (Binnema 2001:74*)*.

4.3.1.1 Pre-1950 Oral and Ethnographic Blackfoot Accounts

With regards to specific usage and perceptions of dune environments, in all early Blackfoot accounts of sand hills, they are referred to as a place where spirits of the deceased reside. In his recounting of Blackfoot oral history, Grinnell (1920) frequently mentions sand hills in a number of contexts. Of primary importance is that he provides us with the Blackfoot perspective that views them as the shadow land, a place of ghosts, and the future land for the Blackfoot (Grinnell 1920:62). Within other accounts, deceased individuals are referred to as having "… gone to the Sand Hills" (Grinnell 1920:62, 94). Within the context presented, the Sand Hills are the sand dune areas that are present on the physical landscape, and do not solely exist on a spiritual plane. This is witnessed through two different aspects found within Grinnell's accounts: the journey to the Sand Hills and the potential to visit the dead in the area.

According to Grinnell, after dying the spirit must undertake a journey to the Sand Hills, much like a living individual who is traveling across the landscape. Individuals who have died are referred to as being "on the road" (Grinnell 1920:44). This aspect of travel to a specific, physical point on the landscape is reinforced by the fact that living individuals can also travel to and visit the Sand Hills. Based on the accounts "Origin of the Worm Pipe" and "The Ghosts' Buffalo", it can be concluded that the Sand Hills are both an environment that can be traversed and used like any other landscape feature, as well an area where individuals can encounter and interact with the deceased, their possessions, and the spiritual environment in which they live. In the first account, a husband makes a physical journey to the Sand Hills to look for his recently deceased wife. With the assistance of deceased relatives, he was able to retrieve his wife from the ghost camp in the hills, although physical interaction with the dead was only possible while he was asleep and dreaming (Grinnell 1920:127–128).

In the second account, “The Ghosts’ Buffalo”, a group of Blackfoot warriors travel through the Sand Hills on their way home from conducting raids on the Cree. During their journey, the young men encountered the sounds of daily life in a ghost camp, although no individuals were seen, in addition to finding personal objects belonging to their deceased parents that were interred with them (Grinnell 1920:132–133). This practice of interring objects the deceased would need in the both the afterlife and for the journey to the Sand Hills was common (Kidd 1986:63). These objects could be removed from the Sand Hills with varying consequences for those who took them. One individual, who removed a stone maul and dog travois, died along with his horse immediately upon returning to his camp. This death was attributed to “the shadow of the person who owned the things was angry at him and followed him home” (Grinnell 1920:133). Two individuals who took objects belonging to their fathers, such as stone and metal arrow points, lived long lives. In both of these cases, their long lives and ability to heal after being seriously injured was attributed to the medicine of their father’s possessions (Grinnell 1920:133-134). A fourth individual discovered an *iniskim*, or a stone shaped like a buffalo that is regarded by the Blackfoot as the focus of sacred power (Forbis 1960:163; Peck 2003:147; Reeves 1993:194; Vickers and Peck 2009:491). This individual obtained from the *iniskim* the ability to make medicine and call buffalo during hunts (Grinnell 1920:134).

Also encountered on their journey was the vision of the father of one of the men. The ghost was witnessed in the process of driving buffalo into a pound while on horseback and butchering one of the buffalos that he had killed. By the time that the group of warriors reached the area where the buffalo had been killed, the man’s father had ridden away. No bison remains were found at the location, although it is at this time that the projectile point belonging to the man’s father was discovered (Grinnell 1920:133).

Within these narratives, the Sand Hills are viewed as not only being an area with supernatural connections, but as an area that physically exists that the living can access. A similar perspective on sand dunes was also recorded by Blackfoot groups residing outside of Alberta and Saskatchewan. While among a Blackfoot group in northwestern Montana in 1903, McClintock (1968) documented oral history he was told during the period when a tribal member had passed away. He related that the Sand Hills were perceived as being a cheerless, alkali landscape surrounded by quicksand and occupied by the ghosts of both people and animals, who lived as they did when they were alive. In relation to where this Blackfoot group resided, the

Sand Hills were located towards the east, and could be reached by following the Crow Lodge River (McClintock 1968:144, 148). Being surrounded by quicksand, it was not possible for the living to enter the area, although ghosts could leave the Sand Hills for periods to return to familiar landscapes in the world of the living. These ties to the living world exist from the first moments after death, as spirits do not immediately begin to travel to the Sand Hills. Instead, they go through a transition period where they linger among familiar locations and individuals for several months until they have become accustomed to their new environment (McClintock 1968:144).

Ghosts could also return to the land of the living through the disturbance of their graves. McClintock (1968) reports one account where a ghost harassed an individual over the course of an evening while he was encamped near the stump of a recently felled tree. Upon inspecting the area in the morning, the individual found skeletal remains near the fallen branches of the tree and concluded that the tree had served as a scaffold burial for the spirit that had been accosting him. When the burial was destroyed by the collapse of the tree, the spirit of the individual placed there was disturbed as well (McClintock 1968:146–148).

Also documenting Blackfoot groups in northern Montana and southern Alberta at this time was Edward Curtis, who mentions briefly Peigan perceptions of death and the afterlife in his work, *The North American Indian* (1970, originally published in 1911). As with other accounts noted above, the Sand Hills or Big Sand (*Ómah-spaflikuyi*) is viewed as being the area to which spirits journeyed after death. His account identified the sand dunes as the Big Sand, which was located near the Sweetgrass Hills in northern Montana. The afterlife here was considered to be similar to the life that is being left behind, although it would contain abundant game and no personal suffering (Curtis 1970b:155). Also dating during this period is a 1911 diary account of a conversation between Wilhelmina Maria Uhlenbeck-Melchior and White Man, a Blackfoot elder in Montana. In it, he recounts his sister who "is at the Sand Hills, where the buffaloes are not scarce & all of the Indians are gathered" (Hungry-Wolf 2006:1430). Although making no mention of the Sand Hills being the area where spirits reside, David Thompson also reiterated these afterworld aspects of plentiful game and no suffering found among the Peigan. However, his account differs from that of Curtis in that Thompson stated that how people conducted themselves in life played a role in what degree of comfort individuals encountered after dying, with those who did misdeeds during their lifetime left to wander in eternal darkness (Thompson 1962:264).

Also contained within oral histories from this period are specific place names for dune areas within the study area. Documented by Dawson and McConnell (1884) these names were largely obtained from surveyors John Nelson and A.P. Patrick during their work in what is now southern Alberta and Saskatchewan (Kennedy 2014:10). Named areas in this work include the Middle Sand Hills (*sitoko'-spatchikway*) between the Red Deer and South Saskatchewan Rivers, and the Drifting Sand Hills (*kasapō-spatchikway*) above Blackfoot Crossing on the Bow River (Dawson and McConnell 1884:163).

4.3.1.2 Post-1950 Oral and Ethnographic Blackfoot Accounts

In several primary and secondary accounts from this period, such as Dempsey (1972, 2001), Ewers (1958), and First Rider (1970), the connection between sand hills and the deceased is made only in passing when discussing other events or subjects. However, this is not the case with all sources, with several works speaking of dunes as areas where the spirits of the deceased reside. First of these is the account of "Scraping High and Mr. Tims" as related by Dempsey (1994). In this account, the son of Scraping High (*Atsa'oan*), a Blackfoot tribe member, is dying of scrofula after being sent to a missionary boarding school in 1985. On his deathbed, he tells his father that he will be waiting for him at the Big Sand Hills, which are located to the east (Dempsey 1994:186-197).

A second modern oral account that sand dunes are viewed as being an area where the spirits of the deceased reside, is the "History of the Shaggy Covered and Arapahoe Medicine Pipe". Recorded by the Provincial Museum and Archives of Alberta in 1968, informant Joe Gambler of the Blood Reserve at Cardston recounts how one man lost his wife. To console his young son, he traveled to the "big sand hills" to retrieve his dead spouse (Gambler 1968).

As in the early accounts recorded by McClintock (1968), accounts recorded by Jenish (1999) list an actual geographic location for the Sand Hills provided by his informants. In the account of a raiding party returning from Crow territory after the loss of several members, *Astohkomi* (Shot Close) describes the Sand Hills as an arid and desolate area east of the confluence of the Red Deer and South Saskatchewan Rivers, beyond the eastern edge of Blackfoot territory. Once there, the spirit would find a peaceful afterlife where it would meet old friends, ride horses and hunt buffalo (Jenish 1999:67-68).

A more recent account of Blackfoot spirituality and the afterlife as it relates to dunes is found in a regional history for the Gleichen area of southern Alberta. Working around the Gleichen area, Martin (1967) recorded a number of Blackfoot oral accounts, including those pertaining to the Sand Hills. As in previously mentioned works, he recorded that the Sand Hills, or "*Spotsa-Kuitapo*", were regarded as being the area that spirits went to after death. Upon arrival, the spirits again took on a physical human form in what he described as "an earthly realm". Once in this physical form, individuals were able to resume activities that they did in life, such as hunting, although these activities took place not on the Sand Hills, but underneath them in large caves and tunnels (Martin 1967:75-76).

Martin also offered an eyewitness account of Blackfoot burials in sand dunes around Gleichen. Removed in 1918, these burials consisted of numerous death lodges dating from an unknown period, although Martin, who last observed them standing in 1912, stated that they were considered to be quite old. This account is notable, as it is the only written record that mentions that burials were specifically placed in dune areas in great number. Based upon the descriptions and maps supplied by Martin, the dunes containing the burials are either the Gleichen Sand Dunes or the Rosebud River Sand Dunes (see Wolfe 2001).

A modern examination of Blackfoot spiritual beliefs is provided by McMillan and Yellowhorn (2004) in their summary of First Nations cultures across Canada. As with other accounts given here, they solidify the concept of the Sand Hills being the entrance to the spirit world. This region is described as being along the eastern frontier of Blackfoot territory, and consists of a bleak and sandy area, beyond which is a bountiful region where people could resume their normal customs. They also report that a giant bison, which only allowed the spirits of the dead through, guards the boundary of this afterlife. In cases where the spirits of the injured strayed too close to the Sand Hills, the bison would chase them back to their physical bodies (McMillan and Yellowhorn 2004:155).

In addition to ethnohistorical data, there exists within the Blackfoot language itself strong evidence for the varied role that dune areas played in their lives. In modern translations, the Blackfoot word for the hereafter (*ómahksspatsiko*) also refers to the geographic feature of sandhills or a desert (Frantz and Russell 1995:160).

4.3.2 The Gros Ventre

Although no longer occupying the study area, Gros Ventre oral histories are significant to this work, as the Gros Ventre were allied with the Blackfoot Confederacy at the time of European contact (Grinnell 1892:153). This alliance existed until 1867, at which time the Gros Ventre entered into conflict with the Blackfoot along with the Crow (Pritzker 2000:319). When they entered into this alliance with the Blackfoot is unknown, though close social relationships between the two in 1772 are recorded in the journals of Matthew Cocking, the first definite mention of the Gros Ventre in historical literature (Cocking 1908:110-111; Fowler and Flannery 2001:677). It is possible that this relationship existed prior to European contact; with Gros Ventre groups making a material contribution to what archaeologists define as Old Women's phase in Saskatchewan and Alberta (Binnema 2001:75). Other researchers however, make connections between the Gros Ventre and Mortlach assemblages found on the Northern Plains (Kehoe and Kehoe 1968:34; Nicholson et al. 2011:156; Wettlaufer and Mayer-Oakes 1960:106-107).

Currently located on the Fort Belknap Reservation in north central Montana, the Gros Ventre can trace their origins, along with Arapaho and Cheyenne groups, to northwest Minnesota and the Red River Valley in Manitoba. Reacting to expansion pressures from the Ojibwa, these groups migrated into Montana, with the Gros Ventre splitting into two tribal groups (Fowler and Flannery 2001: 677; Pritzker 2000:319). The northern group, occupying a territory of varying size in southwestern Saskatchewan between 1700 and 1850, were known as the "Fall Indians" or "Rapid Indians" due to their association with the Forks region of the Saskatchewan River. By 1850, the Gros Ventre were almost entirely displaced into northern Montana and North Dakota (Binnema 2001:75; Magne 1987:224-231).

4.3.2.1 Pre-1950 Oral and Ethnographic Gros Ventre Accounts

What accounts exist that reference Gros Ventre beliefs and perceptions of sand dunes are all recorded within the pre-1950 period. Within Gros Ventre oral histories recorded during this time, dune areas feature prominently in early records examining the afterlife. Within ethnohistorical accounts from Montana recounted by Flannery (1957) and Kroeber (1908), informants describe the "Big Sand" (*ba:snabe* or *basnable*), where the spirits of the deceased travel to, as being a barren and desolate area located to the north of their present location. In the account of a man who was said to have died and come back, his spirit is said to have traveled at least as far north as the Cypress Hills (Kroeber 1908:276). In a second narrative, a sacred drum dance recorded by Flannery described a conflict between the Gros Ventre and Peigan, with the Drum Dancers showing their courage by facing towards and pointing at the north, where both the Big Sand and the afterlife lodge of the Drum Dancers were located (Flannery 1957:8, 225-226).

4.3.3 The Plains Cree

Like the Gros Ventre, the Plains Cree are a cultural group that migrated into the Northern Plains region, in this case from their traditional woodland territories in Eastern Canada. When this movement first occurred however, is subject to some debate, with two distinct schools of thought emerging. Early scholarship thought that the Cree, who originated in the woodlands along the shores of Hudson and James Bay, migrated west as middlemen with the expansion of the fur trade, and the subsequent decrease in game animals due to overhunting. Due to their easy access to European firearms, they were able to displace indigenous groups along their western borders starting around AD 1763 (Mandelbaum 1979:261-263; Milloy 1988:5; Ray 1995:19). By the time of European colonization in Western Canada in the late 19th century, the Cree occupied lands from Hudson Bay to Fort Edmonton. This change in geography is also thought to have fostered a behavioural change as well, with the most westerly groups modifying their woodland subsistence practices to ones more suited for survival on the open plains. This adaptation is also seen in other aspects of Cree cultural behaviour as they established their sense of place within the Northern Plains ecoregion, most notably within spiritual beliefs. Traditionally a polytheistic group within the boreal forest, once they established themselves within the southern grasslands this belief system shifted to a monotheistic one, with the buffalo being central to their cosmology much like Blackfoot system of belief. This shift can be attributed to the role that religious and spiritual beliefs play within hunting practices. As the importance of the multiple boreal forest species diminished, and the role of bison in subsistence practices increased, afterlife beliefs altered to reflect this new cultural perspective (Milloy 1988:25, 1991:62-63).

This theory of recent migration has been challenged, however, by both historical and archaeological research. Using historical documents, Russell (1988, 1991) examined the issue of westward Cree migration into Saskatchewan and Alberta and concluded that there are little data to support this position. These assertions are based on several lines of evidence, including a critical historiography of the concept of Cree western migration. He concluded that all evidence for a recent migration stems from the 1801 journals of Alexander Mackenzie (Russell 1988:137, 1991:213), an individual who is better known for his Arctic travels than his writing on the Plains. Further, he cites the account of Saukamappee, a Cree elder who was adopted by the Peigan as a child, who was interviewed by David Thompson in 1787. Within Saukamappee's narratives of life on the Plains during the early 1700s, he recounts how the Cree and Blackfoot not only were in contact on the grasslands, but also maintained a peaceful relationship. One story given to Thompson describes how Saukamappee and the Cree participated in a Blackfoot battle with the Snake Indians near the Eagle Hills (Russell 1988:137). This tenuous peace between the Blackfoot and Cree is seen as existing until at least 1794 (Binnema 2001:130).

Further evidence for a pre-19th century Cree presence in the study area is provided by Dargin's (2004) and McLeod's (2007) research on Plains Cree cultural narratives. Examining oral histories, Dargin (2004) found that Cree and Nakota groups on reserves within western Saskatchewan and eastern Alberta had both traditional names and established historical narratives connected with geographic features and landscapes within the current study area. He concluded that these specific locations were given unique names because of their importance to Plains Cree groups, and therefore reflects an intimate relationship with the landform that predates the historic period. Additionally, he noted that a further study of these relationships was possible with the dataset he collected from elders but was not conducted due to the sacred nature of the information (Dargin 2004:109-110). With regards to specific locations mentioned, of interest to this work are the descriptions of Sounding Lake (*nipiy-kâpitihkwek* - "the water which makes a noise") and Eyehill Creek (*oskîsikowacihk sîpîsis* - "at eye hill creek"), which are situated adjacent to the FaOm-1, or the Bodo Bison Skulls Site (Dargin 2004:103-104). One unconfirmed account from non-First Nations sources of why the lake has this name can be found in an *Edmonton Bulletin* article from 1919 on the Neutral Hills stampede. It provides an account of how the lake was the source of unidentified sounds that were believed to be coming from buffalo living on a subterranean plain beneath the lake. Fleeing there to escape overhunting, it is said that these animals will return to the surface when man desists in the large-scale slaughter of the buffalo (Edmonton Bulletin, June 27, 1919 edition).

These conclusions on Cree landscape perception and cultural connection are also reiterated by McLeod in his work with family elders of the Thunderchild Reserve near

Turtleford, Saskatchewan. In similar fashion to Basso (1996), he detailed the close relationship between landscape and group cultural narrative, as reflected by place names, through a large portion of the province. He deemed this narrative as "spiritual history", as reflected through the Cree language itself, and posits that it stands in opposition to the Western conception of linear time (McLeod 2007:17-18). With regards to associations with specific dune environments and associated locales, he stated that members of what is now the Thunderchild Reserve traditionally have very close ties to *nipiy kâ-pitihkwêk* or Sounding Lake. This relationship is so intimate that despite the fact that their reserve is located over 160 km to the northeast, the name that they gave their reserve (*kâ-pitihkonâhk*) translates to "The Land of the Sounding Lake People" (McLeod 2007:24). Also offered by McLeod is an alternative explanation for the sacred nature of Sounding Lake. In this account, it is not buffalo herds that escaped overhunting that causes the sounds heard at the lake, but a thunderbird that was dragged below the surface of the water by a snake (McLeod 2007:25).

Archaeologically, there is also evidence that the Cree were within Western Canada earlier than previously thought. Research near Nipawin, in central Saskatchewan, has unearthed pottery sherds that may indicate the presence of Cree peoples within the Northern Plains during the Late Precontact period. Classified as part of the Clearwater Lake complex, this material is considered to be part of the Selkirk Ware Composite and was produced by Cree groups during the Late Precontact and early Historic periods (Brink 1986:50-51; Meyer 1981:27; Syms 1977:108). Based upon this evidence, it is now more readily accepted that Cree groups were present within the study area prior to European contact and the expansion of the fur trade throughout the Northern Plains region.

4.3.3.1 Pre-1950 Oral and Ethnographic Plains Cree Accounts

Cree oral histories and traditions associated with dune areas recorded prior to 1950 differ from that of the Blackfoot and Gros Ventre in that they make no mention of these areas being associated with the afterlife. Rather, they focus upon these regions as being where the "little people with no noses" (*memekwesiwak* or *memegweciwuk*), reside. Mentioned most commonly within Plains and Boreal Forest Cree mythology these supernatural beings, who live within dunes, rivers, and bodies of water, are viewed as being largely benign, with the ability to act as spiritual helpers who could also grant powers. Oral traditions also recount how these beings made the arrowheads that are found within dune environments, and often traded these items with humans in exchange for meat and hides (Mandelbaum 1979:178-179). One account provided by informant Coming Day, recorded by Mandelbaum in 1935, described how one individual named Well-Dressed-Man encountered the beings within sand hills located south of present-day Unity, Saskatchewan. Described as having hollow eyes and snout-like mouths, one of them challenged Well-Dressed-Man to a wrestling match for a white wolf skin that they owned. Losing to the human, the little person gave them an arrow-shaped stone, named *pekpekaha*, that would prevent the owner from being killed and would heal both him and his friends (Coming Day 1935; Mandelbaum 1979:178-180).

While the majority of accounts related to Plains Cree dune perception and usage are in connection with the *memekwesiwak*, oral and written accounts also detail the use of sand dunes for subsistence purposes. Usage of sand dunes for pounding activities was recorded by Hind (1859) in his travels between the Qu'Appelle Valley and South Branch House. Camping with a Plains Cree group near the fork of the Qu'Appelle and South Saskatchewan Rivers, Hind provided a detailed description of the remains of a buffalo pound in sand hills used by the Plains Cree a week prior to his arrival. Measuring 120 feet across and constructed of tree trunks with branches laced between them and outside bracing present, it contained the remains of an estimated 200 bison. Leading up to the structure were what Hind calls "dead men", or a lane of tree branches used to guide herds into the pound structure. Hind depicted the scene as "dreadful and sickening" due to the overpowering smell, the presence of "millions" of flies, and the number of rotting buffalo carcasses (Hind 1859:55). The day after visiting this location, Hind witnessed a second buffalo pound in operation in the sand hills, approximately one-half mile from the first, which had been abandoned due to its condition. During this period the Plains Cree met with Métis and requested that they cease hunting bison on Cree territory during the winter months. All of these events took place around the period of July 29-30, 1858 (Hind 1859:55-56).

A second narrative providing indirect evidence of sand dune usage for pounding purposes is found in oral accounts recorded by Mandelbaum in 1934. Provided by Fine Day, a Cree informant from the Sweet Grass reserve, it provides a detailed account of the construction of a buffalo pound north of the North Saskatchewan River. Established by an individual named *ciki-tumya* (Skunk Skin), it was named Sand Pound. Fine Day recounts the construction and use of this pound occurring within a brush covered area during the winter months. To construct the pound, brush is cleared from the interior of the pound, with the exception of one or two intact trees in the centre, called *kis-kas-ta-gau*. The structure of the pound is built through lashing thin logs to standing trees, with an inclined entry ramp built of sticks and logs. This gateway would also contain a buffalo skull that faced inward towards the pound. Outside the pound a large tipi would be constructed for Elders to live in for the entire duration that the pound was in use. This tipi would contain a single fireplace, as well as a buffalo skull and offerings of cloth and bowls filled with berries. Fine Day also stipulates that pounds were always made with the opening facing east, and were never made in the south, as that area did not contain any brush for construction (Fine Day 1934a).

4.3.3.2 Post-1950 Oral and Ethnographic Plains Cree Accounts

Within modern accounts of sand dunes and the *memekwesiwak*, in addition to further narratives on the production of arrowheads, one relevant aspect that emerges is the role that these beings play within the transmission of medical knowledge to humans (Scribe 1997:4). In accounts recorded by Meyer (1971), Jensen et al. (1968), and Dusenberry (1962) with Cree informants, it is mentioned that medical skills and medicinal plant usage could be obtained from these beings. This occurred through dreams, where individuals visited the *memekwesiwak* where they reside. In exchange for gifts of tobacco, beads, brooches, and necklaces, they would provide medicinal plants. Within Jensen et al. (1968), the informant also stated that they did not know of anyone who still obtained medicine in this manner. Although friendly, they could run away from humans when heard or approached by them. As well, they were known to play tricks on individuals who are non-believers (Cuthand 1990:197; Dusenberry 1962:161; Harper 1973; Jensen et al. 1968; Osecap 1974; Scribe 1987:4).

4.3.4 The Assiniboine

A Siouan group that moved onto the Northern Plains, the origins of the contemporary Assiniboine stem from the woodlands of Minnesota, where historically they were closely associated with the Yanktonai Dakota. At some point prior to 1640, they broke off from this group and migrated to the Lake Winnipeg region, with the Stoney separating from this group at a later time and finally settling in the eastern slopes region of Alberta. While some sources place these separations as occurring during the 17th and 19th Century, other studies suggest a much earlier date for these occurrences. In his examination of Mortlach pottery, Walde (2003) asserts that this ceramic phase most likely represents an Assiniboine presence in the interior of Western Canada that predates written records. Drawing upon the distribution of Mortlach ceramics and on the Northern Plains, the works of Russell (1991) examining historical records, and lexicostatistics as presented by Syms (1991) and Springer and Witkowski (1982), he contends that there is ample evidence to suggest that Assiniboine groups were present within the Northern Plains prior to European contact. From a territorial standpoint, the distribution of Mortlach cermaics, which date to ca. 1500 AD to European contact, matches closely to historical Assiniboine boundaries (Walde 2003:62-73). Historical evidence that places group separation from the Sioux during the 17th Century, at which time they migrated west, can be attributed to the narrative European writers "discovering" the interior of Northern Plains, and not to any large-scale migration of cultural groups. Further, Walde contends that the origin story related to why the Assiniboine split from the Yanktonai Sioux that was recorded by the Jesuits (a dispute over buffalo carcass division) can be found within other groups, including the Crow. As such, he feels that it can be viewed as being apocryphal. Linguistically, Walde (2003) states that lexicostatistical studies suggest that separation between the Assiniboine and Yanktonai languages occurred at approximately 1500 AD, with division between the Stoney and Dakota groups occurring earlier at 1200 AD (DeMallie and Miller 2001: 572; Walde 2003:73-74).

Of note to Walde's conclusions on Assiniboine origins, further research into Assiniboine oral histories for this work found documentation of this origin story, in addition to a second possible cause for the dispute. Found in Kennedy (1972), it recounts how Yanktonai split as a result of a warrior from a prominent family seducing and taking away the wife of another powerful group member. When confronted by the husband the warrior murdered the man, in doing so forfeiting his life to the deceased man's relatives. Before the relatives could kill the warrior, they were attacked and killed by individuals loyal to the murderer. This resulted in an escalation of hostilities between the factions, resulting in scalps being taken, which for the Assiniboine signaled a conflict that can only result in extermination. To escape hostilities, the smaller group, consisting of potentially 1,000 lodges, fled to the north to seek alliance with the Cree in the Lake Winnipeg area (Kennedy 1972:9).

What can be determined from written records is that the Assiniboine established alliances with the Plains Cree within the Northern Plains, where they abandoned much of their Woodlands traditions to adopt Plains subsistence patterns and cultural practices. With the Cree, they were engaged in conflict with both the Blackfoot Confederacy to the west and with their Dakota relations to the south. Territory for the Assiniboine was within southern Saskatchewan and southwestern Manitoba, with evidence to suggest that they extended as far west as to be able to see the Rocky Mountains. In contrast, the Stoney migrated into Blackfoot Confederacy territory, establishing territory for themselves in the eastern slopes of the Rocky Mountains, with historical accounts potentially placing them on the Saskatchewan River and in central Alberta (Binnema 2001:78; Curtis 1970a:127; DeMallie and Miller 2001:573; Getty and Gooding 2001:596-597; McMillan and Yellowhorn 2004:159; Rodnick 1938:1; Russell 1991:181; Walde 2003:72).

To determine if sand dunes played a culturally significant role in the lives of the Assiniboine, a wide body of literature was consulted. Foremost among these are the major ethnographic works produced on the group during the latter half of the 19th and early 20th centuries by Denig (1961, 2000) and Lowie (1909, 1960), who examined Assiniboine populations on the Upper Missouri and in Morley, Alberta respectively. Also dating from this period is Curtis (1970a), who provides a brief ethnographic and historical outline based upon his travels though the Plains region. Further field studies were carried out by Rodnick (1938) in 1935 in the Fort Belknap area for his dissertation examining Assiniboine culture change since their resettlement onto the reserve. Additional works that were examined include the works of Ewers (1955, 1958, 1968), who conducted fieldwork with the Assiniboine and other Plains groups in Montana in the 1950s. Of these, only one (Ewers 1955) focused largely on the Assiniboine, while the other two broadly examined this group in relation to other Plains groups, with a primary focus on the Blackfoot. All available oral histories were also consulted (Handley 1973, Kennedy 1961, Kennedy 1972, Montana Historical Society Press 2003a, Montana Historical Society Press 2003b, Snow 1977) which provided accounts acquired from Assiniboine groups in Montana, Saskatchewan, and Alberta. Current oral history and cultural perceptions were examined in the work of Siemens (1986), who examined Assiniboine health beliefs on the Fort Belknap reservation. Lastly, the recent works of Miller (1987) and DeMallie and Miller (2001) were examined, with the former looking at Assiniboine cultural identity and renewal on the Fort Peck reservation, with the latter providing an overview of Assiniboine history and culture as part of the Smithsonian *Handbook of North American Indians* series.

After an extensive review of these works, which form the bulk of current ethnographic and detailed historical analysis of the Assiniboine, it was found that no mention or reference to dune environments was present. It is recognized that this lack of information with regards to a specific landscape feature may be a result of a lack of primary and secondary sources on Assiniboine culture. Within a historical context, it has been recognized that the majority of references and descriptions of First Nations groups during the Fur Trade period examine Cree groups, due to their role as middlemen (David Meyer, personal communication, 2018). As such, information on the groups that the Cree interacted with, such as the Assiniboine, are lacking in comparison, with observations made only when traders physically ventured out to visit or interact with these communities. Further, Russell (1991) contends that the lack of early historical descriptions on the Assiniboine stems from a lack of interest on the part of French missionaries present on the Northern Plains who wrote many of first documents on First Nations groups. Despite being within the region as early as 1640, few mentions of the group was made, as it was seen as more productive to work with the larger, more sedentary agricultural groups to the south than with the smaller, nomadic Assiniboine (Russell 1991:50). These perspectives are also reiterated by Miller (1987), who contends that at the time of writing of his dissertation that no comprehensive history of all branches of the Assiniboine and Stoney peoples has yet to be compiled (Miller 1987:45).

The lack of references to sand dunes in Assiniboine oral histories and ethnographies can also be attributed in part to the geographic locations of the groups who are the focus of these works. For several sources examined (Miller 1987, Snow 1977), the groups are identified as Stoney, and reside on the eastern slopes of the Rocky Mountains. Breaking off from the Assiniboine within Saskatchewan and migrating west sometime between 1200 and 1700 AD, this group both considers themselves still related to the Assiniboine. This belief is recognized by other groups, such as the Plains Cree and Ojibwa, who refer to the Assiniboine and Stoney by the same group name although others, such as the Crow, distinguish between the two (Getty and Gooding 2001:602). Cultural differences between the two, despite their shared origin and identity, likely stems from the Stoney's migration into the eastern slopes area. As stated earlier, it has been observed that cultural groups who entered new areas can adopt pre-existing perceptions of the sacred from other local groups (Sundstrom 1996:187-188, 2003:283-284). Within the oral history provided by Snow (1977), he states that the Rocky Mountains are sacred to them, being the location where they went to worship, conduct ceremonies, and bury their dead (Snow 1977:13). This belief system can be seen to mirror more of Blackfoot traditional beliefs, in particular those associated with *Ninaistákis* (Chief Mountain), as opposed to those of the other Plains groups examined in this work that have had less physical contact with montane regions (Reeves 1994:272). Evidence of this occurring on the Plains has been observed with the Blackfoot, Cheyennes, and Crow all possessing sacred interpretations of the Moose Mountain Medicine Wheel, as well as at the Bighorn Medicine Wheel, which the Poncas also conducted pilgrimages to (Howard 1965:18; Schlesier 1987:84-87). This adoption of new beliefs can also take place outside of identification with specific geographic features, with Plains Cree groups adopting a monotheistic worldview in response to their shifting subsistence focus from one that relied on multiple species to almost exclusively bison (Milloy 1991:62-63). As such, the absence of dune environments from any summary of cultural landscape may be attributed to an adoption of pre-existing regional beliefs that occurred after the Stoneys undertook their westward migration centuries before.

With this said however, the fact that no mention of sand dunes is made in the larger ethnographic and historical assessments of the Assiniboine groups on the Plains cannot be ignored, given that these landscapes figure prominently in accounts from other contemporaneous groups who lived alongside them on the open, non-montane Northern Plains. Within Blackfoot, Gros Ventre, and Plains Cree accounts and histories, frequent mention of sand dunes in relation to hunting practices and spiritual beliefs are made. Absence of mention within similar studies for Assiniboine groups cannot solely be attributed to a lack of literature on the subject, as these topics have been well-documented and examined by Denig (2000), DeMallie and Miller (2001), Lowie (1909), Rodnick (1938), and Kennedy (1961). In describing hunting methods, the Assiniboine were noted as being prolific buffalo pounders in numerous sources (Ewers 1968:162; Kennedy 1961:100; Lowie 1909:10; MacEwan 1969:24; Rodnick 1938:23). In detailed descriptions of how landscapes are used, and pounds constructed during hunts however, no mention is made of using dunes. Rather, records indicate that the preferred landscapes for hunting activities was sloping declining ground, timbered creek ravines with steep sides, or coulees, within which pounds were constructed. If on the open prairie, eroded creek beds, also containing timber for construction, were selected (Kennedy 1961:100; Rodnick 1938:23). Also mentioned is an alternate form of pound construction when not within ravines, where lodges were placed in a circle and the opening flaps stitched together to form a wall. During the hunt, one end of this structure was left open until the buffalo herds were driven into it, at which point the open end was closed. It is recorded that this type of trap was constructed, and a hunt conducted at the bequest of the Sioux, who were starving and requested assistance from a noted Assiniboine medicine man. This type of structure construction is also recorded as being used in conjunction with ravines to create a hunting enclosure (Kennedy 1961:104-105). Further, within detailed information on the construction of a buffalo pound on the Assiniboine reserve south of Sintaluta, Saskatchewan, no mention of dune environments being used was made. This oral account given by reserve resident Dan Kennedy, recorded in 1940, provided information on the construction, dimensions, and spatial layout of the pound and other structures, as well as on the organizational practices and rituals associated with the hunt (Weeks 1948:14-16).

Additionally, given the identification that sand dunes have with spiritual and mythical aspects of other Plains groups, it is significant that again no mention of these landscapes are made in any oral histories of the Assiniboine. These accounts are diverse in nature, covering topics such as the creation of the world, the origin of seasons, the creation of stars and constellations, ghosts and the afterlife, and narratives of proper behavior, (see Handley 1973, Kennedy 1961, Kennedy 1972, Montana Historical Society Press 2003a, and Montana Historical Society Press 2003b). In spite of this broad focus, no mention of sand dunes was made at any time. In regard to landscape connections with the afterlife, accounts of Assiniboine belief systems mentioned that upon death the human spirit travels to the south, with no mention of any specific landform being the destination, sand dunes or otherwise (Denig 2000:97).

4.3.5 Great Sand Hills Regional Environmental Study

As part of a larger study of Great Sand Hills, the Province of Saskatchewan consulted with Elders from Treaty 4 (Cree, Saulteaux, Sioux and Assiniboine), Treaty 6 (Plains Cree, Woodland Cree and Assiniboine) and Treaty 7 (Blackfoot Confederacy) on traditional usage and perceptions of the region, including spiritual beliefs. For all of these cultural groups, the Great Sand Hills area was considered to be a powerful location suitable for conducting various religious ceremonies and activities, such as vision quests and sun dances (Peters et al. 2006:15-36). In addition, medicinal plants gathered from the area were seen to be more potent than those found in grassland environments (B. Noble, personal communication, 2007; Peters et al. 2006:15-35).

Another commonality among the groups consulted with was the connections between the Great Sand Hills and the dead. Historically, Treaty 4 groups involved in the provincial study reported that the area was used as a cemetery (Peters et al. 2006:15, 22). However, it is only the Treaty 7 groups that viewed the Great Sand Hills as being the land of the dead. As with historical accounts on the spiritual beliefs of Blackfoot Confederacy groups, Peters et al. (2006) found that current groups believe that after death the spirit travels to the Sand Hills. These beliefs are based not only on traditional knowledge and oral history, but also in the first-hand experiences of the Elders interviewed, such as near-death episodes and spiritual encounters (Peters et al. 2006:32–35).

The usage of descriptive terms for dune features has also been noted by Peters and Noble (2007) as part of their cultural assessment for the Province of Saskatchewan's Great Sand Hills Regional Environmental Study. They observed that within the Blackfoot language, specific terms exist that are used to describe sand dunes features, such as soft sand or moving hills (*acoheci*), moving sand hills (*naa-gwuh tih nuhng*), and far away brush and sand (*wah-he-youh-a-taskway-yak*) (Peters et al. 2006:6; Peters and Noble 2007).

4.4 First Nations Traditional Plant Use

Within Plains subsistence patterns, bison procurement and meat consumption has always been at the forefront. Within oral history accounts of Blackfoot subsistence, meat is seen as *natapi waskin*, or "real food", and all other foods were considered *kistapi waskin*, or "nothing food" (Schultz 1962:30). This perception is also reflected in the beliefs of the Assiniboine, who viewed meat as "real food" and considered berries and wild vegetables as appetizers to the meat courses (Rodnick 1938:27). Despite this perception, sources record that camp movements frequently took place in order to gather important plants that were in season. This practice of plant foraging and usage was performed by all members of society, although some medicinal plants required special rights before harvesting due to their being gifted from the Spirit Beings (Blackfoot Gallery Committee 2001:48-49). Numerous oral and written accounts of plant use on the Northern Plains mention the utilization of a wide variety of plant species. Serving a multitude of purposes, needed plants would be acquired by groups not only through their own gathering activities, but through trade as well. Camped within the High River area in 1792, Peter Fidler witnessed one of these exchanges, where the Blackfoot met to trade skins and pelts to the Cree for medicinal plants, as the Cree were regarded as powerful healers. This perception continued at least into the 1960s, with Blackfoot ethnographic accounts recording that Cree medicines were still regarded with a certain level of fear (Johnson 1969: 110-113; Johnston 1970:301). Other Europeans on the Northern Plains who witnessed plant use by First Nations groups include George Bird Grinnell, Walter McClintock, and Christianus Cornelius Uhlenbeck (Grinnell 1920:268-269; McClintock 1968:530; Peck and Vickers 2006:72-78; Uhlenbeck 1912:5).

To examine First Nations' use of sand dune regions for obtaining plant resources, the floral inventories presented in chapter 3 were compared with oral and ethnographic accounts of traditional plant uses. The majority of the information for this analysis is drawn from Blackfoot sources, with smaller studies on Gros Ventre, Cree, and Assiniboine (Stoney) usages also employed. In the case of Clavelle (1997:22), although the Cree communities she examined are located on the southern edges of the boreal forest, they are near the parkland periphery and fall within the northern boundary of the defined study area for this present work. As such, it is felt that the findings from this work had a potential impact on this research and are included in the analysis of plant usage. One additional study on Cree ethnobotany, by Siegfried (1994), is noted during the research for this component of the dissertation. While discussing traditional plant use, it focuses on a Cree group who resides within the Wabasca-Desmarais area, a community located approximately 270 km north of Edmonton, Alberta. As Siegfried's (1994) study area falls outside of the established study area boundaries for this research, it is not included in the present analysis. Information on Gros Ventre plant uses were found to be absent, with the exception of one work that lists four medicinal plant uses (see Appendix A, Table A.1).

Of the species found in the major environmental surveys conducted by Boyd (2000) and Townley-Smith (1980b), 99 have been documented to have some practical or cultural use. These uses are subdivided into five categories, with some species having multiple applications within several categories. First of these categories is food and includes any plant that was used for either sustenance or as a confection. In total, 45 types of plants were used for sustenance, with 66 separate uses (19 Assiniboine, 56 Blackfoot, 12 Cree and 0 Gros Ventre) being noted. The second category of medicinal uses is the largest of any in this examination, with 79 different species being utilized in 290 separate applications (71 Assiniboine, 194 Blackfoot, 41 Cree, and

4 Gros Ventre). This category is limited solely to use on human patients, with treatments varying for simple medical conditions such as headaches, colds, and dandruff to more elaborate uses in the treatment of wounds, burns, and venereal disease. Featuring strongly in the medical category is the usage of certain species to treat issues and problems related to all stages of reproduction, from conception, contraception, and abortion to easing childbirth and increasing a mother's output of milk. Due to the nature of these treatments, a number of these medicinal plants used in treating reproductive issues have been noted as being present in medicine bundles used to influence conception (Hellson 1974:57-60).

The third category of plant usage is related to veterinary treatments specifically with regards to horses. Applications of these plants vary, from the treatment of saddle sores and other wounds to relieving coughs and congestion to the doping of horses prior to a race. Although the majority of treatments listed apply to horses, some mention of their application to dogs is also made. In total, 26 species were gathered for application in 32 different treatments (0 Assiniboine, 32 Blackfoot, 1 Cree, and 0 Gros Ventre). The fourth category examines the spiritual and ceremonial role that certain plants played in First Nation's lifeways. As mentioned previously, some species used for contraceptive purposes or for abortion are found in medicine bundles. In addition, certain species, such as *Juniperus horizontalis*, figure prominently in the Sun Dance while others are used as incense or as floor coverings for *iniskim* or other ceremonies (Hellson 1974:33). Plants also take on a more abstract role in the ceremonial aspects of society, acting as a rough indicator for seasons, being featured in various myths, or being employed in a metaphorical aspect for such things as aging (Hellson 1974:109). In total, 48 different religious or ceremonial uses were recorded for 22 separate species (6 Assiniboine, 41 Blackfoot, 2 Cree, and 0 Gros Ventre). The final category pertains to household uses, where a particular species is employed in everyday activities not covered by the previous four categories. Applications found in this category include wood polish, deodorant, beads, paint applicators, toilet paper, construction material, waterproofing, padding, brooms, pillow filling, and as items in practical jokes for plant species with mildly irritating and inflammatory properties. The number of species within this category was similar to that of food, with 45 unique plants being utilized in 82 separate ways (14 Assiniboine, 68 Blackfoot, 4 Cree, and 0 Gros Ventre). Lastly, within this examination there were found two oral accounts for plants growing in sand dunes that could not be identified. The first, referred to as "silverroot" is mentioned in a Peigan oral account recorded by the Office of Specific Claims and Research of the Indian Association of Alberta. This plant is listed as being used in treating swelling (Crow 1973). The second, found within a Cree account recorded by Mandelbaum in 1934 on the Sweet Grass Reserve in Saskatchewan, describes the plant: *askiwahgonak*, or "Earth Peel". This ground hugging plant was used in cooking, where it was added to boiling meat to form a thick paste (Fine Day 1934b).

Information on the season when plants were collected was found to be limited. For the 99 plants with recorded uses found to occur within sand dune environments, 27 have recorded with them the season or time of year when they were collected (see Table 4.2). For this classification, the months from March to May will be considered the Spring, those of June to August the Summer, from September to November the Fall, and December to February will constitute Winter. Of these seasons, Summer was the most common time of year for plant collection, with 21 species being gathered during this period. Following Summer, the Fall is witness to the greatest number of species harvested with 11, with eight species collected in the Spring. During the winter months, only three species are recorded as being collected, with two of these (*Elaeagnus commutata* and *Rosa* spp.) being harvested in the early Winter. The third species, *Juniperus* spp., is the only one listed as being collected on a year-round basis.

In addition to their use as a food source, medicine, or raw construction material, the role that plants play in the spiritual aspects of bison pounding should be mentioned. Aside from the need for wood as a construction material for bison traps or corrals, within Plains Cree and Assiniboine groups larger trees played a central role in the hunt as medicine poles. Situated within the centre of a pound or corral, these poles or living trees had three charms placed within it to attract animals to the structure, as well as offerings. This tree also served as an escape route, if needed, for the buffalo runners who attracted the animals into the corral (McMillan and Yellowhorn 2004:147-148; Verbicky-Todd 1984:69-81). Within European artwork of the Northern Plains during the 19th Century, this structure can be seen in the Paul Kane painting "A Buffalo Pound" (ca. 1849-1852) (Figure 4.1).

4.5 First Nations Seasonal Migrations

First Nations accounts of seasonal behaviour differ from those found within previously mentioned studies, where examinations of the seasonal round focus largely on ecology and resources. In written descriptions of annual movements across the Northern Plains, emphasis is

Figure 4.1 – "A Buffalo Pound" by Paul Kane

(*Royal Ontario Museum 912.1.33*)

placed upon both hunting practices as well as on social, religious, and other subsistence activities that are not readily visible within the archaeological record. The most detailed written accounts of this seasonal movement are found in relation to the Blackfoot. For this group, the calendar is divided into four periods, with *motoyi* (Spring) being a period of new life where ceremonies commence, and Beaver Bundles and Thunder Medicine Pipe Bundles are opened. This period also sees the planning of the annual gathering (*ako-katssinn*) and the Sun Dance (*ookaan*). This is followed by *niipo* (Summer), when both *ako-katssinn* and *ookan* take place.

This period is also marked with movement across the plains, following animal herds, exploiting in-season resources, and maintaining an annual cycle of ceremonies. The period of *mokoyi* (Autumn) is witness to winter preparations, and the usage of *pis-skaan*, or buffalo jumps or pounds, to obtain meat for the making of *moki-maani*, or pemmican. To ensure the success of the group over the coming colder seasons, Beaver Bundles were again opened as ceremonies were conducted asking for assistance. Lastly was *sstoyii* (Winter), where smaller groups moved to coulees, river bottoms, and foothills to be both sheltered from the weather and to be near wood resources. This period was also marked by all-night ceremonies being conducted (Blackfoot Gallery Committee 2001:40-42).

Table 4.2 – Summary of Plants with Recorded Seasons of Gathering

Species	Season	Source
Achillea millefolium	Spring to Winter	Peacock 1992
Allium textile	May/June	Hellson 1974 Peacock 1992
Amelanchier alnifolia	July-August	Scott-Brown 1977 Peacock 1992
Anemone patens	April-May	Peacock 1992
Arctostaphylos uva-ursi	Late Summer to early Fall	Scott-Brown 1977 Peacock 1992
Artemisia frigida	Spring to Summer	Peacock 1992
Artemisia ludoviciana	Spring to Summer	Peacock 1992
Astragalus canadensis	Spring to Fall	Peacock 1992
Cornus stolonifera	August	Peacock 1992
Coryphantha viviparia	July	Peacock 1992
Elaeagnus commutata	Fall to early Winter	Peacock 1992
Fragaria virginiana	Mid-Summer	Scott-Brown 1977 Peacock 1992
Geum triflorum	Mid-Summer to early Fall	Peacock 1992
Glycyrrhiza lepidota	August	Peacock 1992
Heuchera spp.	Summer	Peacock 1992
Juniperus spp.	Anytime	Peacock 1992
Lilium philadelphicum	Best picked in July	Scott-Brown 1977
Lygodesmia juncea	Summer	Peacock 1992
Osmorhiza occidentalis	Fall, occasionally Spring	Peacock 1992
Populus balsamifera	Early Spring and Summer	Peacock 1992
Populus tremuloides	Sap collected in June	Scott-Brown 1977
Prunus virginiana	Fall	Scott-Brown 1977 Peacock 1992
Ribes oxyacanthoides	Summer	Scott-Brown 1977 Peacock 1992
Rosa spp.	Fall to early Winter	Peacock 1992
Rubus idaeus	Summer	Peacock 1992
Rumex spp.	Late Summer to early Fall	Peacock 1992
Shepherdia argentea	Fall	Peacock 1992

The seasonal movements of Plains Cree groups are briefly summarized in the work of Mandelbaum (1979). As with the Blackfoot, group migration for the Cree were based upon the movement of bison herds. During the summer (June and July), when herds were south of the South Saskatchewan River, group settled within the river valleys. Later in the summer they moved to what is now the Canada-US border region, as bison migrated south to the area between the Missouri Grand Couteau and the Saskatchewan and Qu'Appelle rivers. The Fall saw the Cree following herds northward into major river valleys and into hilly regions containing wood resources. Finally, in the winter bison populations dispersed into smaller herds, a practice that was emulated by the Cree through establishing numerous small hunting camps to continue with hunting activities (Mandelbaum 1979:52).

4.6 First Nations Fire Usage

While fires can originate on the Northern Plains through natural sources of ignition, such as lightning strikes, the intentional burning of specific regions by human groups is a well-documented, but still controversial, phenomenon. Within some interpretations, the impact that humans and climate have upon "natural" fire regimes are mutually exclusive (see Marlon 2013, McWethy et al. 2013). In opposition to these positions, the intentional use of fire by First Nations groups for warfare, signals, clearing land, or driving animals has been documented within the historical and archaeological records for the Plains since the beginning of European expansion into the region (see Boyd 2002, Christy 1892, Coues 1893, Dodge 1877, Hind 1971, Nicollet 1976, Oetelaar and Oetelaar 2008, Roos et al. 2018, Smith 1899, and Stewart 2002). This practice of burning was not a random one, but instead followed a pattern that mirrored the seasonal movement behavior of Plains groups. In examining historical records from the Northern Plains to determine which season saw the greatest number of recorded fires, Rannie (2001) determined that the Fall months of October and November were the most prolific and accounted for over 50% of all recorded fires over the course of the year. Second to this period are the months of April and May, with the remaining months seeing dramatically lower instances of fire occurring. This pattern of burning reflects human behavior and needs during each season, with Fall fires required to drive buffalo into traps and jumps, while the Spring would likely see fire usage for both hunting and to eliminate deadfall, replenish the soil, create grassy areas to attract game species, and to protect tree stands at strategic locations from natural burning (Oetelaar and

Oetelaar 2008). This pattern of seasonal burning peaks is also recorded by Moore (1972) in his examination of the grasslands of central North America (Rannie 2001:23).

In his examination of historic records of fires on the Northern Plains, Higgins (1986) also found this same pattern occurring, with the Spring periods between March and May and the Fall periods between July and November having more recorded fires. For these two periods, peaks were witnessed in April and in October. Further, he concluded, from the records, that First Nations groups did not concentrate on burning larger areas, but instead engaged in practices that saw smaller to moderately sized areas burned frequently for a short duration, frequently near camping areas. For larger fires, no evidence was found to conclude that these events were annually occurring in the same area (Higgins 1986:6). As a result, he proposed that the ignition of large anthropogenic fires was not advantageous to cultural groups, due to the negative impact that larger fires would have on traditional hunting, gathering, and winter preparation practices that also occurred during the peak anthropogenic burning seasons. Citing Thomas (1977), he recounts the narrative of a large fire set by a First Nations group near Hudson House in an attempt to drive buffalo from the area of the post, allowing for them to obtain a higher price for the provisions they were selling. Instead, the resulting blaze was so destructive to fodder that the herd moved farther away than expected, resulting in a food shortage for the area by the Fall (Higgins 1986:5). As well, in his research Higgins (1986) found that, with the exceptions of those lit near campsites, there was insufficient evidence to support that groups engaged in anthropogenic burning had little provision to control the fire, potentially leading to injury or death in cases where it was too large (Higgins 1986:9).

As examined in chapter two, the extent to which intentional burning practices influenced the pre-European landscape have led some scholars, such as Oetelaar and Oetelaar (2007, 2008) and Stewart (2002), to conclude that the environment that we define as the Plains region is the result of intentional human intervention and burning practices by First Nations groups in the past (Oetelaar and Oetelaar 2007:79-83; Oetelaar and Oetelaar 2008; Stewart 2002:114). This subject of isolating archaeological evidence of anthropogenic burning on the Northern Plains was examined by Boyd (2002), who extracted grass phytolith from within buried soil horizons at the Lauder Sandhills to determine how frequently fires impacted the vegetation of the area (Boyd 2002:477-478). Based upon the identification of particulate carbon within phytolith bodies, he concluded that a peak in fire frequency after 2,500 BP, as compared with earlier and post-contact time periods, resulted from an intensification of bison hunting and subsequent anthropogenic burning during the Sonota-Besant period, observed by Frison (1978), and not from climatic factors (Boyd 2002:482-484; Frison 1978:223).

An examination of the archaeological record for evidence of past anthropogenic burning and the impact that this practice has upon “natural” conditions was also conducted by Roos et al. (2018) at drivelines along the Two Medicine River in Montana. These features are associated with four Old Women’s bone beds within the river drainage basin dating between 1050 to 300 BP. Analyzing two stratigraphic profiles in association with these drivelines, between five and eight charcoal layers were present between alluvium or colluvium layers (Roos et al. 2018:2). AMS dating of eleven charcoal samples from these layers were obtained, as well as four dates from charcoal deposits bracketing fire deposits. The results found evidence for an unusually high frequency of prairie fires between 850 and 300 BP, a date range that is coeval with the occupation periods for Old Women’s phase in the area (1000 to 300 BP), with a peak burning period between 550 and 300 BP, which also coincides with the peak times when the drive lanes were utilized. Further stratigraphic evidence from periods that predate and postdate the presence of Old Women’s phase in the area shows a lack of comparable deposits resulting from fire. These findings cannot be attributed to shifts within the climate, as similar wet conditions were present during both periods of use and non-use. The moister periods would naturally result in an increased chance of fire, as the growth of grasses would provide a source of fuel (Roos et al. 2018:3). In addition, seven of the thirteen dates obtained from the charcoal represent short or modest wet periods, which would decrease the chance of “natural” fires from occurring. Evidence for intensive burning during these periods suggests human involvement in local fire regimes resulted in the amplification of burning within specific regions despite conditions that would decrease the chance for ignition. Finally, based upon the peak probabilities for individual fire layers at the two localities, it is surmised that drivelines may not have been used simultaneously, supporting historical evidence (see McClintock 1968) that use of kill sites were rotated on a periodic basis.

4.7 Analysis

From this examination of beliefs and practices for cultural groups within the study area, several conclusions are drawn on the role of sand dune environments through the theoretical perspectives of this work. First among these is the specific recognition of sand dunes within oral and written histories as an important landmark for three of the groups examined. With the Blackfoot this relationship is such that not only are sand dune areas seen as unique individually-named locations, but also the mechanics of dune activation and mobility are recognized through the use of technical language to describe sand mobility and vegetational features associated with dune formations. This recognition and naming of landscapes conform to the concepts stressed by Basso (1996), where landscapes can transcend being merely resource areas, but can be named locations that also convey history, meaning, and identity for the groups that live there. Further, the use of technical descriptions in association with sand dunes suggests that these areas were not only frequented by human groups but were utilized in such a fashion where the conveying of information on such aspects as vegetation and dune stability was required.

In addition, for the Blackfoot, Gros Ventre, and Plains Cree, these areas are associated with particular aspects of the supernatural. For the Blackfoot and Gros Ventre, sand dunes, and in particular the Great Sand Hills, are perceived as being the area to which spirits travel to when an individual die. This perception is consistent throughout early and later Blackfoot narratives, with little variation in accounts, with the exception of Martin (1967), who described the sand hills as the entrance to an underground afterlife. In both early and later accounts however, the afterlife for an individual mirrored the one that they had in the world of the living, with the exception of more plentiful game and resources. Although consisting of only pre-1950 accounts, this belief is also shared with Gros Ventre groups, who were closely allied with the Blackfoot.

Within the narratives from both groups, the Sand Hills are viewed as not only being an area with supernatural connections, but as an area that physically exists that the living can access. As seen in several accounts, it was possible for the living to travel through and reside in areas where both spirits and burial goods can be found. The location of the Sand Hills where spirits travel to differs between the Blackfoot and the Gros Ventre as the former view them as being in the east, while the latter identify them as being to the north. For the Blackfoot, this identification of the afterlife with the east can be viewed as metaphorical, with rebirth in the afterlife being associated with the direction of the daily rising sun and the creation of a new day (Gerald Oetelaar, personal communication, 2018). The difference in this directional association found with the Gros Ventre however, suggests that these differing perceptions on the location of the Sand Hills may not be metaphorical. Rather, when the history of the oral accounts is taken into consideration, these differences are instead indicating an actual physical location on the landscape, which can be visited. By the time that both of the Gros Ventre accounts, where the north is indicated as the direction spirits must travel in to access the Sand Hills (Flannery 1957, Kroeber 1908), had been recorded they had since been relocated to Montana and no longer inhabited an area in southwestern Saskatchewan. In travelling north, past the Cypress Hills as indicated in the account by Kroeber, one would roughly encounter the Great Sand Hills, a region identified by Treaty 7 groups in the Great Sand Hills Regional Environmental Study as being the area not only to which spirits travelled to, but also served as their recognized eastern boundaries of their traditional territory. From these accounts, it is surmised that not only are the Great Sand Hills the focal point for histories and narratives given on the afterlife and the migration of spirits, but that the Blackfoot and Gros Ventre share similar cultural perceptions and belief systems, likely stemming from their close historical and political association.

In comparison, perceptions of sand dunes differ greatly for Plains Cree groups within the study area, although these beliefs are also connected with the supernatural. For them, these areas are one of the residences for the *memekwesiwak*, or the supernatural Little People, who inhabit much of North America. Seen as shy and largely gregarious beings, if they were found and treated well they would trade items such as projectile points in exchange for food and hides. Found only within the post-1950 records however, is the observation that these beings would also trade medicinal knowledge and plants to individuals as well. Although potentially a recent perception adopted by the Plains Cree, their association of dunes with medicinal plants and knowledge is significant, owing to the extensive pharmacopeia present within sand dune environments and the reputation of the Cree as healers with other Northern Plains groups. In accounts provided by Johnston (1970) and Curtis (1970a), both the Blackfoot and Assiniboine are recorded as both having a great reverence for Cree healers and trading with Cree groups for medicinal plants and the rights to their associated healing songs (Curtis 1970a:132; Johnston 1970:301). As noted by Milloy (1991), when the Cree migrated onto the plains, to create a sense of place within their new environment that contained a dominant food resource in the form of the bison, group religious beliefs shifted from polytheism to monotheism to reflect this subsistence change (Milloy 1991:62-63). As beliefs in the *memekwesiwak* were also present prior to this expansion onto the Plains, it is possible that upon viewing both established beliefs on the supernatural nature of dunes and the plant resources found there, medicinal and otherwise, that beliefs on the residence patterns for these beings expanded to include these regions.

In addition to playing a role within the belief systems of Northern Plains groups, sand dunes also served as resource areas for plant gathering activities and hunting. As mentioned above, it was common practice to not only collect plants for medicinal purposes, but to also trade for these medicines from groups like the Cree who had established reputations as healers. In addition, sand dune flora was also utilized for food, as well as for household, spiritual, and veterinary purposes. These practices take advantage of the floral diversity present within these dune environments, with 99 separate species being employed by human groups out of the 262 total species recorded as being found within Western Canadian sand dunes (see Appendix A, Table A.2). This total represents almost 38% of all species recorded within sand dunes in this study area for which detailed plant inventories have been conducted. From both the number of species utilized and variety of uses given, plant resources are a critical component of the lifeways of Northern Plains groups, equal to that of the resources obtained through more visible activities such as bison hunting. Further, as dunes have the physical capabilities to support many species that are exploited to meet the various needs of human groups, these areas are also significant to the everyday physical and cultural survival of Northern Plains societies. With this conclusion reached, a further question of how human populations may have potentially influenced the "natural" plant population structures in order to better exploit the natural conditions of these areas can be posed. Involving the application of principles of Historical Ecology and findings from other chapters of this research, this topic is explored in chapter eight.

It should be noted with the ethnobotanical component of this study that one cannot accurately draw any cultural comparisons on plant utilization between the four groups. As can be seen in the dataset used in this study the vast majority of Northern Plains ethnobotany studies have been conducted within Blackfoot groups. Of the sources used in this work, five of them were written on Blackfoot plant usages (Hellson 1974, Johnson 1969, Johnson 1970, Johnson 1982, Peacock 1992), with one each on the Cree (Clavelle 1997), the Assiniboine (Scott-Brown 1977), on the Gros Ventre (Hart 1992). This unbalanced number of studies from one group in comparison with the others is also reflected in the work of Moerman (2009), which includes a summary of ethnobotanical studies for the entirety of North America. Extensive research revealed that there is currently no further source material on the ethnobotany of these groups at this time. From these findings, any comparisons conducted, or conclusions drawn on the prevalence of plant use within Northern Plains groups would not be accurate.

With regards to hunting activities, historical evidence illustrates that sand dunes were selected as areas to establish bison pounds. In this research, the Plains Cree featured prominently in the usage of dunes as intensive hunting areas to take advantage of the natural topography and resources found there, in particular wood. In descriptions of pound construction, both cut logs and living trees are used in the construction of these structures. Wood was also needed for the spiritual aspect of the hunt through the erection of a medicine pole in the centre of the pound. Although also employing medicine poles in pound construction, one group that did not regularly employ sand dunes as pounding areas were the Assiniboine. Again, differing from the practices of other Northern Plains groups, they selected different topographic features (i.e., ravines, coulees, and the open plains) using surrounds constructed from lodges placed in a circle. Known as prolific bison hunters and pounders, they were able to establish this reputation among other First Nations and EuroCanadians without making documented utilization of a geographic region that, in examining records associated with other groups, had the ability to support extensive kill activities.

The usage of sand dune regions as hunting areas brings forward in this study the impact that fire could potentially have on sand dune environments. From this chapter, the practice of anthropogenic burning to facilitate large-scale hunting activities is one that occurred within the study area. Evidence for this practice is not only found within the historical record, which documents burning practices in association with hunting and details differences in seasonality for prairie grass fires that reflect hunting practices, but in the archaeological record as well. This topic will be expanded upon further in chapter eight with the incorporation of findings from the other chapters.

Despite encountering the same types of landscapes with the same physical and environmental constraints, Northern Plains groups exhibit the concept of Possibilism through the development of their own culturally significant perceptions, cultural associations, and uses in relation to them. Although commonalities exist, such as between the Blackfoot and Gros Ventre with regards to perceptions of the afterlife, significant differences are also present between groups both living in the same area and who are traditionally allied. The sharing of spiritual beliefs between politically allied groups should not be assumed in every instance, despite this practice occurring between the Blackfoot and the Gros Ventre. As noted by Dusenberry (1962) in his studies of the Montana Cree, Assiniboine groups residing nearby and closely affiliated with the Cree possessed distinctly different concepts on the nature and manifestation of the soul (Dusenberry 1962: 106). This concept is also exemplified in the lack of Assiniboine sand dune usage when compared with their Cree allies.

From the perspective of Island Theory, ethnographic accounts find that sand dunes were observed to be unique landscapes by some, but not all, Northern Plains groups. The meaning and use of these landscapes are found to vary, depending upon the cultural group in question, although spiritual and supernatural aspects are associated with sand dunes for all groups who recognize them (i.e., Blackfoot, Assiniboine, and Cree) within their oral and written histories.

In examining and detailing the multicultural perception and behavior related to sand dunes, the larger question posed by Historical Ecology of how these aspects influence dunes arises. With varied and intensive activities occurring in these areas, as well as associations with the sacred and spiritually imbued, to what extent and degree can we begin to view sand dunes as being anthropogenic landscapes? While providing some initial answers, the dataset from this examination of ethnography and history can only begin to address this query. This question of the larger interaction between dunes and human cultures, using all of the datasets in this research, will be synthesized in chapter eight.

Chapter 5

Previous Archaeological Research in Northern Plains Sand Dunes

5.1 Introduction

Although thousands of Precontact archaeological sites have been located within sand dune environments across Western Canada, comparatively little research has been conducted interpreting the role these areas played within larger regional cultural practices. This topic however, has not been ignored completely as past researchers have recognized that sand dunes represent a unique environment and have examined them either individually or in small-scale regional surveys. The following overview of research is not meant to describe all works conducted within dune environments, but to examine those that have described dune sites and have attempted to place them within a larger archaeological and environmental context. As well, in light of the topics examined in the previous chapters, it is possible to assess to what extent geomorphological, biological, and ethnographic information has had on past research focused on dune areas.

5.2 Saskatchewan

Prominent among those who have focused on dune environments is Henry Epp (1974), who conducted research in the Great Sand Hills of Saskatchewan during the 1970s. Using data from previously recorded surface collections and material obtained through block surveys and test excavations, Epp examined the spatial and temporal distribution of Precontact and early Historic sites within the Great Sand Hills. From the dataset of 68 sites examined during field investigations he found that all Precontact time periods (Early, Middle, and Late) were represented by diagnostic projectile points although frequencies of specific point types varied. Epp attributed this variance to changes in the climate of the Northern Plains, which caused groups to periodically abandon the Great Sand Hills for more hospitable environments and return when conditions were more favourable (Epp 1974:12-13). Based upon this projectile point frequency data, he postulated that the area was sparsely used by Oxbow and McKean groups, owing to the low number of projectile points found (21 and 27 respectively). Epp correlated these phases with the Atlantic period (8450 – 4680 BP), which saw relatively dry conditions, and the Atlantic – Sub-Boreal transition period (4680 – 2890 BP), during which conditions gradually became moister (Epp 1974:12; Epp and Johnson 1980:112). During the Sub-Boreal period (2890 – 1690 BP), when Saskatchewan was occupied by Pelican Lake and Besant peoples, the Great Sand Hills appear to have been used more extensively, due to the increased moisture levels resulting in a higher carrying capacity for game animals within the dune environment. In total, 39 Pelican Lake points and 37 Besant points were found within the study area (Epp 1974:12; Epp and Johnson 1980:112). Although projectile point frequencies for the above listed groups in the Great Sand Hills do show an increase, Epp stated that one contemporaneous point style, Avonlea, was not readily present, with only 16 points found within the study area. While suggestive that Avonlea peoples did not occupy the Great Sand Hills to the same extent as other groups during this time period, Epp stated that "recent finds" show that Avonlea is present in greater quantities than is reflected in his study. Further explanation for this shortfall in point frequencies is given with the advent of arid conditions on the Northern Plains starting around 1700 BP, which Epp stated as coinciding with late Avonlea (Epp 1974:12).

These arid conditions continued until the Neo-Atlantic period (1200 – 900 BP), which saw a return to warmer climatic conditions. As a result, it is believed by Epp (1974) that use of the Great Sand Hills intensified. This is based upon an increase in the number of Prairie Side-Notched projectile points with 37 being identified, although their frequency did not reach the same total as those found with Pelican Lake and Besant. Drier conditions returned during the Pacific period (800 – 400 BP), which Epp felt resulted in the Great Sand Hills being used to a lesser extent witnessed by only 25 Plains Side-Notched points being found in the study area. However, Epp did stipulate that this decrease cannot be just seen as a reflection of climate, as Prairie Side-Notched groups were still present in the area during the beginning of the climatic period (Epp 1974:12-13; Epp and Johnson 1980:112).

Epp did not perform any analysis on Paleoindian occupations within the Great Sand Hills. This is due to the comparatively low numbers of diagnostic artifacts found when compared with later groups. Sixteen Early Precontact diagnostic points were found, representing Plainview, Agate Basin, Alberta, Cody and Early Side-Notched periods (Epp 1974:12; Epp and Johnson 1980:112).

In addition to concluding that the Great Sand Hills were exploited on an intermittent basis determined by climate, Epp also concluded that the distribution of sites across the dune landscape was not random. He found that sites were clustered within two separate areas: near the northern dune/grasslands periphery of the northern portion of the Sand Hills, and around semi-permanent and permanent water sources like Crane Lake and Big Stick Lake (Epp 1974:12-13, 1984:330; Epp and Johnson 1980:129). This distribution is attributed to both ecological and cultural factors. Epp postulated that the transition areas along the dune/grasslands periphery, as well as areas near water, were originally selected for settlement due to their diverse resource base of flora and fauna that was available on a year-round basis. Further, he felt that the higher site concentrations found in the northern portion of the Sand Hills periphery, as opposed to the south, were part of a regional trend for sites to cluster within 50 kilometres of the South Saskatchewan River. In contrast, few sites were found in the interior of the Sand Hills (Epp 1974:13; Epp and Johnson 1980:129; Epp and Pendree 1978:37). Once established for ecological factors, these sites were continuously visited over time due to group tradition (Epp and Johnson 1980:129-130).

Epp also noted this pattern of site distribution during his investigations at the Harris Sand Hills, located near Saskatoon. In this instance, he utilized "F" tests, a statistical comparison of standard deviations that can test a null hypothesis against an alternate hypothesis to determine the randomness of point distributions within three separate ecological zones. He classified these zones as the Sand Hills Surroundings, representing a mixed prairie grasslands environment, the Sand Hills Proper, represented by the flora and fauna of a dune environment on the Northern Plains, and the Sand Hills Basin and edge area which incorporates aspects of both a grasslands and dune environment (Epp 1986:57). In his opinion, the results from these tests confirmed three hypotheses that he outlined in the beginning of the study: the temporal distribution of diagnostic artifacts in and around the Harris Sand Hills was not random, the geographic distribution of diagnostic artifacts in and around the Harris Sand Hills was not random, and the frequency variance of Precontact site components between the Harris Sand Hills and the Great Sand Hills was not significant (Epp 1986:60). Specifically, he found that the majority of archaeological sites were found in the northwest portion of the Sand Hills within the Sand Hills Basin ecological zone. Epp felt this site distribution pattern was due to both the fact that the area is an ecological edge and that it is located between Eagle Creek and Crystal Beach Lake and served as a migration route for bison (Epp 1984:329-330; 1986:57). Although possessing a similar settlement pattern to the Great Sand Hills specifically through the use of ecological edges, he did note that the Harris Sand Hills was relatively densely settled in the interior, specifically by Besant and Avonlea peoples (Epp and Pendree 1978:37).

Epp also cited work done by Ian Dyck (1977) in the Dunfermline Sand Hills as evidence for edge area use by Precontact groups. Dyck (1977) reported that the location of the Harder site, an Oxbow campsite, provided both shelter and wood for pound construction and fires, in addition to easy access to pasturelands that would be frequented by bison herds. The sand hills themselves also provided a vital resource in the form of rolling terrain that would allow for the easy construction of bison pounds and surrounds (Dyck 1977:200).

Epp's conclusions on the use of edge areas in the Harris Sand Hills however, have come under some criticism. Following the argument cautioning archaeologists on the adoption of ecological principles as defined by Rhoades (1978), Hardesty (1980), and King and Graham (1981), Neil Mirau (1990) contended that there is no definitive proof that ecotones such as the edge areas used by Epp were more attractive to humans than any other ecological zone. He proposed that these areas represent a less desirable environment because of their increased sensitivity to climatic fluctuations. In addition, he pointed out that non-environmental factors could also play a role in determining settlement and subsistence practices (Mirau 1990:11). Looking specifically at the work that Epp (1986) completed in the Harris Sand Hills, Mirau stated that the area containing most of the sites used in the study not only lies in what can be viewed as an ecotone area, but also between Eagle Creek and Crystal Beach Lake, two largely permanent bodies of water. Although not negating the role that a diverse resource base could have in the settlement pattern found within the Sand Hills, he contended that the presence of a fresh, stable water source should not be discounted (Mirau 1991:6). He concluded that while the presence of fresh water in an area of high usage in the Harris Sand Hills did not disprove any of Epp's claims that a grassland/dune parkland contained a larger resource base that attracted settlement, it did show that further work must be done before any claims of edge area settlement can be accepted. The focus he felt archaeologists have upon Parkland and forested areas may not just be due to what is viewed in the archaeological record, but also to our own Eurocentric ideas of what makes an "ideal" landscape. Citing Rees (1988), he saw the infatuation with trees present in environmental literature as stemming from the European viewpoint that a rich environment is one that contains developed forests containing grassy clearings. Present in ecological as well as archaeological literature (see Odum 1971:158), Mirau postulated that we may be imposing our own cultural biases on not only settlement patterns of Precontact groups on the Northern Plains, but on the ecological and archaeological potential of other transition areas which do not contain densely forested tracts (Mirau 1990:12).

Additionally, Mirau (1990) pointed out the difficulty in defining exactly what an ecological edge is and in defining what role it plays in archaeological settlement patterns. He viewed the perspective that discrete biotic communities exist within defined boundaries as problematic, as these communities are made up of individual plant and animal species. Each of these species, although occurring together in an area, is individually dependent upon certain ecological factors to survive. As these factors, such as moisture, temperature, altitude and soil conditions change over time, the species living within a certain area change as well. With this perspective, he felt that the case of communities existing within a definable area, and not in other areas, cannot be made. Instead, he viewed the ecological landscape as being a continuum, where individual species boundaries overlap each other, rather than being separated from each other by defined borders (Mirau 1990:4).

Further work in Saskatchewan dune research was undertaken by Neal (2006), who examined the utilization of dune areas on the Plains as part of her thesis on two sites within what Wolfe (2001) has identified as the Elbow Sand Hills. Conducting a general overview of several sites in Saskatchewan, Manitoba and Nebraska, she observed that material from the Early, Middle and Late Precontact periods have been found within sand dune sites (Neal 2006:167-170). Using historical records on the usage of pounds within dune areas as well as archaeological material, Neal also observed that a large resource base was exploited on a year-round basis, even during periods of what she called “environmental stress” (Neal 2006:163-167).

Evans (2006) also examined the geoarchaeology and site settlement patterns in and around the Elbow Sand Hills. His analysis of archaeological sites from the Paleoindian to Late Precontact periods showed that the highest site densities were found in areas of high topographic complexity, specifically sand dunes and meltwater spillways. This is a result of these areas possessing a more heterogeneous ecological foundation, due to their varied topography forming a large number of ecotones (Evans 2006:89). Other topographic areas, such as glaciofluvial plains, glaciolacustrine plains and hummocky moraines were found to have a lower site density. Sites were also located within low-lying areas within 5 kilometres of major permanent water sources (Evans 2006:91).

Evans also commented on the role that water plays in the settlement of dune areas themselves. As the stratigraphy of the Elbow Sand Hills consists of semi-permeable sand overlaying semi-impermeable glacial tills, a high and stable aquifer is formed. As such, these areas are more resistant to drought conditions, and sustained not only human occupations, but also the floral and faunal resources needed to support any settlement (Evans 2006:92-93).

He also examined the question of seasonality by looking at the usage of a number of large-scale bison kills located within sand dunes. He concluded that all of these sites were occupied between the late autumn and early spring, a period that also coincides with the time of year when the potential for aeolian erosion and deposition would be low. Citing David (1993) for his examination of human activity and the impact it has on dune activation, Evans suggested that the decreased chance hunting and subsistence activities would have to destabilize dunes during the winter may have played a role in their use during this period (Evans 2006:84-85).

This issue of the role that human usage plays in dune destabilization in the Elbow Sand Hills was also studied and expanded upon by Wolfe et al. (2007), who examined the topic through the use of archeological site data, historical narratives and photographs, and optically stimulated luminescence dating (a form of absolute dating where it can be determined when a sandy sediment was last exposed to sunlight, indicating when it was buried) obtained from stable sand dunes. They concluded that the region was heavily used by First Nations groups, as witnessed by the presence or archaeological materials representing Early, Middle, and Late Precontact periods (Wolfe et al. 2007:187-188). In addition, historical accounts by Hind (1859) indicated that Cree groups repeatedly used the margins of the Elbow Sand Hills for pounding activities (Hind 1859:55-56; Wolfe et al. 2007:183-184). Potential destabilizing factors for sand dunes resulting from these pounding activities would consist not only of trampling by both humans and bison, but from the removal of vegetation resulting from both the construction of pounds and the use of fire to drive bison into traps (Boyd 2002:474-475; Wolfe et al. 2007:187-188). It is felt by Wolfe et al. (2007) that these anthropogenic factors would increase the likelihood of destabilization within dune formations.

These conclusions are supported by their analysis of dune activation within the region following European settlement. With the introduction of new land-use and management practices by the Canadian government, First Nations activities in the Elbow Sand Hills ceased. With this change in how the region was being used, Wolfe et al. (2007) believed that a trend towards dune stabilization was initiated that is continuing today. Supporting this claim is an examination of historic air photos of the region, which show the total area of active sand in the region as decreasing gradually since 1939. This observation is corroborated by a series of optically stimulated luminescence dates obtained upwind from the presently active region of the sand dune, which also show a general trend towards stabilization (Wolfe et al. 2007:181-183).

Lastly, Hanna (2007) examined the role that sand dunes played in Plains habitation patterns in her thesis examining the Hartley site (FaNp-19). Based upon excavated material from the site, as well as the location of the site in relation to both water sources and the periphery of the dunes, she concluded that during the Late Precontact Period selected areas along the dune/grassland periphery were used, due to their close proximity to both bison herds wintering on the grasslands and the availability of other resources, such as water and wood (Hanna 2007:169). In addition, due to their unique topography dune landscapes were also viewed as being well-suited areas for the construction of bison pounds and surrounds (Hanna 2007:142-143).

5.3 Manitoba

Stemming from the research work completed in the SCAPE Project a large amount of new information on sand dune occupations in Manitoba has been recorded. Of greatest interest to the focus of this thesis is the work undertaken by Hamilton and Nicholson (1999), who employed Island Theory in their examination of Vickers Focus peoples located within the *Makotchi-Ded-Dontipi* locality in the Lauder Sandhills. As stated previously, Hamilton and Nicholson concluded that the locality, being similar to those used by Vickers Focus peoples for horticultural practices in the Eastern Woodlands, was also employed on the Plains when they adopted bison hunting practices. They observed that "...microhabitats were used as a familiar base of operations for foraging, as a staging area for bison hunting, or as a sheltered base for horticultural production" (Hamilton and Nicholson 1999:22-23). By employing stabilized environments familiar to Vickers Focus, Hamilton and Nicholson (1999) proposed that the Lauder Sand Hills acted as both a conduit for migration and an environmental haven enabling Vickers Focus groups to adapt to a radically different resource base. In addition, the use of sand dunes by people who produced materials known as Vickers Focus may also have led to their disappearance as a distinct cultural group on the Northern Plains. In her graduate research on Vickers Focus and

Mortlach ceramics from Manitoba, Mokelki (2007) concluded that, through contact with Mortlach groups, mostly in the Lauder Sandhills, Vickers Focus peoples gradually amalgamated with their western neighbours (Mokelki 2007:128).

While conducting research in the Lauder Sandhills, Hamilton and Nicholson (2000) also investigated evidence of a small Métis settlement within their study area. Although not a prime focus of their SCAPE research, they did investigate the presence of several historic pit features associated with wetlands within the Sandhills. They concluded that historic groups used the dune microhabitats in a similar fashion to Precontact groups, as resources such as water and wood were readily available. Additionally, the Lauder Sandhills also provided good grazing for bison, protection from prairie fires, and access to a diverse floral and faunal resource base. They postulated that the area was also used for small-scale subsistence farming by both Métis and European settlers, due to the ample water resources available from wetlands associated with the Oak Lake aquifer (Hamilton and Nicholson 2000:267-268). Similarly stemming from the SCAPE Project is graduate work done by Boyd, who performed a study on the Late Quaternary geoarchaeology of the Lauder Sandhills. As stated earlier, Boyd concluded that the Sandhills area, due to its geology and hydrology, contains a greater diversity of plant species than found in surrounding grasslands (Boyd 2000a:20-30).

Boyd also examined the role that landscape played in site selection for McKean groups in the Lauder Sandhills. Using pre-existing archaeological site file records as well as geological and palaeoecological records for the area, he concluded that water resources played a large role in the distribution of sites starting at 4,000 BP. This is based not just upon the clustering of sites around such features as the Swan River Valley and the Pembina River, but also on increased environmental stability seen during this period in the Hind Basin, where the study area is located. As a result of this stability, and a high-water table, the area became a mosaic of grasslands and wetlands that would be attractive both as camping and hunting areas (Boyd 2000b:36). Viewing Middle and Late Precontact site locations, in relation to water sources throughout Manitoba, Wiseman et al. (2006) confirmed this hypothesis. Of the 191 sites (128 Sonota/Besant, 55 Blackduck/Duck Bay and 8 Vickers Focus) examined it was found that between 71% and 87.5% of all sites (71% for Sonota/Besant, 72.5% for Blackduck/Duck Bay and 87.5% for Vickers Focus) were located within 500 metres of a permanent or intermittent water source (Wisemen et al. 2006:446). In addition, their research showed that not all types of water sources were used to the same extent by different cultural groups. While the percentage of Vickers Focus sites located within 500 metres of any water is the highest of the three groups (87.5%), only one of the eight sites (12.5%) is located near a permanent water source. All other sites are located near intermittent sources, which Wiseman et al. (2006) concluded to be less attractive to bison hunters on the open plains. This settlement pattern by Vickers Focus groups was seen to be an adaptive strategy, as their subsistence pattern was partially based upon horticultural practices originating from the woodlands of southern Minnesota and northern Iowa. The ability to grow and store a small food surplus may have made them attractive targets for frequent visitation by their neighbours, who would be able to acquire a portion of this surplus through the rules and behaviour required of hosts. As such, Vickers Focus groups may have placed themselves in more traditionally out of the way areas, such as intermittent water sources, to avoid frequent visitations while still maintaining their way of life (Wiseman et al. 2006:448-449).

5.4 Alberta

In contrast to Saskatchewan and Manitoba, little investigation has been conducted into the occupation of sand dune sites in Alberta. This subject has only been touched on in two graduate theses, the first of which was completed by Kurtis Blaikie in 2005. Looking at a $25m^2$ area excavated at the Bodo Bison Skulls site (FaOm-1) as part of an oil development testing and mitigation program, he concluded that the area represents an intensive bison processing area and peripheral camp associated with Old Women's Phase pottery and projectile points (Blaikie 2005:135-143). Radiocarbon dates from five samples taken from the lower of two occupations show that the oldest occupation at the site occurred between AD 1650 and the present (Blaikie 2005:131). A sixth date, obtained from the upper occupation, has an earlier date of AD 1580 however, Blaikie felt that this earlier date is correct and not the result of contamination or sampling error. Due to the weathered appearance of the faunal material from the upper occupation, he maintained that material was redeposited from an upslope occupation that was destabilized and slumped into the younger occupation (Blaikie 2005:132-133).

Blaikie also stated that the area in and around the site was possibly used year-round, due to the variety or resources available within the dune area, included bison, waterfowl and wood (Blaikie 2005:155-156). In addition, he cited ethnographic sources from Kidd (1986), which

Blaikie believed illustrates that the Blackfoot viewed sand hills areas as an afterworld “paradise”, due to their diverse resource base (Blaikie 2005:156).

The second work based largely on Alberta sites was the doctoral dissertation written by Peck (2001) that examined the seasonal use of environments in Alberta and Saskatchewan by migrating bison herds. Although not focused specifically on sand dune sites, his analysis does include data from the Bodo Bison Skulls site (FaOm-1) and the Tschetter site (FbNr-1). Using dental cementum growth increments on bison teeth, he determined that FaOm-1 represented a kill event occurring between late October and late March, while FbNr-1 was utilized between late December and March (Peck 2001:185-188). This usage during the late Fall to winter months fits in with the overall pattern of landscape use that Peck proposed, where the open prairie grasslands were abandoned by bison herds during the winter in favour of the plains/parkland periphery and forested river valleys (Peck 2001:248).

This position on seasonality and bison migration has received some opposition from other scholars such as Malainey and Sheriff (1996) who found historical evidence for a more widespread bison settlement pattern during the winter months on the Northern Plains. Using primary historical documents from European fur traders and surveyors, they cited eyewitness accounts of bison being seen in the open grassland during the winter months (Malainey and Sheriff 1996:341-346). As a counterpoint for this argument, Vickers and Peck (2004) examined the same historical documents with a focus on the environmental setting rather than the presence of bison. They concluded that, depending on the season, the main resource for Precontact First Nations groups on the Northern Plains was not bison, but wood. They contended that during the winter months, for example, greater emphasis is placed upon obtaining a source of fuel and construction materials for housing and pounds rather than on food (Vickers and Peck 2004:99-102). Locations on the grasslands noted by Malainey and Sheriff (1996) as containing bison actually represented small, forested pockets that occurred on the open plains. By viewing the Northern Plains as containing a patchwork of small environments, Vickers and Peck (2004:103) maintained that they avoided the environmental oversimplification that they saw in Malainey and Sheriff’s classification scheme, where an area is either arid plains or wooded parkland.

5.5 Discussion and Summary

Representing over forty years of research, the above summary provides the body of knowledge available on the archaeology of sand dune regions in Western Canada and how these sites have been incorporated into larger assessments of human mobility. However, despite providing a detailed analysis of both individual dunes and major dune sites over smaller regions, none of these works offers an overall examination of how sand dunes were used by Middle and Late Precontact groups across the Northern Plains. Further to this, all of these studies approached the questions of Indigenous landscape perception and usage from a largely resource-based perspective that do not take into account cultural and historical aspects that are incorporated within this research. Additionally, when cultural concepts of landscape usage are examined, they are not placed within any larger culture-specific or theoretical context, nor do they extensively research topics of cultural significance as they relate to dune environments.

Although problematic, the adoption of a perspective largely based upon the presence of natural resources, water, and geographic features cannot be dismissed as being either biased or too narrowly focused. All human societies require a resource base from which to physically survive, with the methods used in extracting these resources having the potential to become detectable within the archaeological record. By solely focusing on this economically-based to represent the entire lifeways of a group however, a limited portrait of past behavior is presented.

From these works, several significant conclusions can be drawn that have impacts on the present study. First among these is the validation for the use of Island Theory through its implementation in studying site placement, hydrology, edge effect, and ecology within the Lauder Sandhills. In the works of Hamilton, Nicholson and Boyd, they argued that the Sandhills could be considered an ecological island, within which distinct economic behaviours can be observed. The second conclusion that can be drawn from these works is that while there is no evidence for ecological determinism, ecology does play at least a partial role in dune environments being utilized by Northern Plains groups. Examining the ecological diversity found within edge ecotones and regional hydrology, Boyd (2000a), Evans (2006), Wiseman et al. (2006), and Hanna (2007) concluded that these factors are significant to the settlement patterns that are witnessed within the study area. Finally, the issue of site usage is addressed within several works with the general conclusion being drawn that dune areas played a role in First Nations lifeways as hunting areas.

Although dominated by examinations of the natural resources, several of these works also bring forth ideas on the cultural usage and perception of dune environments. In their examination of Vickers Focus landscape usage, Wiseman et al. (2006) concluded that social factors and the retention of traditional practices played a role in the selection of habitation areas. Cultural influences in landscape usage area was also addressed by Epp (1986), who noted the selective use of sand dunes by different Northern Plains groups during the Middle and Late Precontact periods. Blaikie (2005), after Kidd (1986), also commented on Blackfoot sacred perceptions of dune areas, but does not provide any further examination of the topic. Finally, the concerns of culturally-based perceptions in historical interpretation raised by Mirau (1990) are significant. By not utilizing fully First Nations perceptions, it is possible for scholarship to not fully comprehend, or in some cases obscure, the cultural and historical activities that archaeologists are attempting to accurately interpret and research.

It is the goal of this dissertation to use the work undertaken by previous researchers as a basis for examining how and why sand dune areas were used on both a regional and individual basis during the Middle and Late Precontact periods on the Northern Plains. Although generated from a largely resource-based perspective, this past research is foundational in establishing a large component of the knowledge body that will be used in this dissertation to establish a holistic interpretation of sand dune usage by First Nations groups.

Chapter 6

Challenges and Concerns in Studying Dune Sites

6.1 Introduction

In previous chapters, the overall research questions surrounding dune environments, cultural history, usage, and perception have been addressed on a topical basis. From the archaeological data found within the next chapter, sand dune usage across the Northern Plains as a whole is compared to determine how these environments were exploited during the Middle and Late Precontact periods, if any commonalities exist between these sites, and how these results compare with the conclusions obtained from chapters three and four of this work. Although providing a unique contribution, it should be recognized that the use of the archaeological record in this manner for sites located in dune fields has its limitations. These potential issues are outlined by Walker (1992) in his examination of concerns surrounding the use of absolute dates. He viewed the use of radiocarbon chronologies from archaeological sites to define cultural patterns over extended periods of time as problematic. Date distribution can be affected by multiple factors outside of human behaviour, including site visibility (with later sites being more readily encountered due to better preservation), the number of archaeological sites themselves that have undergone radiocarbon dating, and sample contamination (Walker 1992:128). Due to the unique nature of sand dunes, it is important that these topics are examined within the context of aeolian features to acknowledge any specific concerns that may exist.

6.2 Site Visibility

As sand dune areas are dynamic landscapes and have the potential to be active for extended periods, they have the capacity to destroy or bury any previously deposited archaeological material. When examining any stratigraphic profile or archaeological landscape, it is important to remember that what is being viewed is not a complete physical record of all past events, but one that has potentially been transformed over time by both depositional and erosional forces. In his work, *Formation Processes of the Archaeological Record*, Schiffer (1991) acknowledged that the processes of site formation are not purely aggradational, where all events and artifacts are preserved within the archaeological record. Rather, all aspects of the archaeological record, from the artifacts to the site to the region, are subjected to cultural and natural processes that dictate if it will be preserved, and if so in what form. In examining sites and landscapes, he acknowledged that these areas are not static entities, but are instead subject to natural and cultural processes that can alter or eliminate part or all of the record of past events. These processes include erosion, redeposition, pedoturbation, faunal-turbation, floral-turbation, and aeroturbation (Schiffer 1991:199-217).

Within this light, through examining the conclusions drawn from chapter three, we see the potential for the archaeological record within sand dune sites to be impacted by aeolian processes. As deflation at a site can destroy any original artifact context or stratigraphic record of human occupation, the rapid deposition of aeolian materials onto the former living floor is required to best preserve any *in situ* site data. Even if rapidly buried after formation an archaeological site can still be subject to deflationary processes that can rework previously occupied sites into new dune formations, as well as alter the context of any artifacts or features present. In examining areas where this process has occurred, it is not uncommon to find cultural material on the substrate in interdune areas, in a sense "left behind" as active dunes migrate over the surface, or within deflated regions where the disturbance has reached a depth to impact any buried archaeological deposits. This process can also result in the comingling of artifact assemblages in cases where sites with multiple occupations have been substantially deflated. While the deposition of further aeolian materials can provide sufficient protection to any archaeological deposit, the best protection for any sediments are paleosols and interdune pond sediments like clays or marls (Albanese 1978a:62; Albanese 1978b:377-381; Waters 1992:196-197).

Even in cases where a site has yet to be buried, it is possible for aeolian processes to disturb any original cultural context. Depending upon the size, shape, and weight of the artifact, the nature of the depositional substrate, and the yearly meteorological conditions, cultural material can be laterally displaced or fall into smaller depressions that have been deflated on the upwind side of the object. Tested under laboratory conditions, it was found that in five days of simulated aeolian conditions in a dune environment between 40 and 100 mm of vertical sediment displacement took place. As well, 39% of the flakes, sized 10mm or less, utilized were deflated (Lancaster 1986:361). While artifact size played a role in why this percentage was so high, it should be noted that larger artifacts were also moved through aeolian processes, although to a lesser extent. The largest artifact to be displaced, a semi-rounded hammerstone, was found to have moved 100 mm from its original location and had been toppled over (Lancaster 1986:360-362; Waters 1992:196). Abrasion of lithic material from wind action may take place, altering exposed surfaces of stone. This action can also form ventifacts, or stones faceted by the wind, that can resemble lithic artifacts created through cultural practices (Waters 1992:28-209).

Acting in concert, these processes play a role in impacting the preservation of dune sites on the landscape and in the archaeological record as a whole. Most evident are the negative impacts of deflation, activation, and dune superimposition, where sites' stratigraphy can be collapsed, stratigraphic records erased, and artifacts spatially displaced and stripped of any context (Waters 1992:196). Over time, these impacts would potentially alter how we view the archaeological record and interpret early dune sites, as older sites would be subjected to these forces for millennia. As a result, Early Precontact sites within dunes have an increased chance to be destroyed, and a decreased chance of being observed on the surface when compared with sites of a younger age, due to the greater depth at which they occur. These factors, and the potential impact that they have on the comparative representation of Early Precontact sites in comparison with younger sites, led in part to the decision to exclude Early Precontact sites from this study.

Although potentially destructive when activated these same processes also have within them the capacity to encourage site preservation as well. Through sediment deflation, entrainment, and transportation, sand dunes also possess the physical capacity and materials to bury and preserve archaeological sites. Saltating sand particles settle and accumulate on uneven surfaces, which includes sites of human occupation that contain within them discarded cultural items, garbage, and the remains of habitation and other human activities. Provided that an area is covered rapidly, and no deflation or activation processes take place, any sites contained within it will be protected in a relatively intact state but will exhibit low site visibility.

6.3 Absolute Dating and Dune Environments

The issue of radiocarbon dating is also a concern, given the potential sources of error and non-consistency of practice that exist with the process. As a method itself, it has undergone refinement since it was first employed to determine absolute dates in 1950 (see Arnold and Libby 1949). Used exclusively to date organic material from archaeological sites, radiocarbon dating has been supplanted by accelerator mass spectrometry (AMS), which relies upon measuring carbon isotopes as opposed to radioactive decay to determine an absolute calendar date. First recognized as having applications in archaeology in 1977 (see Muller 1977), it is seen today as the preferred method of absolute dating in archaeology due to the comparatively small sample size that is required. The use of these two dating methods by Northern Plains archaeologists over the past fifty years is of concern for this study, as the use of radiocarbon dates obtained by using older methodologies and calibration methods that were potentially more inaccurate than modern techniques, as well as less rigorous in regard to reducing potential sources of error, can skew any results. Further to this, previous techniques and methods have embedded within them assumptions on radiocarbon methods that have since been disproven, such as the constant rate of ^{14}C in the environment (Morlan 1992:4; Morlan 1994:760). Added to these concerns are issues surrounding any pretreatments and sample collecting that takes place prior to the dating process itself. In his compilation of radiocarbon dates from archaeological sites in Saskatchewan, consisting mostly of dates obtained from the former Saskatchewan Research Council Laboratory, Morlan (1992) noted that for the first 1299 radiocarbon samples the lab processed the pretreatment methods applied to eliminate foreign carbonaceous matter were inadequate. As a result, the returned dates are likely younger than the actual sample age (Morlan 1992:59). Additionally, the practice still exists among some archaeologists to submit multiple organic samples from the same approximate provenience to be processed together to produce one absolute date. This is seen as problematic and a potential source of error. Although each radiocarbon sample may be from the same location, each has their own depositional history and potential for contamination, and thus can introduce error into any results (see Ashmore 1999).

Adding to these two issues is the danger of contamination, as faunal material deposited into a sandy environment may be exposed to repeated saturations from groundwater. This inundation can cause diagenetic changes, where elements are naturally exchanged between buried bones, the water, and their environment, including both old and new carbon. Contamination has been most noted to occur in cancellous bone, as opposed to cortical bone, as a result of the less dense structure found in the former (Hedges et al. 1995:285-286; Johnsson 1997:431; Tisnérat-Laborde et al. 2003:409). This process was noted as happening with the faunal remains from the Harder Site, which were found to be enriched and coated with a clay material when taken out of storage for reanalysis (Morlan 1994: 760-761). Due to the smaller sample size as compared with conventional radiocarbon dating, when AMS dates are obtained on contaminated materials, the impact that the inclusion of foreign carbon and other materials causes error to be amplified (Morlan 1992:5).

6.4 Conclusions

From this and previous chapters, the case can be made that sand dune areas represent unique landscapes on the Northern Plains that are subject to a diverse number of formation and deflationary processes. From an archaeological standpoint, both the geophysical nature of dunes and the forces that created and alter them have implications for the interpretation of past human activities within these landscapes.

In critically examining the radiocarbon dating of material from dune sites, several concerns surface. Primary among these is the possibility of sample contamination resulting from the hydrology present within sand dunes. As well, in examining a dataset constructed from excavation reports and research spanning over forty years, changes and refinements in the methods of absolute dating can create additional discrepancies in the interpretation of the chronologies of these regions. Further to this, it is evident in light of the current reconstructions of sand dune activation that the destruction of deposits has likely occurred, particularly during the Altithermal period, when temperatures in western Canada were higher, as portions of some sequences are missing (David 1993:80). From this same data, although similar conditions existed during the Medieval Warm Period, it does not appear as though deflation occurred on the same scale as that previously seen, likely due to the moisture that was present during this period. With the time frame for this study beginning at the end of the Altithermal, dune deflation, while present, is not as great as it would be if earlier time periods were examined. With this knowledge in mind, and the issues that are present when interpreting data from dune sites, a contextual examination of dune sites on the Northern Plains can take place.

Chapter 7

Archaeological Dataset and Analyses

7.1 Introduction

In order to obtain a comprehensive, yet manageable, perspective on dune occupations in Western Canada, a process of selecting dune archaeological sites for detailed analysis was devised. Distinctions on inclusion or exclusion were made largely on the basis of the nature of the deposits (e.g., intact versus disturbed), the extent of any excavation, and the availability of published and unpublished sources. The summaries presented in this chapter serve as the basis for the examination of the archaeological components found in sand dune regions in the southern portions of the Prairie Provinces. Due to variations in the degree to which some sites were excavated, some of the datasets given below are viewed on the scale of the entire site complex, while others represent single, well-documented sites. In addition, information pertaining to seasonality and radiocarbon dates is not available for all locales. Regardless, they represent some of the best-documented archaeological sites excavated on the Northern Plains over the past 40 years. All absolute dates acquired for these sites are listed in Appendix B, Table B.1 and B.2. All three prairie provinces are displayed in Figure 7.1 along with associated individual provincial maps that document the archaeological sites discussed from that specific province (see Figures 7.2 – 7.4).

7.2 Site-Specific Analysis – Alberta

The archaeological sites discussed from Alberta can be seen in Figure 7.2.

7.2.1 The Bodo Bison Skulls Site (FaOm-1) and the Bodo Overlook Site (FaOm-22)

Both the Bodo Bison Skulls Site and Bodo Overlook Site are located within the Sounding Lake Sand Hills, which are comprised of one larger and five smaller dune areas. Both sites are situated within one of the smaller dune areas located in the southeast near the hamlet of Bodo, Alberta. The Sounding Lake Sand Hills are located on a large glacial outwash deposit, and consist of blowout hollows and blowout dunes, in addition to North Battleford-type ridges. The dunes act

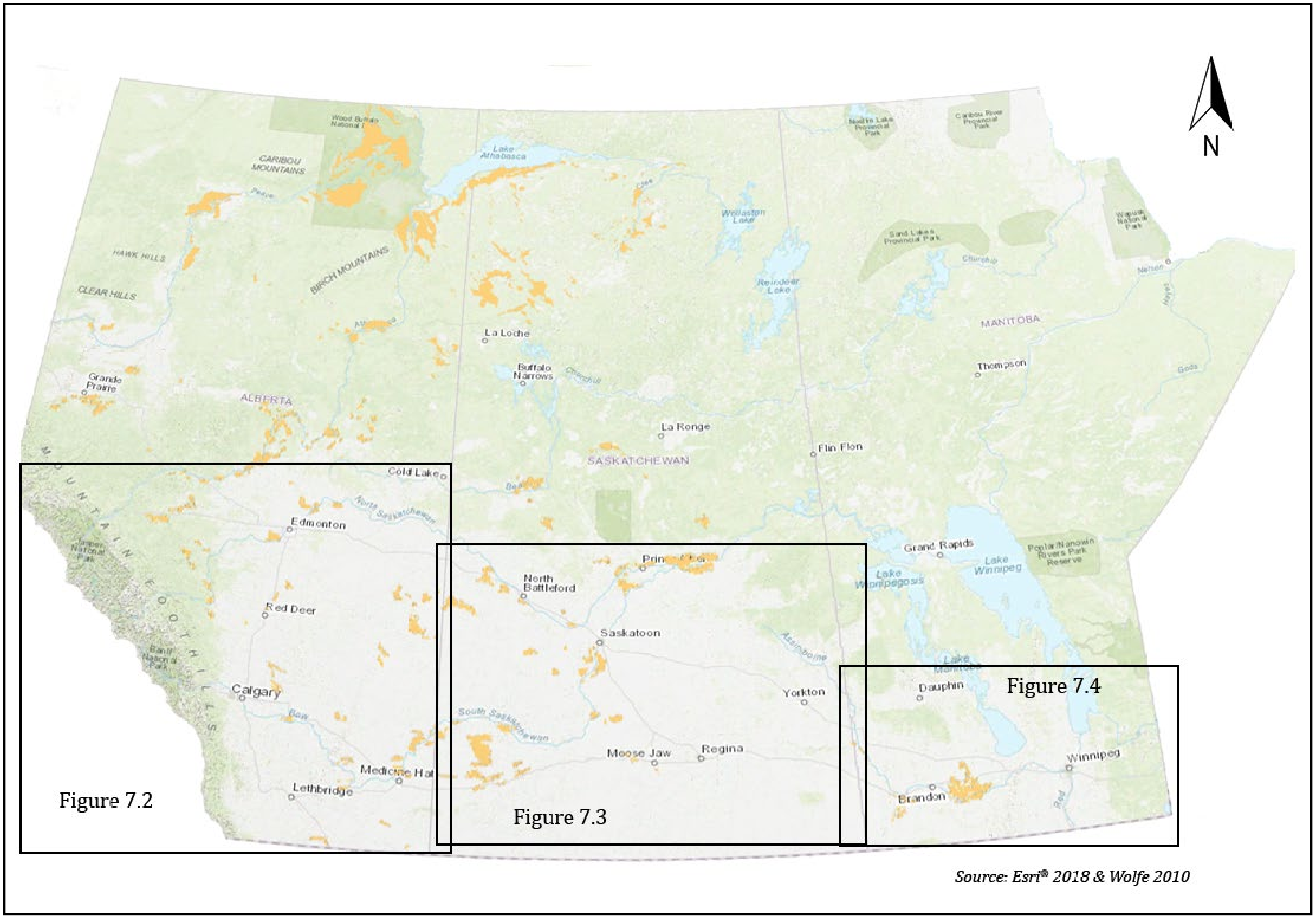

Figure 7.1 – Prairie Provinces with Associated Individual Provincial Maps

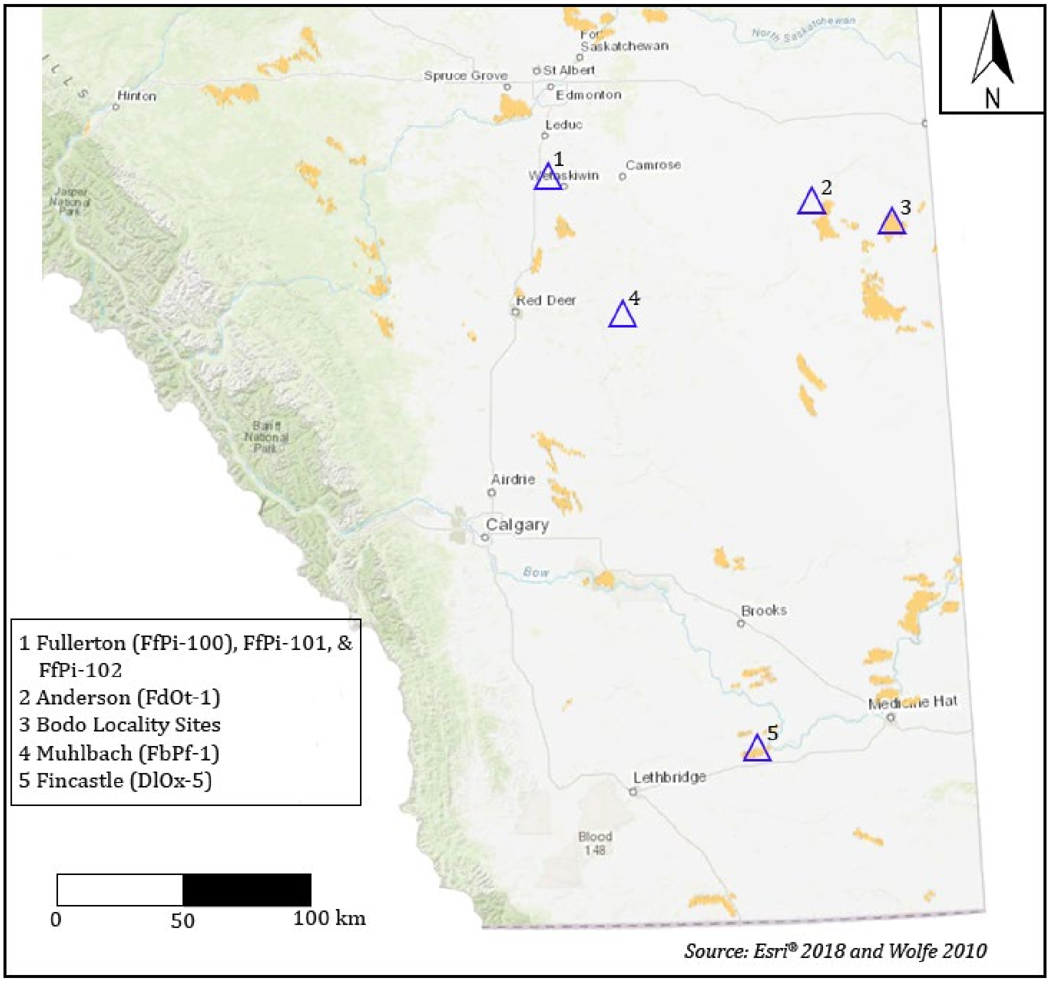

Figure 7.2 - Alberta Archaeological Sites Used in Analysis

as recharge sites for groundwater situated between one and seventeen metres below the surface, with groundwater being discharged into regional sloughs and ephemeral lakes (David 1977:133-134; Gilliland 2007:13-14). Soils within the region are regosolic and exhibit rapid drainage (Canadian Soils Survey Committee 1978:103; Gilliland 2007:24).

Archaeological work has been undertaken at FaOm-1 since 1995. Prompted by the discovery of four bison skulls and associated lithic material in a pipeline trench two kilometres southwest of Bodo, Alberta (Gibson and McKeand 1996:18), site dimensions and complexity have grown considerably due to both assessment and mitigation projects and the University of Alberta archaeology field school that has been held at the Bodo locality between 2002 and 2008 (see Gibson 2001, 2002, 2004a, 2004b, 2005a, 2005b, 2006a, 2006b, 2007; Gibson et al. 1998; and McKeand and Gibson 2006). At present, the site is estimated to cover an area of over five square kilometers and is thought to be comprised of at least 35 separate occupation localities that have undergone varying degrees of examination (Gibson 2004a:4-46). While much of the research that has been done at FaOm-1 is either preliminary or currently undergoing analysis, some work has been completed and is available. This body of literature consists of three completed master's theses by Blaikie (2005), Grekul (2007), and Gilliland (2007), in addition to numerous interim and final permit reports for both University of Alberta field schools and oilfield assessment and mitigation projects.

From these works, it can be concluded that FaOm-1 contains an extensive Late Precontact archaeological component that covers the entire extent of the site in all known localities. These materials are largely found within either a buried paleosol or a larger organic deposit that is believed to result from prolonged periods of refuse disposal and the discarding of butchered animal remains (T. Gibson, personal communication 2003). Features found within the paleosol associated with the Late Precontact component include bone beds, middens and hearths (Gibson 2001:16, 2005a:10). Late Precontact projectile points found at FaOm-1 consist of both Prairie and Plains Side-Notched points, occasionally in the same excavation unit (Gibson 2001:13, 2005c:18-19; Gibson et al. 1998:90-91; Grekul 2007:29). Other researchers, using the criteria for point identification outlined by Peck and Ives (2001), identified one area, Locality 6, as containing Cayley Series points that are viewed as being ancestral to modern Blackfoot populations (Blaikie 2005:61). Non-diagnostic lithic tools found at the site include flakes, shatter, choppers, bifaces, unifaces, wedges, retouched flakes, cores, endscrapers and sidescrapers (Blaikie 2005:57-67; Gibson et al. 1998:38-94).

Pottery found within the site indicates an affiliation with Old Women's groups, although preliminary analysis of stylistic attributes of some fragments indicate that Mortlach and Selkirk groups may also be present (Gibson 2004a:6, 2006a:30; Gibson et al. 1998:68-77; Grekul 2007:34; Mann 2007:28-29, 2009; McKeand and Gibson 2006:28-29; Meyer and Russell 1987:3; Peck 2011:397). Locality 6 was also found to contain one fragmented Ethridge vessel that is affiliated with Avonlea groups (Blaikie 2005:149). Subsequent analysis of the ceramic assemblage by MacDonald (2014) proposes that three of the sherds from FaOm-1 represent the Ross ceramic type, which possibly represents a discrete family or band unit. This type, originally classified as Etheridge Ware, possesses a combination of stylistic attributes first observed at the Ross Site in central Alberta (MacDonald 2014:170-178). Non-diagnostic tools found at FaOm-1 include a large number of scrapers, knives, and bifaces as well as numerous bone tools, including awls, spatulate tools, and one canid longbone used as a blank for bone bead production (Blaikie 2005:125-127; T. Gibson, personal communication 2003; Grekul 2007:34-35).

An immense faunal collection also exists for the site, consisting almost exclusively of bison remains. This material, in some cases found within bone beds, show signs of intense processing, as indicated by both the presence of cut marks and the highly fragmented nature of many of the bones, an indication of marrow processing for bone grease (Blaikie 2005:41; Gibson et al. 1998:22; McKeand and Gibson 2006:29-31). Although dominated by bison, the faunal collection at FaOm-1 also contains other species, such as mollusks, canid, coyote, raptor, corvid, pike, and duck (Blaikie 2005:120-124; Gibson et al. 1998:11-16; Grekul 2007:39; McKeand and Gibson 2006:33). A detailed faunal analysis of a 2m x 2m excavation unit at Locality 7 by Grekul (2007), a butchering disposal site containing a bone bed, found that 3228 bison fragments were present, representing a MNI of 16 animals, with more females than males being present (Gibson 2004a:10; Grekul 2007:40-137). Using both tooth wear and epiphysis fusion as age indicators, it was determined that the majority of animals killed were between the ages of four and nine, although two calves less than one year old were also present (Grekul 2007:104). Based upon individual element representation in the faunal collection, Grekul also concluded that the locality was used as a primary butchering location, as the portions of the bison skeleton that would contain the greatest amounts of meat and grease (back, breast, sides and upper limbs) were either heavily butchered or missing, suggesting that they were carried to other areas for further processing (Grekul 2007:89).

The faunal collection at Locality 6 was also examined by Blaikie (2005), who found that the upper occupation at the locality contained little intact faunal material, with the exception of an intact bison third incisor (Blaikie 2005:41). The lower occupation however, was found to contain extensive faunal material, consisting of 1492 fragments representing a minimum of 10 individual bison varying in age from neonatal to adult. Although all types of elements were found, not all elements were represented equally, with the snout, jaws and long bone elements dominating the collection, while the sternum, crania, and horn cores were almost always absent (Blaikie 2005:103-105). Also found in the lower occupation were the remains of at least three canids, two ducks, a corvid, two raptors, rodents, fish, and mollusks (Blaikie 2005:120-124).

In addition to these faunal collections, organic preservation in some areas of the site is excellent, resulting in the discovery of bison hair in an organic layer that is believed to be the remains of bison viscera and other portions of bison carcass discarded during butchering (Gibson 2001:2; Grekul 2007:25).

Using dental cementum, population structure, evidence of human activities and the presence of foetal bison bone and other species, seasonality for the Late Precontact occupation at FaOm-1 has been suggested to be almost year-round. This determination of continuous occupation is the result of combining the results from varying techniques being employed by different researchers at different occupation areas within the large locality. The topic of seasonality was first explored by Peck (2001), who examined dental cementum from five bison molars from the bone bed in Locality 7. Based on increment analysis, one molar was found to indicate a late October to late December kill event, while the other four suggested a late December to late March kill event (Peck 2001:185). Further work at Locality 7 was undertaken by Grekul (2007) who examined seasonality at the site on the basis of both population structure and the presence of foetal bone. She suggested that the site was occupied during the summer to fall, based on both the absence of foetal bone and the inferred comingled age and gender structure of the herd based on the analysis of faunal collection. This analysis found that the group consisted of at least seven adult females, three adult males, two calves, and at least four other individuals, which is felt by the original researcher to represent a herd congregating in the summer and fal for the rutting season (Grekul 2007:140).

Lastly, Blaikie, using foetal bone and the presence of migratory bird remains, concluded that the Locality 6 assemblage represents a late spring to early summer occupation (Blaikie 2005:145). In addition, he also suggested that the locality might have been occupied during winter months as well, based upon the large amount of fragmented bone discovered. While circumstantial, he felt that this might be the byproduct of bone grease production activities, which is thought to have occurred largely during winter months. Further circumstantial evidence for this claim is provided through the presence of split bison phalanges and bird remains, which may be considered marginal foods accessed only during times of deprivation (Blaikie 2005:146).

A number of radiocarbon dates have been obtained for FaOm-1 at both Locality 6 and 7. At Locality 6, six radiocarbon dates were obtained from two hearth features present in the main occupation area, with one taken from each feature or above it, one from below the feature, and one from the occupation floor associated with the feature. This testing produced uncalibrated results, which were calibrated using Stuiver et al. (1998), of 245 ± 35 BP (BGS 2553: cal 1453 [1520, 1587, 1625] 1647 AD), 137 ± 35 BP (BGS 2554: cal 1644 [1667, 1782, 1794] 1948 AD), 20 ± 35 BP (BGS 2555: cal 1654 [1675 1776, 1801, 1940, 1946] 1950 AD), 65 ± 35 BP (BGS 2556: cal 1667 [1688, 1729, 1810, 1923, 1948] 1952 AD), 133 ± 35 BP (BGS 2557: cal 1645 [1668, 1781, 1796] 1949 AD), and 60 ± 40 BP (BGS 2558: cal 1656 [1679, 1740, 1753, 1756, 1804, 1935, 1947] 1951 AD). Of these, the first, and oldest, is considered to be in a secondary context, as it was found to be in the same level or above all of the other material that was radiocarbon dated. From these six dates, only two (BGS 2553 and BGS 2555) are not blended samples (Blaikie 2005:130-133). Based upon these results, it is felt by Blaikie that the locality was occupied during the Little Ice Age, a period of increased precipitation and cooler climate that he feels would have increased the soil stability at the site and made the area more hospitable for occupation (Blaikie 2005:148). At Locality 7, four bison bones were dated from the bone bed, producing uncalibrated results, which were calibrated using Stuiver et al. (1998), of 290 ± 40 BP (BGS 2654: cal 1480 [1640] 1790 AD), 460 ± 40 BP (BGS 2655: cal 1410 [1440] 1480 AD), 330 ± 40 BP (BGS 2656: cal 1450 [1520, 1570, 1630] 1650 AD) and 500 ± 40 BP (BGS 2657: cal 1330 [1430] 1450 AD). Although varying in range, when the calibration curves for these dates are compared as to where they overlap, it is felt by the orginal researcher that the locality contains a single occupation dated to approximately 1450 AD (Grekul 2007:24-26).

In addition, a Middle Precontact component is also represented at FaOm-1 in the form of Oxbow, Pelican Lake, Duncan, and Hanna projectile points (Gibson 2004a:13-16, 2005c:19-49; Grekul 2007:14-15). These materials are not associated with any buried paleosol, and largely come from a disturbed context. As a result, the extent and nature of the Middle Precontact component at FaOm-1 is not well defined apart from knowledge of said occupation.

Also present at FaOm-1 is evidence that the site may contain a protohistoric or historic component. Located during assessment of a wellpad in Locality 55 is a single metal projectile point (Gibson 2001:16, 2004a:24; McKeand and Gibson 2006:28). Although little is known about the archaeology of this period in the area, initial research on the projectile point’s metric dimensions would place it being made between pre-1790 and 1835 AD (Babiuk 2002:5; McKeand and Gibson 2006:28).

During the 2003 University of Alberta field school, a second major site was discovered west of the then known boundaries of FaOm-1. Named the Bodo Overlook site (Gibson 2005a and 2005c), FaOm-22 is located largely on north facing terraces overlooking the Eyehill Creek valley, and currently consists of 18 known localities (Gibson 2004a:50). In addition to the discovery of extensive Late Precontact artifacts, a possible older *in situ* Middle Precontact component was identified in a poorly defined sand layer (T. Gibson, personal communication 2003).

The artifact assemblage found at FaOm-22 is very similar to that found at FaOm-1, and it is felt by some that these two sites may in fact be one large site, as the area between the two has never been adequately surveyed and recorded. Along with the presence of the same type of non-diagnostic tools and faunal material as found in FaOm-1, the site also contains a large number of Plains and Prairie Side-Notched projectile points, as well as *in situ* artifacts that resemble Oxbow projectile points. In addition, Hanna points have also been found, although in a disturbed context (Gibson 2004a:55-78, 2005c:18-49; Gilliland 2007:32). Like FaOm-1, FaOm-22 also contains pottery that is suggestive of both Old Women's and Mortlach influences, as well as one sherd that was later classified as a Ross type (Gibson 2005c:54; MacDonald 2014:172; Mann 2009). Lastly, evidence exists for a protohistoric or historic component at FaOm-22 through the presence of both an iron fragment that was discovered in one of the hearth features and horse bones (Gilliland 2007:32; McKeand and Gibson 2006:28).

Nine radiocarbon dates were obtained from bison bone and teeth for the identified occupation layers at FaOm-22 from three different profiles, with calibration based on Stuiver et al. (1998). From profile South L2, four uncalibrated dates of 70 ± 40 BP (Beta 214251: cal 270-210 BP, 140-20 BP, 0 BP) sampled at 15 cm DBS, 930 ± 40 BP (Beta 214253: cal 930-750 BP) sampled 30 cm DBS, 620 ± 50 BP (Beta 214255: cal 670-530 BP) sampled at 60 cm DBS, and 2430 ± 40 BP (Beta 209522: cal 2720-2350 BP) sampled at 70-80 cm DBS were obtained, although it is suspected that the date obtained at 60 cm DBS is anomalous, as it is earlier than samples above it, and is due to rodent burrowing (Gilliland 2007:70-74). In profile North L2, three uncalibrated dates of 80 ± 40 BP (Beta 214252: cal 270-200 BP, 150-20 BP, 0 BP) sampled at 20 cm DBS, 1100 ± 40 BP (Beta 214254: cal 1070-940 BP) sampled at 55 cm DBS and 1080 ± 40 BP (Beta 214256: cal 1060-930 BP) sampled at 70 cm DBS were obtained (Gilliland 2007: 79). A further two samples were later tested from this profile 1080 ± 40 BP, with the first returning a date of 1137 ± 25 BP (OxA-19986: cal 783-788 AD, 815-844 AD, 859-983 AD) and the second a date of 1140 ± 33 BP (OxA-19898: cal 780-792 AD, 806-984 AD). Both of these samples were obtained from 25 cm DBS within a sand matrix (Munyikwa et al. 2014:119). In test pit L2-9 two uncalibrated dates of 1040 ± 40 BP (Beta 222510: cal 1040-1030 BP, 1000-920 BP) sampled at 30-40 cm DBS and 1100 ± 40 BP (Beta 222511: cal 1070-940 BP) sampled at 40-50 cm DBS were obtained (Gilliland 2007:82).

7.2.2 The Muhlbach Site (FbPf-1)

The Muhlbach site (FbPf-1) is a Besant bison trap located south of Stettler, Alberta. Situated within the basin of a proglacial lake, the unnamed lacustrine sands were transformed over time into a low dune field (Gruhn 1971:130). While the method of entrapment is unknown, what is certain is that a large number of bison were killed and deposited in a substantial bone bed. Two theories proposed by Gruhn on the nature of the trap are that the animals were driven into either a pound structure or a marsh although no evidence for a structure were found (Gruhn 1971:144). Evidence for a marshy environment is found in the black sand layer (Layer C) that contains the bone bed. Due to the degree of organic preservation in this layer, Gruhn speculated that it represented a marshland soil (Gruhn 1971:135). This site is thought to represent a one-time kill event and is not considered to be the result of multiple occupations (Gruhn 1971:144). As stated earlier, the site has been assigned to the Besant period based upon diagnostic projectile points found *in situ*, although while re-examining material recovered from the site Gruhn expressed the opinion that one of the projectile points may bear attributes that would classify it as a Late Precontact period side-notched point. A reevaluation of this site is difficult however, due to the disappearance of many of the projectile points recovered from this site from museum collections (R. Gruhn, personal communication 2004; Varsakis 2006:38). One radiocarbon date obtained from burned bone from the bone bed returned an uncorrected date of 1270 ± 150 BP (GSC 696: cal 1522-918 BP), which was calibrated using Stuiver and Reimer (1986). This uncalibrated date is outside of the normal date range for Besant (1500 to 1600 BP) as defined by Vickers (1986), with the calibrated age just nominally inside of accepted temporal bounds for the phase. It is believed that this discrepancy is due to the black organic layer, contained within the bone bed, which has been contaminated by an overlying layer of manure making it appear younger (Gruhn 1971:144; Wilmeth 1978:92).

Further analysis of the site was carried out by Graham (2014) using original site records and a new suite of AMS dates obtained from material from Gruhn's original excavations. In examining the issue of seasonality, he utilized age at death and sex ratios to draw a conclusion for the site, as well as providing cautions for the accuracy of his conclusions on this matter. In examining the physical makeup of the herd butchered at the site, he concluded that at least 128 bison are represented, consisting mostly of adult females, with some adult males and juvenile individuals also being present (Graham 2014:120). Using the six foetal and neonatal remains recovered from the site and employing the linear regression equations developed by Unfreed and Walde (2005) for determining foetal age, he provided a tentative range from early May to early September for site occupation (Graham 2014:105). This tentative assignation using foetal remains stems from the error ranges for the linear regression being high, as well as from the estimated ages of the animals studied extending beyond the averaged gestational period for bison. As such, they should be considered neonatal rather than foetal, and would involve the use of different growth curves. Further, Walde himself has become critical of the approach he developed, citing the fact that 20% of bison calves are born out of peak season and that some bison herds have extended seasons for conception, which will impact any conclusions made on seasonality that rely upon foetal remains (Graham 2014:104; Walde 2006b:482-489). When consulted on the results from the Muhlbach site by Graham in 2014, Walde expressed the opinion that all that could be concluded is that the evidence at best suggests a non-summer occupation (Graham 2014:106).

As a second avenue of interpretation, Graham also employed sex ratios to determine the seasonality of the site. This concept follows the observation that the presence of male animals within bison herds fluctuate over time, with an increased male presence being seen during the rut season of late summer and early autumn (Graham 2014:95). Within modern bison herds, this demographic shift has been seen to vary, with males making up 17% of a main herd in the spring and up to 44% during the rut (McHugh 1958:15-16). Using metrics from multiple elements (e.g., metapodials, metatarsals, and calcanei), Graham determined that males made up between 11% to 36% of the population at the site, depending upon which element ratio was being examined. When compared against past sex ratio studies and the seasonalities that are associated with them (see Fawcett 1984, McHugh 1958, Shortt 1993), this percentage range makes the Muhlbach site results contradictory. He further questioned these results in light of studies that have criticized this method of seasonality determination due to both the overrepresentation of female animals in kills due to herd movements in jumps and pounds (see Speth 2013) and the underrepresentation of juvenile animals due to predation (see Driver and Maxwell 2013). In addition, he postulated that the sex ratios seen at the site may be more indicative of butchery preferences, as opposed to seasonality, as metapodial frequencies at Muhlbach (24% male and 76% female) mirror those found at the Fitzgerald kill site (17% male and 83% female), which Hjermstad (1996) attributed to the preferential butchering of female animals (Graham 2014:99-102; Hjermstad 1996:162). Based upon the results from these two studies, Graham made a tentative proposition that the site was occupied during the late spring to early summer (Graham 2014:107).

As another component of the reanalysis of the Muhlbach site, Graham submitted 13 bone samples for AMS dating from three areas of the site to examine any potential age variation across the site. Four samples were submitted and yielded uncalibrated dates of 1685 ± 25 BP (UCIAM 896984: cal 1688-1543 BP), 1585 ± 20 BP (UCIAM 89685: cal 1535-1410 BP), 1600 ± 20 BP (UCIAM 89686: cal 1545-1414 BP), and 1615 ± 20 BP (UCIAM 89687: cal 1559-1415 BP). As one of the samples (UCIAM 89685) was suspected of containing carbon contaminants, a further set of five AMS dates were obtained. This suite of dates returned uncalibrated results of 1590 ± 15 BP (UCIAM 114940: cal 1532-1415 BP), 2335 ± 15 BP (UCIAM 114941: cal 2357-2336 BP), 2675 ± 20 BP (UCIAM 114942: cal 2844-2750), 1565 ± 15 BP (UCIAM 114943: cal 1523-1410 BP), and 1555 ± 15 BP (UCIAM 114944: cal 1523-1401 BP). Again, based upon the results the potential for erroneous dates was noted, this time in the form of the bones that yielded the two oldest date (UCIAM 114941 and 114942) showing evidence of sun bleaching with no signs of processing or butchering, leading Graham to believe that they may be older surface materials that were incorporated into the site deposits. To eliminate the possibility of intrusive elements resulting from natural animal death, and to resolve sampling biases, a third suite of AMS dates was obtained from expedient bone tools that were found within the faunal collection. These four samples produced dates of 1660 ± 20 BP (UCIAM 131378: cal 160-1529 BP), 1620 ± 20 BP (UCIAM 131379: cal 1563-1416 BP), 1645 ± 20 BP (UCIAM 131380: cal 1609-1445 BP), and 1625 ± 20 BP (UCIAM 131381: cal 1567-1416 BP). From these results, he concluded that the site represented a single occupation, once the two anomalous dates from suspected intrusive material are excluded from the analysis (Graham 2014:33-37).

7.2.3 Fullerton Site (FfPi-100)

Also located within a proglacial lake basin is the Fullerton Site (FfPi-100), first identified in 1964 by Alan Bryan of the University of Alberta. Found within the sands of Glacial Lake Malmo in the Peace Hills near Wetaskiwin, it was classified as a poorly defined multi-component hunting and living area (Taylor 1967:16). Cultural material found *in situ* indicated that the site had been used on and off by hunter-gatherer groups for the past 7000 years as Scottsbluff points were discovered at the lowest stratigraphic levels. Also recovered from Fullerton were later projectile points such as Oxbow, McKean, Hanna/Duncan, Pelican Lake, Besant, Avonlea, Prairie Side-Notched, and Plains Side-Notched (Taylor 1967:17-18). Diagnostic artifacts are also present in the form of ceramics, which include sherds with a punctate (n=8) or cord-wrapped (n=1) decoration (Taylor 1967:16; Taylor 1969:38-52). Lastly, Taylor noted that several obsidian microblades were found *in situ* during the course of the excavation. One normalized radiocarbon date of 1230 ± 30 BP (GSC 641: cal AD 689-882) was obtained for the site and has been calibrated in this volume using the IntCal 13 curve on OxCal 4.3 (Bronk Ramsey 2009; Brumley and Rushworth 1983:156; Taylor 1969:67-69; Wilmeth 1978:89). Further mitigation work by Gibson (1987) determined that the site had previously been heavily impacted by road development, with approximately 250 m^2 remaining intact. Subsequent auger testing by Gillespie (2003) determined that much of the stratigraphy in the site is deflated, causing an admixture of archaeological deposits (Gillespie 2003:11).

7.2.4 FfPi-101

Taylor made note of a number of other sand dune sites within the Peace Hills that were discovered over the course of his fieldwork. The first of these sites is FfPi-101, located in a gently rolling dune area that has had a history of cultivation. Dating at this site is difficult due to the fact that both farming practices and rodent disturbance have called into question the provenience of all recovered artifacts. This situation is not remedied by the artifact analysis. Although diagnostic points and pottery are found, Taylor used his own categories (e.g., Fullerton 4c point) to identify materials, which were then compared to specimens in other published papers. In the case of FfPi-101, two projectile points have been identified as Prairie Side-Notched, a third is only referenced to lithic material Richard Forbis excavated from the Fletcher Site (Taylor 1969:4-45). Unfortunately, Taylor referenced a number of possible points from

Forbis' paper, all of which were given different identifications by Forbis. As such, the third point can be considered to be either Scottsbluff or a Hell Gap variant (Forbis 1968:3-5). Also found at FfPi-101 are two distinct pottery types, the first being identified as Moose Jaw Cord Marked. First identified at the Mortlach Site as a distinct culture, it has been dated at approximately 1780 AD (Taylor 1969:79; Wettlaufer 1955:26). The second type was identified as having no known comparable type.

7.2.5 FfPi-102

Approximately 1.3 km east of the Fullerton Site is another site examined by Taylor, FfPi-102. Like the Fullerton Site, it was also located on top of a large dune and offered an excellent view of the surrounding area. In addition to lithic debitage, and bone fragments, this site also contained flake tools, scrapers, cores, and two different pottery types. The first of these types has been identified as most similar to the Mortlach Check-Stamped style, first identified by Boyd Wettlaufer at the Mortlach Site. Dates for this material are approximately 1780 AD (Taylor 1969:78; Wettlaufer 1955:20). Taylor also noted similarities between this first pottery type and the Type 5 pottery identified by Wettlaufer and William Mayer-Oakes at the Long Creek Site in Saskatchewan. Distinguished by incised vertical lines at the rim of the vessel, these sherds differ from those found at Long Creek only on the basis of hardness and interior finish. Dates for this style are given at 1500-1600 AD (Taylor 1969:78; Wettlaufer and Mayer-Oakes 1960:28). The second sherd from Fullerton has been identified as most similar to that of the Wascana ware, identified by Alice Kehoe as having a punctate, grooved or cord-impressed design along their neck. As the western geographic range for this pottery style was originally identified in 1959 as the 106th Meridian, and Meyer and Russell (1987) identify Wascana ware as being of Selkirk origin, their possible presence in a site located near Wetaskawin is of interest. It should be noted however, that the evidence of a distinct Selkirk complex in the Moose Jaw area and further west is considered weak (Meyer and Russell 1987: 20-21). Approximate dates for this design range from Late Precontact (side-notched point association) to the Protohistoric (Kehoe 1959:240-241; Taylor 1969:101).

7.2.6 The Fincastle Site (DlOx-5)

The Fincastle site is located within the Grassy Lake Sand Hills, formed from a thin deposit of lacustrine sands on the south bank of the Oldman River. This area is principally made up of blowout hollows, blowout dunes, parabolic dunes and composite dunes, all oriented in a northeasterly direction as a result of the high-velocity winds that caused their formation (David 1977:128-129; Odynsky 1958:58).

The Fincastle site was first discovered in 2003 due to vandalism and looting reported to Alberta Community Development by local individuals interested in protecting the site. Subsequent investigation was initially undertaken by the Archaeological Society of Alberta, followed by the University of Lethbridge who established a field school at the site in 2004, 2006, and 2007. Excavation of the site focused on two areas within the dunes, designated the West Block and East Block, which are located approximately 100 metres apart from each other (Foreman 2010:27; Leiff 2006:28; Mills 2009:40-42; Varsakis 2006:88-98; Watts 2008:79-83). The site is identified as a large-scale single use Sonota/Besant kill, consisting of a bone bed that is found in both the West and East Blocks (Foreman 2010:31; Varsakis 2006:366-369). Lithic artifacts found included 37 complete and 82 incomplete Sonota/Besant points, in addition to scrapers, utilized flakes, knives, drills, borers, wedges, cores, choppers, hammerstones, microdebitage, and fire-cracked rock. The vast majority of the faunal material (over 60,000 fragments) found at the site was from bison, although canid, pronghorn, and ground squirrel remains were also found. Notable among these remains was an intact canid skull that was found facing downwards at the bottom of a pit feature (Foreman 2010:41-49). Detailed analysis of a portion of the bison remains recovered from the East Block found that both primary butchering activities, such as dismemberment and the removal of meat, tongues, and hides, and secondary butchering activities, such as marrow extraction, took place in different areas of the site. This conclusion was supported through a spatial analysis of artifact distribution across the site (Mills 2009:123; Watts 2008:241-246). Based upon the presence of articulated elements and intact long bones, it was also suggested that the kill took place during a period of food abundance, which would explain why these possible food resources were not exploited (Watts 2008:249).

Nine features were also recorded at DlOx-5 in the West Block, East Block, and in shovel tests conducted between these two areas. The West Block contained one pit feature that was filled with canid and bison bone, in addition to one bone placed vertically within the pit. The

East Block also contained a bone pit containing an upright bone, in addition to five upright bones. The test pits between the East and West Blocks were found to contain one bone upright feature and an ash pit (Foreman 2010:47-59).

Seven bone samples were submitted for radiocarbon dating, with five taken from the East Block and two from the West Block. Respectively, they returned uncorrected dates of 2540 ± 50 BP (Beta-201909: cal 807-515 BC), 2490 ± 60 BP (Beta-201910: cal 790-429 BC), 1310 ± 40 BP (Beta-241256: cal 789-431 BC), 3100 ± 40 BP (Beta-241257: cal 894-590 BC), 2680 ± 40 BP (Beta-241258: cal 651-772 BC), 2490 ± 40 BP (Beta-241254: cal 1449-1260 BC) and 2610 ± 40 BP (Beta-241255: 908-797 BC) that have been calibrated in this volume using the IntCal 13 curve on OxCal 4.3 (Bronk Ramsey 2009). All of these dates were obtained from bone within the bone bed, with the exceptions of Beta-241256 and Beta-241257, which were sampled from bone found 15 centimetres above the bone bed. These two dates are also considered by the authors to be erroneous for the bone bed and are the result of intrusive material being transported from another area as a result of aeolian processes (Bubel 2014:213-214; Foreman 2010:32-33; Mills 2009:47-48; Varsakis 2006:110-111; Watts 2008:89). Given the weak nature of aeolian transport processes, however, this explanation may be called into question (A. Aitken, personal communication, 2018). In addition, eight optically stimulated luminescence dates were obtained from sediments at the bone bed in the East Block. Of these, Bubel felt that six can be used to date the feature, with two samples obtained from the bone bed returning dates of 2050 ± 0.13 BP (UNL2547) and 33140 ± 0.17 BP (UNL2545). A second set of samples were obtained beneath the feature, with the first of these located directly below the bone bed returning a date of 2900 ± 0.15 BP (UNL2546) while the second, obtained 10 cm below the bone bed, was dated to 4640 ± 0.25 BP. The third set of samples, taken 10 cm and 40 cm above the feature, produced dates of 1780 ± 0.13 BP (UNL2548) and 1270 ± 0.06 BP (UNL2549), respectively. The final two samples were obtained from 30 cm below the bone bed, dated to 5170 ± 0.32 BP (UNL243) and from 130 cm below the surface in a blowout area, which returned a date of 170 ± 0.02 BP (UNL2550). It was felt by Bubel that these luminescence dates indicated that a period of aeolian deposition occurred around the time of kill activities that persisted for the next millennia (Bubel 2014:212-213).

7.2.7 The Anderson Site (FdOt-1)

This site located south of the town of Hardisty, Alberta, has been the subject of oilfield mitigation investigations since the 1980s. The most thoroughly investigated of a series of dune sites within the immediate area, it is found within a dune area formed from Pleistocene outwash sand and gravel topped by Holocene aeolian deposits (Quigg 1979:137; Quigg 1984:151). It was first located in the 1960s, with subsequent testing taking place in 1975 and 1978 by the Archaeological Survey of Alberta. This early work found surface materials covering an area of nearly 12,000 m^2, with recovered lithic material representative of Old Women's, Avonlea, Besant, Pelican Lake, Hanna, and Bitterroot (Mummy Cave) occupations, in addition to ceramics associated with an Avonlea point. Of these occupations, the Old Women's and Avonlea levels were found to be largely disturbed, with the older occupations possessing a greater degree of integrity, and with the Bitterroot level being the most intact cultural level. Other lithics found include debitage, unifaces, bifaces, scrapers, and a hammerstone. Also recovered was butchered and fragmentary bison bone (Quigg 1979:137-138; Quigg 1984:154-156). Four radiocarbon dates for the Bitterroot occupation were also obtained from two bison bone samples. These two samples were blended and consisted of several elements each. In addition, each sample was tested using both bone apatite and bone gelatin, resulting in two dates being obtained for each sample. For Sample #2, these corrected dates were 4345 ± 160 BP (GX6129-AL: cal 3498-2501 BC) and 4725 ± 150 BP (GX6129-G: cal 3908-3027 BC), while Sample #3 returned dates of 4370 ± 210 BP (GX6130-A: cal 3630-2488 BC) and 5460 ± 160 BP (GX6130-G: cal 4679-3966 BC). These dates have been calibrated in this volume using the IntCal 13 curve on OxCal 4.3 (Bronk Ramsey 2009). Distinctions are made between the material used to obtain these dates, with "A" signifying apatite and "G" bone gelatin (Quigg 1984:156). While the use of bioapatites in radiocarbon dating has been viewed as being questionable, recent studies have shown that it is the most reliable source of inorganic carbon to use for obtaining absolute dates, provided proper pretreatment takes place (Surovell 2000:604-605; Zazzo and Saliège 2011:60). From these results, he concluded that the site represents a series of localized encampments and felt that the site is of considerable significance to understanding the precontact history of the region (Quigg 1979:138).

Following these investigations, work at the site took place during the following 35 years due to the development of extensive oil and gas infrastructure within the region. Investigations between 1987 and 2013 determined that the site contained Middle and Late Precontact stratigraphic layers, containing Bitterroot, McKean, Pelican Lake, Besant, Avonlea and Old Women's lithics, as well as ceramic fragments from the late variant of the South Saskatchewan Ceramic Tradition, which has been associated with late Avonlea and Old Women's components. These investigations also determined that there were continuous cultural materials throughout the area, with no large sterile regions present (Wondrasek et al. 2017:40). Subsequent investigations in 2015 excavated 60 1m^2 units, 192 shovel tests, and 5 backhoe tests, which recovered over 7,300 lithics, 9,700 faunal artifacts, and 180 ceramic fragments (Wondrasek et al. 2017:42). Work within these regions concluded that two occupation layers were present, with the upper representing an Avonlea/Old Women's phase within a paleosol, and the second being undetermined due to the lack of diagnostic materials. Both of these occupations have been interpreted as being grease extraction sites, with Occupation 1 being more intensively utilized (Wondrasek et al. 2017:128-135). In addition to large amounts of fragmentary faunal material, other artifacts found consist of projectile points, utilized and retouched flakes, bifaces, endscrapers, cores, sidescrapers, flakes, and a wedge were also recovered (Wondrasek et al. 2017:127-128). Also recorded in the two occupations were numerous features, consisting of six hearths, four boiling pits, two bone uprights, six middens, and one bone-filled pit (Wondrasek et al. 2017:42).

It is this latter feature found in Occupation 1, Feature 10, which is of particular interest due to its unique layout and inferred purpose within the site. It is described as a linear distribution of faunal material and artifacts that extended through nine excavation units, with a depth extending from 15 cm to 180 cm below the present ground surface. It is suspected that this feature was not intentionally dug but was a badger den that was utilized for the placement of these materials. Approximately 450 elements were recovered, representing bison, canid, mammal, ungulate, and bird species. These remains were situated in the feature with canid remains being found at the deeper base, followed by bison material, ungulate remains, and finally cultural material at the den opening, consisting of a ceramic vessel and four projectile points (two Prairie Side-Notched and two Avonlea), a biface, endscrapers retouched flakes, cores, a wedge, a hammerstone, and flakes (Wondrasek et al. 2017:102-104). The incomplete pottery vessel, refit from 74 fragments, is similar in decoration to material recovered from the Tschetter site. Based on its attributes, it is considered to be Ethridge ware that is associated with

Old Women's and represents the transition between this phase and Avonlea (Wondrasek et al. 2017:106). Based upon the faunal remains, it is suggested that this feature was constructed during the fall months.

When consulted, Blackfoot Elders who were involved with the project indicated, based upon the depositional pattern of the faunal remains, artifacts and the presence of canid remains that the feature was of ceremonial origin. The significance of the canid remains stems from its use as a spiritual proxy for the bear, whose importance does not allow for it to be sacrificed. This importance is also underlined by the order in which remains were placed within the burrow, as it mirrors a spiritual hierarchy. Placed first within the burrow is the bear, in the form of the canid proxy, followed by bison, upon which the bulk of First Nations Plains groups subsistence is based. This is followed by ungulates, which supplemented their diet, and finally by humans in the form of cultural material. This conclusion on the usage of the feature for ceremonial purposes is reinforced by the lack of butchering marks on the canid remains, suggesting that the animals were not killed for consumptive purposes. This type of feature is not unique to FdOt-1 and has been witnessed at Head-Smashed-In Buffalo Jump (DkPj-1), the Morkin site (DlPk-2), and possibly at the Donald Site (EePl-218) near Okotoks, Alberta (Wondrasek et al. 2017:107-108).

Thirteen radiocarbon dates were obtained from the site, which were calibrated using IntCal13 (see Reimer et al. 2013). Of these, three were taken from Feature 10 at three different depths below surface (25-30 cm, 50-55 cm, and 140-145 cm). This examination returned uncorrected dates of 890 ± 30 BP (Beta 387934: cal 1040-1220 AD), 940 ± 30 BP (Beta 387935: cal 1020-1165) and 920 ± 30 BP (Beta 387936: cal 1025-1190), respectively. The next series of seven dates were obtained from Occupation 1, with results of 990 ± 30 BP (Beta 411515: cal 995-1050 AD, 1085-1125 AD, 1140-1150 AD) from within a suspected feature (Feature 7) that was later determined to be a rodent hole, 980 ± 30 BP (Beta 411512: cal 1015-1050 AD, 1080-1150 AD) from within a pit feature (Feature 15), 920 ± 30 BP (Beta 411513: cal 1025-1190 AD) at 15-20 cm DBS, 920 ± 30 BP (Beta 411514: cal 1025-1190 AD) at 25-30 cm DBS, 1060 ± 30 BP (Beta 375622: cal 900-925 AD, 945-1020 AD) at 5-10 cm DBS, 870 ± 30 BP (Beta 375625: 1050-1085 AD, 1125-1140 AD, 1150-1225 AD) at 20-25 cm DBS, and 860 ± 30 BP (Beta 375624: cal 1050-1082 AD, 1150-1250 AD) at 25-30 cm DBS (Wondrasek et al. 2017:116-128). Three further dates were obtained for Occupation 2, with results of 1160 ± 30 BP being obtained at 40-45 cm DBS (Beta 434274: cal 775-980 AD), 940 ± 30 BP at 65-70 cm DBS (Beta 434273:

cal 1020-1165 AD), and 1000 ± 30 BP at 100-105 cm below DBS (Beta 375623: cal 990-1045 AD, 1095-1120 AD, 1140-1145 AD). The report authors rejected all of the dates from Occupation 2, as it is suspected that their contemporaneity to results from Occupation 1 is due to groundwater contamination (Wondrasek et al. 2017:116-135).

7.3 Site-Specific Analysis – Saskatchewan

Archaeological sites discussed in the following sections on Saskatchewan can be seen in Figure 7.3.

7.3.1 The Tschetter Site (FbNr-1)

The Tschetter site is located west of Saskatoon within what has been identified as the Dunfermline Sand Hills. This dune feature, formed from glaciolacustrine and glaciodeltaic sediments that accumulated from Glacial Lake Saskatoon approximately 14 500 years BP, is described as consisting of blowout hollows and blowout dunes with North Battleford type ridges present in the south (David 1977: 91-93; Wolfe 2001; Wolfe et al. 2002:219). Two optically stimulated luminescence dates obtained from one profile in the Dunfermline Sand Hills found dune activation occurring at 5210 ± 220 BP and 2760 ± 320 BP (Wolfe et al. 2002:222-223). The site of a University of Saskatchewan archaeological field school, as well as testing by the Saskatchewan Archaeological Society, the Tschetter Site was excavated between 1971 and 1984 (Linnamae 1988:101). Although disturbed by the construction of both the Tschetter homestead and associated range road, it was possible to determine that the site consisted of a pound structure measuring approximately 70 metres by 50 metres enclosing a substantial bone bed. The exact shape of the pound structure is not known, although eight post holes were discovered, some within the kill area itself, suggesting that the pound was reused several times, with the boundaries changing over time. In addition to the pound itself other habitation areas were discovered, including secondary processing areas, pit features, disposal areas, meat storage pits, and one articulated buffalo spinous process buried in an upright fashion (Linnamae 1988:104–107).

Diagnostic materials recovered from FbNr-1 consist of approximately 270 complete and incomplete Prairie Side-Notched projectile points (Linnamae 1988:109; Prentice 1983:99-102).

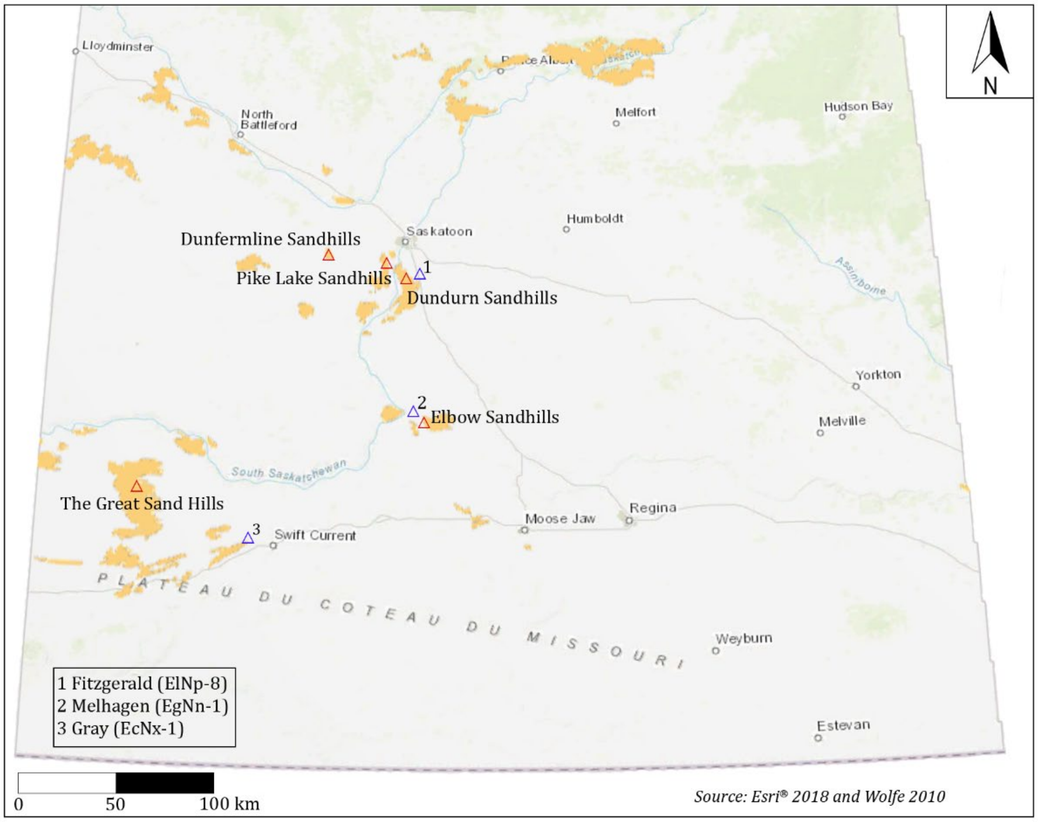

Figure 7.3 - Saskatchewan Archaeological Sites Used in the Analysis

*(*blue triangles indicate archaeological sites; red triangles indicate individual sand sheets and their respective names)*

In addition, 92 ceramic sherds were also found, representing a minimum of four separate vessels. All styles conform to what Byrne (1973) has identified as a Late Variant of the Saskatchewan River Basin Complex, which has been associated with Prairie Side-Notched points (Prentice 1983:134). This complex was first defined by material from four sites in southern Alberta, although different variants of this style have been found in a number of Saskatchewan sites, including Long Creek, Garratt, and Lumsden. In addition, surface materials have been found near Dundurn and Saskatoon (Byrne 1973:373-376; Prentice 1983:134). Date ranges for the Late Variant span from between 800 BP to 1700-1800 BP (Byrne 1973:341).

While excavations at the Tschetter Site have found evidence for a bison pound structure, the habitation and camping areas have not been discovered (Linnamae 1988:115). Dental cementum from bison molars recovered from the Tschetter Site was used to establish the seasonality for the occupation as sometime between December and late March (Peck 2001:187-188), a finding that corresponds with previous studies using tooth eruption and wear that found the site to be used during the late fall to winter, as well as with conclusions drawn based upon the location of the site (Linnamae 1988:91; Prentice 1983:195; Walker 1979:53-60). Two bone samples were obtained for radiocarbon dating from the bone bed at the site, with a third bone sample obtained from an area south of the bone bed. These samples returned uncalibrated dates of 1005 ± 75 BP (S-669: cal 1060 [933] 800 BP), 914 ± 45 BP (S-1631: cal 935 [832] 729 BP), and 1020 ± 100 BP (S-2225: cal 1160 [938] 720 BP), respectively (Prentice 1983: 32). These dates were later calibrated by Morlan (1992) using the CALIB program (Morlan 1992:29). One further uncorrected date of 1035 ± 40 BP (NZA 15751) was obtained by Leyden (2004) from a bone sample, which was calibrated using Stuiver et al. (1998), and returned a modern date that is thought to be due to either contamination or the submission of a modern bone sample (Leyden 2004:65-67).

7.3.2 The Harder Site (FbNs-1)

Another significant site located within the Dunfermline Sand Hills is the Harder Site. Situated within a large depression, this site consists of six to eight dwelling floors, Oxbow projectile points, stone tools, fire-cracked rock, bone fragments and anvil stones. Bone fragments found represent not only bison, but other animals as well, including martin, fox, rabbit, moose and canid (Dyck 1972a:28, 1977:35-49). Based upon the artifact assemblage, Dyck determined that the area was used as a campsite where bone breaking, hide processing and lithic reduction activities took place (Dyck 1977:196-197). Although numerous activities are represented at the Harder Site, one that is not is the primary kill area that supplied the vast quantities of bison bone found. Dyck speculated that the kill area lies elsewhere, possibly as close as 200 metres away (Dyck 1977:198-199). Further analysis of the faunal collection by Morlan (1994) determined that the fracture patterns present indicates that butchered limbs may have been frozen and stored prior to processing (Morlan 1994:773). Additionally, he noted charring in some of the canid remains, causing him to speculate that dogs were butchered and consumed at the site for their fat reserves (Morlan 1994:771). Lastly, he concluded the assemblage represented a kill pattern indicative of several smaller hunts, rather than one typical of a large-scale kill, although he did not discount the possible use of a pound at the site. He further noted that particular emphasis was placed upon the hunting of young bulls and cows (Morlan 1994:768-770). This evidence for the use of small individual kills corresponds with conclusions drawn by Dyck on Oxbow hunting patterns and site visibility, as Oxbow kill sites are not commonly found within the archaeological record. He attributed this absence to site visibility, as individual kills are harder to detect in the archaeological record than larger-scale hunting practices like jumps and pounds (Dyck 1977:10, 1983:96). This conclusion was supported by Green (2005) in his re-examination of the Oxbow Dam site in southeastern Saskatchewan. He postulated that the use of individual kills by Oxbow groups was rooted in the subsistence patterns of ancestral Mummy Cave groups, who inhabited the region during the Altithermal Period. Due to the aridity of the period, the use of individual or small group kills allowed for bison populations to be hunted during periods of environmental stress without causing the collapse of individual herds. Although living on the Northern Plains during moister conditions, these behaviours may have been maintained by Oxbow groups (Green 2005:101).

Uncalibrated radiocarbon dates obtained by Dyck from charred, comminuted bone date the site at 3360 ± 120 BP (S-490: cal 3909 [3626] 3369 BP) and 3425 ± 105 BP (S-668: cal 3979 [3690] 3459 BP), which were calibrated by Morlan using the CALIB software (Dyck 1977:31; Morlan 1992: 29-30; Wilmeth 1978:103-104). During his reanalysis of the faunal material from the Harder site, Morlan (1994) suspected that these dates were the result of contaminated samples, based upon mineral deposits found coating and enriching the collection, and obtained a second series of dates. Three samples of unburned bone he submitted for testing produced uncalibrated dates of 3420 ± 140 BP (S-3453: cal 4082 [3689] 3369 BP), 4410 ± 150 BP (S-3444: cal 5459 [4986] 4572 BP) and 4190 ± 90 BP (S-3452: cal 4972 [4729] 4451 BP), which were calibrated using the CALIB program (Morlan 1994:760; Stuiver and Reimer 1986). This discrepancy of almost a millennium is attributed to contamination from modern carbon present within groundwater. It is believed that this contamination, and subsequent diagenetic changes in the bone, resulted from the dune depression that the site is located in periodically becoming inundated with groundwater from the region's groundwater recharge and discharge system (Morlan 1994:761). These findings also reinforce the conclusion that radiocarbon dating pretreatment practices in place at the Saskatchewan Research Council Laboratory for the first 1299 samples were inadequate to eliminate contamination. The conclusion that the site is actually older than originally stated is reinforced by a radiocarbon date taken by Leyden (2004) that returned an uncorrected result of 4221 ± 45 BP (NZA 15746: cal 6510-6796 BP) that was calibrated using Stuiver et al. (1998) and the INTCAL 98 software (Leyden 2004:67).

Seasonality for the campsite was difficult to assign, but due to the great distance between the site and stable sources of water Dyck (1977) concluded that the area was occupied during a time of year when snow was present. This claim can be disputed using findings from Wiseman et al. (2006), who found that the location of permanent water sources did not play as large a role as thought in the location of sites within the Lauder Sandhills (Wiseman et al. 2006:448-449). However, Dyck’s conclusion was supported by an analysis of tooth eruption and wear patterns, which Morlan (1994) believed to represent multiple kill events during the winter months (Dyck 1977:199; Morlan 1994:767).

7.3.3 The Rousell Site (FbNs-2)

Research in the Dunfermline Sand Hills during the late 1960s and early 1970s also uncovered several other, less well-documented, archaeological sites. First of these is the Rousell Site, located within a shallow stabilized dune depression crosscut by north-south and east-west roadways. Ian Dyck first recorded this site in 1969, when pockets of mammal bone were found eroding out of the road cuts however, the area was only investigated in 1971 when two Oxbow projectile points were discovered on one of the roadways. Subsequent testing found that the bone concentrations located in the road cuts were associated not with Oxbow materials, but Avonlea (Dyck 1972a:7). Dyck speculated that, as the Oxbow points were found near the bottom of the depression on a dirt road, they represented either a lower, undiscovered occupation to the Rousell Site, or intrusive material from the nearby Harder site (Dyck 1972a:7-8). Faunal material found *in situ* indicates that the area may have been used as a either a habitation site or a kill site where some butchering took place, as both articulated portions of bison skeleton and fractured bones are present. Although discovering no direct evidence for the hunting method employed at the Rousell Site, Dyck speculated that either a pound or surround was used to trap and kill a minimum of three bison (Dyck 1972a:6-9). A blended bone sample sent for radiocarbon dating returned an uncorrected date of 1185 ± 70 BP (S-670: cal 1280 [1080] 950 BP) that, using Stuiver and Reimer (1986), was calibrated (Morlan 1992:30; Rutherford, Wittenberg, and McCallum 1975:342; Wilmeth 1978:107).

7.3.4 The Carruthers Site (FbNs-3)

Also found by Dyck in the Dunfermline Sand Hills during this period was the Carruthers Site, another site discovered as a result of roadway disturbance. From surface collecting and excavation, three Oxbow projectile points and one Oxbow triangular biface uncovered, as well as numerous end scrapers, unifaces, bifaces, retouched flakes, and bipolar core fragments (Dyck 1972a:12-13). Faunal remains were highly fragmented, resulting in only a small sample (84 grams out of 420 grams) being identified tentatively as *Bison bison*. A blended sample of bone taken from nine profiles found along the roadway ditch were sent for dating (S-742: cal 3459 [3295] 3009 BP), which returned an uncorrected date of 3050 ± 80 that was corrected using Stuiver and Reimer (1986) and the CALIB program (Morlan 1992:30). Dyck concluded that this site represented an Oxbow occupation but did not speculate on the exact activities that took place here due to a lack of concrete evidence. However, he did mention that the lithic assemblage found at the Carruthers Site was similar to that found at the nearby Harder Site; as such, the Carruthers Site may also represent a bison kill and camp site located within a dune environment (Dyck 1972a:14).

7.3.5 The Goosen Pasture Site (FbNs-15)

Also located in the Dunfermline Sand Hills is the Goosen Pasture site, which underwent limited salvage excavation by the University of Saskatchewan and the Saskatchewan Archaeological Society in 1984 when a hearth feature and associated artifacts were found eroding out of a road cut bank (Smith and Richards 1987:1). Excavation of fourteen shovel tests and one excavation block recovered 10 tools and 150 pieces of debitage. Of the tools found, three are Avonlea preforms, while two are unifaces, four are utilized flakes, and one is a biface (Smith and Richards 1987:24-31). Pottery found at the site consists of 100 sherds, represented by two neck sherds, 26 large body sherds and 72 small body sherds. Decorations in the form of exterior punctates are found on the two neck sherds. These remains are thought to represent one vessel that has been classified as a net-impressed, concoidal, straight-walled Avonlea pot similar to those found at the Lebret site (Smith 1986:182-185; Smith and Richards 1987:23-24). As well, fifteen identifiable bison elements representing one mature and one immature individual, in addition to 1.5 kilograms of unidentifiable burned and unburned bone, were also recovered (Smith and Richards 1987:18-22). One hearth feature, located at the bottom boundary of a paleosol overlying a layer deposited through aeolian processes, was also recorded, leading Smith and Richards to conclude that the site was occupied during a period of stability when the paleosol was just forming (Smith and Richards 1987:14-16). They further speculated that the site was a single occupation that represented a disposal area where ash and garbage may have been deposited (Smith and Richards 1987:33-34). One radiocarbon date (S-2690: cal 1270 [986] 790 BP) was obtained from an unburned bison bone, returning an uncorrected date of 1095 ± 110 BP that was corrected using Stuiver and Reimer (1986) and the CALIB program (Morlan 1992:30; Smith and Richards 1987:33).

7.3.6 The Moon Lake Site (FaNq-5)

A fourth site excavated by Dyck, located in the Pike Lake Sand Hills is the Moon Lake Site, a dune formation that is similar to that of the Dundurn Sand Hills mentioned previously (David 1977:93-94). It is identified as a short-term Oxbow campsite located near Moon Lake, an oxbow pond. Lithic tools recovered consist of four Oxbow points, two unnotched triangular points, one drill, three complete bifaces, two biface fragments, seven scrapers, and one scraper fragment (Dyck1970:27; Morlan 1992:25). Also found were 421 flakes that displayed no signs of retouch (Dyck 1970:15-16). Faunal material recovered consisted almost exclusively of elements from two bison, in addition to the long bone of a goose. Long bones from the bison were found to be broken and, in some cases, burned, indicating that they were processed for marrow extraction (Dyck 1970:16). Features found at the site consist of a hearth and a row of postholes that extend back from the hearth feature, which Dyck speculated might be the remains of a structure, most likely a wind-break (Dyck 1970:10). Based upon these results, Dyck believed this site to represent a small campsite where tool reduction and small-scale kill and processing activities took place. Based upon the presence of goose remains, it was thought that the site was occupied during either the Spring or Fall (Dyck 1970:17). One radiocarbon date (S-403: cal 4859 [4606] 4409 BP) obtained from a blended sample of burned bison bone obtained from different units in the site returned an uncalibrated result of 4100 ± 90, which was calibrated using Stuiver and Reimer (1986) and the CALIB program (Dyck 1970:16; Morlan 1992:25).

7.3.7 The Grandora Site (FaNr-2)

Last of the dune sites to be examined by Dyck in the Pike Lake Sand Hills is the Grandora Site, a multi-component site located twelve kilometres west of Saskatoon. Like other sites in the area, it was also discovered as a result of roadway disturbance, in this case the construction of what is now Highway 14. First identified by a local avocational archaeologist, who also collected cultural material disturbed by construction activities, the site was tested by Dyck in 1966, who returned in 1969 to carry out more detailed excavations (Dyck 1972b:1). Based upon the results obtained from this work, Dyck concluded that the site contained three separate components, represented by the presence of Pelican Lake, Oxbow, and Besant projectile points (Dyck 1972b:3). Of these three, the least is known of the Pelican Lake and Oxbow components, as all diagnostic material for these components were discovered during surface collecting activities, although Dyck suspected that they originated from a calcareous deposit associated with the cessation of aeolian activities located approximately one metre below the surface and were displaced as a result of construction activities. This layer was found to contain fragmented bison bone and teeth and was dated using a soil sample to an uncorrected date of 3730 ± 80 BP (S-489: cal 4404 [4089] 3869 BP) that was corrected using Stuiver and Reimer (1986) and the CALIB program (Dyck 1972b:6-8; Morlan 1992:26).

Unlike the older components of the site, *in situ* diagnostic materials were found for the upper component, which contained two complete and six broken Besant projectile points, in addition to bifacial and unifacial scrapers. Debitage was also represented in the site collection, as 1115 flakes were discovered *in situ* (Dyck 1972b:9-11). Organic material collected at the site consists of the fractured remains of one bison, including the skull, atlas, axis, carpals, tarsals, and phalanges. Also found were heavily charred partial remains of a dog, in addition to several chokecherries (*Prunus virginiana*) that have been charred (Dyck 1972b:11-12).

Dyck concluded that this earlier occupation represented a very short-term stay of perhaps a week or less, due to the presence of only one butchered bison. Activities that took place include camping, bone processing and bone grease extraction, and the sharpening and thinning of lithic tools. Bones present within a hearth feature represent not their use as fuel, but as a bed for the fire itself as the fragments would absorb a large amount of heat from the fire and release it slowly and consistently over time. Based upon the presence of charred chokecherries, the site was classified as a late summer to early fall occupation (Dyck 1972b:12-15). One uncalibrated radiocarbon date of 1560 ± 60 BP (S-542: cal 1570 [1472] 1330 BP), calibrated using the CALIB program (Stuiver and Reimer 1986), was obtained from insoluble collagen from charred bone located in two adjoining excavation units (Dyck 1972b:9; Morlan 1992:26).

7.3.8 The Gowen Sites (FaNq-25 and FaNq-32)

First excavated in 1977 and 1980, the Gowen Sites were also located in the Pike Lake Sand Hills (Walker 1992:1). It is believed that the two sites are related, with Gowen 1 (FaNq-25) being a processing site and Gowen 2 (FaNq-32) a habitation area (Walker 1992:110). Lithic material recovered from Gowen 1 were mostly constructed from quartzite and chert, and consist of 23 Gowen points, a preform, bifaces, bifacial knives, scrapers, unifaces, gouges, spokeshaves, perforators, anvil stones, hammerstones, bipolar cores, flakes, and retouched lithics (Walker 1992:43-65). Bone tools found at Gowen 1 consist of a bone tube, as well as several flaked and polished bone fragments (Walker 1992:66-70). Approximately 95% of the faunal remains were bison, with evidence for the presence of two wolves, two medium-sized canids, one antelope, pocket gophers, and a crow. Macrofossils obtained through flotation samples produced six macrofossils of *Chenopodiaceae* spp., possibly Goosefoot or Lamb's Quarters. Based upon the faunal remains and the macrofossils, indicate a late summer or autumn occupation (Walker 1992:97-103). Features at Gowen 1 consist of three hearths and four pits (Walker 1992:110-111).

Gowen 2, discovered three years after Gowen 1, is interpreted to be a habitation area. Lithic material obtained from excavations consist of over 70 Gowen points, two Oxbow points, two Bitterroot points, hafted bifaces, bifacial knives, scrapers, unifaces, gouges, perforators, an anvil stone, hammerstones, cores, core fragments, flakes, and retouched lithics (Walker 1992:71-90). Also found was a piece of polished bitumen, suggested to be a bison form, and a polished concretion that was broken in half (Walker 1992:95-96). Bone tools consist of awls, perforators, knapping tools, and several tools of indeterminate use (Walker 1992:94-95). Similar to Gowen 1, faunal material recovered at Gowen 2 was dominated by bison, with a MNI value of fourteen, although Least chipmunk, pocket gopher, muskrat, swift fox, coyote, three wolves, and two medium-sized canids were also present. Despite the presence of abundant faunal material, seasonality could not be accurately determined (Walker 1992:103-107). Eleven features were also recorded at Gowen 2, consisting of two ash concentrations, four hearths, one pile of hearth ash that had been removed and discarded, one hearth and associated pile of hearth ash, one post hole, and two activity areas, one interpreted to be a habitation area where a hide was staked out and the other a lithic reduction area (Walker 1992:115-119).

Radiocarbon dates were obtained for both Gowen 1 and Gowen 2, with five dates obtained for the former and six for the latter. From bone collagen from bison bone, Gowen 1 produced uncorrected dates of 4730 ± 130 BP (S-1526: cal 5729 [5463] 5049 BP), 5670 ± 135 BP (S-1527: cal 6843 [6461] 6309 BP), 5760 ± 140 BP (S-1448: 6889 [6584] 6299 BP), 6070 ± 200 BP (S-1488: cal 7403 [6913] 6459 BP), and 6150 ± 110 BP (S-1457: 7274 [7088] 6751 BP) that were calibrated using the CALIB program (Stuiver and Reimer 1986). Uncorrected radiocarbon dates from Gowen 2 are 5080 ± 150 BP (S-2036A: cal 6189 [5795] 5484 BP), 5910 ± 170 BP (S-2036B: cal 7179 [6738] 6319 BP), 5670 ± 110 BP (S-2037: cal 6729 [6461] 6289 BP), 5920 ± 130 BP (S-1970: cal 7159 [6774] 6449 BP), and 6080 ± 160 BP (S-1971: cal 7289 [6949] 6562 BP), were also calibrated using the CALIB program. For samples S-2036A and S-2036B, the same piece of bone was tested, with the latter sample being treated with 1 M HCl to remove contaminants (Morlan 1993:67). One further uncorrected date of 5863 ± 55 (NZA 15746: cal 6795-6510 BP), obtained by Leyden (2004), was calibrated using Stuiver et al. (1998) (Leyden 2004:67). In his original interpretation of the site using t-tests Walker (1992) excluded the date of 4725 ± 130 BP, and using the averaging technique outlined by Long and Rippeteau (1974) determined that the average occupation date for both sites to be 5870 ± 48 BP (Walker 1992:25).

7.3.9 The Whiting Slough Site (ElNs-10)

Also located in the Pike Lake Sand Hills was the Whiting Slough Site, a single occupation Avonlea kill site and primary processing area. The site was first discovered in 2013 during assessment for proposed Highway 7 expansion south of Vanscoy. In initial testing, one Avonlea point, one piece of shatter, and 371 faunal remains were recovered (Sullivan and Whatley 2013:41; VanderZwan 2016; VanderZwan and Pollio 2016:17-18). Subsequent testing and mitigative excavation in 2015 uncovered extensive deposits that are felt to represent an Avonlea buffalo pound and primary processing area. Almost all of the artifacts and features are located within a single black organic layer (VanderZwan 2016). At the time of writing, 261 593 artifacts have been recovered from the site, with material from Stage 3 excavations still undergoing analysis. Included in this count is a minimum of 175 Avonlea points and 31 tools, including scrapers, a chopper, bifaces, retouched flakes and three possible bone tools. Faunal analysis has determined an MNI for the site between 35 and 40 animals, with bird, rodent, and canid remains also found. Element analysis has found a high number of low utility elements, including vertebrae, ribs, mandibles, and lower limb components. Element distribution across the site is not viewed as random, with distinct concentrations of highly crushed and burned faunal material, in addition to other concentrations of unburned complete bones (VanderZwan 2016).

One of the most interesting aspects of this site is the presence of bone upright features. To date, 38 uprights have been found, consisting of rib, vertebrae, mandible, and lower limb elements placed into intentionally dug holes. These features are roughly laid out in four parallel lines across the site. Other features noted are circular pits containing crushed and burned bone, which are occasionally surrounded by unburned bone, and small clusters of bones that are found on top of grey soil staining (VanderZwan 2016). Five uncorrected radiocarbon dates were obtained for this site, with four taken from within or above the occupation layer and one below. These dates have been calibrated in this volume using the IntCal 13 curve on OxCal 4.3 (Bronk Ramsey 2009). Of these four, two dates were obtained for bone uprights, with results of 1330 ± 20 BP (ULA-6042: cal 651-764 AD) and 1320 ± 20 BP (ULA-6043: cal: 656-765 AD). Within the paleosol a third date of 1325 ± 15 BP (ULA-6040: cal 655-764 AD), with a fourth date of 3645 ± 20 BP (ULA-6053: 2125-1945 BC) being obtained above the paleosol. The final bone sample, obtained from below the paleosol, returned a date of 3700 ± 20 BP (ULA-6052: cal 2190-2029 BC). Of these five, the date for ULA-6053 is suspected of being erroneous due to rodent disturbance (K. VanderZwan, personal communication, 2017).

7.3.10 The Hartley Site (FaNp-19)

Excavations at the Hartley Site, a multi-component occupation located on the south side of Saskatoon, have been conducted since the 1950s. The site was located on the edge of the Moose Wood Sand Hills, a minor aeolian deposit that is part of the Dundurn Sand Hills formation, on a stabilized surface that was also a wetland after the site was occupied. The Dundurn Sand Hills are formed from glaciolacustrine sediments that were deposited as a result of an ice dam that formed across part of the South Saskatchewan River valley. The area is marked by blowout dunes and blowout hollows in the north and North Battleford-type sand ridges in the south (David 1977:91-93; Hanna 2007:28-30; Stantec 2003:3.1; Wolfe 2001). Occupation of the site has occurred for over the past 2,000 years, with excavated evidence for usage by Avonlea, Old Women's and Mortlach groups, with the latter two represented by both pottery and Plains and Prairie Side-Notched points (Clarke 1995:8-12; Hanna 2007:30). In addition, some protohistoric material has also been discovered, in the form of copper or brass sheeting, as well as an iron projectile point (Clarke 1995:12; Hanna 2007:28; Meyer 1995:9).

Four chronometric dates have been obtained for the Hartley Site using two different dating techniques. The first, a radiocarbon date obtained from an adult bison tibia produced an uncalibrated date of 1120 ± 60 BP (S 3382: cal 762-1013 AD) that has been calibrated using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program (Rev. 2.0). Taken from the same area was a thermoluminescence sample from a hearth feature, which produced a date of AD 700 ± 360 (DUR 93TL170-1ASpfg) (Clarke 1995:17-18). The area that both of these dates were obtained from is associated with what is believed to be a single Avonlea/Old Women's transition occupation. Two other radiocarbon dates were obtained from an area of the site more associated with the Mortlach phase occupation, producing uncalibrated results of 709 ± 40 BP (BGS 2663: cal 1239-1390 AD) and 814 ± 40 BP (BGS 2790: cal 1159-1284 AD) using Stuiver and Reimer (1993) (Hanna 2007:31-32).

Analysis of the faunal collection from the Avonlea/Old Women's component produced three important conclusions on the usage of the Hartley Site. First, there is the high diversity of species found at the site. Twenty-two different vertebrate species and four genera of invertebrates were identified, including the remains of bison, wolf, fox, rabbit, squirrel, teal, pike, raven, and mussels (Clarke 1995:32-33). While some of these species found are the result of natural deposition, there is strong evidence that a wide range of faunal resources were exploited. Secondly, the mortality pattern from the bison remains indicates that animals were killed on an occasional, small-scale basis rather than in a larger-scale communal kill. In his work analyzing the collection from this site, Clarke does not feel that this conclusion may be the result of a smaller sample size (Clarke 1995:200). Thirdly, there is the question of seasonality, which was examined by both Clarke (1995) and Farrow (2004). Examining both macroscopic and microscopic faunal remains, they both concluded that there is evidence for an extended period of occupation over the course of the year. Using data obtained from bison foetal material and mandibles, it was determined that the site was occupied from December to late March (Clarke 1995:55). However, evidence from both migratory waterfowl and rodent remains found at the site indicate that it was occupied from late April/early May to early November. This hypothesis for a winter to spring habitation period is supported by the presence of fish species, such as pike, that normally spawn during the spring months (Clarke 1995:124; Farrow 2004:70-71).

7.3.11 The Fitzgerald Site (ElNp-8)

Located in the Moose Wood Sand Hills is the Fitzgerald Site, a Besant bison pound with an associated processing area. Excavated in 1992 and 1993, the site consists of a single cultural component located within a 15-centimetre-thick paleosol approximately 50 to 75 centimetres below the present ground surface (Hjermstad 1996:30). Examining the material culture, the site produced not only 148 complete and incomplete projectile points, but also 22 other stone tools (bifaces, unifaces, end scrapers and a pièce esquillée) and over 260,000 bison bone fragments (Hjermstad 1996:47). Pottery collected at the site consists of only two undecorated ceramic sherds and one round daub, or hardened ball of clay (Hjermstad 1996:81).

In addition, a number of unique features were discovered, including a bone bed, a pit feature, an area of burned bone, seven post holes, some of which contained bone uprights (a bone or bone fragment inserted vertically into the soil), and a single bone upright not associated with a feature (Hjermstad 1996:85-93). For the faunal remains, an MNI value of 49 for the excavated portion of the site was calculated, with speculation by Hjermstad that the MNI value for the entire site may be closer to 800 (Hjermstad 1996:114). Butchering patterns show that elements were highly processed, with both what the individual elements themselves are and the degree of processing that they were subjected to differing between the kill and processing areas (Hjermstad 1996:214).

Four radiocarbon dates were obtained from collagen removed from faunal material obtained from two locations at the site and were sent to two different laboratories. This testing procedure produced uncalibrated dates of 1160 ± 170 BP (S 3547: cal 1070 - 1410 BP), 1270 ± 140 BP (S 3546: cal 1210 – 1490 BP), 1340 ± 60 BP (Beta 69004: cal 1355 - 1485 BP), and 1490 ± 90 BP (Beta 69005: cal 1480 - 1660 BP), which were calibrated using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program (Rev. 2.0) (Hjermstad 1996: 25). Of these dates, the latter two dates from Beta Analytic are seen as more accurate due to their lower standard deviation. Overall, Hjermstad accepts a weighted, non-calibrated average date of 1362 ± 45 BP, with a weighted calibrated average date being placed at 1283 ± 20 BP, which is consistent with other known Besant Complex sites in Saskatchewan (Hjermstad 1996:25-29). A fifth uncalibrated date of 1563 ± 45 BP (NZA 15750: cal 1341-1543 BP) was obtained by Leyden (2004:67), which was calibrated using Stuiver et al. (1998). Seasonality for the site usage was determined as being between late October and early December using immature bison mandible and maxillary elements (Hjermstad 1996:146).

7.3.12 Finn Bog Locality (ElNo-3, ElNo-3b, and ElNo-3c)

Within the Dundurn Sand Hills are three sites classified under one Borden number, ElNo-3. These four sites, excavated over the course of sixty years, are found in proximity to and within a bog located north of the town of Dundurn. The first of these, the Finn Bog site (ElNo-3), is not well documented, as all original field notes and documents were destroyed during a records culling that occurred at the Royal Ontario Museum in the 1970s or 1980s (McCann 1986, 1995:1). What is recorded is that the site was discovered in 1923 by the landowner, who found faunal material eroding out of the bog. This material was sent for examination to the Royal Ontario Museum, who incorrectly concluded that the remains were from *Neomeryx finni*, a species of antelope now extinct on the Plains (McCann 1995:1). These findings prompted excavations to be conducted at the site in 1924, which recovered over 450 artifacts from two excavations located within the main spring, and the second two feet away. This work recovered debitage, projectile points, ground stone artifacts, and faunal material (McCann 1986).
Of greatest note is the amount and diversity of worked faunal material found, including beads, pendants, and gorgets shaped from the shells of local freshwater clams (*Lampsilis radiata*), bone beads shaped from elk teeth, fish vertebrae, and a bird talon, pendants made from teeth and bone, and a bone whistle. In his re-examination of the Finn Bog assemblage in the 1980s, McCann (1986) reiterated an observation made by King (1961) on the similarities between gorgets found at the Finn Bog Site and at the Bracken Cairn, a Pelican Lake burial site in southwestern Saskatchewan containing the remains of at least five individuals, concluding that the gorget style may be used as a diagnostic marker for Pelican Lake. Based on these stylistic attributes, he further disassociated this material from gorgets found at the Gray Site, an Oxbow cemetery examined in section 7.3.17 (King 1961:49; McCann 1986; Walker 1982:10-29). Other worked-bone artifacts recovered included awls and suspected pegs, handles, and digging tools. Diagnostic lithic artifacts consist of Oxbow, Pelican Lake, Duncan, Avonlea, Sandy Bay, Prairie

Side-Notched and Plains Side-Notched projectile points (McCann 1986; McCann 1995:92). In addition to debitage, ground stone artifacts were also recovered, consisting of at least one pestle-shaped object and grooved mauls (McCann 1982:10, 1995:97). Stratigraphy at the site was recorded as being “muck” for the upper four feet (1.2m), overlaying sands that continue for another six feet (1.8m) before encountering basal clays similar to that found in shallower stratigraphy surrounding the site. All cultural material was recorded as being found ten feet (3m) below the surface at the sand/clay interface, with the sand matrix being coarse and containing gravels (Parks 1925:429-30).

Subsequent fieldwork conducted by McCann in the early 1980s saw him designate two additional localities to the site: the Cline Locality (ElNo-3b), located approximately 50 metres southeast of the Finn Bog Site, and the West Finn locality (ElNo-3c), located immediately west of the Fin Bog site along the shore of the bog. This work recovered diagnostic projectile points (two Pelican Lake and an Oxbow), as well as lithic tools tools and debitage. In addition, faunal remains from a number of different species (bison, mollusk, muskrat, canid, small and large bird, fish vertebra) were found, as well as and a drilled shell fragment and a possible hearth (McCann 1982,1983:50, 1986, 1995:21-38). In spite of these results, the data and conclusions from this work are not included in this examination, due to the lack of detailed information and documentation on the later excavations. The material from the 1924 excavations however, are included due to the Parks (1925) article available on the work, as well as the photos of the artifacts taken by McCann in his reassessment of the site.

7.3.13 The Great Sand Hills

The Great Sand Hills are the largest dune area within the Canadian Plains, covering an area of 1136 km^2. They originate from glaciofluvial and glaciolacustrine deposits, which underlie dune and blanket sands, as well as localized occurrences of loess (David 1977:82, 1993:62). These deposits derive from sandstone bedrock eroded during the most recent period of glacial advance, approximately 18,000 to 13 000 years BP (Townley-Smith 1980a:10). Contained within the Great Sand Hills is a wide range of dune forms, consisting mostly of various types of blowout and parabolic dunes. Four distinct types of physiographic features have been identified in the Great Sand Hills, consisting of active complexes, where deposition and erosion takes place, stabilized dunes, sand flats, and stabilized sand flats (Townley-Smith 1980a:16). Aeolian deposits in the region vary between 1.5 to 30 metres in depth, while soil development is weak, which acts as an inhibitor to vegetation growth with some depressed areas containing saline soils. The periphery of the Great Sand Hills is clearly demarcated from the surrounding grasslands in the west, with a more gradual transition present in the east in the form of elongate dune projections originating from the main body of the sand hills. The eastern periphery also contains seasonal alkali lakes and non-sandy morainic hills and ridges (David 1977:83; Townley-Smith 1980a:10-12).

Due to the significance of the Great Sand Hills, the area has been the focus of intensive archaeological study. Much of the work undertaken has been conducted at an avocational level, although professional surveys and mitigation work has occurred as well. Unfortunately, many of the reports on the findings from this work are currently unavailable. Of the available works, the most notable is the study conducted by the Saskatchewan Department of the Environment in the late 1970s and early 1980s. Survey and testing programs initiated by Epp and Johnson in the area found an archaeological record that extends from 11 000 BP to the Historic period (Epp and Johnson 1980:131). This work built on earlier work done by Epp, which examined the spatial distribution of sites within both the sand hills and the surrounding area (Epp 1972:6-13, 1974:13-14). This work resulted in the documentation or re-visitation of 68 sites within the Great Sand Hills. Of these, 51 are listed as multi-component sites, 20 have affiliation with Oxbow material, 38 with Prairie Side-Notched material, and 28 with Plains Side-Notched points (Epp and Johnson 1980:101-109). Among these sites is EeOh-6, which is listed as a ceremonial site that also contains human burials. Not associated with any diagnostic material, it contains the remains of at least one individual that is found immediately west of a semi-circular north/south line of nine animal skulls (eight buffalo and one elk), all of which have their horns pointing east. Although not affiliated with a particular period, historic materials, including a brass projectile point, have been found at the site (Epp and Johnson 1980:102; N. Friesen, personal communication, 2011).

Also, of importance is EdOh-23, a single occupation Besant site located within an exposed paleosol within an activated dune. Surface materials collected include two complete and five incomplete Besant points, in addition to knives, retouched flakes, endscrapers, a chopper, fire-cracked rock, and bison bones. One radiocarbon date was submitted from bone collected from the surface, which returned an uncorrected result of 1675 ± 115 BP (S-2348:87-605 AD) which has been calibrated in this volume using the IntCal 13 curve on OxCal 4.3 to 87-106 AD and 120-605 AD (Bronk Ramsey 2009). Johnson (1983) speculated that one of the attractions for people to use this site was a shallow spring located 1500 metres away that may be obtained if needed by digging (Johnson 1983:41-44).

Overall, diagnostic material from all the sites within the Great Sand Hills consists of projectile points representing all Precontact time periods found on the Northern Plains, as well as pottery fragments, although the cultural affiliation for these sherds is not given. Point types found consist of Alberta, Oxbow, Pelican Lake, Avonlea, Besant, Prairie Side-Notched and Plains Side-Notched.

While extensive, the work conducted by Epp and Johnson were not the only investigations conducted in the Great Sand Hills. Although limited in number, there are several reports available on mitigation work done within the region that examined sites similar to those found in other dune areas but have not been excavated to the same extent. First among these is EcOf-2, discovered in 1972 eroding out of a road cut, and noted by Epp and Johnson (1980). Although surface materials were recorded collected between 1972 and 1978, and four shovel tests dug, no records exist documenting this work other than a site form. What is known from this time period is that numerous tools were found at the site, including an awl fragment, bifaces, preforms, blades, and unifaces, in addition to large amounts of bison bone, fire-cracked rock and pottery sherds. Diagnostic material either recorded or collected consists of 19 projectile points and point fragments, including Plains Side-Notched, Prairie Side-Notched, and one possible Avonlea. At the time, it was felt that this site represents a bison processing area, with the possibility that a large kill area nearby (Paquin and Novecosky 2006:101-102).

This site was investigated again in 2003 when the potential arose for the site to be affected by development. Subsequent examination of the road cut found thousands of large mammal bone fragments in the area, in addition to a large assemblage of lithic artifacts, including flakes, shatter, retouched flakes, unifaces, bifaces, cores, and fire-cracked rock. In addition, pottery fragments were also observed and collected, but did not have any diagnostic features. Stratigraphy of the site was recorded along a road cut, where four paleosols were recorded, with the deepest containing burned and unburned bone fragments (Paquin and Novecosky 2006:103). The dimensions of the site were estimated to be 2 kilometres east-west, and an unknown distance north-south (Paquin and Novecosky 2006:105).

Also inspected, as part of a historical resources impact assessment, is EdOh-21, a large site that was examined in 1990 to determine if it was going to be disturbed by nearby development. While no diagnostic material was found, a hearth feature was discovered, as well as a concentration of bone within a 15 metre by 30 metre area. These materials are associated with a buried paleosol that was seen to be intermittent and occurring at varying depths. A second paleosol was also examined within a pipeline trench and was found to contain 182 pieces of bison bone that represent two individuals, a cow and a calf. Investigators concluded that the site represents a number of small activity locales that are spread out over a large area (Dau 1991:32-35).

Lastly, there is EdOg-9, a potentially significant site discovered as a result of survey work for a planned pipeline. First noted due to cultural material, consisting of a Besant point, a core, debitage and bone fragments, being found within a blowout area, the site was subjected to both shovel testing and excavation programs. This work uncovered three bone fragments and one faint regosol. Detailed survey of the surrounding area discovered two other surface concentrations of artifacts, with one consisting of a biface and several bison limb elements 100 metres east from the initial find spot, and the other consisting of two flakes and between 20 to 30 bone fragments 100 metres west of the initial find area. Investigators concluded that this site might represent an important, but deeply buried site (FMA Heritage Resources Consultants Ltd. 1991:38-43).

7.3.14 EgNn-9

First discovered in 1999 as part of a pipeline assessment and mitigation program, EgNn-9 is located in the Elbow Sand Hills (also referred to as the Douglas Sand Hills in the below reports), located on the north side of the Qu'Appelle Valley near the town of Elbow in central Saskatchewan. Developed from glaciolacustrine deposits of the Laurentide Ice Sheet at approximately 14 000 BP, it is composed of elongate blowout dunes, several circular and parabolic dunes, and a number of ridges that resemble North Battleford-type ridges (Dyke et al. 2003; David 1977:91). Optically stimulated luminescence dating at two locations within the dunes found evidence of dune activation at 5690 ± 240 BP, 3040 ± 40 BP, 1980 ± 80 BP, 1480 ± 60 BP, 215 ± 17 BP, and 145 ± 20 BP, with a period of soil development occurring between 2740 ± 120 BP and 1980 ± 80 BP. A radiocarbon date was also obtained from organic matter found three metres below the surface and returned an uncorrected date of 1460 ± 40 BP (GSC 761), which corresponds with the findings from the optically stimulated luminescence dating for this depth (Wolfe et al. 2007: 176; Wolfe et al. 2002:221-222).

Testing and excavation between 1999 and 2001 at EgNn-9 have shown that the site is comprised of four distinct paleosol layers in the upper 40 centimetres of the site, representing both Middle and Late Precontact occupations (Neal 2006:14). Late Precontact diagnostic material at the site consists of two Side Notched points, as well as one Late Triangular point and one possible Avonlea point (FMA Heritage Resources Consultants 2002: 392-394; Neal 2006:A1-A2). In addition, the Middle Precontact period is represented by three Besant points/fragments, three Pelican Lake points, one indeterminate point resembling either Sandy Creek or Oxbow, one possible Sandy Creek point and one indeterminate atlatl point (Neal 2006:A1-A4). Unfortunately, post-depositional processes within the Sand Hills have disturbed a portion of the original site, making it difficult to determine the exact number of occupations represented by the diagnostic artifacts. Of the points listed above, all of the Late Precontact materials were surface collected, in addition to one Pelican Lake and one Sandy Creek point (Neal 2006:207).

What can be determined from the material record is that bison procurement activities did take place during all time periods, as indicated by the presence of both fragmented faunal remains and processing tools, including bifaces, scrapers and fire-cracked rock (Neal 2006:83). A single uncorrected radiocarbon date of 4600 ± 40 BP (Beta 167308: cal 3517-3118 BC), calibrated in this volume using the IntCal 13 curve on OxCal 4.3, was obtained for one occupation layer thought to be associated with a possible Oxbow occupation in another part of the site. However, owing to possible contamination found in other areas of the site, this single date is questioned by the author (Bronk Ramsey 2009; Neal 2006:85).

7.3.15 EgNo-23

Discovered along with EgNn-9 as part of an oilfield mitigation project, EgNo-23 is a multi-component site in the Elbow Sand Hills. First recorded by a regional collector in 1986, subsurface deposits were unearthed in 1999 during the monitoring of pipeline excavation (Neal 2006:86-87). Disturbed archaeological material found within the backdirt of this development consists of 65 lithic tools, 20 cores, 486 pieces of debitage, one Avonlea point, two Besant points, one possible Pelican Lake point, one possible Hanna point, one McKean point, and seven fragmentary points. Also recovered were 4249 faunal specimens representing an MNI of 19 individuals, with a seasonal site usage determination of mid- to late summer being made on the presence of immature remains. Two paleosols were also noted as being in the wall of the pipeline trench with a thickly developed A-horizon. Two right radio-ulnae were sent for radiocarbon dating, returning two uncorrected dates of 3540 ± 50 BP (BGS 2366: cal 4086-3733 BP) and 3530 ± 50 BP (BGS 2386: cal 4085-3730 BP) that have been corrected using the CALIB Rev.4.3 program (Webster 2004:146). Due to evidence of dune stability and the presence of a large number of animals, it is suspected by Webster (2004) that the site represents an ambush kill similar to that of the McKean kill at the Cactus Flower site (Webster 2004:158). Further post-impact studies and research were conducted in 2000, with subsurface testing identifying three buried components associated with campsite activities. Based upon the presence of diagnostic points, the upper component is associated with Besant, while the middle is associated with Hanna. The lower component was found to contain no diagnostic material. Additional research work was undertaken in 2001, with the excavation of two distinct blocks. The first of these, designated Block 2, is located in proximity to the pipeline trench and bone bed associated with the McKean points. Although showing some evidence of component mixing due to pipeline construction, agricultural activities, dune activation, and bioturbation, four cultural occupations were identified within this area, although no diagnostic material was found. Material recovered from this location consisted of debitage, cores, wedges, expedient tools, faunal remains, and FBR.

The second excavation block, referred to as the Main Block, is located 30 metres northwest of Block 2. It contains seven occupation levels that have been separated into four separate zones (Webster 2004:159). The first of these, Zone 1, is associated with a Besant campsite. Material recovered from this level include three Besant points, FBR, debitage, cores, scrapers, expediency tools, and faunal material. Artifact distribution suggests that the eastern and western portions of the occupation were used for lithic production, while the northern was utilized for faunal processing. Also found in Zone 1 is a Pelican Lake occupation, based upon the presence of one broken projectile point. This occupation was found to contain a bone bed with the remains of possibly four bison, consisting of at least one adult male, one adult female, and one juvenile. In addition, the talus of a white-tailed jackrabbit was also found. Additionally, a lithic workshop area was identified, consisting of two fragmentary projectile points, nine tools, twelve expedient tools, and over 1000 pieces of debitage. This Zone is noted as being impacted by cultivation activities (Malasiuk 2015:271; Neal 2006:125-136). One uncalibrated radiocarbon date of 1880 ± 50 BP (BGS 2365: 2000-1800 BP), which was calibrated as above, was obtained from the bone bed from this occupation (Neal 2006:139-143; Webster 2004:161).

Zone 2 consists of at least two Duncan/Hanna occupations, with the stratigraphy for this occupation being compacted into one layer in the western portion of the site. As a result, the cultural descriptions for this occupation have been divided by Webster (2004), with the western portion designated Occupation 2 and the eastern portion split into Occupation 2a and 2b. Cultural designation in Occupation 2 is made on the presence of two projectile points, with one complete and one fragmentary (Webster 2004:167). Also recovered were six bifaces, thirteen retouched/utilized flakes, one uniface, one wedge, 2327 pieces of debitage, and 425 pieces of FBR. A total of 2048 fragments of bison bone were also recovered, representing a minimum of three animals. Four features are also present in Occupation 2, including a basin-shaped feature containing bone fragments and FBR. One uncalibrated radiocarbon date was obtained from the feature, returning a date of 3440 ± 55 BP (BGS 2364: cal 3980-3640 BP), which was calibrated as above (Webster 2004:161). Other features found consist of an organic stain and two scatters of debitage and fragmentary faunal remains (Webster 2004:163-164).

Occupation 2a was found to contain two fragmentary Duncan/Hanna projectile points, one scraper, one uniface, three bifaces, two cores, four utilized flakes, two wedges, 300 pieces of debitage, and 248 pieces of FBR. Also recovered were 1601 faunal specimens representing at least one bison. Within this occupation one feature were observed, consisting of a bone concentration and an associated organic stain (Webster 2004:173-180). One uncalibrated radiocarbon date of 3348 ± 50 BP (BGS 2363: 3830-3565 BP) was obtained from a recovered bison radio-ulnae, which was calibrated as above (Webster 2004:161). Occupation 2b is much smaller in comparison than that of 2a, with no features or diagnostic material being found. This Occupation does contain four utilized flakes, a side scraper, a wedge, and 66 FBR fragments. Also recovered were 596 faunal fragments, representing bison and large mammals (Webster 2004:181-184). An uncalibrated radiocarbon date of 3430 ± 40 (Beta 167310: cal 3890-3650 BP) was obtained, which was calibrated as above (Webster 2004:161).

Zone 3 is associated with the McKean occupations of the site. Examined extensively by Webster (2004), it contains one McKean projectile point and one fragmentary point that is similar to Besant. Based upon the stratigraphy and the presence of sediments associated with rodent burrows, it is suspected that this point has been redeposited from overlying occupations. Also recovered were numerous lithics, consisting of seven bifaces, five endscrapers, ten cores, twenty utilized flakes, two perforators, two spokeshaves, five wedges, one hammerstone, 452 pieces of debitage, and 475 pieces of FBR. Faunal material recovered consists of 1471 bison and large mammal fragments representing at least three animals, as well as one canid bone fragment. Features associated with this Zone are a small concentration of FBR and debitage thought to be a trash dump from a hearth and a small basin-shaped hearth partially lined with FBR. It is speculated that this occupation represents a secondary processing area, as well as a primary production area for flake tools (Webster 2004:186-198). One uncalibrated radiocarbon date of 4140 ± 60 BP (Beta 183521: 4870-4575 BP) was obtained from bison bone from this Zone. As the other dates from this site, it was calibrated using CALIB Rev.4.3 (Webster 2004:161).

The final Zone within this site, Zone 4, consists entirely of the material associated with the Oxbow phase. Isolated solely to the western end of the main block, it is not associated with a paleosol (Webster 2004:159). No detailed description of this Zone exists, although a radiocarbon date of 1860 ± 40 BP (Beta 167311) was obtained, which was normalized to 1960 ± 40 BP. This date is rejected by Webster (2004) due to possible diagenetic changes resulting from calcium carbonate deposits found in lower sediments (Webster 2004:161). Also noted within the site by Neal (2006) are Late Plains materials, although no mention of provenience for these diagnostics is given (Neal 2006:144). From available information, it is assumed that they were found as part of the surface surveys by both avocationals and professionals within disturbed context areas.

7.3.16 The Melhagen Site (EgNn-1)

Also located in the Elbow Sand Hills is the Melhagen Site, a Besant bison kill, and processing area first excavated in 1967 by both the Saskatoon Archaeological Society and the University of Saskatchewan (Ramsay 1991:2). The site consists of a single bone bed representing what is believed to be a single occupation, although evidence exists for trampling to have occurred, which may have disturbed any evidence for multiple uses (Ramsay 1991:15). The artifact assemblage itself consists of 52 Besant projectile points (Ramsay 1991:247-249) in addition to bone and hide processing tools, debitage, microdebitage, and both burned and unburned bone (Ramsay 1991:215-217). Based upon the makeup of the lithic and faunal assemblages, it is suspected that the site represents two different occupations by Besant groups (Ramsay 1991:149). This conclusion is further supported by the presence of soil features identified as being the result of trampling or loadcasting (i.e., the compression of soft sediments by heavier overlying sediments), which would result in the compaction of the bone bed stratigraphy (Ramsay 1991:32). A number of different activity areas have been identified at the site, including one kill area and primary, secondary and tertiary processing areas. Based upon the excavation results, it is further hypothesized by Ramsay that other kill areas/pounds, processing areas and at least one campsite are located within the site area but have yet to be excavated (Ramsay 1991:215-216). Based upon seasonality data obtained from bison mandibles, it was determined that the site was occupied from the fall to spring, although it is not known if this represents a single extended period of occupation or if the area was occupied for differing shorter periods over a number of years (Ramsay 1991:165). Radiocarbon dating of faunal material from the site produced six uncalibrated dates that were calibrated using Stuiver and Becker (1986), of which five, 1960 ± 90 BP (S 491: cal 2148-1710 BP), 1919 ± 70 BP (S 1640: cal 2041-1700 BP), 1710 ± 45 BP (S 1641: cal 1770-1524 BP), 1905 ± 110 BP (S 2855: cal 2145-1567 BP), and 1575 ± 115 BP (S 2856: cal 1770-1290 BP) fall within the established date ranges for Besant in Saskatchewan (Dyck 1983:113; Ramsay 1991:149, 287). The sixth date obtained of 810 ± 205 BP (S 2857: cal 1173-500 BP) falls outside of the established date range for Besant and is believed by Ramsay to be the possible result of contamination from modern organic material during excavation, possibly from algae (Ramsay 1991:149-150, 287). It is suggested by Ramsay that these accepted dates, based upon their standard deviations, represent at least two separate occupations, although she cautions that the statistical evidence for this is weak (Ramsay 1991:150).

7.3.17 The Gray Site (EcNx-1)

Differing from other sites in this study, the Gray Site is located not in a formal dune complex, but within an undifferentiated aeolian landform as identified by Wolfe (2001). Approximately 8 kilometres northwest of Swift Current, the site is found in the west side a major glacial outwash channel that has undergone aeolian activity in three localities (Millar 1978: 11, 1981:104). The site was first noted in 1963 by the landowner, Earl Gray, who discovered a human skull in a blowout. Subsequent investigation and salvage work by the Royal Canadian Mounted Police and the Museum of Natural History, Regina, within a 20 metre area yielded portions of an estimated 21 individuals, in addition to numerous unworked flakes, one worked flake, a projectile point tip, and a number of bison faunal remains. It was also noted that the human remains were covered in red ochre (Kehoe 1963:1-3; Millar 1978:65; Millar et al. 1972:13).

Diagnostic material dating the site to the Oxbow period was not found until 1969 when the area underwent further testing by the University of Saskatchewan. This work was continued between 1971 and 1973 and resulted in the excavation of 60% of the site (Millar 1978:72). Overall, the remains of 304 individuals were recovered within 99 separate burial units, with the number of individuals found within each unit varying from one to fourteen. Of these, only 29 are primary internments, with the remaining 274 secondary burials, where the body had been placed previously in a primary burial context, but the remains collected at a later date and reinterred as bundle burials. As well, there is one case of cremation (Millar 1981:104).

In addition to the human remains, 19 projectile points associated with the Oxbow complex were found within the burials (Millar 1978:259-277). Other lithic artifacts include bifaces, scrapers, retouched and utilized flakes, flakes, pebble tools, mauls, a mortar for ochre crushing, and a stone pendant (Millar 1978:277-315). Native copper artifacts, while few, consist of three pieces of rolled copper and one small copper sheet (Millar 1978:335-337). Faunal artifacts excavated include worked bone segments, rounded bone segments, cut bone, a drilled bone fragment, bone beads, a shell gorget, shell pendants, and shell beads (Millar 1978: 315-335). Most of the unmodified faunal material recovered were canid (MNI=10), with bison, mallard duck, marmot, ground squirrel, and golden eagle. It is suggested by Millar (1978:363-373) that the ground squirrel and eagle remains have some symbolic meaning as suggested by the elements present and their location; for the ground squirrel, only incisors are found in association with infant burials, while golden eagle talons are found in association with five burials. Features noted consist of two pavements of cobbles, one of which containing the dispersed remains of two infants, and one circular shaped stone feature containing ash and burned bone (Millar 1978:353-357).

Seventeen radiocarbon dates have been recorded for EcNx-1 from human bone collagen. Corrected using the CALIB program (Stuiver and Reimer 1986) they are 2915 ± 85 BP (S-

1449:cal 3349 [3068] 2849 BP), 3415 ± 105 BP (S-1450: cal 3972 [3687] 3459 BP), 3485 ± 195 BP (S-706: cal 4401 [3765] 3349 BP), 3550 ± 295 BP (S-693: cal 4814 [3844] 3165 BP), 3750 ± 180 BP (S-707: 4807 [4110] 3638 BP), 3755 ± 100 BP (S-646: cal 4419 [4149] 3849 BP), 4420 ± 190 BP (RIDDL-515: 5578 [4989] 4529 BP), 4340 ± 250 BP (GX-3373: cal 5589 [4989] 4529 BP), 4510 ± 140 BP (RIDDL-512: cal 5575 [5130] 4737 BP), 4600 ± 170 BP (RIDDL-513, cal 5724 [5309] 4849 BP), 4600 ± 130 BP (RIDDL-514: cal 5626 [5309] 4849 BP), 4750 ± 160 BP (SFU-295: 5891 {5531] 4991 BP), 4955 ± 165 BP (S-619: cal 6166 [5690] 5319 BP), 5100 ± 390 BP (S-647: cal 6729 [5787] 4869 BP), 5150 ± 160 BP (SFU-294: cal 6299 [5932] 5589 BP), 5320 ± 160 BP (SFU-296: cal 6419 [6174, 6145, 6104] 5729 BP), and 5620 ± 320 BP (SFU-297: cal 7179 [6414] 5729 BP), with only four of these dates directly associated with Oxbow points (Millar 1978:387; Morlan 1992:17-19; Wade 1981:122). Early theories on site use based on radiocarbon dates speculated that usage occurred on a sporadic basis, although later dating methods showed that the use of insoluble collagen can provide erroneous younger dates (Chisholm et al. 1983:357). As a result, dates from more recently analyzed material from EcNx-1 (RIDDL 512, RIDDL 513, RIDDL 514, RIDDL 515, SFU 294, SFU 295, SFU 296, SFU 297) that were obtained as part of carbon isotope ratios as indicators of palaeodiet (see Lovell et al. 1986) are older than those previously obtained, casting some doubt on the possibility that the site was used by later cultural groups (Millar 1978:386-389; Morlan 1992:18-19). Further, the palaeodiet study conducted by Lovell et al. (1986) on the remains of 50 individuals from EcNx-1 using δ^{13} C-values concluded that the population possessed a dietary uniformity over both age ranges and sex (Lovell et al. 1986:53-54).

7.4 Site-Specific Analysis – Manitoba

All archaeological sites from Manitoba used in the subsequent analysis are displayed in Figure 7.4.

7.4.1 The Jackson Site (DiMe-17)

The first Manitoba site to be examined is the Jackson site (DiMe-17), located in the Lauder Sandhills, a Vickers Focus bison kill site with a possible Blackduck association within the *Makotchi-Ded-Dontipi* locality. Evidence for the site being occupied by Vickers Focus groups

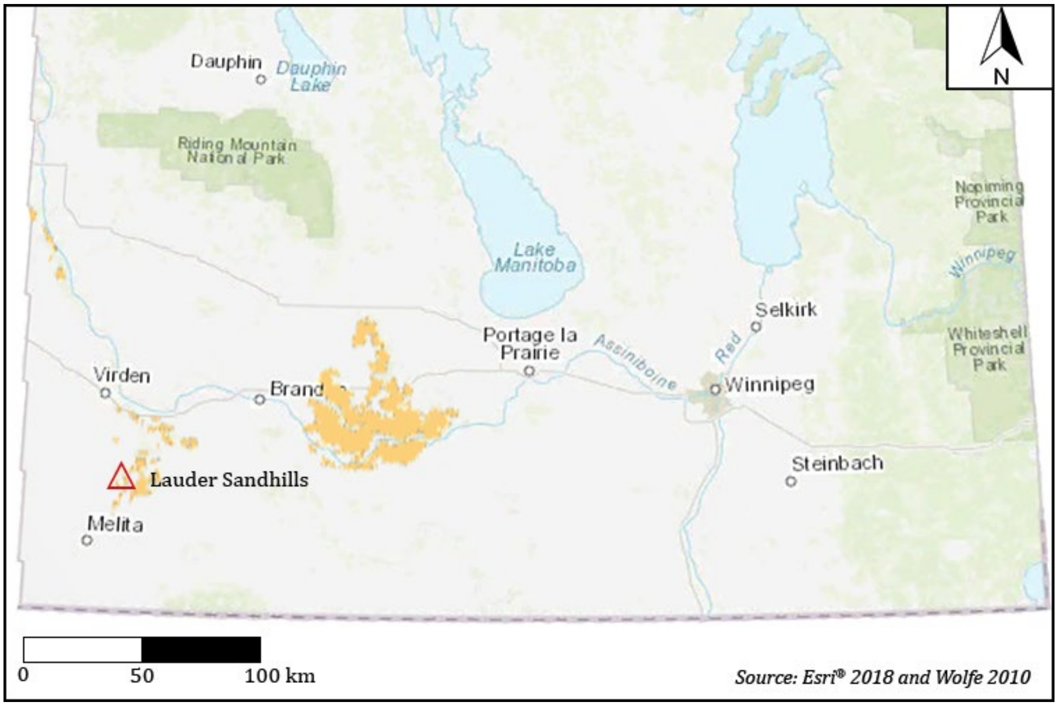

Figure 7.4 - Location of the Lauder Sandhills and Associated Archaeological Sites Used in the Analysis

stems from multiple factors, including the presence of Lowton and Middle Missouri pottery, which is also found in other Vickers Focus sites in eastern Manitoba (Mokelki 2007:83; Nicholson and Hamilton 1999:17-21; Playford 2001:22-23). Also acting as an indicator is the large size of the Jackson site, the diverse pottery assemblage present, and the location of the site, which Nicholson and Hamilton (1999) believe allowed Vickers Focus groups, traditionally horticultural, to abandon their traditional subsistence pattern as seen in the Tiger Hills of Manitoba and adopt a hunter-gatherer economy centered on bison procurement (Nicholson and Hamilton 1999:15; Playford 2001:22). Other artifacts found include Plains and Prairie Side-Notched projectile points, knives, scrapers, drills, spokeshaves, debitage, and bone tools used in hide processing.

Detailed analysis of the faunal collection and use area at the Jackson Site have found that the site itself consists of a number of smaller activity areas, including a small bison kill, processing and midden areas, disposal areas, a habitation area, and one area containing a boiling pit. Bison remains represent a mix of male, female, and juvenile individuals, indicating that the site represents a number of kill events that took place involving both bull and nursing herds rather than one single usage. The presence of foetal remains also serves to indicate that the site was occupied during the winter months (Belsham 2003:192-193; Mokelki 2007:42; Playford 2001:145-146; Playford and Nicholson 2006:406-412). Further evidence for a winter occupation is seen in the lithic collection recovered from the site, that displays evidence for both curation and the re-use of tools, which is felt to be an indicator of winter activities as lithic sources would be less accessible during the colder months (Nicholson and Hamilton 2001:63).

Also found at the Jackson site was a bison skull that Nicholson and Nicholson (2007) interpreted as being ceremonial in nature, due to the lack of damage. Found in association with an unidentified projectile point type, it was oriented along a southeast/northwest axis (Nicholson and Nicholson 2007:319).

Five calibrated radiocarbon dates have been acquired for the Jackson site. Three of these calibrated date ranges, 350-470 BP (Beta 82792), 270-390 BP (Beta 82795), and 230-370 BP (Beta 83864), place the site in association with Vickers Focus groups. A fourth date, 240-340 BP (Beta 83865), may indicate that the site was occupied during the beginning of a period previously argued to reflect an occupation hiatus that Nicholson (1996) identifies as having occurred in southwestern Manitoba (McNeely et al. 2000:165; Nicholson 1996:71-74; Nicholson and Hamilton 2001:56; Nicholson et al. 2002:319). A fifth date of 540 ± 60 BP (Beta 65952: cal 555-685 BP) has been tentatively attributed to Blackduck (McNeely et al. 2000:165; Nicholson 1996:71). All dates have been calibrated from a measured or estimated carbon-13 ratio (McNeely et al. 2000:150).

7.4.2 The Bradshaw Site (DiMe-20)

Also explored in some detail is the Bradshaw site (DiMe-20), which covers an estimated area of between 10 and 12 hectares. It is located immediately southeast of the Jackson site, examined in section 7.4.1. Although containing few diagnostic artifacts, what does exist indicates an affiliation with both Vickers Focus and, in the southern portion of the site, Mortlach groups. Of greatest interest is the information that can be obtained from the faunal collection present at the site. Consisting of beaver and the remains of duck-sized waterfowl, Nicholson and Hamilton (2001) believe the site to be occupied during a period of open, unfrozen water (Nicholson and Hamilton 1997b:31, Nicholson and Hamilton 2001:63). Further, based upon the thin distribution of faunal material across the site, they conclude that animal-based resources were not the only means of sustenance used at the Bradshaw site. Local floral resources that may have been utilized include cattail, bulrush, reed grass, chokecherries, saskatoon berries, and raspberry (Nicholson and Hamilton 2001:63-64).

7.4.3 The Vera Site (DiMe-25)

The third major site in the *Makotchi-Ded Dontipi* locale is the Vera site (DiMe-25), a markedly smaller component located east of the Jackson site near what is believed to be a seasonal waterhole (Nicholson et al. 2002:320). Activity localities identified at the Vera site include a disposal and processing area, containing features such as hearths and post molds, as well as possible living area (Playford and Nicholson 2006:408-410). Based upon the ceramic assemblage, it has been affiliated with Vickers Focus peoples, although one imported pottery fragment has been found that is associated with Mandan wares due to its similarity to material found at the Mandan Double Ditch site in North Dakota (Mokelki 2007:83; Nicholson and Hamilton 1999:17, 2001:64). Analysis of organic residue found on some pottery sherds has provided evidence for the presence of beans (*Phaseolus vulgaris*) and corn (*Zea mays*) in either cooking or storage vessels (Boyd et al. 2006:1135). Like the Bradshaw site, seasonality at the Vera site has been placed during warmer months, due to both the lack of foetal bone present and the presence of heat-reddened soil found underneath hearth features, which has been witnessed to occur when a fire is able to provide sustained heat to change the soil colour. As such, it can be used as an indicator of seasonality as the temperatures required to cause a colour change have not been achieved when a fire is lit on frozen soil (Nicholson and Hamilton 2001:65; Nicholson et al. 2002:320-321). Subsequent faunal analysis can be seen to call this seasonality determination into question, as foetal MNI values for bison at the site were calculated to be three, with the remains of ten adults and two juvenile animals also determined to be present (Playford and Nicholson 2006:412). Two calibrated radiocarbon date ranges obtained for the Vera site, 280 - 400 BP (Beta 106109) and 200 – 300 BP (Beta 111141), place it within the known range for Vickers Focus occupations (McNeely et al. 2000:165; Nicholson and Hamilton 1997b:31, 2001:56; Nicholson et al. 2002:319). All dates have been calibrated from a measured or estimated carbon-13 ratio (McNeely et al. 2000:150).

In addition to this Late Precontact material, three Middle Precontact components have also been identified at the Vera site. These *in situ* occupations have been identified as

Besant/Samantha, Duncan/Hanna, Oxbow and Pelican Lake based upon the recovery of diagnostic projectile points. The Samantha occupation consists of one projectile point found in association with fire-cracked rock and ungulate tooth fragments. The Besant occupation consists of one projectile point in association with flakes and fire-cracked rock. The Duncan/Hanna occupation consists of one Hanna and one Duncan point found in association with bison bone, flakes, charcoal, and abundant fire-cracked rock. Due to the nature of these deposits, it is felt that they represent limited camping activities (Nicholson and Hamilton 1997a:45-47). At present, all that is known of the Pelican Lake and Oxbow occupations is the presence of diagnostic material (Playford and Nicholson 2006:405).

7.4.4 The Twin Fawns Site (DiMe-23)

The Twin Fawns site (DiMe-23) is a protohistoric site located on the eastern edge of the known boundaries of the *Makotchi-Ded Dontipi* locale. It is thought that the site represents a period of early contact between European and First Nations groups, as two bone slot knives, one still containing a brass blade, were found at the site. The classification as an early contact period site stems from there being no other European trade goods present at the site with the exception of the two knives (Mokelki 2007:63). Pottery sherds at the site analyzed by Mokelki (2007) indicate an association with Mortlach groups, although earlier work by Nicholson et al. (2003) suggested that the ceramic assemblage represents both Vickers Focus and Mortlach traits (Mokelki 2007:99; Nicholson et al. 2003:126). Analysis of organic residue found on the ceramics indicates that corn (*Zea mays*) was present at the site (Boyd et al. 2006:1135). Other artifacts of note include a number of ice gliders, a gaming dart that is constructed of a bison rib with trailing wooden “tails” inserted in the end that is slid across an ice surface during the winter months (Majewski 1986:104; Mokelki 2007:65; Nicholson et al. 2003:121-123). Based upon the nature of the deposits, it is believed that the site was occupied for only a very short period of time, with the belief that it was a winter occupation based upon the presence of the ice gliders (Nicholson et al. 2003:126). Using the Calib Radiocarbon Calibration Program (see Stuiver and Pearson 1993), one calibrated radiocarbon date range of 90 - 210 BP (Beta 96111) was obtained for the site from bison bone, with no actual radiocarbon date and sigma values given (Hamilton and Nicholson 2007:140; Mokelki 2007:64).

7.4.5 The Schuddemat Site (DiMe-22)

The last site to be examined within the *Makotchi-Ded Dontipi* locale, the Schuddemat site was first discovered in 1995 as the result of fence construction. Although little analytical work has been done on the lithic assemblage from the site, the pottery assemblage is similar to that found at the Twin Fawns site and displays both Vickers Focus and Mortlach traits. Residue analysis of some sherds indicates that they once held corn (*Zea mays*) and beans (*Phaseolus vulgaris)* (Boyd et al. 2006:1135; Mokelki 2007:56-57). Based upon the presence of foetal bone, the site is considered to represent a winter occupation (Mokelki 2007:56).

7.4.6 The Crepeele Site (DiMe-29)

Located south of the *Makotchi-Ded Dontipi* locale, the Crepeele site is interpreted by Nicholson and Nicholson (2007:319) as being a habitation and secondary processing area. Also found at the site was a supine bison skull oriented along a southwest to northeast axis. The skull was intact, an anomaly given that most skulls are shattered to obtain the brain, tongue, and the contents of the maxillary cavities, although the petrous bones, maxillary teeth, and occipital condyles were absent, creating a cavity within the skull. Upon excavation, it was discovered that this cavity contained the remains of an unevenly fired clay bowl that had been painted with red ochre. The firing of the vessel itself was found to have occurred from the interior of the bowl, as the exterior showed signs of deterioration, in addition to the bone hollow in the skull showing no signs of burning or calcification. This feature was interpreted as being a shrine, wherein a bison skull was cleaned and prepared; including the removal of teeth and several bones, and a damp clay bowl was left within the hollow created. This vessel was later treated with ochre, and offerings of sage, sweetgrass, or tobacco fired within it using hot coals. Though speculative, it is felt that these offerings were given to either ancestors or to the bison in the associated processing area in thanks for sacrificing themselves. No chronologically diagnostic artifacts were found at the site, but one uncorrected radiocarbon date of 1620 ± 120 BP (TO-11881: cal 140 – 626 AD) was obtained on a long bone from the habitation, with a corrected date of AD 425. No method of correction was provided (Nicholson and Nicholson 2007:319-322). Due to the the lack of a date range on the corrected date, this date was recalibrated in this study using the IntCal 13 calibration curve on OxCal 4.3 (Bronk Ramsey 2009).

7.5 Summary

Although investigating only a select number of sand dunes within the study area, the initial examination of this summary illustrates that Precontact groups on the Northern Plains frequently utilized these landscapes in manners that left behind substantial archaeological records. In total, 33 sites where extensive excavation, testing, absolute dating, or detailed analysis have been conducted serve as the database for this study. Many of these sites, such as the Tschetter site, the Gray site, the Muhlbach site, and the Jackson site, are some of the most well-researched, well-documented, and frequently referenced archaeological sites to be found in Western Canada. All of the sites used in this study are found within only eight of the 68 dune areas identified by Wolfe (2001) as being within the defined study area, with an additional three locations (which contain the Muhlbach site, the Anderson site, and the Gray site) that are located within dunes and sand sheets that have not been named in any literature. In addition, the Great Sand Hills is included as a study region, which contains such notable sites as EeOh-6 and EdOh-23, among others. These well-researched sites collectively represent only a small percentage of all of the sites that can be found in all dunes on the Northern Plains, with those that have not been well investigated possessing the potential to contain a similar archaeological record. In the following chapter, the data on the sites presented here will be comparatively examined to detect patterns of human behavior with regards to seasonality, usage, and periods of occupation. These results will be combined with conclusions drawn from other chapters of this thesis to create a holistic interpretation of sand dune occupations over space and time on the Northern Plains.

Chapter 8

Integrated Dataset Analysis of Sand Dune Occupations

8.1 Introduction

As stated in section 7.6, upon initial examination of archaeological site catalogs and the presence of diagnostic materials, it is evident that humans made extensive and diverse use of sand dune areas throughout the Middle and Late Precontact periods. To answer the detailed questions posed within this work however, additional examinations are required. Using data from archaeological sites where more detailed analyses have taken place, it is possible to make determinations on the usage and perception of arid environments within the study area, the anthropogenic impacts of human occupation on these environments, as well as to offer commentary on larger issues within Plains archaeology. This is accomplished through examining and integrating patterns of behaviour within the seasonality, site usage, radiocarbon dates, spiritual usage and perception, and evidence of social interaction present within the archaeological record. In each of below sections, the findings for each topic are discussed and summarized individually, with a larger integrated summary, including conclusions from previous chapters, provided in section 8.2. For all of these sections, it is acknowledged that sample size can be viewed as a concern, as in some cases cultural complexes are represented by only one or two sites. As stated previously, it is felt that these findings and conclusions represent the current knowledge base for sand dune archaeological sites within the study area and should be considered an impetus to conduct further research on both existing collections and previously uninvestigated sites to create further dialogue on the topic of sand dune usage on the Northern Plains.

8.2 Archaeological Analysis

8.2.1 Seasonality

Of the archaeological sites in this study, fifteen (seven Middle Precontact and eight Late Precontact) have had conclusions drawn by the original authors on the season of occupation (Table 8.1). Prior to summarizing these results however, a critical assessment of the physical evidence used to draw these conclusions is necessary. In Saskatchewan, several sites can be seen to have questionable seasonality assessments made, based upon the information being used to make that determination. At EgNo-23, although seasonality is determined based on the presence of immature remains that are thought to be associated with a McKean bone bed, it is difficult to accept this conclusion. Due to the disturbed nature of the deposits, and the inability to conclusively state which layer the juvenile remains originated from, no definitive conclusion can be drawn for this site.

Also, of concern is the seasonality determination made by Dyck (1977) for FbNs-1. Based upon the lack of fresh water at the site, and with no other supporting evidence, he concluded that the site was likely occupied during the winter months, as snow would have served as the only source of fresh water (Dyck 1977:199). As with other sites mentioned previously, this statement cannot be easily accepted without supporting evidence from physical material from the site assemblage. In this case however, investigations by Morlan (1994) on the faunal remains from the site indicated that it was occupied during the winter. This conclusion is based upon bison tooth eruption and wear patterns, fracture patterns on limb bones that indicate they were frozen at the time of butchering, and the presence of charred canid remains, which may indicate the butchering and consumption of dogs for their fat reserves (Morlan 1994:767-773).

As well, the seasonality determination made for FaNr-2 deserves further consideration. At this site, based upon the presence of charred chokecherries, it was concluded that it was occupied during the late summer to early fall, as this would have been when the berries would have been ripe and collected (Dyck 1972b:11-12). The use of plant remains in determining factors such as seasonality can be problematic, as modern seeds and fruit within archaeological sites can be deposited from natural processes, such as wind, water, insects, or animals (Deal 2005:131). As well, contamination by moved material can also occur from the improper collection and processing practices of field samples by archaeologists (Minnis 1981:144-145). In examining this issue, Keepax (1977) found that plant material associated with buried archaeological deposits was typically charred or burned, while uncharred plant remains were found almost exclusively from samples taken from non-archaeological deposits. As it is not typical of seed rain, or the distribution of seeds by the wind, to occur with material that has been burned, a general rule of practice has been adopted based upon these results that view burned material as being representative of prehistoric deposition, while unburned materials are likely modern (Keepax 1977:224-226; Minnis 1981:147). This use of the degree of preservation is one of five distinguishing criteria devised by Keepax to delineate between ancient and modern plant material, with the other four being the radiocarbon dating of the material in question, the comparison of species composition between archaeological and non-archaeological soils, and comparisons of the size and morphology between cultivated and wild grains (Keepax 1977:226-228). Although potentially from other sources, given these established analytical criteria, in the context of FaNr-2 and the use of burned plant material as a seasonal indicator, there is no methodological reason to discard the conclusions made on this site.

In addition, three sites from Manitoba can be seen to also have questionable evidence supporting claims of seasonality: DiMe-20, 23, and 25. In the case of the first, a broad and undefined occupation period of "during periods of open water" is given based upon the presence of beaver and duck-sized faunal remains. While the presence of migratory waterfowl can be seen as an indicator of spring or fall occupations, since no speciation of these remains was conducted, no assumptions on seasonality can safely be made. Likewise, the presence of beaver does not necessarily indicate that open water is present, as the hunting of beaver during the winter months was possible, as witnessed by practices during the historic fur trade period (Martin 1982:16). At DiMe-23, a winter occupation was designated at the site due to the presence of ice gliders in the artifact assemblage. While suggestive, it is felt that the presence of corroborative data from other definitively established sources as found at other sites in this study is required prior to making a conclusion on seasonality. At DiMe-25, a generalized warm season of occupation as found at DiMe-20 was assigned, in this case based on the lack of foetal bone as well as the presence of reddened, heat-treated earth beneath the hearth feature. According to Nicholson and Hamilton (2001) and Nicholson et al. (2002), this colour change only occurs when the ground beneath a hearth feature is not frozen, indicating that the occupation took place during the warmer months of the year (Nicholson and Hamilton 2001:65; Nicholson et al. 2002:320-321). While suggestive of the summer and fall months, as the date when the ground freezes for the winter can vary seasonally, no conclusive occupation season can be ascribed to this site. Likewise, the lack of foetal remains cannot be a definite indicator of a summer occupation, as taphonomic processes, field methods, and the amount of excavation conducted may account for this lack of material.

Finally, for one site in Alberta the claims of seasonality must be addressed. At FaOm-1, Grekul (2007) concluded that the site was occupied during the summer months due to the lack of foetal bone and the population structure of the faunal material that was recovered, which she felt

Table 8.1 – Inferred Seasonality of Sites within the Study

Site	Time Period	Season and Evidence Used	Reference
FbNs-1	Middle Precontact	Winter (Lack of nearby water and faunal evidence)	Dyck 1977; Morlan 1994
FaNq-5	Middle Precontact	Spring or Fall (Goose Remains)	Dyck 1970
FaNr-2	Middle Precontact	Besant: Late Summer to Early Fall (Chokecherries)	Dyck 1972b
EgNo-23	Middle Precontact	McKean: Mid- to Late Summer (Immature bison)	Webster 2004
ElNp-8	Middle Precontact	Fall/Winter (Bison mandibles)	Hjermstad 1996
EgNn-1	Middle Precontact	Fall to Spring (Bison mandibles)	Ramsay 1991
FaNq-25	Middle Precontact	Late Summer/Autumn (Faunal material and macrofossils)	Walker 1992
FaOm-1	Late Precontact	Late October to March (Dental cementum) Possible summer (Lack of foetal bones and population structure) Spring to early summer (Migratory bird remains) Possible winter (Split bison and bird bone)	Blaikie 2005; Grekul 2007; Peck 2001
FbNr-1	Late Precontact	December to late March (Dental cementum and tooth eruption)	Linnamae 1988; Peck 2001; Prentice 1983; Walker 1979
FaNp-19	Late Precontact	Possible year round, with emphasis on spring and winter (Bison foetal and mandibular remains: December to late March; Waterfowl, rodent and pike remains: April to early November)	Clarke 1995; Farrow 2004
FdOt-1	Late Precontact	Fall (faunal remains)	Wondrasek et al. 2017

Table 8.1 – Inferred Seasonality of Sites within the Study Continued

Site	Time Period	Season and Evidence Used	Reference
DiMe-17	Late Precontact	Winter (Foetal remains and curated lithic collection)	Belsham 2003; Mokelki 2007; Playford 2001; Playford and Nicholson 2006; Nicholson and Hamilton 2001
DiMe-20	Late Precontact	Periods of open water (Presence of beaver and duck sized waterfowl remains)	Nicholson and Hamilton 1997b; Nicholson and Hamilton 2001
DiMe-23	Late Precontact	Winter (Ice gliders)	Mokelki 2007; Nicholson et al. 2003
DiMe-25	Late Precontact	Winter (Lack of foetal remains and head reddened soil)	Nicholson and Hamilton 2001; Nicholson et al. 2002

was indicative of a summer herd (Grekul 2007:140). As with other sites mentioned earlier, it is felt that the lack of faunal material from a particular age group cannot be seen as convincing evidence for making a seasonality determination.

Like FbNs-1 however, other sources of evidence, in this case the presence of migratory bird remains reported by Blaikie (2005), also suggest a spring to early summer occupation. From this examination, of the original fifteen archaeological sites with conclusions drawn on their seasonality, eleven can be seen as having results that can be used to determine seasonality patterns within sand dunes, with six from the Middle Precontact period and five from the Late Precontact period (Table 8.2). The conclusions on seasonality for these sites were derived from the measurements of dental cementum increments, tooth eruption patterns, the presence and ageing of foetal remains, the presence of seasonal waterfowl remains, the identification of seasonal plant remains, and the comparative analysis of lithic raw material collections. Based upon these results, two patterns of seasonal usage emerge for the two time periods. For the Middle Precontact, usage by Gowen groups based upon the results from FaNq-25 indicates a late summer to fall occupation. For the two sites containing Oxbow materials, site usage is expanded, with evidence for occupations present for all seasons, with the exception of the summer. This increase in seasonality usage is further seen with Besant groups, for whom evidence indicates utilized dunes during all seasons except for early summer.

Table 8.2 – Summary of Accepted Site Seasonalities

Middle Precontact	Affiliation	Spring	Summer	Fall	Winter
FbNs-1	Oxbow				
FaNq-5	Oxbow				
FaNr-2	Besant		Late	Early	
ElNp-8	Besant				
EgNn-1	Besant				
FaNq-25	Gowen		Late		
Late Precontact	**Affiliation**	**Spring**	**Summer**	**Fall**	**Winter**
FaOm-1	Prairie SN Plains SN		Early		
FbNr-1	Prairie SN	Ending in March			Beginning in December
FaNp-19	Prairie SN Plains SN				
FdOt-1	Avonlea Prairie SN				
DiMe-17	Vickers				

During the Late Precontact period, this pattern of differentiated usage is seen to continue, depending upon the group examined. For the two sites containing both Prairie and Plains Side-Notched points (FaOm-1 and FaNp-19), dune utilization appears to occur on a year-round basis. In contrast, for the one site that exclusively contains Prairie Side-Notched material, this habitation pattern shifts to a much more transitory one, centered around a four-month period between December and March. For FdOt-1, a suspected Avonlea/Old Women's transition site, this limited pattern of usage is present again, with a focus upon the fall seasons. Lastly, the Vickers Focus site for which seasonality was established (DiMe-17), a winter occupation was determined based upon foetal remains and the raw materials diversity of the lithic collection that is typically associated with winter habitation sites.

8.2.2 Precontact Uses of Dune Environments

Also subject to examination are conclusions made upon archaeological site usage within the study area (Table 8.3). For the 26 sites or components for which usage was determined, fifteen dates from the Middle Precontact period, with EgNo-23 containing four identified cultural

Table 8.3 – Sites with Inferred Usage within the Study Area

Site	Time Period (Affiliation)	Use	Reference
FbPf-1	Middle Precontact (Besant)	Bison Trap	Gruhn 1971
DlOx-5	Middle Precontact (Besant/Sonota)	Kill site with primary and secondary butchering	Foreman 2010; Varsakis 2006
FbNs-1	Middle Precontact (Oxbow)	Dwelling area with bison processing and lithic reduction	Dyck 1977
FaNq-5	Middle Precontact (Oxbow)	Short term campsite	Dyck 1970
FaNr-2	Middle Precontact (Besant)	Camping, bone processing and grease extraction	Dyck 1972b
ElNp-8	Middle Precontact (Besant)	Bison pound	Hjermstad 1996
EgNn-1	Middle Precontact (Besant)	Bison kill, primary, secondary, and tertiary processing areas	Ramsay 1991
EcNx-1	Middle Precontact (Oxbow)	Cemetery	Millar 1978; Millar et al. 1972
EgNo-23	Middle Precontact (Besant, Pelican Lake, Duncan/Hanna, McKean)	Besant – Lithic production and faunal processing Pelican Lake – Bison kill and lithic workshop Duncan/Hanna – Small kill and lithic production McKean – Secondary processing and camp	Neal 2006 Webster 2004
FaNq-25	Middle Precontact (Gowen)	Bison processing	Walker 1992
FaNq-32	Middle Precontact (Gowen)	Habitation area	Walker 1992
EdOh-23	Middle Precontact (Besant)	Habitation area	Johnson 1983

Table 8.3 – Sites with Inferred Usage within the Study Area Continued

Site	Time Period (Affiliation)	Use	Reference
FaOm-1	Late Precontact (Plains SN, Prairie SN)	Primary bison butchering, disposal, processing, and habitation	Blaikie 2005; Gibson 2004a; Gibson and McKeand 1996; Grekul 2007
FaOm-22	Late Precontact (Plains SN, Prairie SN)	Disposal area and habitation	Gibson 2004a; Gibson 2005a; Gibson 2005c
FdOt-1	Late Precontact (Avonlea/Old Women's)	Camp with processing, disposal area, and possible ceremonial feature	Wondrasek et al. 2017
ElNs-10	Late Precontact (Avonlea)	Bison kill and primary processing	VanderZwan and Pollio 2016
FbNr-1	Late Precontact (Prairie SN)	Bison pound with processing and disposal area	Linnamae 1988
FbNs-2	Late Precontact (Avonlea)	Small bison kill	Dyck 1972a
FbNs-15	Late Precontact (Avonlea)	Single occupation and disposal area	Smith and Richards 1987
DiMe-17	Late Precontact (Vickers)	Small bison kill with disposal, habitation, processing areas, and possible ceremonial feature	Mokelki 2007; Nicholson and Hamilton 1999;
DiMe-23	Late Precontact (Vickers/Mortlach)	Short term campsite	Mokelki 2007; Nicholson et al. 2003
DiMe-25	Late Precontact (Vickers)	Bison kill, disposal and processing areas	Playford and Nicholson 2006

Table 8.3 – Sites with Inferred Usage within the Study Area Continued

Site	Time Period (Affiliation)	Use	Reference
DiMe-29	Late Precontact (Unknown)	Habitation and secondary processing with possible ceremonial feature	Nicholson and Nicholson 2007

components. Dominant during this period is the use of sand dunes as major pound and kill sites exclusively by Besant groups, with the identification of four sites (FbPf-1, DlOx-5, ElNp-8, and EgNn-1). Further evidence of Besant occupations was found at three other sites, with FaNr-2 containing evidence of short-term camping activities, as well as the processing of one bison, including bone grease extraction. The second location, a component of EgNo-23, contains evidence of lithic reduction and the processing of at least four bison. Lastly, EdOh-23, located in the Great Sand Hills, is a small single occupation found within 1500 metres of a shallow spring.

It should be noted that although Webster (2004) proposed that the McKean occupation at EgNo-23 was associated with an extensive bone bed, indicating a large-scale kill, these materials were found within the disturbed context of a pipeline development, along with diagnostic materials from other periods. Despite two radiocarbon dates obtained from bison bone-produced dates that are concurrent with that of McKean, due to the disturbed and mixed nature of the deposits, and the documentation of multiple cultural components being present as this site, an accurate conclusion on the origin of this entire assemblage cannot be safely drawn.

For other groups during the Middle Precontact period, the usage pattern for dunes is one where evidence exists for multiple tasks taking place. At the sole McKean occupation, found within EgNo-23, evidence exist to conclude that the area was used for camping and for the secondary processing of at least three bison. For Oxbow groups, material from FbNs-1 indicates that the site was used as a longer-term camp area where lithic reduction took place and bison, martin, fox, rabbit, moose, and canids were processed. In comparison, FaNq-5 is considered to be a short-term campsite. Finally, the two Gowen sites within this study, FaNq-25 and FaNq-32, are believed to represent a bison processing area also containing elk and canid remains and a habitation area, respectively.

The final Middle Precontact sand dune site identified as having a use is EcNx-1, the Gray Site. The usage of this sand sheet as an extensive cemetery of primary and secondary burials makes this site unique, not only within the context of this study, but within that of Plains archaeology as well. The presence of this site within a dune environment is not viewed as a coincidence, but rather the product of social perception by the Oxbow groups who created it. This topic is discussed later in this work (see section 8.3.3) within the context of dune environments and archaeological evidence of religious and sacred practices.

For the eleven Late Precontact sites for which occupation activities were determined, three are associated with Avonlea groups. The first of these, ElNs-10, is considered by VanderZwan and Pollio (2016) to be a major pound site. Also considered by the Dyck (1972a) to be a pound is FbNs-2, although it is considered here to be a smaller kill due to the small MNI value (N=3), as well as the lack of evidence, in the form of post molds or bone uprights, for any pound structure. The third site, FbNs-15, is a single occupation area and associated disposal area that contains the remains of one mature and one immature bison. A fourth site, FdOt-1, is considered by Wondrasek et al. (2017) to represent the transition period from Avonlea to Old Women's. This site contains evidence of multiple activities, including habitation, bison processing, and faunal material disposal. As well, it contains an extensive subsurface feature of faunal remains that is considered to serve a ceremonial function.

In addition to this transition site, three other sites affiliated with Old Women's through the presence of Prairie Side-Notched points have activities associated with them. The first of these, FbNr-1, is a large bison pound with associated processing and disposal areas. To date, the habitation areas associated with this kill have not been located. The two remaining sites associated with Prairie Side-Notched material are also found to contain Plains Side-Notched points as well. These two sites, FaOm-1 and FaOm-22, are in close proximity to each other within the Bodo locality. For the latter site, from the excavated assemblage it is believed to represent a habitation and garbage disposal area. For FaOm-1, the archaeological deposits are more extensive, and are thought to be the result of primary bison butchering and processing, faunal disposal, and habitation. Although this site is speculated to be associated with a pound (T. Gibson, personal communication, 2003), to date no evidence of a large kill structure has been found or reported.

The last three sites affiliated with a cultural complex that have inferred uses are found within Manitoba. Two of these sites, DiMe-17 and DiMe-25, are associated with Vickers Focus. At DiMe-17, evidence suggests its use as a small kill site where animals were hunted over a span of time, as opposed to resulting from one larger kill event. Also present are associated processing, disposal, and habitation areas, as well as an intact skull placed on a southeast/northwest directional axis that is thought to have ceremonial significance. At DiMe-25, the remains of adult, juvenile, and foetal bison were found in association with processing and habitation areas. Located near a waterhole, no kill areas were found in association with this site. Lastly, a suspected Vickers Focus/Mortlach transition site, DiMe-23, was identified by Mokelki (2007) and Nicholson et al. (2003) as being a short-term campsite within the *Makotchi-Ded Dontipi* locale.

The final site with a precontact usage related to it to be examined is DiMe-29. Although not associated with any diagnostic material or ethnographic group, this site is significant due to the presence of suspected ceremonial features, in this case an intact bison skull placed on a southwest/northeast axis with a fired clay bowl contained within its inner cavity. This suspected shrine was found within an area that also contained evidence of serving as a habitation and secondary processing area.

8.2.3 Radiocarbon Dates and Periods of Occupation

As examined in chapter six, the use of radiocarbon dates in the analysis of sand dune occupations can be problematic due to the unique hydrology and soil chemistry of these areas that can serve as a source of sample contamination. With the advent of better sample pretreatments and the use of AMS dating, the impact of these factors has been decreased, although not entirely eliminated. As well, collection methodologies, such as the use of blended samples, can serve as a source of error in determining the age of archaeological deposits. With these factors in mind, a methodological approach to examining the radiocarbon and AMS results from dune sites was created to examine the absolute dates obtained for cultural occupations. Although issues do exist for radiocarbon dates obtained before the development of AMS and more effective pretreatment methods, within the context of this study there is no means to develop a protocol for determining which of these dates contain the least amount of error due to contamination. The most accurate way in which this would occur is for new samples to be assessed and used in comparison against the previous results. As such, any dates which the original authors and researchers considered accurate, at the original time of reporting, are included in the present analysis. The only exclusion of dates implemented as part of this study are in cases where the original author has specified that a particular result was determined from a blended faunal sample. As illustrated by Ashmore (1999), the use of this methodology greatly increases the chances of contamination and error within any results. Given the unique conditions within sand dunes for contamination to begin with, let alone increasing that error through sampling methodologies, it is felt here that the use of blended samples in the present study poses a greater risk to the quality of the results from a comparative study of occupations. As such, any samples that are listed as blended have been excluded as well (see Appendix C). Additionally, two dates from EgNo-23 (BGS 2366 and BGS 2386) have been excluded, as they were obtained from faunal material from a known disturbed context, as well as one date from FdOt-1 (Beta 411515) that was obtained from a suspected feature that was later determined to be a rodent burrow. Further, one date from FaNq-32 was excluded (S 2036A) due to results that illustrated that the sample was contaminated. During testing, a portion of sample S 2036A, which was designated as S 2036B, was pretreated separately with 1N HCl. It produced results that differed greatly from that of the non-treated sample.

In addition, dating results obtained from EcNx-1 were not included in this analysis. The rationale behind this decision is based on two factors, the first being that the site is anomalous to both the context of this analysis, examining daily subsistence and habitation activities, and to the Northern Plains itself due to its exclusive use as a cemetery. As such, the behaviours and cultural site formation processes that underlie the creation of this site are different from those seen at other sites in this study. Although it is recognized that sites such as DiMe-29 and FdOt-1 contain possible religious and sacred features as well, they are found in conjunction with evidence for subsistence-based practices. Second, as noted by Chisholm et al. (1983), Lovell et al. (1986), Millar (1978), and Morlan (1992), there are issues surrounding the use of soluble collagen as a dating method at the site that can result in the return of erroneous early dates. As a result of this, EcNx-1 will be examined as a separate entity, working with the results from Lovell et al. (1986:53-54) that concluded that the population buried there represented one group over time as seen in dietary uniformity over both age ranges and sex. Finally, dates from FaOm-22 were not included, as they were obtained from a geoarchaeological study from stratigraphic layers that do not contain cultural materials. As such, they potentially represent only dune stability, and may be devoid of any human activity.

From the 142 calibrated absolute dates listed in chapter seven and summarized in Appendix D, 85 have been used to examine the temporal usage patterns in sand dune areas across the Northern Plains study area. In cases where the original researcher did not calibrate their dates, they have been recalibrated in this study using the IntCal 13 calibration curve on OxCal 4.3 (Bronk Ramsey 2009). In sites where multiple dates were obtained from one location at the site that are associated with one type or types of diagnostic materials, and the calculated date ranges overlap, the calibrated date ranges are used as one large dataset to produce one date range associated with that artifact type at that site. Where date ranges at one site do not overlap, they are separated. Lastly, where dates are obtained from two defined areas, they are separated in the final analysis. This methodology has resulted in the creation of 24 date ranges for occupation within 18 separate sites (Figure 8.1). Although it is acknowledged that this dataset is of a smaller size, in comparison with the entire study area as a whole, it does represent the current state of knowledge with regards to sand dune occupations on the Northern Plains.

From this examination, both trends in occupation by past cultural groups and periods of non-usage can be seen within the archaeological record. For the study area, archaeological evidence indicates that dunes were almost continuously utilized for the past 6,000 years, with the exception of four intervals. For the first lapse period during the Middle Precontact period (between 6289 and 5459 BP), causation can be found in the behaviour of Mummy Cave groups in response to the climate during this time period. In his examination of Altithermal sites across the Northern Plains, Walker (1992:144) noted that Mummy Cave kill and habitation sites on the Northern Plains are frequently limited in their extent, contain sparse cultural assemblages, and are located close to sources of water such as rivers or oxbow lakes. This pattern of behaviour can be viewed as a direct result of the more arid climatic conditions present in the region during the time period, with groups altering activities that were practiced earlier to ensure the continued survival of the smaller bison herds present on the Northern Plains (Wilson and Davis 1978:316). In other sites in the study area, such as the Dog Child site (FbNp-24), this change in subsistence patterns is reflected through evidence for increased foraging activities and plant usage, as well as the exploitation of other subsistence patterns away from large-scale bison procurement to a larger number of faunal species as compared to sites from earlier periods (Pletz 2010:246-247). At the Gowen sites, this shift resulted in the procurement of smaller groups of bison than those found in jump sites, with the kills taking place along the west floodplain bank of the South

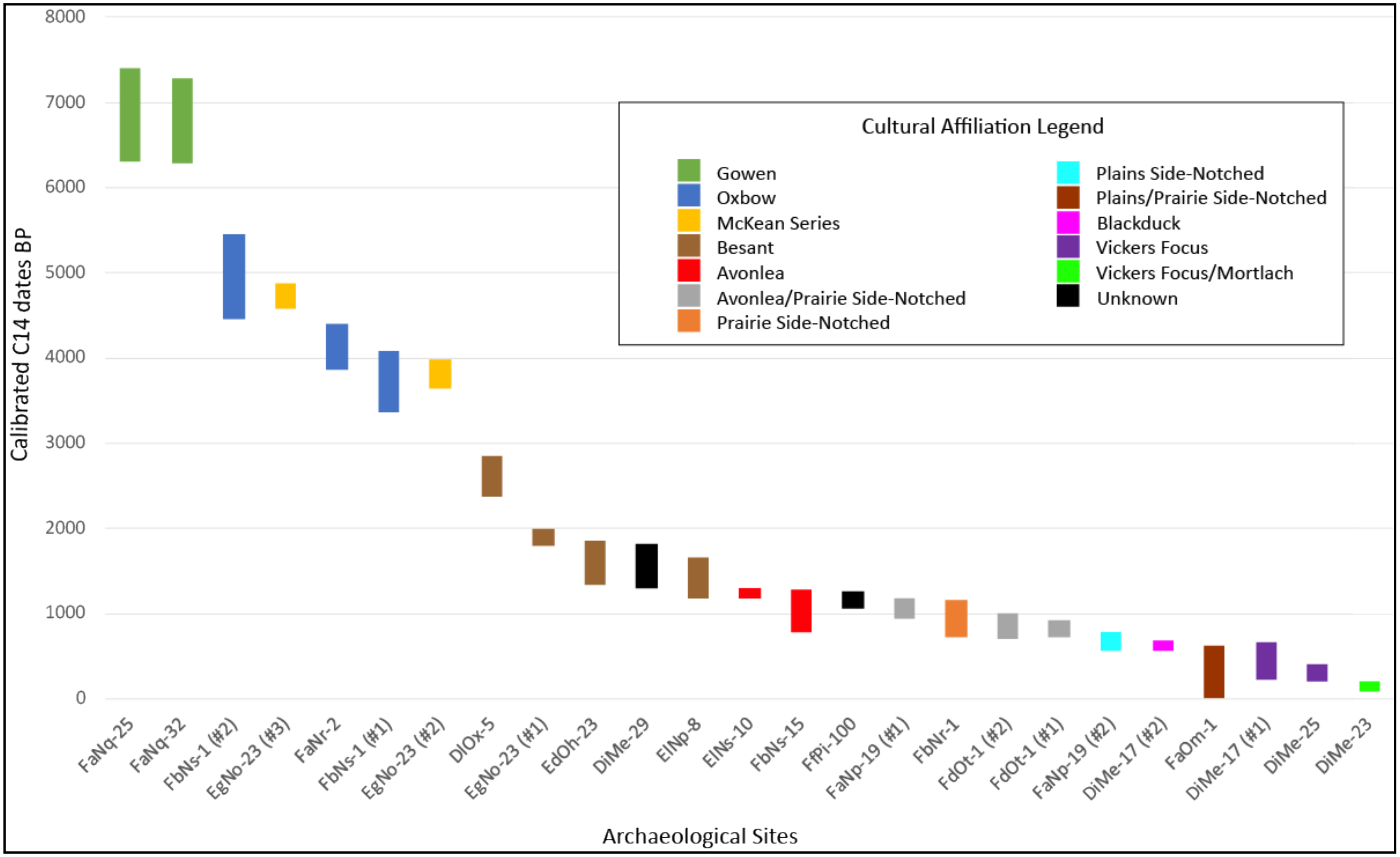

Figure 8.1 – Calibrated Radiocarbon Date Ranges for Archaeological Sites Used in this Study

Saskatchewan River in sand hill areas, when bison had access to a fresh, stable water source (Walker 1992:130).

In examining the lack of dune sites on the Northern Plains during the Mummy Cave period, as well as archaeological sites from this period as a whole, it is this proximity to water sources that emerges as the most important factor in where sites are located. In addition to FaNq-25 and FaNq-32, for all of the major Mummy Cave sites in the study area, including Stampede (DjOn-26), Amisk (FbNp-17), the Norby site (FbNp-56), the Dog Child site (FbNp-24), the Below Forks site (FhNg-25), the St. Louis site (FfNk-7), and the Long Creek site (DgMr-1), a fresh water source is located nearby (see Amundson 1986; Cyr 2006; Gryba 1976; Johnston 2005; Kasstan 2004; Pletz 2010; Wettlaufer and Oakes 1960; Zurburg 1991). A regional response to the more arid conditions occurring during this period, with groups concentrating their subsistence activities near stable water areas that would attract bison herds, it can also be viewed as an indicator of dietary preference. As noted by Cyr (2006:156), Meltzer (1999:410), Pletz (2010:246), and Walker (1992:130), bison continued to play a large role in the subsistence patterns of Northern Plains groups, dominating the faunal assemblages at sites within the study area, in spite of the harsher climatic conditions that may have favoured the adoption of other subsistence patterns, the exploitation of a wider variety of species in greater numbers than those seen in Mummy Cave sites in the region, or relocation to higher elevations where archaeological evidence suggests that large-scale kills were still feasible. In regions of the Central and Southern Plains, such as Kansas, Iowa, and Nebraska, Mummy Cave groups are believed to have adopted a foraging economy, relying upon a wider faunal and floral subsistence base in order to survive the more arid conditions (Walker 1992:130).

This continued reliance on bison as a dietary staple may have in turn limited the landscape usage for Mummy Cave groups, as they were required to occupy only regions that provided a stable source of potable water. Although gradually recovering from the arid conditions of the Altithermal, water sources during the Mummy Cave period, such as lakes, rivers, spring, and aquifers were both depleted and contained a higher concentration of carbonates (Meltzer 1999:405; Vance et al 1993:117). This lack of potable water would have placed mobility restrictions on migrating bison herds and, in turn, the cultural groups who subsisted on them. The decrease in moisture, and the subsequent abandonment of regions that did not contain a supply of reliable, drinkable water for both animals and humans, cannot explain why no sand dune sites are recorded on the Northern Plains during this period, with the exception of FaNq-25 and FaNq-32. As seen in chapter four, very few intact dune deposits are known to exist on the Northern Plains between 8000 and 5600 BP, as a result of dune activation either during or immediately after this time period (Wolfe et al. 2002:224-225). In either case, this would suggest that groundwater levels within dune environments were depleted to the point where large-scale activation was taking place on a regular basis during the Mummy Cave period. With this lack of surface water, active dune regions would not be as frequented by animal populations during this period, in turn causing a decrease in the number of dune sites. It is felt that the presence of FaNr-25 and FaNr-32 in the Pike Lake Sand Hills is due not to the dunes themselves, but to the water resources offered by the South Saskatchewan River.

While this lack of dune sites can be attributed to site visibility factors, as older sites have a decreased chance of survival compared to more recent sites due to their age, statistical evidence exists that this factor is not of concern for the time period in question. In an examination of Mummy Cave site distribution over time, Walker (1992) illustrated that the frequency of radiocarbon-dated sites/occupations between 5750 and 4515 BP is above average for the entire Altithermal period between 5000 and 7500 BP. Further, although minor fluctuations exist in the latter portion of the period, site occupancy is seen to be equal to or greater than frequencies seen at the beginning of the Altithermal, when conditions were moister and cooler (Walker 1992:129). This is suggestive that the lack of Mummy Cave dune sites is not solely due to the number of sites that have been discovered, but intentional environment selection by First Nations groups during the mid-Holocene.

The second hiatus in this study is very brief, occurring between 4404 and 4451 BP. Due to the extremely short period of time (47 years) during this "break", and the fact that it occurs during a period of documented occupation by Oxbow groups, it can be interpreted as a lack of dated Oxbow sites located within sand dunes. It is felt that this lack of absolute dating at Oxbow sites is related to issues of site visibility for this period (see Dyck 1977, Dyck 1983, Green 2005, and Morlan 1994) and is explored further in section 8.3.1 as part of the analysis of dune usage patterns for archaeological cultures.

For the third and fourth Middle Precontact lapse periods (3369 to 2858 BP and 2379 to 200 BP), explanation can be found in the subsistence practices for both Duncan/Hanna/McKean and Pelican Lake groups. For the former, as discussed earlier (see section 7.3.15), hunting methods focused on ambush techniques in association with steep cliffs and river edges, which would have resulted in a decreased site size and frequency for kills within sand dunes (Brumley 1975:192). Although Webster (2004:158) did speculate on this method being employed with the McKean occupation at EgNo-23, due to the site disturbance from pipeline excavation and the multicomponent nature of the site, it cannot be determined if the material representing what he described as a bone bed came from one or multiple deposits. For Pelican Lake, hunting practices also did not depend upon mass kills such as pounds, instead relying upon stalking techniques. These methods, as with those seen with Duncan/Hanna/McKean, would not be as dependent upon resources such as wood for pound construction, and would have a diminished presence in the archaeological record as larger-scale kill sites, a fact that is reflected in the limited number of known Pelican Lake sites (Peck 2011:236). Of the 20 sites in this study associated directly or indirectly with large- and small-scale kills, or contains evidence of bison processing activities, only one (EgNo-23) is associated with either Pelican Lake or McKean phases. Further, mitigation excavations at this site have not uncovered any evidence of structures associated with large formal pounds, with only the remains of four bison being recovered from the Pelican Lake site. This number can be considered low in comparison with similar kill sites associated with Besant and later side-notched projectile point phases and would not have required the use of a pound. With the McKean occupation, it is considered by Webster (2004:186-198) to be a secondary processing site, with no MNI values calculated for the remains, as well as lithic workshop. Despite the predominance of large-scale hunting activities within dune environments associated with other cultural groups, it is felt that the lack of evidence for large-scale kill and habitation areas for Duncan/Hanna/McKean and Pelican Lake groups stems not from sampling error, but from intentional hunting and subsistence practices that favoured smaller-scale kills in a variety of terrains that included non-dune areas. This pattern of behaviour would reduce the visibility of sites for these groups within dunes, stemming from their size and frequency, which could be in turn impacted if sand dunes containing sites activate, disturbing any *in situ* materials.

8.3 Integrated Summary of Findings

While each of the above sections provide insight into past behaviours within sand dune sites from a singular perspective, further conclusions can be drawn when integrating these perspectives together under the theoretical perspectives of Island Theory, Historical Ecology, and Possibilism.

8.3.1 Dune Usage Across Cultural Groups and the Role of Climate

As observed in section 8.2, physical evidence for sand dune usage indicates that these areas have been witness to a diverse array of cultural practices over time. Despite the Northern Plains region being continuously occupied for the past 6000 years examined in this study, this habitation pattern is not reflected in archaeological and historical records for sand dunes. In addition, the behaviour that is witnessed is not consistent, with groups varying in how these landscapes are perceived and utilized. In part, this behaviour is felt to be a response to the climatic conditions they were living under.

As mentioned previously, sites associated with Mummy Cave typically have a limited extent, contain few artifacts, and are found close to dependable water sources. This archaeological record is reflective of a pattern of subsistence based on small-scale hunting near these water sources and intensive plant-gathering activities due to both the arid climate of the period and conservation efforts to ensure the long-term survival of bison herds on the Northern Plains. Due to the diminished size of Mummy Cave sites as compared with those from other time periods, the probability of them surviving intact within the archaeological record and being found by archaeologists are decreased.

In light of the arguments for poor kill site visibility for Oxbow groups (see Dyck 1977, Dyck 1983, Green 2005, and Morlan 1994), and the lack of major climatic shifts during this period (see Beaudoin 1999) the second Middle Precontact lapse period (between 4451 and 4404 BP) can also be viewed as the result of smaller, individual kills that are not represented well in the archaeological record (Dyck 1977:10; Dyck 1983:96; Green 2005:100; Morlan 1994:758). Given the ties drawn between the Oxbow complex and earlier Mummy Cave, it is conceivable that Oxbow groups maintained, for a period, traditional small-scale hunting practices even after the climate shifted in such a way that larger scale kills became feasible again (Reeves 1973: 1245; Walker 1992:144). While it is acknowledged that the accepted dates used in this study originate from three occupations found in two sites (FbNs-1 and FaNr-2), these dates do encompass almost the entire range of Oxbow groups occupying the study area. Collectively, this evidence suggests that Oxbow groups inhabited dune areas on a continual, small-scale basis similar to that of Mummy Cave groups as Northern Plains environmental conditions cooled, and dune environments became more saturated.

A second source of evidence for the continued usage of dune areas by Oxbow groups can be seen in the dataset obtained from the Gray Site (EcNx-1). Although used as a burial site, and not as a habitation area, radiocarbon dates obtained from the graves indicate that the region was used for internments over an approximate3000-year period. While not directly representing hunting and habitation activities, the presence of this significant and unique site within a dune environment is suggestive of deeper social meaning for Oxbow groups associated with this type of landscape. Further, as illustrated by Sussman (2003), this site would likely have associated habitation locales nearby, as the physical needs of ceremonial participants would have to be accommodated in order to support these intensive burial practices (see Sundstrom 2003). This topic is discussed further in section 8.3.3.

For the absence of Duncan/Hanna/McKean and Pelican Lake groups from sand dunes, an explanation can be found in the subsistence practices for each of these groups. For the former, as discussed earlier (see section 7.3.15), hunting methods focused on ambush techniques in association with steep cliffs and river edges, which would have resulted in decreased site visibility and frequency within sand dunes. This conclusion is supported by both the documented tendency of McKean habitation sites to occur near large rivers, as well as the hiatus witnessed at Head-Smashed-In Buffalo Jump between approximately 4100 and 3100 BP (Brumley 1975:91-92; Brumley 1978:192; Dyck 1983:100; Dyck and Morlan 2001:120; Reeves 1978:170; Reeves 1990:180; Syms 1969:168). For Pelican Lake, hunting practices also did not depend upon mass kills such as pounds, instead relying upon stalking techniques. These methods would not be as dependent upon resources such as wood for pound construction and would have a diminished presence in the archaeological record as larger-scale kill sites, a fact that is reflected in the limited number of known Pelican Lake sites (Peck 2011:236). Of the sites examined in this study, only one (EgNo-23) is associated with either Pelican Lake or McKean phases. Mitigation excavations at this site have not uncovered any extensive archaeological remains, such as those associated with structures for large formal pounds. Rather, the largest assemblage found are the remains of four bison being recovered from the Pelican Lake bonebed. This low MNI value can be considered low in comparison with similar kill sites associated with Besant and later side-notched projectile point phases and may not have required the use of a pound.

With a reliance on bison as a food source, the movements of these cultural groups on the Northern Plains were influenced by the landscape usage of these animals, which in turn were impacted by changes in climate. Immediately following the Altithermal period, although conditions were becoming cooler and moister, potable water resources were limited, resulting in bison herds congregating near stable sources such as rivers and oxbow lakes. To exploit these faunal resources, human groups used these areas as principal hunting grounds, while relying less upon any resources found in dune environments due to the lack of both bison and drinkable water. This behaviour is reflected in the archaeological record for Mummy Cave, Duncan/Hanna/McKean, and Pelican Lake groups, who did not rely heavily on dune landscapes, instead preferring to exploit river and cliff edges using stalking techniques and small-scale kills. While FaNq-25 and FaNq-32 can both be found in a dune environment, the principal reason for these sites being occupied can be viewed as being nearby fresh water resources, and not the dunes themselves. As such, despite the potential for large-scale hunting activities within dune environments for cultural these groups, it is felt that the lack of evidence for large-scale kill and habitation areas for Duncan/Hanna/McKean and Pelican Lake groups stems not from sampling error, but from intentional hunting and subsistence practices that favoured smaller-scale kills in a variety of terrains that included non-dune areas.

For Besant groups, this pattern of occupation can be seen as reversed. Of the seven sites associated with this group, four of them are considered to be pound or kill sites, with a further two containing evidence for bison processing and grease extraction. The expansion of intensive bison hunting activities within dunes can in part be attributed to the changing climatic conditions during the period. With the onset of modern climatic conditions approximately 3500 years ago, the resulting moister conditions on the Northern Plains would have caused the establishment of a more usable resource base in dune environments for bison herds. These resources took the form of increased fresh ground water supplies and a plentiful and diverse floral population, with the latter facilitated by dune stability that would be promoted in part by the presence of a higher water table and expanded plant growth. With increased bison populations occupying dune environments, large-scale kill tactics would have become more advantageous to adopt, which is witnessed by the prevalence of Besant pound structures within dune environments (Walker 2016:136-137). This period of intensive usage also occurs during the Scandic Period (1550 to 1050 BP), which is hypothesized to be a period of warmth that depleted floral and faunal resources. This climatic shift is thought to cause Plains groups, in particular Avonlea, to both expand their resource base and intensify their resource acquisition (Davis and Fisher 1988:112-113; Duke 1988:269). For dunes, these conditions could possibly result in the increased potential for dune activation, causing both the abandonment of sand dune regions and the destruction of archaeological sites. However, site evidence from EdOh-23 and ElNp-8 indicates that this fluctuation did not impact dunes to the degree that it impeded their use by Besant groups as habitation or pound areas.

Although living concurrently with Besant groups on the Northern Plains, the archaeological record documenting dune usage for Avonlea groups is comparatively smaller. Only three of the sites within the dataset for which uses have been determined contain Avonlea diagnostic material. Of these, two have absolute dates assigned to them, with both the kill site (ElNs-10) and the single occupation site (FbNs-15) dating to between 1299 and 759 BP, just prior to the disappearance of Avonlea on the Northern Plains. While it may be assumed that Avonlea did not occupy dune environments prior to this period due to the drier conditions of the Scandic making sand dunes more inhospitable, this argument cannot be accepted due to the presence of the Besant sites mentioned above. As well, the corrected date ranges for ElNs-10 and FbNs-15 also fall partially within the time frame for the Scandic, calling into question the role, if any, that this climatic period had in influencing dune occupations on the Northern Plains.

While this period of climatic aridity likely did not play a large role in the near absence of Avonlea sites from dunes, explanation for these findings can be found by examining the larger patterns of cultural behaviour associated with Avonlea and their interaction with Besant groups. It is suggested by Duke (1988) that, despite both Avonlea and Besant having an economy focused on the exploitation of bison, these two groups scheduled their subsistence practices in such a way to avoid each other. To support this conclusion, he cited the findings from major kills such as Head-Smashed-In Buffalo Jump, where Besant is absent, and the Old Women's Buffalo Jump, where Avonlea is not present (Binnema 2004:64; Duke 1988:269). Further, Cloutier (2004) concluded that not only did the two groups avoid each other, but that evidence exists that Besant groups either abandoned or were forced out of territory in southern Alberta and Saskatchewan at approximately 1400 BP, with Avonlea groups subsequently occupying these areas (Cloutier 2004:150).

The findings from this study reinforces these hypotheses, as Avonlea groups did not intensively exploit dune environments for hunting purposes that were concurrently being utilized by Besant. All of the accepted radiocarbon dates obtained for the three Avonlea sites within this study (FaNp-19, FbNs-15, and ElNs-10) place them after 1400 BP. Of greatest interest to this conclusion is the occupation at ElNs-10, which produced a calibrated radiocarbon date range of 1299 to 1185 BP. This places usage for the bison pound immediately after the displacement of Besant groups on the Northern Plains.

This pattern of site occupation is suggestive that, despite the ability of sand dunes to support intensive bison hunting activities, Avonlea groups did not extensively utilize these environments and the faunal resources found there. Instead, evidence suggests that to avoid Besant occupations that were firmly entrenched within these landscapes, alternate environments and resources were utilized, such as fish that were exploited along lake and river terraces. Also occupied during this time are Avonlea sites dedicated to fish and pronghorn procurement, such as the Lebret and Lost Terrace sites respectively (see Davis and Fisher Jr. 1988, Smith 1986, and Smith and Walker 1988). This subsistence behavior can be viewed as being atypical of Plains groups during this period, which witnessed a cultural expansion from eastern North America along with the expansion of bison hunting on the Plains (Walker 2016:136-137). Radiocarbon dates from the Lebret site (EeMw-26), which contains extensive evidence for fish procurement, date to periods both before and after the hypothesized displacement of Besant from dune environments by Avonlea groups. Further, no archaeological evidence for intensive Besant fish procurement has yet to be found, casting into doubt the claims that the Scandic caused all Plains groups to utilize a broader range of resources (Davis and Fisher 1988:112-113; Duke 1988:269). Additionally, this avoidance of sand dunes cannot be attributed to Avonlea groups not employing bison pounds in favor of other means of subsistence. On the Northern Plains, there are a considerable number of known large-scale Avonlea kill sites in non-dune areas, such as the Upper Kill site, the Long Creek site, the Gull Lake site, the Boarding School Bison Drive, Head-Smashed-In Buffalo Jump, the Manyfingers site, Ramillies, and the Irvine/Ross Creek Kill site (see Brumley 1973, Forbis 1960, Kehoe 1966, Milne 1988, Quigg 1988, Reeves 1983, Wettlaufer and Mayer-Oakes 1960), indicating that the practice of pounding was employed. It is suggested here that the absence of Avonlea sites in sand dunes prior to 1400 BP and the usage of other ecological islands and the resources they contain, such as lakes, is due to their being excluded from them by Besant groups. Immediately following the displacement of Besant from dunes however, Avonlea groups began their own intensive utilization of these areas, as exemplified by the Whiting Slough site. In this analysis, it is recognized that this conclusion is based in part on the presence of only one Avonlea sand dune bison pound, and that more of these sites may exist that contain dates from occupations concurrent with Besant. However, it is felt that the fact that in over forty years of research on the Northern Plains only one Avonlea pound within dunes has been discovered, in comparison with the frequency of this site type in dunes for contemporaneous Besant groups. Further, this hypothesis also considers the alternate resource strategies employed by Avonlea groups during a time period that saw the expansion and industrialization of bison pounding by Besant, again with sand dunes playing a large role in these activities. While requiring further field studies to either confirm or deny this hypothesis, it is felt that given the initial evidence that this is a question that should be examined in the future.

The usage of dunes is seen to continue unabated for various purposes through the Late Precontact period, beginning with the transition for Avonlea into groups affiliated with Prairie Side-Notched points, represented at three dated sites/occupations (FaNp-19 #1, FdOt-1 #1 and #2) that contain both styles of diagnostic material. The latter two occupations are seen to represent bison processing and disposal areas, with the presence of an extensive ceremonial feature as well. Prairie Side-Notched groups are also found at FbNr-1, a bison pound, as well as at FaOm-1 and FaOm-22, where extensive archaeological materials suggest the co-occurrence of Prairie-Side Notched and Plains Side-Notched groups within areas associated with habitation, bison butchering, and disposal. Plains Side-Notched materials are also found within an occupation of FaNp-19, thought to represent small-scale hunting practices. In Manitoba during the latter Late Precontact period, dune sites are seen to be occupied in one instance (FaNp-19 #2) by Blackduck groups, as well as by Vickers Focus. In the case of the latter, three sites are found to contain materials from this group, representing bison kills, campsites, and processing areas. For one of these sites, DiMe-23, Vickers Focus materials is seen to co-occur with Mortlach. For all of these sites, the behaviours are seen to be consistent across all groups, with no breaks in occupation, as well as evidence for activities centered around habitation, as well as intensive and sporadic exploitation of bison resources. For sites from this period where seasonality determinations have been accepted (FaOm-1, FbNr-1, FaNp-19 and FdOt-1, DiMe-17), all of them fall within the fall to winter months, when bison herds would be occupying more forested regions, such as dunes and river valleys. This pattern of utilization in dunes can be seen as enduring until EuroCanadian contact and expansion into the Northern Plains.

8.3.2 Dunes as Pounding Areas and Their Environmental Impact

As stated earlier, evidence for extensive pounding activities in dunes is seen with Besant groups during the Middle Precontact period, with the activity also seen in association with Avonlea and Prairie Side-Notched materials during the Late Precontact. This behaviour coincides with what conclusions have been drawn on the seasonality of occupation for these groups, which focus on the fall and/or winter months. In examining historical records, these seasonality behaviours mirror those of groups who focus upon intensive bison hunting activities (Schaeffer 1978:244; Verbicky-Todd 1984:34). Numerous historical accounts note the use of pounds during the fall and winter months (see Cocking 1908, Coues 1897, Franklin 1970, Gough 1992, Grinnell 1920, Hector and Vaux 1861, McDonnell 1889 and Skinner 1914), as well as one account (see Hind 1971) where pounding activities are witnessed during the late summer. Other activities, such as habitation or lithic production, are commonly seen in association with pounding activities. This pattern of usage confirms archaeological evidence from larger-scale kills on the Northern Plains. As seen above, evidence suggests that the fall months were selected for jump and pounding activities due to peak fat stores within preferred bison cows, as well as milder seasonal temperatures that would have decreased insects and the chance of meat spoilage (Brink 2016:111).

From the perspective of Possibilism, these results illustrate that despite the environmental potential for sand dunes to support both the herds involved in intensive bison hunting practices and the landscape modification practices required to make these hunts successful, not all groups engaged in these practices. For some, such as Gowen and Duncan/Hanna/McKean, the environmental conditions were such that intensive exploitation of bison resources in dune environments was not a possibility. However, following the end of the Altithermal, conditions gradually became moister, facilitating increased environmental stability within dune environments, which in turn would have increased plant growth in dune areas that would have attracted larger bison herds. Despite these conditions, the archaeological record indicated that Pelican Lake groups during this period maintained the traditional hunting practices of using ambush and stalking techniques. This adherence to past practices is reflected in both the comparative lack of Pelican Lake sites across the Northern Plains and their almost complete absence within sand dune environments.

Cultural practices are also reflected in the usage patterns of Avonlea groups within sand dunes. Occupying the Northern Plains during warm and moist climatic periods conducive to the large-scale hunting of bison, this group did not exploit one of the most well-adapted habitats for this activity. Instead, evidence in the archaeological record illustrates that Avonlea groups avoided contact with Besant, exploiting other resources and ecological islands such as fish within the Qu'Appelle Lakes region. Despite conducting pounding activities in other types of environments, only one example of an Avonlea dune site pound is known. In contrast, Besant groups during this same period established a tradition of intensive bison pounding, with sand dunes playing a significant role to this subsistence practice. Evidence of Avonlea pounding in dunes only manifests once Besant groups are in decline and being displaced from their Northern Plains territories, including sand dunes. Once established, this tradition of pounding continues throughout the Late Precontact period until contact with EuroCanadian groups.

The practice of pounding with regards to its impact on the environment can be interpreted as a highly destructive one especially with the effect that it could have on sand dune activation. In examinations of deflated areas in dunes, Wolfe et al. (2007) and David (1993) concluded that dune destabilization and activation is caused by human activity within a confined space, including plant removal, anthropogenic burning, and trampling from bison pounds. Although based upon the presence of artifacts found in deflated regions, conclusions drawn from this holistic study place these assumptions into question. In assessing how these practices influence dune stability in this new light, their impact can be seen as negligible, and in some cases beneficial towards the stability of sand dunes.

In examining the impact of anthropogenic burning, used to clear landscapes for pounds and strategically driving animals, evidence indicates that the practice contributes to the overall stability of dune environments. While removing trees and ground cover, this process also burns deadfall and other dry material, contributing to the nutrient base of the area. For numerous Plains adapted plant and tree species, they have evolved extensive and deeply buried root systems that allow for quick regeneration, enabling them to survive fires. Although surface vegetation has been removed, stability is maintained in dunes by the presence of these structures. Following burning, impacted areas regenerate rapidly, with grass species returning quickly, which in turn attract larger animals such as bison. Although potentially causing disturbances through trampling, they also contribute to the surface stability of dunes by adding nutrients through their faecal matter and physical remains. Also contributing to stability is the rapid growth of tree species such as Quaking Aspen, which regenerates and colonize areas quickly after fire episodes. The presence of aspen contributes to stability not only through root systems, but also with the shade provided, inhibiting surface moisture evaporation.

The construction and use of pound structures also aid in the stability of dune environments. While disturbances do occur with the driving and entrapment of animals, other processes contribute towards dune stability, most notably being the killing and butchering of the bison. In the aftermath of the kill, while butchering does take place, large amounts of animal remains are left either within the pound structure or are deposited in secondary locations around the sand dune. These organic deposits contribute to stability through the additions of moisture, ground cover, and nutrients through their decomposition. Further, these remains will attract scavengers, who will in turn spread the material across a further area within the dune as well as deposit additional faecal matter. The process of pound construction also can improve growing conditions for plant species that provide stability with the removal of older, mature tree stands that can allow younger plants to establish themselves within the region. As well, historical records indicate that some pound structures did not use posts driven into the ground as supports for the walls, but instead utilized living, standing trees. Collectively, while serving as a possible source of destabilization through processes like human and animal trampling, the use of pounds and the performance of hunting-related activities also served to stabilize dune regions as well and contribute to the ecological fitness of these areas.

8.3.3 Spiritual Uses of Dune Environments

Compared with economic and subsistence practices, there is less identified evidence in the archaeological record originating from religious or spiritual behaviour in dune sites. These findings concur with that of Sundstrom (2003), who concluded that artifacts left at sacred areas or landscapes are difficult, if not impossible, to identify within the archaeological record once they have been separated from their social and depositional contexts. Lacking association with religious features such as cairns, effigies, medicine wheels, or rock art, it is difficult to distinguish between assemblages of a ceremonial and spiritual nature and those that had a more utilitarian purpose.

Despite not being able to easily identify individual sacred artifacts, it is possible to view religious behavior through the particular features and sites that it created. This component of the archaeological record typically falls within two broad categories: burials and ceremonial sites/features. Within the sites examined in this study, two burial sites, EcMx-1 and EeOh-6, are identified within the southwestern corner of Saskatchewan. Of these two, EcMx-1 or the Gray site, is the best documented. Containing the remains of at least 304 individuals, it is the largest Middle Precontact cemetery on the Northern Plains. In the context of this study, it is believed that the presence of such a site within a dune environment is not a random occurrence that resulted from the ease involved from burying an individual in sand as opposed to soils or clay. Instead, it is felt that the site reflects a clear intent by Oxbow peoples to inter their dead within a landscape that has cultural significance to them and that is reflected in cultural beliefs documented in later historic accounts. Evidence for this cultural significance is drawn from both the burial practices observed at the site and contemporaneous burial practices found in the Northern Plains.

A hypothesis of randomness might suggest that individuals were interred due to the expediency and ease with which burials could take place. If such were the case, then no distinct pattern would be visible with respect to the usage of the site and the pattern of disposal. Upon investigation however, a distinct pattern of usage is evident that suggests that the cemetery was created based upon a specific set of cultural ideals. Investigations by Wade (1981:126) concluded that the cemetery was used by one cultural group over a protracted period of time, rather than by a number of different complexes over the course of the Middle and Late Precontact periods. Further to this conclusion, Walker (1986) determined that the mortuary behaviour displayed at the Gray site is unique to the Oxbow complex. Utilizing ochre in burials that are either large cemeteries or are isolated, single burials, these practices differ from later McKean complex burials, where individuals are recovered from the living floors of habitation areas with no usage of ochre in the post-mortem treatment of the body (Walker 1984:148; Walker 1986:259-260). Other unique behaviour seen at the Gray site includes the intentional fragmentation of long bones and post-cranial bones, the heat treatment of bones, and the placement of cobbles on the dead, which Millar (1981:116) has interpreted as the living attempting to prevent either the malevolent soul of the dead or the dead themselves from returning.

Further evidence for the Gray site being created with specific intent is visible in the nature of the burials themselves, and in particular the evidence for secondary burials. Out of the 304 individuals recovered from the site, 275 represent secondary burials, where the remains were transported to the area after primary internment and decomposition had already taken place. In numerous instances, the remains have been at least partially skeletonized, with evidence for any remaining soft tissue being removed from the body and the bones being covered in ochre. This practice suggests that the dune region in which the site is located has specific meaning for the group that is using it, as the remains of group members are being intentionally transported to the area for reburial after they have been exposed to the elements for a protracted period of time, normally through the use of scaffold burials (Millar 1981:107-108). If ease of burial or expediency were the primary concerns, it would have been easier to leave these burials in their primary context, or to bury the individual near them. Lastly, the lack of large-scale burials like the Gray site within dunes illustrates that internment within sand dunes was not a common occurrence. If the main reason for burials to occur in dune areas is the ease of excavating graves, it would be expected that large cemeteries would be the norm on the Northern Plains, rather than restricted to just one site.

Due to the lack of diagnostic material associated with EeOh-6, few definitive conclusions can be drawn on the site. What is known is that the remains of at least one individual have been found within a blowout in the Great Sand Hills in association with a brass projectile point. In addition to the historic material, other cultural material found at the site consists of nine animal skulls located to the east of the body and placed in a north-south alignment. Representing eight buffalo and one elk, all the horns/antlers on the skulls are pointed to the east, a direction typically associated with rebirth and the afterlife. Interpreted as a ceremonial site by Epp and Johnson (1980), the placement of the skulls in a semi-circular pattern with orientation towards a specific direction is documented as a feature that is created to honour ancestors (Nicholson and Nicholson 2007:318-319; St. Clair 2003:20-21).

In addition to these burials, four sites with ceremonial features are found within the study area. Within Manitoba, DiMe-17 and DiMe-29 both contain an individual bison skull that has been interpreted by Nicholson and Nicholson (2007) as being a shrine providing offerings to either ancestors or to the spirits of bison who sacrificed themselves so that humans could survive. The presence of ceremonial bison skulls is not uncommon on the Northern Plains, as the bison is viewed as a sacred animal due to the spiritual and physical provisions it provided to Plains groups (St. Clair 2003:15). Use of skulls in a ceremonial context is documented at numerous locales, including the Papegnies site, the Cooper site, the Ruby Bison Pound, the Glenrock Buffalo Jump, and the Vore site (Bement 1999:181; Nicholson 1994:165; Reher and Frison 1980:19; St. Clair 2003:23-24). While not unique to dune sites, these features are frequently associated with kill sites, as ceremonies were performed to both ensure the success of a hunt and to offer thanks to the animals that were killed (Nicholson and Nicholson 2005). Their presence at DiMe-17 and DiMe-29 reinforces conclusions (see section 8.32.) drawn earlier on the usage of dune environments as a preferred area for communal hunting activities such as pounds. In addition, the discoveries of four intact bison skulls at FaOm-1 during backhoe excavation and an intact canid skull in a feature at DlOx-5 are suggestive that some type of ceremonial activity may have occurred at these sites as well (Foreman 2010:41-49; Gibson and McKeand 1996:18).

Comparable to these bison skulls is Feature 10 at FdOt-1 and the interpretation that it reflects ceremonial activity, possibly related to feasting (R. Wondrasek, personal communication, 2017). This determination was made only after consultation with Blackfoot Elders, in conjunction with the depositional context for the different species and cultural material. Representative of the Blackfoot worldview, this type of feature is not endemic to dunes, but has been found in other kill sites as well. Oral history exists that explains the significance of canid materials within other Old Women's sites, most notably the skull at FdOt-1 mentioned previously (see section 7.2.7).

For all the sacred features mentioned above, it should be noted that they were discovered within sites that have been identified as either kill sites or camp/processing areas. This identification of social behavior within areas almost exclusively associated with economic practices illustrates the concept of sites having multiple uses and meanings within the archaeological record. Although seemingly disparate behaviours, the archaeological record provides evidence for bounded activity areas to contain evidence for the inseparable cultural connections between religious and economic practices.

Lastly, the bog feature at the Finn Bog site (ElNo-3) can be viewed as having sacred aspects due to the presence of cultural material that has only otherwise been found at the Gray site and the Bracken Cairn. What distinguishes this aspect of the site is the unique depositional environment of these items with religious connotations, as they were recovered from the bottom of a bog within the Dundurn Sand Hills. Further, although not well understood due to the excavation methodologies employed, the area immediately around the slough has evidence for small-scale habitation activities which again reinforces the work of Sundstrom (2003) in the need for supporting elements within any religious site. Based upon the cultural material found within the bog, the site suggests that the area was significant for Oxbow, Pelican Lake, Duncan, Avonlea, Sandy Bay, Prairie Side-Notched and Plains Side-Notched groups for an extended period of time. With regards to the nature of the religious practices occurring at the site, no definite conclusions can be drawn due to the lack of ethnographic or detailed archaeological evidence. However, based upon the oral histories surrounding dune areas and bodies of water (see chapter four), it is suggested that the site may be connected with offerings to the afterlife and deceased and/or to the *memekwesiwak* (little people). Before a definitive answer regarding the purpose of this site, First Nations consultation must take place, as well as detailed subsurface testing.

Through the perspective of Historical Ecology, further evidence of the religious nature of dune environments can be seen through the presence of sacred and medicinal plants within dune environments. Within oral histories it is recorded that plants gathered for these purposes are more potent or spiritually-imbued when found within sand dune environments. This is due to the sacred connections that exist between these landscapes and supernatural powers, which as observed can vary between the afterlife and the *memekwesiwak*. Contributing to this perception is the practice of plant disposal, where floral material left over from ceremonies or the distillation of medicine are reburied in a ceremonial manner. This practice can be seen to have two outcomes, the first of which being the expansion of culturally significant medicinal and utilitarian plants through transplanting practices into an environment that is physically capable of sustaining them during periods of environmental stress. In doing so, practitioners are ensuring that these resources will be available in the future within a landscape that is both protective and culturally significant, due in part to these important floral populations.

This concept of the sacred connected to sand dunes is the second outcome of these transplanting processes. Although initially possessing unique physical characteristics that can define it as a significant area (see Sundstrom 2003), as well as having the physical potential to support a diverse plant population, it can be interpreted that the concepts of the sacred surrounding sand dunes and their floral populations is in large part the product of this human behaviour. By engaging in a seasonal practice of environmental stewardship with the addition of new plant materials, as well as through making contributions to overall ecological health for sand dunes through burning and pounding practices, the populations floral species used by humans within dunes would be have the potential to artificially flourish beyond environmentally-imposed limits on plant populations. By expanding the presence of important species within an environment considered sacred, the importance of that environment and the status it has as a spiritual landscape would expand.

Within this practice also lies the potential for expanding our capacity for identifying areas of religious significance based upon the archaeological record. As mentioned previously, it is difficult to identify spiritually significant sites based upon artifacts, with the exception of areas such as rock art sites, medicine wheels and other stone alignments, and vision quest locations, as offerings given that part of a ceremony can be misinterpreted due to a lack of larger context. Discussed in chapter one, in initially looking at the potential site dataset as defined by the study area for this research, the majority of locations consisted of what is classified as isolated finds or uninterpreted sites. An example of this can be observed in the site database for the Lauder Sand Hills, where of the 225 sites recorded within the region, a total of 120 (53.3%) were classified as isolated finds and were considered to have little heritage value. It is felt that by taking anthropogenically-generated concentrations of utilized plants into consideration that greater context can be provided to the formation of some of these smaller sites. This can be accomplished through an examination of utilized plant concentrations in comparison with the location of recorded sites within dune environments, with the potential for a spiritual or ceremonial context to artifact deposition being inferred through the correlation of anthropogenically-modified plant populations with archaeological material. Detection of anthropogenic plant populations can be accomplished through examining the density of species within a small discrete area, indicating the intentional burial of large amounts of roots or seeds, or in the identification of species native to a region of the Northern Plains. Due to the prominence of Plains Cree healers within historical literature, and the connections this group has with Boreal Forest Cree communities, it may also may be possible to detect this behaviour through the presence of species more commonly found within boreal forest or parkland environments within dune sites on the Plains. Through trade for medicinal plants with the Cree more typically found in the north, with any remains left over from treatment being reinterred within sacred landscapes, typically northern plant populations can be introduced or reinforced within an environment that would support growth and expansion. In examining these plant populations, it would be possible to begin to spatially locate regions of cultural significance within dunes that were previously not identified due to a lack of cultural context that can now be obtained by recognizing the unique spiritual behaviour that influenced the site formation processes of these smaller sites.

8.3.4 Social Interaction within Dune Areas

A further trend discussed as part of this analysis is the usage of sand dune archaeological sites within the study area from a social perspective. Previous sections (see sections 3.6 and 4.4) in this work have established the unique resource base and species diversity present within dune environments and how they were exploited by humans. In addition, work by Hickey (1974) and Meyer et al. (2008) have also established the use of unique resource areas similar to this in northern Canada as being a region of culture contact and innovation. Given this foundation, we can examine sites found within dune environments to determine if this social trend is also visible within sand dunes on the Northern Plains.

Although difficult to detect in the archaeological record, cultural contact and influence has been inferred as occurring at several sites within this study. First of these are the Bodo Bison Skulls and Bodo Overlook sites, where Mann (2007, 2009) speculated that points and pottery representing Old Women's and Mortlach phases, in addition to possible Selkirk pottery, are present. This conclusion, based upon archaeological evidence, correlates with the oral and written histories associated with the region that depict the Neutral Hills and Sounding Lake region as neutral territory with sacred overtones, where any group could access the abundant resources available. Further, the sites are located in close proximity to both the territorial boundaries for Old Women's and Mortlach and a noted trail system that allowed for access to Sounding Lake from both the east and west. Based upon current interpretations of Late Precontact material, the archaeological record of these sites indicate that they were occupied by Blackfoot, Assiniboine, and Cree groups, although it is debatable as to if these groups were in the Bodo region at the same time. However, given the established resource base present at the sites, as well as the focused seasonal usage of dune environments, the chances of groups encountering each other are increased. Further, during the period when FaOm-1 and FaOm-22 were occupied, group relations between the groups represented at the sites were amiable, with political, social, and economic ties established between all parties (Binnema 2004:130).

Also inferred as possessing evidence of culture contact and adoption are Vickers Focus sites within the Lauder Sandhills. In their examination of the Jackson site, Mokelki (2007), Nicholson and Hamilton (1999), and Playford (2001) postulated that the disappearance of Vickers Focus peoples in Manitoba might be due to interaction with Mortlach groups, eventually leading to the amalgamation of the former by the latter. Based on the prevalence of Vickers-variant Mortlach sites in the Lauder Sand Hills, such as Twin Fawns and Schuddemat, it is also postulated that the sand dune environment functioned as a region where both culture contact and integration took place between these Eastern Woodlands and Plains groups (Mokelki 2007:128; Nicholson and Hamilton 1999:15; Playford 2001:24-5). Evidence also exists at DiMe-17 for the use of dune environments by Blackduck groups, illustrating that the potential for further contact also occurs with other Woodlands groups inhabiting the Northern Plains during the Late Precontact period.

Despite being located in the eastern and western regions of the study area, the Lauder Sand Hills and Sounding Lake Sand Hills can be seen as similar within this context of social interaction and human boundaries. Both of these locations were situated near the political boundaries of groups on the Northern Plains and contain archaeological assemblages that indicate that multiple contemporaneous groups made use of both areas. Both ecological and historical data support the hypothesis that human and animal populations were drawn to dune environments due to the plant and animal resource bases that were present. As multiple cultural groups made use of these regions, dunes became not just a region of environmentally-based resources, but social resources as well, as groups came into contact with each other and established social relationships. This interaction is observed in the archaeological record at the Lauder Sand Hills and Sounding Lake Hills with the presence of diagnostic material from contemporaneous Late Precontact groups, as well as pottery that displays traits from multiple cultural complexes. This social contact would result in the transmission of ideas and the movement of individuals to new groups as the result of intergroup marriage, but would also initiate the transfer of medicinal, spiritual, and utilitarian plant materials that would be distributed over a larger area than was possible under natural dispersion forces when groups continued their seasonal movements.

While the presence of desired resources can act as an incentive for groups to travel to, meet at, and utilize sand dune environments, it can also serve as the basis for contemporaneous groups to practice avoidance with each other. Such is the case with Avonlea and Besant groups, where distinct habitation and subsistence patterns are observed with regards to dune areas. From the archaeological record, it is observed that these two groups did not engage in any social activity that would have produced the assemblages that are observed at other dune sites such as FaOm-1 and DiMe-23. Rather, it is felt that Avonlea groups avoided dune environments entirely due to the presence of Besant, despite their capacity to support intensive bison hunting activities. This aversion to regions that are thought to be in part supporting the fluorescence in bison hunting during this period is reflected in the more diverse subsistence practices that are associated with Avonlea, including antelope hunting and fishing. As Besant groups are displaced from the Northern Plains however, we see the almost immediate use of sand dunes by Avonlea peoples, who engage in pounding activities that they have been conducting within other ecological areas prior to this period.

8.3.5 Dune Usage and Seasonality

The last topic to be discussed as part of this analysis is the seasonality determinations made from both the archaeological record and ethnographic sources on optimal plant gathering periods. From the 15 sites where seasonality has been determined by the original authors, all of them contained a site usage pattern during the late summer to the winter, reflective of prime season bison hunting and processing activities as postulated by Brink (2016). However, for two of these sites from the Late Precontact period (FaOm-1 and FaNp-19), evidence of occupation also exists for the spring and early summer through the presence of bison foetal remains and migratory waterfowl bones. While deviating from the norm for bison hunting, for which there is ample archaeological evidence, this expanded range of occupation is indicative of plant gathering activities documented in chapter four. For the 27 species from which the collection period has been documented (see Table 4.2), nine of them are collected during the spring to early summer months. Uses for these plants (*Achillea millefoliuim*, *Allium textile*, *Anemone patens*, *Artemisia frigida*, *Artemisia ludoviciana*, *Astragalus canadensis*, *Juniperus* spp., *Populus balsamifera*, and

Populus tremuloides) encompass all major categories within this study. These findings suggest that sand dune areas served more than one role as subsistence areas for the Late Precontact groups where spring and early seasonality have been determined, with variations in usage occurring depending upon the resource that is being exploited. While evidence of fall bison hunting dominates the archaeological record in dunes, this disparity can be interpreted as a function of site formation processes, as the procurement of bison in small- or large-scale kills would produce a greater material record to be examined by archaeologists rather than plant gathering activities. In some cases, these practices may only take a brief period of time over the course of one day, which would not require the establishment of smaller camp areas, resulting in the absence of any physical record of these activities. Further, the use of dunes for hunting during late summer to fall months overlaps with the prime collection seasons for 23 of the species listed in Table 4.2. This evidence would indicate that, in addition to engaging in bison pounding activities, Late Precontact groups were also able to exploit plant resources during the best time to collect them within an environment that not only supported a diverse range of species, but also imbued them with enhanced potency in cases where their use was either medicinal or spiritual. While this practice of summer collecting may also have taken place during the Middle Precontact period, evidence of seasonality will be required to substantiate this claim.

Seasonality evidence indicating a predominance of fall and winter occupations associated with bison hunting activities also impacts our understanding of human seasonal round movements and their use of environments. As detailed in chapter five, debate exists between those who advocate for the usage of the Parkland by bison during colder months (see Vickers 1991, Peck 2001, and Vickers and Peck 2004), and those who maintain that the grasslands were utilized during the winter (see Malainey and Sheriff 1996). Using information from this work, a new perspective on seasonal usage can be formulated.

The continual presence of human groups in dune environments during the winter months can be viewed as corresponding to the hypothesis put forth by Vickers and Peck (2004), who postulated that wood, and not bison, was the main resource First Nations groups focused on collecting during the winter months (Vickers and Peck 2004:99-102). Further, Morgan (1978) stipulates that the main stimulus for bison migration was the search for superior forage, with water being a major force during the fall and the search for shelter during the winter (Morgan 1978:223-224). In light of the findings from chapter three, it is clear that dune environments which emulate a Parkland ecotone, are more suited for the growth and support of trees than the surrounding grasslands environment, and as such would have been occupied by human groups who would exploit both floral and faunal resources.

The issue of floral and faunal resources however, is only one component of determining larger-scale seasonal settlements. Of equal significance to this question is where dune areas are located. Although providing resources found within the Parkland, the dune areas within this study are located within a region that, viewed broadly, is thought to be part of a Plains grasslands environment. Upon examination (see Wolfe 2001), it is apparent that Malainey and Sheriff (1996:340) have classified regions containing dunes as being within a grasslands ecoregion through the use of generalized ecological literature. In doing so, both the ecological diversity of the Plains and specific behavioural patterns associated with it are masked by broad classificatory generalizations. Looking further into the historical and archaeological records used in their analysis, it is found that many mentions of fall and winter activities occurred in areas in close proximity to dune areas. These accounts include those of Thompson (1985), who mentioned extensive winter encampments within the Lauder Sand Hills (Malainey and Sheriff 1996:348; Thompson 1985:101-126). Also mentioned is Alexander Henry the Younger, who places a Blackfoot pound in the vicinity of sand sheets and dunes associated with the Ukalta Sandhills, located east of present-day Edmonton on the south shore of the North Saskatchewan River. As well, Peter Fidler observed a Blood encampment near present-day Stettler that may have made use of the sand sheets located to the south of the town (Henry the Younger 1988:421-422; MacGregor 1966:85; Malainey and Sheriff 1996:347-348). Further, the account of Kane's visit to an active bison pound, which occurred in the fall, locates the structure as being six miles from Fort Carlton, which potentially places it within the Duck Lake Sand Hills (Kane 1968:80).

Archaeological evidence from this work also shows an intensive winter use of dune environments that are mistakenly classified as grasslands, including such sites Bodo Bison Skulls, Bodo Overlook, Muhlbach, Hartley, EgNn-9, and EgNo-23. Further evidence for the usage of a broader range of ecological islands can be seen with other historical accounts and sites selected by Malainey and Sheriff to support their argument, with many occurring within or near river valleys and lakes, which would display an ecological diversity similar to that found in dunes, and distinct from that found in an open grassland (Malainey and Sheriff 1996:346-351)

From this seasonality study, it is proposed that a new theory of wintering and seasonal landscape usage be adopted that considers salient points from both sides of the debate. Areas within the grasslands have, in the past, been used during the winter months by both human and bison populations, as proposed by Malainey and Sheriff. Many of these areas however, coincide with ecological islands like sand dunes that contain an ecology more commonly found along the grassland/parkland boundary and within river valleys. By adopting a perspective that takes into account the influence that ecological islands such as sand dunes have on seasonal migration patterns, both perspectives can be viewed as correct to a certain extent, as bison do winter in both a parkland biome and in a region identified as being the grasslands.

This concept should not be seen as an amalgamation of these two theories, as it is felt that both Vickers and Peck and Malainey and Sheriff do not take into account all of the environmental factors that would make an area attractive to both animal and human populations. With this perspective, wood, the main resource that is being exploited in wintering areas as suggested by Vickers and Peck, is only one of several resources playing a role in the use of sand dunes during the fall and winter. Equal in importance would be the acquisition of food resources, specifically bison, which would sustain groups during the coldest season of the year. The unique ecology found within dunes provided both food and shelter for bison herds, this increased concentration of animals in a confined area by itself would attract the attention of hunting parties, regardless of if there were other resources present. Similar ecological conditions are observed in the Yukon, where caribou were attracted to ice patches during the summer (June to August) for thermal regulation and to seek relief from biting insects (Farnell et al. 2004:248). Archaeological investigations at these patches have found that, due to this seasonal increase in caribou concentrations, they had been exploited as hunting grounds for over 8000 years (Hare et al. 2004:260). It should be noted that the use of these areas was primarily for hunting, as there are no major floral resources present along the ice margins. As well, in addition to the artifacts that are being discovered melting from the receding ice patches, a large amount of caribou dung is also being found melting out of the ice. Deposited over time by the large herds that frequented the ice patch margins, it can be expected that a similar deposition of dung occurred in dune areas during the fall and winter months, providing not only nutrients to the floral community, but a source of fuel that would be more readily available than those surmised of by Vickers and Peck (2004) in their overview of possible fuel sources on the Northern Plains (Vickers and Peck

2004:99). As concluded by Wright (1986, 1994), buffalo chips can produce abundant heat, are always present when following and hunting large mammals, and are well-suited for the heating of rock for stone boiling, a practice that would be used when processing meat and bones from a bison pound (Wright 1986:28; Wright 1994:242).

Further, the hypotheses put forth by Vickers and Peck, and Malainey and Sheriff rely on ecological assessments done on a regional scale. As such, they do not recognize that ecological islands exhibit floral and faunal populations that can differ greatly from the surrounding dominant environment, which in turn can result in these landscapes being utilized differently by both humans and animals. As seen from chapter three, abundant plant resources are found within dune environments that have been utilized for food, medicine, veterinary needs, household activities, and spiritual ceremonies. Although this behavior can be difficult to detect in the archaeological record, their seasonal usage cannot be ignored when constructing the past lifeways of Northern Plains groups. It should be recognized that reconstructions of seasonality must be based on small-scale ecological assessments that take into account islands such as sand dunes that have an impact on how past First Nations groups exploited the resources of an area. This concept was first proposed by Walker (1974), who observed that topography plays a key role in bison migrations, and that animals will disperse to whichever area provides the best shelter, and not in a specific direction. In addition, he also noted numerous examples within the ethnological literature of large-scale bison kills occurring during the winter months (Walker 1974:1-4).

8.4 Dunes as Islands and Anthropogenic Landscapes

From the inferences drawn from previous chapters and in this section, several conclusions can be made on the role of sand dune environments on the Northern Plains over the past 6000 years. First, sand dunes should be considered as “islands” stemming not only from their physical properties, but also from the usage and perceptions of these areas by First Nations groups over the past 6000 years. From a geographic perspective, there is sufficient evidence on the unique origins, formation processes, landforms, and hydrology to show that these environments substantially differ from those of the surrounding grasslands regions. In turn, these unique properties support floral and faunal populations that are more diverse than those found within grassland regions, with the greatest diversity being found in the environmental edges between the two regions. This conclusion is supported by the findings of numerous scholars who have studied individual dune areas throughout the Northern Plains, including Boyd (2000a), Epp (1984), Vickers and Peck (2004), Hamilton and Nicholson (1999), Wolfe (2001) and Pfeiffer and Wolfe (2002). On a site- or dune-specific basis, they have determined that these areas contain physical characteristics that distinguish them from other landforms within what has been classified as broad, homogeneous ecoregions within works such as Acton et al. (1998) and Strong and Leggat (1981) that are frequently used by archaeologists and other researchers when defining the environmental settings of sites. In the context of this work, the results obtained from previous studies on dune formation, geomorphology, and floral and faunal resources are consistent for these landforms across the study area.

In addition to the physical features and resources that distinguish sand dunes as unique areas, so too do the ethnographic and historical records document the varied perceptions that Northern Plains groups possess towards these features. These beliefs vary greatly, and reflect the histories, beliefs, and affiliations for the Blackfoot, Gros Ventre, Plains Cree, and Assiniboine who resided in the study area prior to EuroCanadian expansion. For the Blackfoot, Gros Ventre, and Plains Cree, dune environments are perceived as being regions with meaningful spiritual connections, although the nature of these connections differ with each group. For the former two, their significance stems from the association that dunes have with the spirits of the dead and the afterlife, which are constant through accounts that span over a century. The similarities between Blackfoot and Gros Ventre beliefs can be traced to their close political and cultural affiliation, which were maintained until the 1800s. For the Plains Cree, their perspectives of sand dunes and their association with the *memekwesiwak* can be interpreted, due to their migration onto the Northern Plains from the Boreal Forest, as one where traditional belief have been adapted to reflect the existing conditions of a new environment. Documented by Milloy (1991) with regards to Cree monotheism, in this respect it is felt that the sacred interpretation of dune landscapes present within Blackfoot culture, whose presence on the Northern Plains pre-date that of the Plains Cree, were adopted in part by the latter group with variations to accommodate their own traditional belief system.

Although encountering the same physical landforms, with the same environmental advantages and limitations, Assiniboine perceptions of dunes differ drastically, with no mention of these regions being made in any oral histories documenting religious belief, hunting practices, or subsistence. As with the other Northern Plains groups, it is suspected that this unique perception and usage of landscape as reflected in available records is due to the history of this group migrating into the region and, while adopting certain practices to adapt to environmental conditions, still maintained their traditional beliefs and perceptions. These variations in practice found in all groups reflect the concepts of Possibilism, with group agency playing a vital role in determining perception, adaptation, and utilization of a particular environment. Although that environment will present natural boundaries and limitations to any human society utilizing it, due to its location, hydrology, and physical makeup, these human groups are not predisposed to only one method of resource extraction, nor to one unified perspective on how these regions should be perceived, historicized, or interpreted for future generations.

The variations in dune perception found within ethnographic groups are also present within the archaeological record for these areas. Spanning just over 6000 years within the context of this study, evidence from over forty years of investigation have revealed a pattern of usage that is reflective of culture-specific subsistence and occupation that is influenced by environmental conditions, cultural traditions, and political relations between groups. Far from being deterministic based on resource availability, it again is reflective of the concept of Possibilism, which considers the role that agency plays within cultural behavior and how it is conveyed and reflected within historical records, in this case the pattern of archaeological materials left at dune sites across Western Canada.

By addressing the topic of Northern Plains dune perception and usage from the viewpoint of Historical Ecology, further conclusions can be drawn on the unique biomass and stable geographic features observed within these landscapes. As shown by Oetelaar and Oetelaar (2007, 2008), the Northern Plains is a region that has been heavily impacted by anthropogenic land management practices to create environments that support cultural activities and provide human groups with an augmented resource base that would not be available without human intervention in natural processes. While their work examines what are now park regions in southern Alberta, this same perspective can be applied to this examination of dune environments. When done so, a pattern of evidence emerges that supports the conclusion that dune environments, due to their unique geomorphology, have been potentially impacted by anthropogenic practices at a level that is greater than that of the forest and montane regions examined in previous work. This pattern of behavior is suggested as occurring in relation to the Late Precontact period occupations examined in this study, where intensive bison hunting is observed. While some aspects of the below model may be occurring during this period, such as the treatment of sacred plants within dune environments, it is felt that the nature of bison hunting during this period, in comparison with that seen in the Late Period, limits the human impact on stability within sand dunes.

The first aspect of this anthropogenic influence is the transplanting of species into dune environments, resulting in both the introduction of new plant life to the region, as well as the expansion of existing plant populations with defined cultural uses. Within sand dunes, the practice of successfully transplanting species has been documented by Hamilton and Nicholson (2000), with the discovery of asparagus (*Asparagus officinalis*), an introduced species, in the historic Métis component of the Twin Fawns Site (DiMe-23) in the Lauder Sandhills. It is thought that the presence of this plant is due to the intentional introduction as part of a small garden plot associated with historic cabin features at the site, as this perennial plant requires humans to establish itself within a suitable environment. However, once introduced, it can establish itself and thrive from the original root, in this case for over a century (Hamilton and Nicholson 2000:255). Despite not engaging in larger-scale agricultural practices as seen with other Plains groups as the Mandan, Precontact Northern Plains groups also had the potential to influence species diversity within dune areas. This influence stems from the cultural practices associated with the gathering of plants, and other rituals that involve plant resources. As documented by Peacock (1992) and Siegfried (1994), First Nations groups traditionally present offerings prior to any plant collection, particularly with any plant collected for ceremonial purposes. Further, disposal of any collected plant remains is also done within a ceremonial context, with any material not used being returned to the Earth with care and appropriate offerings (Peacock 1992:71; Siegfried 1994:128-129). From the perspective of Historical Ecology and niche construction, Oetelaar and Oetelaar (2007) contend that these practices act as mechanism through which human groups can alter culturally significant landscapes though the introduction of desired plant species. This introduction occurs from the placement of viable plant remains, such as roots and seeds, into specific location as offerings. From this practice, culturally significant plant populations are created or reinforced within locations that have meaning for a certain group. This practice also serves to increase the plant diversity that is found within a location, further strengthening the usage of an area by cultural groups due to the resources and cultural significance it possesses (Kidder 1998: 157-159; Oetelaar and Oetelaar 2007:78).

The addition and maintenance of these plant species to dune environments also contributes to the ability of these landscapes to remain stable and act as resource areas for human, animal, and plant populations. By increasing the number of plants within a sand dune region, the chance for activation decreases with the addition of more root systems to trap moisture and sediment, as well as shade to prevent the evaporation of surface water. Additionally, through decomposition, when plants either die off or are burned, increased amounts of nutrients are returned to the soil than would be available if only natural plant succession patterns were enacted. Through the practice of plant introduction, the long-term stability of dune regions is supported by the provision of elements such as shade and sediments traps needed to stabilize dunes and create an environment that can serve as a reliable resource area for human populations.

This support of stabilizing elements within dune environments is also observed within the practice of anthropogenic burning. Typically associated with seasonal hunting activities, this practice also serves to increase the capacity of sand dunes to support both floral and faunal species. This is accomplished through the elimination of deadfall, the expansion of species diversity within an area by creating the opportunities for plant colonization, and the return of nutrients to the soil. Although dunes may have the potential to activate once impacted by fire, this chance is decreased by the extensive networks of plant roots beneath the ground that are not impacted by burning. Provided they remain intact, they will act as stabilizing agents, ensuring that dune areas will not deflate during the period it takes for new surface growth to establish itself. Further, canopy species in dunes such as *Populus tremuloides* are adapted to fire, allowing them rapidly to flourish and colonize following a burn event. As it takes up to two years for trees impacted by burning to die off, any area that is subject to anthropogenic firing would receive the benefit from having both mature species present as well as new growth for a brief period of time. Following this die-off of larger trees, new aspen will mature in as little as four years, thereby continuing to act as a stabilizing agent within sand dune areas. As seen from historical records, anthropogenic burning was a common practice on the Northern Plains, resulting in these impacts that support ecological health being conducted in dune environments on a regular basis. Support for the presence of these activities is also observed through an examination of the historical record, which indicates that tree growth was not as substantial on the Northern Plains as it is today, due to the removal of groups who engaged in anthropogenic burning and the introduction of new cultural practices (see Mirau 1990) that encouraged the rapid growth of trees. As observed by Campbell et al. (1994) in Elk Island National Park, with the elimination of bison species and anthropogenic burning, aspen tree stands expand at the expense of open grasslands capable of sustaining large bison herds. As these grassland regions would act as attractors to animals as feeding grounds, another source of nutrients would be introduced through their faecal matter and carcasses when individual deaths would occur.

The practice of pounding and intensive bison hunting also serves to stabilize dune areas on the Northern Plains. Although destabilization has been noted in some areas associated with human activity (see Wolfe et al. 2007), these practices also serve to introduce stabilizing factors into a dune environment that can aid in their long-term stability, allowing for their extended use by human groups as resource and spiritual regions. The contribution that pounding activities make towards dune stability can be found in multiple aspects of Northern Plains hunting activities. First, within the construction of the pound deadfall and smaller trees are removed from the area. As seen above, this practice serves to eliminate deadfall and open areas up from aggressive tree growth to allow for the creation of species diverse grassland areas. With the pounding activities themselves, while the herding of large populations of bison into a confined space may disturb soil surfaces to the point that they begin to actively deflate, they also serve to help stabilize these regions by providing the physical and chemical agents to encourage plant growth and introduce moisture and nutrients. This is accomplished through the actual hunt itself, where large amounts of organic material would be distributed in and around the kill area by both humans and animal scavengers. This material would provide nutrients, moisture, and shade to specific locations within dunes, creating smaller microenvironmental pockets of environmental productivity. As historical records show that pounds were frequently abandoned due to the large amount of bison remains that were generated, practice of these stabilizing factors would potentially take place throughout larger dune areas over an abbreviated period of time.

From the combination of these perspectives and practices, it can be concluded that the cultural perceptions associated with and practices occurring within sand dunes act in concert to enhance the natural attributes of these regions to support human life on the Northern Plains at least during the Late Precontact period. Without human interaction, dunes possess the means to support a diverse array of floral and faunal species through their unique physiography, response to drought conditions, and hydrology. Despite these attractive attributes, they also possess the capacity to activate under the proper conditions. In doing so, they would also eliminate many of the resources that would make them attractive to human populations. Through the acknowledgement of these areas as sacred, and introduction of cultural practices such as intentional planting of important species, burning, and intensive hunting practices that also serve to increase the ecological health and long-term stability of these regions, human behavior transforms sand dunes from natural spaces to anthropogenic ones. These impacts are seen to not just influence the floral and faunal species who live in these areas, but the areas themselves through the application of cultural practices that support their stability on a long-term basis. With continued re-visitation over the course of the seasonal round, the ecological health of these areas can be maintained to ensure that floral and faunal species continue to use sand dunes on an annual basis. In doing so, dunes are established as a seasonally-dependable resource area, with particular plants and animals being available at known times over the course of the year. While these practices serve to maintain a stable resource base for humans, they also provide for the long-term environmental health of the area by ensuring dunes contain a constant supply of nutrients to support a biologically diverse array of plant species that provide for faunal species such as bison, who in turn act as agents for the introduction of nutrients and organic material that support the stability of dune areas and the biota that reside there.

Chapter 9

Conclusions and Further Research

9.1 Dune Environments and their Usage on the Northern Plains

From this analysis, a hypothesis has been constructed that adopts a holistic perspective in understanding how these dynamic landscapes played a role in the lifeways of Precontact First Nations groups on the Northern Plains.

At the outset, several diverse questions were posed concerning dune use and perception by both First Nations groups and the researchers who study them. To answer these questions, sources were examined from fields including history, archaeology, ethnography, geography, and botany through a theoretical lens that encompasses Island Theory, Historical Ecology, and Possibilism to develop a concept of how these areas were perceived and utilized by human populations, and how these activities could in turn influence dune landscapes themselves. By viewing the landscape, archaeological record, oral histories, and documentation as an interrelated record, rather than as disparate datasets from various disciplines, a cohesive depiction of human and environmental perception and interaction has been created. With this approach, it is possible to place sand dunes within a context where it becomes clear not only the impact that these landscapes had upon human behavior, but also the influence that human activities had upon them.

From an environmental standpoint, dune areas differ greatly from surrounding grasslands environments with regards to their formation, morphology, hydrology, and floral and faunal resource base. Consequently, they function as ecological islands that support a more diversified biomass than seen within grassland environments. Further, the boundaries between dunes and grasslands function as edge areas, and generally are the most ecologically diverse areas to be found in sand dunes. Given the proper conditions, sand dunes can become active features that can dramatically change in morphology over time. This process however, is not easily initiated, as it requires sufficient wind regimes and a lack of moisture and ground cover to take place. Given proper conditions, it is possible for dunes to be stable for extended periods, witnessed by the intact living floors found at the archaeological sites examined in this study. The processes of activation and stability are not immune to the influence of human habitation and activities, with both being initiated or enhanced through various cultural practices and their resultant physical impacts. In cases such as those seen during the Late Precontact period, it is felt that human intervention can result in the transformation of sand dunes into anthropogenic environments. With regards to implications for the study of dune sites and the faunal material collected from them, several issues arise. First among these is the dynamic potential of sand dunes themselves. Stemming from their formation history and physical traits, in comparison with other Plains geographic features, dune site stratigraphy can be altered in a very short period of time through activation and deflation. In turn, this action can damage or destroy the *in situ* archaeological record for an impacted area. Despite this capacity, the assumption that assemblages within dune sites have been greatly altered either through the loss of sediments or collapsed stratigraphy cannot be made until the geomorphology of the location has been examined. Due to the variation in landforms, vegetation, and subsurface hydrology, this analysis cannot employ a generalized interpretation of a particular dune area. To be accurate, it will have to take place on a site to site basis to determine the depositional and formation history of a specific location.

The second factor concerns the groundwater contamination of faunal materials that can take place within sand dunes. The introduction of carbon into these materials can provide researchers with erroneous radiocarbon dates that may not be identified due to their falling within acceptable date ranges for associated diagnostic materials. Further complicating this issue are testing methodologies that use multiple bone fragments to generate a single radiocarbon date, which acts as another potential source of error. From this analysis, it can be concluded that when conducting absolute testing on archaeological materials the context of the materials is vital to providing a relevant understanding of past behavior within a site, with particular caution to be taken when examining material from sand dunes.

Like environmental conditions, this holistic interpretation of dune areas shows that First Nations usage and perception of these areas is not a cohesive universal across time and space but is subject to the factors of cultural interpretation and group history as seen within Possibilism. Although a pattern of usage as a pounding area during the fall and winter months was found, this was not seen as widespread across all cultural groups and time periods. Further, evidence suggests that this usage can be curtailed by environmental, political, and cultural factors that transcend previous models of behaviour on the Northern Plains. In kind, the perception that sand dunes are spiritual areas, the residence of both ghosts and supernatural beings, is not a universal among all groups, nor is the criteria for establishing sacredness shared amongst all groups who view these areas as significant.

From this broad-based analysis, it can be concluded that dune areas represent a region that defies easy classification by either natural or social science methods. As physical entities, each sand dune will respond to both natural and cultural elements based upon its own unique attributes, such as size, location in relation to wind patterns, and hydrology. Further, as human groups encountered these landscapes, their own individual experiences led them to structure their behavior in manners that they deemed appropriate. As such, the narrative of sand dunes on the Northern Plains cannot be one where there is only one story, based upon ecology, sediments, or bison, but of multiple unique experiences across both space and time. To properly interpret and understand these important regions, it is felt that they should not be treated as one homogenous feature, but as individual and unique archives that reflect both the natural and cultural history of that specific location. In doing so, we will recover the individual identities that these spaces had as part of a larger cultural pattern, where locations were not broadly defined but integrated into a system of cultural behavior that relied upon named locations with their own histories to guide, define, and physically support cultural groups on the Northern Plains. As seen in this body of research, this can be accomplished through the application of multiple theoretical concepts to the problem of landscape perception and usage within Western Canada. From Island Theory, we obtain the tools necessary to accurately view the specific physical and cultural attributes for each unique dune, and to establish how these areas both changed and stabilized over time. Using Possibilism, we acknowledge that no one group at any particular time will observe or react to the conditions present within a landscape in the same manner. In doing so, we provide the proper context for understanding the diverse records available to us to interpret past behaviours within sand dunes, and how these behaviours can change over time. Lastly, through Historical Ecology we acknowledge the role that humans play in creating and influencing the environments within which we live. Although easily assumed that hunter-gatherer groups resided in "natural" areas that were not impacted by human behavior, sufficient evidence generated over the past two decades has shown that Northern Plains groups were active agents in modifying their world to better meet their physical and cultural needs. Without these theoretical perspectives, it is likely that social aspects not linked to economic behavior, such as spiritual belief and social interaction, will be obscured or overlooked, as well as the role that humans have in engineering landscapes to meet their physical and social needs.

9.2 Further Research

As stated in the introduction, this work is viewed not as being a definitive, final conclusion on the role of sand dune areas in the Northern Plains, but as an introduction to the question of how these areas were used, perceived, and influenced. This approach stems from the broad-based, holistic methods that were adopted in order to solve this problem. As this methodology fostered further questions on the patterns of behavior and issues that developed in relation to how we interpret and study sand dunes, the work required to address these items would far exceed the scope and purpose of this research. As such, these avenues of inquiry are featured here in order to specify future areas of concern and foster further work into the study of Precontact sand dunes on the Northern Plains.

Broadly speaking, this section on further research can recommend precisely that: the need for further research. Over the course of investigation, multiple areas were identified that will require investigation in the future. Primary among these is the need for increased usage of holistic studies in the examination of the Northern Plains during the pre-European contact period. As this research illustrates, both quantitative and qualitative data sources, when placed into a cohesive theoretical perspective of viewing landscapes as archives, can be incorporated to create a narrative that offers a more detailed depiction of past First Nations lifeways. Central to this approach is the incorporation of First Nations knowledge, oral history, and perspectives into current research methodologies that may remove Indigenous knowledge from Western scientific perspectives and place it within the context from which it originated. Simultaneously, information gathered from fields such as archaeology, ethnography, history, and the natural sciences can be integrated into this concept of archive as current interpretations of past landscape and landscape usage that can used in conjunction with qualitative data.

Related to this topic is the need for a more culturally diverse database from which researchers can work from. It was noted over the course of this work that most of historic and modern ethnographic studies consulted were based upon work done with Blackfoot groups. This discrepancy is thought to be in large part the product of group displacement, with all groups but the Blackfoot being dispersed out of their traditional Northern Plains territories after

EuroCanadian settlement in Western Canada. This is particularly true for the Gros Ventre, who are no longer in Canada, and reside at the Fort Belknap Reserve in Montana. By engaging these groups, it is felt that further insight into their history and cultural perceptions as it relates to sand dune areas will be documented, with the caveat that this would be a modern perspective influenced by their post-contact histories.

Also needed are detailed excavations to take place at a larger number of dune sites in a wider number of sand dunes. As each sand dune serves as an individual archive and narrative, in order to fully understand cultural patterns over space and time better insight into as many dunes as possible is needed. For the purposes of this study, major sites from only 11 of the 68 named sand dunes and undifferentiated sand sheets located within the study area were examined. While comprehensive from the standpoint of using available reports and monographs on sand dune occupations, the current body of literature on dune sites does not adequately sample all of the dune environments on the Northern Plains. This issue is most evident when examining the body of literature available on the Great Sand Hills, where no detailed excavations have taken place despite the region being highly significant from both from a historical and ecological perspective. Although much of what is known of this area is the result of work completed on surface finds, mitigation programs have suggested that larger archaeological deposits are intact within the dunes. If a greater understanding of aeolian regions is to be achieved, sites such as these need to undergo detailed excavation and analysis. As seen from this study, the examination of sand dune sites has the potential to add valuable insight into the examination of seasonal migration patterns, subsistence systems, and cultural interaction in Western Canada.

Also requiring further research is the role that plant resources played in the lifeways of Northern Plains groups. As discussed in chapter three, dune environments contain an abundant floral resource base, with 99 species having a documented food, medicinal, or household usage within First Nations societies. Although ethnobotanical studies for the region extensively list plant usages, they infrequently provide data on when plants are collected. Given the pattern of seasonal usage witnessed for dune environments in this work, data on plant gathering practices will provide an increased clarity on group movements and resource use during the seasonal round. This examination of plant usage should not be limited to ethnographic sources but should extend to archaeological remains as well in an attempt to determine which plant resources were being used by Precontact groups. Although difficult to accomplish, due to issues of deposition and context, initial efforts (see Boyd et al. 2006, Peck and Vickers 2006, and Stuart and Walker 2018) have been made to recover floral material from Northern Plains sites that hopefully will be developed further in the future.

Another area of further research is the concept of the sacred that surrounds sand dunes for Northern Plains groups. As seen from this study, different belief systems and behaviours such as the burials at the Gray site and associations with *memekwesiwak* are associated with dune environments. What is not well known at this time are the specific belief systems that surround each sand dune area for each of the groups who use the resources found there. While historical and ethnographic literature indicates that concepts of the sacred surround dunes, only one sand dune complex within the study area, the Great Sand Hills, is mentioned by name. While the existence of the Gray site can be viewed as circumstantial evidence for sacred beliefs to be associated with all sand dunes, further research is required before this determination is positively made. Implications from such a study would extend not only to archaeology, with the presence of burials within dunes, but also to ethnobotanical studies and medical anthropology, as cultural perceptions of sacred areas carriescarry over to resources that are collected from them as well (see Peters et al. 2006). As such, seasonal migration patterns and resource collection practices may have been impacted by a desire to obtain more spiritually-imbued flora and fauna.

A final concern is dating issues surrounding sand dunes themselves. As noted by Morlan (1994), diagenetic changes can occur in bone deposited within a sand dune environment, resulting in erroneous radiocarbon dating results. Coupled with the use of blended samples and older dating methods that increased the chance of error, only just more than half of radiocarbon dates obtained from sites within the study area were accepted. This exclusion of so many dates highlights the risks associated with radiocarbon dating and calls into question the use of organic materials as a possible source of absolute dates within dune sites. Fortunately, other absolute dating methods are available to archaeologists when dealing with dune environments, most notably optically stimulated luminescence dating. Using this technique, it is possible to date not the artifacts found at a site, but the sand matrix within which the artifacts are found by determining when these sediments were last exposed to sunlight. Through the adoption of this technology, it is not only possible to confirm or refute dates obtained from material culture, but to establish a chronology of dune activation and stabilization, which can provide a valuable source of information when examining issues such as environment reconstruction and the role that climate change can have in site usage and abandonment. This potential for using optically stimulated luminescence dating within dune sites has been highlighted previously (see Gilliland 2007). Given the potential for inaccurate dating however, its adoption by archaeologists working in these areas should be viewed as mandatory if questions concerning site chronology and landscape usage patterns are to be examined. Also, of interest is the reconstruction of dune activation patterns themselves as a means of supplying more information on Middle Precontact sites that may have been impacted by the movement of aeolian sediments. Using modern transport models, it may be possible to examine dune dynamics across the Northern Plains over the past 6000 years.

9.3 Conclusion

Despite the need for further work in the field of sand dune studies across all fields, it is felt that this study provides a firm foundation from which further work can be pursued. Rather than viewing the use of aeolian environments on the Northern Plains as a random pattern of settlement, it is evident that the use of dunes was part of a larger system of integrated behaviour that varied, depending upon the environmental conditions and the cultural group in question, for over 6000 years. With this research, it is hoped that further investigation will be conducted to refine our understanding of sand dunes and their use by past First Nations groups on the Northern Plains, resulting in a better holistic understanding of these unique landforms.

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Appendix A: Sand Dune Flora and Their Uses on the Northern Plains

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

(Compiled from Clavelle 1997; Hart 1992; Hellson 1974; Johnson 1969, 1970, 1982; Moerman 2009; Peacock 1992; and Scott-Brown 1977)

Table Legend:

A = Assiniboine

B = Blackfoot

C = Plains Cree

G = Gros Ventre

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

(*Compiled from Boyd 2000 and Townley-Smith 1980b*)

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Acer negundo	Manitoba Maple	Sugar from sap							X	
Achillea millefolium	Yarrow	Tea made from leaves and flowers						X		
			Tea made from the whole plant used as a laxative					X		
			Tea from the leaves and flowers used as a diuretic and to treat consumption, stomach trouble and headaches, and applied as a lotion for sore eyes					X		
			Plant boiled and applied as a poultice to sore fingertips and toes					X		
			Leaves brewed into tea to induce childbirth and post-delivery contractions					X		
			Flower brewed for drink during childbirth					X		
			Infusion of plant drunk and rubbed on affected areas to treat gastroenteritis pain, liver trouble and swelling					X		
			Strong infusion of plant used for sore throat				X	X		
			Flowers chewed and applied to swelling					X	X	
			Roots brewed as tea for arthritis						X	
			Leaves and flowers brewed in tea for diabetes					X	X	
			Above ground portion used in compound poultice for headache						X	
			Flowers used with other herbs in poultice for cuts to relieve pain and blood poisoning						X	
			Flowers packed into nose for nosebleeds				X			
			Flowers and leaves chewed and saliva applied to stop bleeding				X			
			Medical smoke prepared from leaves				X			
			Used to treat diabetes					X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Achillea millefolium	Yarrow				Flowers burned to repel mosquitos		X			
						Used as eyewash for horses		X		
Acorus calamus	Sweet flag		Roots chewed for toothache and heart issues						X	
			Decoction of roots, roots chewed, or smudged for cold treatment						X	
			Infusion of root for colic					X		
			Ground, mixed with tobacco and smoked for headache					X		
			Mixed with hot water in poultice and applied to a sore throat, sore chest, toothache, or to relieve cramps					X		
			Used to cause an abortion					X		
			Roots brewed in tea for digestive ailments						X	
			Chewed for "heart trouble"					X		
			Rhizome sucked for sore throats, dry mouth, and pain relief						X	
			Rhizome boiled for phlegm and pneumonia						X	
			Rhizome poultice used for arthritis						X	
			Rhizome grated and infused to treat diabetes						X	
			Rhizome part of mixture to treat facial paralysis from stroke						X	
				Found in medicine bundles					X	
Allium textile	Prairie onion	Boiled with meat or preserved						X	X	
		Used as flavouring in soups and stews, added to boiled fish, or eaten raw					X		X	

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Allium spp.	Onion	Bulb used to spice soup of wheat and marrow						X		
			Infusion of bulb to stop vomiting, treat persistent cough, used as eyewash and for ear infections, and to treat disease that causes a swollen penis and severe constipation.					X		
			Infusion of *Allium* and *Monarda* drunk or used to steam patient for emetic and can be placed on swollen areas					X		
			Bulb put in smudge to fumigate cold patient					X		
			Snuff from dry bulb used to open sinuses					X		
			Smudge of plant used for headaches and sinus trouble					X		
			Roots brewed in tea for colds, sore throats, and stomach ailments					X		
			Roots/leaves brewed for wash for wounds and infections					X		
						Smudge of bulb used on congested horses		X		
						Brewed with *Monarda* and used on saddle sores		X		
					Hide dipped in decoction of bulb and used to polish arrows			X		
					Bulb rubbed on quiver as deodorant			X		
Amelanchier alnifolia	Saskatoon	Berries eaten fresh and preserved					X	X	X	
		Used in soups and pemmican					X	X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Amelanchier alnifolia	Saskatoon	Crushed leaves mixed with blood for winter broth						X		
			Unripe berry juice or juice boiled from older berries used as eye and ear drop					X		
			Used to treat upset stomach					X		
			Used as laxative				X	X		
			Root in compound used to treat diarrhoea in children					X		
			Decoction of buds used to slow diarrhoea						X	
			Infusion of cambium for acne				X			
				Berries and berry soup used in ceremonies				X		
				Favours asked when presenting four berries				X		
				Berry used as offering at Sun Dance, bundle offerings, and special ceremonies				X		
				Wood used as incense tongs at ceremonies				X		
					Wood used for arrow shaft			X		
					Berries used in necklace			X		
Anemone multifida	Cut-leaved anemone		"Cotton" from ripe seed heads burned and smoke inhaled to treat headaches					X		
			Used to cause abortions					X		
Anemone patens var. *wolfgangiana*	Crocus anemone		Crushed leaves applied to affected parts as counter-irritant					X		
			Plant boiled and drunk to speed childbirth					X		
			Flowers boiled for eyewash					X		
			Flowers moistened and tied over cuts				X			
			Boiled stems used as heart medication				X			
					Given as toilet paper in pranks due to blistering properties			X		

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Anemone patens var. *wolfgangiana*	Crocus anemone					Plant heals cuts and stops bleeding on horses		X		
Aralia nudicaulis	Wild sarsaparilla		Used as tonic and purgative						X	
			Grated root is ingredient for poultice to treat infection						X	
Arctostaphylos uva-ursi	Bearberry	Berries eaten fresh or dried with sugar					X	X		
		Leaves brewed into tea						X		
			Infusion of plant used as mouthwash for canker and sore gums					X		
			Infusion of plant mixed with grease and boiled hooves and applied to itching and peeling scalp, rashes, sores, and used to bathe a baby's head					X		
			Infusion of berries used for diarrhoea				X			
			Infusion of leaves used as wash for sores				X			
			Roots used as tonic for long-term ailments				X			
				Leaves smoked during ceremonies				X		
					Leaves dried and mixed with tobacco for smoking		X			
					Dried berries used as beads and in rattles			X		
Artemisia campestris	Plains wormwood		Decoction of leaves used to abort difficult pregnancies					X		
			Fresh leaves chewed for stomach trouble					X		
			Infusion of leaves used for cough and applied to eczema					X		
			Chewed leaves applied to sore eyes and rheumatic parts					X		
			Runners chewed leaves for mentholating properties					X		
			Infusion used as a hair tonic to cleanse and treat scalp infections especially in children					X		

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Artemisia campestris	Plains wormwood				Root infusion used on tanned hides			X		
						Root infusion used to treat back sores on horses		X		
Artemisia cana	Hoary sagebrush		Decoction of leaves used as hair tonic and restorer					X		
			Leaves chewed to relieve thirst					X		
						Used as horse fodder		X		
Artemisia frigida	Pasture sage	Crushed leaves stored with stored meat to keep good odour						X		
			Pad of plant worn by women during menses to reduce skin irritation				X	X		
			Leaves chewed and applied to wounds to lessen swelling				X	X		
			Leaves brewed as tea for colds and sore throats					X		
			Leaves chewed for stomach and digestive ailments					X		
			Leaves used as tea for kidney problems and colds				X			
			Used as nasal pack for nosebleeds				X	X		
						Horses rolled in patches of sage to treat wounds		X		
						Infusion given to horses for coughs and sneezing		X		

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Plant Name		Usages					Groups			
Latin Name	Common Name	Food	Medicinal	Spiritual/ Ceremonial	Household	Veterinary	A	B	C	G
Artemisia frigida	Pasture sage					Burned as smudge to attract horses escaping flies		X		
					Deodorant for saddles, women's pillows, hide bags, and quivers			X		
					Used as forms for hide rattles			X		
					Used to clean bone paint applicators			X		
					Placed on coals to create mosquito smudges		X	X		
					Treatment of hides			X		
					Toilet paper, in particular for children			X		
					Used as perfume			X		
					Used to revive gophers in children's game			X		
Artemisia ludoviciana	White sagebrush	Leaves chewed as confection						X		
		Leaves used to smoke meat						X		
			During a sweat or steam for respiratory problems the leaves are chewed					X		
			Infusion of leaves taken for chest and throat constrictions					X		
			Leaves applied to burst boils and blisters					X		
			Leaves brewed as tea for colds and sore throats					X		
			Leaves brewed as tea for diabetes					X		
			Wash of leaves used for sores				X			
			Juice from leaves used to soothe mosquito bites					X		

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Artemisia ludoviciana	White sagebrush		Infusion used for high fever							X
				Used to cleanse objects, offerings, and individuals				X		
				Floor covering in sweat lodges				X		
				Used to make bed for *iniskim* during rituals				X		
				Used in Peigan horse medicine bundle				X		
				Leaves put in shoes of women to help them run faster			X			
				Used in smudge to turn away thunder			X			
				Only sage used for spiritual purposes				X		
						Smudge used to treat horse distemper		X		
					Placed in moccasin as foot deodorant			X		
					Used as toilet paper		X	X		
					Plant burned in fire to repel mosquitos		X			
Aster spp.	Aster		Infusion of plant given as enema for babies through a greased eagle wing-bone for colic or intestinal problems					X		
				Different colour forms of genus seen to reflect aging process, from white to blue to yellow				X		
				Necklace of Holy Woman of Sun Dance is yellow form of genus to reflect age				X		

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Plant Name		Usages					Groups			
Latin Name	Common Name	Food	Medicinal	Spiritual/ Ceremonial	Household	Veterinary	A	B	C	G
Aster spp.	Aster					Infusion of plants given to horses and dogs for nasal problems		X		
						Infusion of plant used as eye wash for infections in dogs		X		
Astragalus canadensis	Canadian milkvetch	Roots gathered in the spring and fall and either eaten raw or boiled in blood						X		
			Root chewed or taken as infusion to treat spitting blood					X		
			Steam from boiled root inhaled for spitting blood and water poured over chest					X		
			Chewed roots applied to cuts, snake bites, swelling, blisters, and frostbites					X		
Betula occidentalis	Water birch		Decoction of flower and leaves used to cause an abortion					X		
			Catkins and/or bark infusion for diarrhoea					X		
				Found in medicine bundles used to prevent conception				X		
				Branches traditionally used to construct sweat lodges				X		
					Possible material to construct bowls			X		
					Used for pegs and digging sticks			X		

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Betula occidentalis	Water birch				Excellent firewood			X		
Betula spp.	Birch		Roots brewed in tea for stomach and digestive tract ailment					X		
Bouteloua gracilis	Blue grama			Used to predict the severity of winter depending on the number of fruit spikes present				X		
Campanula rotundifolia	Harebell		Tonic made from whole plant				X			
			Roots crushed and placed on cuts				X			
			Roots chewed by nursing mothers to increase lactation				X			
Cirsium spp.	Thistle	Flower and pedicel eaten fresh						X	X	
			Poultice of root paste applied to linen cloths and bound to the wound						X	
Clematis ligusticifolia	Virgin's Bower		White portions of bark steeped for fever					X		
			Foliage chewed for colds and sore throats					X		
Cleome serrulata	Rocky Mountain beeplant		Plant used to make tea for fever					X		
Cornus stolonifera	Red osier dogwood	Ripe berries eaten						X		
			Infusion of the cambium given for liver disorders					X		
			Infusion of bark given for chest colds					X		
			Leaves brewed as tea for colds and sore throats					X		
			Berries eaten and leaves brewed for stomach ailment					X		
			Berries eaten as laxative					X		
			Dried cambium smoked for headaches				X			
			Tea made from cambium for fever and vomiting				X			
			Infusion of leaves used as wash for bleeding nose				X			
				Species mentioned in Napi mythology				X		

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Latin Name	Common Name	Food	Medicinal	Spiritual/ Ceremonial	Household	Veterinary	A	B	C	G
Cornus stolonifera	Red osier dogwood			Bark smoked and included in medicine bundles				X		
					Cambium dried, crushed, and mixed with tobacco for smoking		X			
					Used to construct tamps and pipestems when usual wood not available			X		
					Bark used in construction of gambling wheels			X		
					Roots used as rope		X			
					Berries chewed and smeared on musket balls and arrows to cause infections			X		
Corylus cornuta	Beaked hazelnut	Nuts eaten							X	
Coryphantha vivipara	Pincushion	Fruit eaten when ripe						X		
			Fruit eaten for stomach ailments					X		
			Seeds used as eye medicine					X		
Elaeagnus commutata	Wolf willow	Berries eaten fresh or mixed with grease and stored as confection					X	X	X	
		Used in soups						X		
			Strong solution of bark used to treat children's frostbite					X		
			Bark brewed for salve for wounds					X		
			Boiled berries given to children to quiet them during battles				X			
					Used in necklaces and as clothing decoration		X	X		

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Elaeagnus commutata	Wolf willow				Bark braided and used to whip stone tops in children's winter game			X		
					Bark plaited and used as rope		X	X		
Equisetum hyemale	Common scouring rush		Ingredient in solution to correct menstrual irregularities						X	
			Plant decoction used as diuretic						X	
			Plant used to treat febrile conditions				X			
					Used to polish arrows and wood			X		
						Decoction of foliage used as a horse drench		X		
Erigeron canadensis	Canada fleabane		Used for chronic diarrhoea and childbirth hemorrhage					X		
Fragaria virginiana	Wild strawberry	Berries eaten					X	X		
		Tea made from brewing leaves						X		
			Roots brewed in tea for stomach ailments					X		
			Roots brewed into poultice for wounds and burns					X		
			Root chewed to treat rapid heartbeat				X			
			Used to treat anemia				X			
			Made into tea for fevers				X			
			Boiled roots for nosebleed and stomach ache					X		
			Root infusion for diarrhoea					X		

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Plant Name		Usages					Groups			
Latin Name	Common Name	Food	Medicinal	Spiritual/ Ceremonial	Household	Veterinary	A	B	C	G
Fragaria spp.	Strawberry	Berries eaten					X			
			Infusion of plant used to treat diarrhoea					X		
Gaillardia aristata	Blanketflower		Infusion of root for gastroenteritis					X		
			Infusion of plant as nose drop, eyewash, and rubbed on nursing mother's sore nipples					X		
			Chewed powdered root applied to skin disorders					X		
			Flower heads used to absorb broth and served to invalids as spoons					X		
			Foot wash from infused flower heads					X		
			Flower infusion given to non-pregnant women for intermittent menses				X			
						Root infusion used on saddle sores, where hair is falling out, and as an eyewash on lacerations		X		
					Flower heads rubbed on rawhide bags for waterproofing			X		
Galium boreale	Northern bedstraw		Flowers used to stop blood flow in nosebleeds				X			
					Used as perfume		X			
Gentiana affinis	Pleated gentian				Used as attractive flower			X		

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Latin Name	Common Name	Food	Medicinal	Spiritual/ Ceremonial	Household	Veterinary	A	B	C	G
Geum triflorum	Three-flowered avens		Roots boiled for sore and swollen eyes					X		
			Foliage dried, crushed, and mixed with other medicines as tonic					X		
			Infusion of root applied to wounds and used as mouthwash for canker and sore throat					X		
			Infusion of root mixed with grease for sores, rashes, blisters, and flesh wounds					X		
			Infusion of plant used as general tonic for severe cough					X		
			Root scraped and mixed with tobacco to "clear head"					X		
			Roots chewed and brewed into tea colds and sore throat					X		
			Roots brewed as tea for stomach and kidney ailment					X		
			Used to treat heart problems				X			
			Roots boiled for upset stomach				X			
						Root infusion used on boils and castration wounds of horses		X		
Glycyrrhiza lepidota	Wild licorice		Infusion or root used for cough, chest pain, sore throat, and applied to swelling					X		
						Horse windgalls treated with plant root		X		
				Ghosts used the burrs to shoot their victims and inflict them with disease				X		
					Buffalo runners put burrs in their mouths to prevent thirst			X		

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Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Grindelia squarrosa	Gumweed		Leaves and flowering tops have resin used as expectorant, an antispasmodic, and in treating bronchitis and asthma					X		
			Decoction or tea of plant used as an antisyphilitic and for kidney trouble						X	
			Upper part of plants, the sticky buds in particular, used as a cough medication					X		
			Decoction of boiled root taken for liver trouble					X		
			Leaves, flowers brewed as tea for stomach ailment, coughs, and colds					X		
Gutierrezia sarothrae	Broomweed		Steam from boiling roots inhaled for respiratory ailments					X		
Helianthus maximilianii	Narrow-leaved sunflower	Roots eaten in spring and fall, but rotten in summer					X	X		
Heuchera richardsonii	Alumroot		Rootstock chewed for diarrhoea					X		
			Root used for kidney problems				X			
Heuchera spp.	Alumroot		Roots brewed as tea for colds, sore throats, stomach ailment, and diarrhoea					X		
			Roots ground as salve for wounds					X		
						Root mixed with buffalo fat, boiled, and applied to saddle sores		X		
Juncus balticus	Baltic rush				Brown dye that shades to green created from stems			X		

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Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Juniperus communis	Common juniper	Berries used in pemmican						X		
			Decoction of berries used to treat lung and venereal diseases					X		
			Berries eaten or made into tea to prevent conception				X			
			Used to treat tuberculosis				X			
				Leaves are burned to turn away thunder			X			
				Used for smudging				X		
Juniperus horizontalis	Creeping juniper		Seeds steeped in water used to treat kidney trouble				X	X		
			Needles steeped as a wash for sores				X			
			Tea made for fevers and to ward off illness				X			
				Used as carpet for the Holy Lodge dancer for the Sun Dance				X		
				Used to construct dancer's headpieces for ceremonies				X		
				Branches held by dancers at ceremonies				X		
				Branches used to smudge for purification and protection				X		
					Berries dried and made into necklaces		X	X		
						Water soaked in roots used to give shine to a horse's coat		X		
Juniperus spp.	Juniper		Berries brewed in tea for stomach ailments					X		
			Root infusion given as a general tonic					X		
			Roots brewed as liniment for arthritis					X		
					Used to yellow hides			X		

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Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Liatris punctata	Dotted blazingstar	Roots sometimes eaten raw						X		
			Roots boiled and applied to swelling					X		
			Tea used for stomach aches					X		
Lilium philadelphicum	Western red lily	Bulb eaten fresh or with soup					X	X		
			Crushed or chewed flowers used as poultice for bite of small poisonous brown spider				X	X		
			Roots made into tea for fevers				X			
Lithospermum incisum	Narrow-leaved puccoon			Tops and seeds dried for incense				X		
					Violet blue dye obtained from roots			X		
Lonicera dioica	Wild honeysuckle		Stems boiled as a diuretic						X	
			Used it tea for sickness during pregnancy				X			
			Berries used for “women’s troubles”				X			
			Tea from stems and branches for heart, bladder, kidney problems, and fever				X			
			Roots used in rinse for hair loss				X			
			Cambium used in skin wash				X			
			Bark used in eyewash				X			
					Stems used as pipe-stems and as straw				X	
					Used to make necklaces		X			
Lupinus spp.	Lupine		Infusion of plant used for indigestion, gas, and hiccups					X		
			Infusion of root rubbed on mumps and consumed					X		
				Used as incense in traditional Ghost Dance				X		
				Ceremonialist sponsoring Ghost Dance chewed leaves prior to any face painting				X		

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Lupinus spp.	Lupine					Infusion of leaves used to treat small fly bites on horses		X		
Lygodesmia juncea	Skeletonweed	Juice from broken stems left to harden and chewed for flavour						X		
			Infusion from stems applied to sore eyes					X		
			Tea from foliage given to nursing mothers to increase milk flow					X		
			Decoction of plant given to pregnant women showing symptoms of heartburn					X		
			Infusion of plant given as general tonic to children for kidney trouble					X		
			Infusion of stem for burning cough					X		
			Infusion of stem mixed with grease and used as hair tonic					X		
			Galls pulverized and used to make diuretic tea					X		
			Stems and leaves brewed as tea for colds and sore throats				X	X		
			Tea used to treat febrile conditions				X			
					Stems crushed and stored for use as moccasin padding			X		
					Stem mixed with red ochre and applied to freshly tanned hides as colour and waterproofing			X		
						Infusion of plants used for saddle sores and leg wounds		X		

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Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Mammillaria vivipara	Purple cactus	Ripe fruit eaten as confection						X		
			Small amount of fruit eaten for diarrhoea					X		
			Matter removed from eye by inserting seed and rubbing with the lid closed					X		
					Cactus placed in bed as joke			X		
Mentha arvensis	Wild mint	Tea made of leaves						X		
		Leaves mixed with dried meat to preserve freshness						X		
		Used in smoking of meat						X		
			Leaves brewed as tea for colds and sore throats					X		
			Leaves brewed as tea for diabetes					X		
			Leaves pounded or chewed to treat burns				X			
			Leaves used as lactifuge				X			
			Plant infusion used to treat stomach ache, fever, loss of appetite, and rheumatism				X			
			Infusion taken for headaches							X
				Mint tea used in ceremonies and with bundles				X		
					Used to rub animal traps to remove smell of humans		X			
Muhlenbergia richardsonis	Mat muhly					Probable horse medicine		X		
						Horses fond of root		X		
Opuntia polyacantha	Prickly pear cactus	Stems eaten in times of scarcity						X		
			Peeled stems bound to wounds as dressing				X	X		
			Juice rubbed on warts and moles					X		

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Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Opuntia polyacantha	Prickly pear cactus		Afflicted body parts cured by inserting spines into area and lighting them on fire					X		
				Fruit spread around lodge in Blackfoot legend to serve as protection from sister who was turned into a bear				X		
					Juice used to clarify muddy water			X		
Orobanche ludoviciana	Prairie broom-rape		Plant chewed and blown into wounds					X		
Orthocarpus luteus	Yellow owl's clover				Used to dye small skins, feathers, or horsehair by crushing herbs or blooming plant being rolled onto object to produce a red or reddish colour			X		
Oryzopsis hymenoides	Indian rice grass	Large seeds used for food						X		
Osmorhiza occidentalis	Western sweet cicely	Chewed as confection, particularly in winter						X		
			Roots brewed as tea for stomach and kidney ailments					X		
			Roots brewed for poultice for arthritis					X		
			Scent inhaled for headache					X		
			Root used to reduce infant fever					X		
			Infusion used for coughs, sores, and swollen breasts					X		
			Root infusion used for eye and nose problems and to sweeten smell of infant diapers					X		
					Root used as feminine deodorant			X		

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Osmorhiza occidentalis	Western sweet cicely				Root used as deodorant in clothing and quivers			X		
					Stems mixed with ochre and applied to clothing			X		
						Root ground and applied to horse nose to refresh them		X		
						Root used to treat horse distemper		X		
Oxytropis sericea	White point-vetch		Infusion of leaves for ear problems and applied to sores					X		
			Roots and leaves chewed for colds and sore throats					X		
					Used to make headdress in children's game			X		
Oxytropis spp.	Locoweed		Leaves chewed, and liquid swallowed for sore throat					X		
Petalostemon candidum	White prairie clover	Leaves used for tea						X		
		Root chewed for taste						X		
			Bruised leaves steeped in water and applied to fresh wounds					X		
			Decoction of leaves used as prophylactic					X		
Phlox hoodii	Moss phlox		Infusion of plant used for chest pains and given to children as a mild laxative					X		
					Used as dye			X		
Polygala senega	Seneca snakeroot		Decoction of root used to treat respiratory diseases					X		
			Root ingredient in poultice for cuts and to prevent blood poisoning						X	

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Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Polygala senega	Seneca snakeroot		Applied to tooth for toothache						X	
			Root chewed or sucked for sore throat						X	
			Root used to cure fever				X			
Populus balsamifera	Balsam poplar	Inner bark eaten						X		
			Roots and cambium eaten as general tonic					X		
			Bark brewed in tea for liver ailments					X		
			Crushed buds inserted into nose to stop bleeding				X			
			Sap used to cure headache				X			
			Buds used to stop bleeding from cuts				X			
				Buds burned to turn away thunder			X			
				Used as centre pole for Dancing Lodge of Sun Dance				X		
				Juice of inner bark taken by Elders at Medicine Lodge				X		
				Used for burial scaffolds				X		
					Wood used for shelters and firewood			X		
					Buds used as perfume			X		
					Burls used as bowls			X		
						Inner bark used to feed horses		X		
Populus tremuloides	Trembling aspen	Cambium eaten, especially by children						X		
		Inner bark eaten in spring						X		
		Anyone on a liquid taboo could suck a piece of bark						X		
		Sap allowed as nourishment during Sun Dance					X			

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Populus tremuloides	Trembling aspen		Boiled bark scrapings used to induce birth					X		
			Infusion of bark used to treat heartburn symptoms					X		
			Bark brewed as tea for stomach ailments					X		
			Bark brewed as eyewash						X	
			Inner bark chewed as heart medication						X	
			Green bark boiled to treat diarrhoea						X	
			Outer bark infusion for diabetes						X	
				Used as centre pole of Holy Lodge of Sun Dance (*Okan*) and Motokiks Society lodges				X		
				Members of Motokiks society wore headwreaths of aspen				X		
					Whistles constructed from bark and moistened leaves			X		
					Rotten wood used to smoke meat				X	
					Wood ash used in clothing soap		X			
					Used as brooms			X		
						Young bark used as winter feed for horses		X		
Populus spp.	Poplar		Infusion of springtime bark from rover cottonwoods to treat liver trouble					X		
				Centre pole of ceremonial lodges			X			

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Potentilla anserina	Silverweed	Roots eaten boiled or roasted						X		
			Chewed roots applied to sores and scrapes					X		
			Plant immersed in water and drunk as an emetic for stomach disorders					X		
			Roots brewed in tea for stomach ailment					X		
			Roots used for diarrhoea					X		
					Pillows filled with leaves			X		
					Runners used as cord to fix leggings in place and tie up blankets			X		
Prunus virginiana	Chokecherry	Berries eaten raw, used in pemmican production, soups, and stews					X	X	X	
		Juice a special drink for husband or favoured child						X		
		Twig stripped of bark and inserted into roasts as spice						X		
			Bark boiled and added to other ingredients to treat dysentery				X	X		X
			Boiled inner bark used to treat colds					X		
			Dried root chewed and placed in wound to stop bleeding					X		
			Berry juice used to treat colds and diarrhoea					X		
			Given as enema to babies					X		
			Infused cambium taken as purge					X		
			Chokecherry tea drunk by nursing mothers to pass on medicinal qualities to baby					X		
			Bark boiled in tea for stomach ailments						X	
			Root ingredient in diarrhoea treatment in children						X	
			Branches, bark, and roots used as laxative				X			
			Used in tea during childbirth				X			
			Cambium used for flu-like symptoms				X			

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Prunus virginiana	Chokecherry		Powdered bark used on sores				X			
				Chokecherry soup brewed for Beaver bundle ceremony and for sponsors of the Holy Lodge at the Sun Dance				X		
				Chokecherry stick used for hot coal removal at ceremonies				X		
					Straight branches used to make back rests			X		
					Used to make incense tongs and roasting skewers as the wood does not burn well			X		
Psoralea argophylla	Silverleaf Indian breadroot		Decoction of plants used to wash wounds					X		
Pyrola asarifolia	Bog wintergreen		Leave used in tea for kidney problems and colds				X			
Pyrola spp.	Wintergreen		Infusion of leaves and roots used to expel childbirth					X		
			Infusion of leaves as laxative					X		
			Infusion of leaves and/or roots used as diuretic					X		
			Infusion of flowers used to treat coughing children					X		
			Root chewed as throat lozenge					X		
			Root chewed and applied to eye and ear disorders					X		
			Root chewed and applied to wounds					X		
			Infusion of root applied to swollen neck glands					X		
Ratibida columnifera	Upright prairie coneflower				Yellow and orange dye extracted from roots			X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Rhus trilobata	Skunkbush sumac		Dried berries ground and dusted on smallpox pustules in an attempt to find a cure					X		
Ribes oxyacanthoides	Canadian gooseberry	Berries eaten fresh or added to soups					X	X		
			Tea of roots for kidney problems and as skin wash				X			
			Infusion of stem and root for tonic				X			
			Eyewash from bark				X			
			Berries eaten as mild laxative					X		
					Used in children's game			X		
Ribes spp.	Currant	Berries eaten fresh and added to soups					X	X		
		Leaves and petals used as survival food						X		
			Berries used as a mild laxative					X		
					Berries used in children's game			X		
Rosa acicularis	Prickly wild rose	Ripe fruit eaten					X			
		Leaves and petals used as survival food					X			
		Hips used in soup					X			
			Root part of decoction for cough or menses irregularities						X	
			Chewed leaves applied to bee sting				X			
			Berries boiled for wash or eye drops for sore eyes				X		X	
			Berry infusion used for tuberculosis				X			
Rosa spp.	Rose	Rose hips crushed and added to pemmican						X		
		In winter dried fruit found on trees used as famine food						X		
		Berries eaten						X		
			Roots brewed to treat diarrhoea					X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Rosa spp.	Rose			Bloom of rose used as indicator by Blackfoot for the annual rise of the Missouri River				X		
					Dried fruit used as beads				X	
Rubus idaeus	Wild red raspberry	Berries eaten					X	X	X	
			Root ingredient in diarrhoea treatment for children						X	
Rumex venosus	Veiny dock				Burnt orange dye obtained from peeled roots			X		
Rumex spp.	Dock		Seeds brewed in tea for stomach ailments					X		
			Leaves brewed as wash for sores					X		
			Decoction of plant for painful joints and swellings					X	X	
Sagittaria cuneata	Arumleaf arrowhead	Tubers eaten raw or boiled					X	X		
Salicornia rubra	Red saltwort	Plant boiled to obtain salt							X	
Salix spp.	Willow	Cambium and galls eaten						X		
			Decoction of twigs used as a painkiller and to treat fever					X		
			Fresh roots crushed and used to treat symptoms of “waist trouble” and internal hemorrhage					X		
			Infusion of root used to treat throat constriction and bloodshot or troublesome eyes					X		
			Infusion of root mixed with kidney fat used to treat head sores					X		
			Roots dried, crushed, soaked in water, and mixed with grease to cure dandruff					X		
			Inner bark decocted for constipation and diarrhoea						X	
				Used in sweat lodge construction			X	X		
				Wood used to construct ceremonial sticks				X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Salix spp.	Willow			Branches and twigs used to weave thanks offerings to bears					X	
					Pussy willows used to create dye			X		
					Used to create back rests			X		
					Used as dye			X		
					Loosened bark around branch could be used as a whistle			X		
						Root chewed and spit into horse's eye if it was clouded or bloodshot		X		
Scirpus paludosus	Prairie bulrush	Tubers dug for food in the fall						X		
Selaginella densa	Prairie spikemoss	Dried and used to spice meat						X		
			Decoction of plant used to induce childbirth and expel afterbirth					X		
			Infusion of plant given for spitting blood					X		
			Leaves brewed in tea for colds and sore throat					X		
						Powdered root given to racehorses to make them hyperactive		X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Shepherdia argentea	Silver buffaloberry	Fruit eaten fresh or preserved					X	X		
			Berries eaten for stomach trouble and as a mild laxative					X		
					Red dye extracted from berries			X		
Sisyrinchium montanum	Common blue-eyed grass		Tea from whole plant for fever				X			
			Plant used as "love medicine"				X			
Sium suave	Water parsnip		Root eaten raw as tonic or for chest congestion						X	
			Roots used in many herb mixtures for heart, headache, or fever						X	
Smilacina stellata	False Solomon's seal		Powder from dried root gathered in fall used to clot blood					X		
Solidago spp.	Goldenrod		Tea given to treat sore throat, throat constriction, or nasal congestion made from flowers or leaves					X		
			Root chewed to offer relief from sore throat or congestion					X		
Sphaeralcea coccinea	Scarlet mallow		Plant chewed and applied to sores and wounds				X	X		
			Put on hands and arms of medicine men to prevent scalding when dealing with boiling water and when retrieving meat from pots					X		
Symphoricarpos occidentalis	Western snowberry	Fruit eaten during periods of scarcity						X		
			Infusion of leaves for sore eyes					X	X	
			Stems and white berries part of decoctions for diuretic or kidney problems						X	
					Twigs used for arrowshafts			X		
					Buckbrush shrugs used as brooms			X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Symphoricarpos occidentalis	Western snowberry				Fire from green twigs used to blacken surfaces of newly made pipes			X		
						Liquid from boiled berries given to horses to relieve water retention		X		
						Plant decoction used as diuretic for horses		X	X	
Thermopsis rhombifolia	Golden bean			Flowering rough indicator of when buffalo leave their wintering grounds for prairie grazing				X		
				Flowering indicator of the fattest time of the buffalo				X		
				Flowering indicator for sponsors of the Holy Lodge to begin collecting buffalo tongues for the Sun Dance				X		
					Arrow shafts rubbed with yellow petals for colouring			X		
Townsendia sericea	Low townsendia					Roots boiled, and infusion given to tired horses through the nostril or mouth to revive them		X		

Table A.1: First Nations Ethnobotany of Plants Found Within Dune Areas on the Northern Plains

Plant Name		Usages					Groups			
Latin Name	**Common Name**	**Food**	**Medicinal**	**Spiritual/ Ceremonial**	**Household**	**Veterinary**	**A**	**B**	**C**	**G**
Triglochin maritima	Seaside arrow-grass	Seeds parched and eaten						X		
						Leaves known to be poisonous to stock		X		
Typha latifolia	Common cattail	Stalks edible							X	
		Rhizome cooked and eaten							X	
			Dressing for burns and scalds						X	
			Cattail pads used in diapers				X	X	X	
					Used as cradleboard and moss bag padding				X	
Viola adunca	Early blue violet		Infusion of leaves and roots applied to sore and swollen joints and given to asthmatic children					X		
					Blue dye from plants used on arrows			X		
Yucca glauca	Yucca		Roots used as soap substitute and hair wash					X		
			Grated roots boiled and affected areas placed in steam to reduce swelling in breaks and sprains					X		
			Grated roots placed on cuts to reduce bleeding					X		
			Roots boiled and used as tonic for hair loss					X		
			Roots brewed for poultice for arthritis					X		
			Used to treat breaks and strains					X		
					Roots used as soap substitute			X		
						Roots boiled and applied to saddle sores		X		

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Acer negundo	Manitoba maple	X	X
Achillea millefolium	Yarrow		X
Acorus calamus	Sweet flag	X	
Agoseris glauca	Large-flowered false dandelion		X
Agropyron pectiniforme	Crested wheatgrass		X
Agropyron repens	Quack grass	X*	X*
Agropyron subsecundum	Bearded wheatgrass	X	
Agropyron trachycaulum var. *unilaterale*	Awned wheatgrass		X
Agrostis scabra	Rough hair grass		X
Alisma plantago-aquatica	Broad-leaved water plantain		X
Allium textile	Prairie Onion		X
Allium spp.	Onion		X
Ambrosia psilostachya	Perennial ragweed	X	
Amelanchier alnifolia	Saskatoon	X	X
Andropogon hallii	Sand bluestem	X	
Androsace septentrionalis	Pygmyflower		X
Anemone canadensis	Canada anemone	X	
Anemone cylindrica	Thimbleweed		X
Anemone multifida	Cut-leaved anemone		X
Anemone patens var. *wolfgangiana*	Crocus anemone		X
Andropogon scoparius	Little bluestem		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Antennaria parvifolia	Small-leaved everlasting		X
Arabis holboellii	Holboell's rockcress		X
Aralia nudicaulis	Wild sarsaparilla	X	
Arctostaphylos uva-ursi	Bearberry		X
Arenaria lateriflora	Blunt-leaved sandwort		X
Artemisia campestris	Plains wormwood		X
Artemisia cana	Hoary sagebrush		X
Artemisia frigida	Pasture sage	X	X
Artemisia ludoviciana	White sagebrush	X	X
Artemisia spp.	Sage	X	X
Asclepias speciosa	Showy milkweed		X
Aster ciliolatus	Many-flowered aster	X	
Aster ericoides	White aster	X	
Aster laevis	Smooth aster	X	X
Aster pansus	Many-flowered aster		X
Aster spp.	Aster	X	X
Astragalus canadensis	Canadian milkvetch		X
Astragalus kentrophyta	Spiny milkvetch		X
Astragalus missouriensis	Missouri milkvetch		X
Astragalus pectinatus	Narrowleaf milkvetch		X
Astragalus purshii	Prush's milkvetch		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Astragalus striatus	Ascending purple milkvetch		X
Astragalus tenellus	Looseflower milkvetch		X
Atriplex nuttallii	Nuttall's saltbush		X
Beckmannia syzigachne	Slough grass		X
Betula occidentalis	Water birch	X	X
Bouteloua gracilis	Blue grama	X	X
Bouteloua spp.	Grama	X	X
Bromus ciliatus	Fringed brome	X	
Bromus inermis	Smooth brome	X*	
Calamagrostis montanensis	Plains reedgrass		X
Calamagrostis neglecta	Narrow reedgrass		X
Calamovilfa longifolia	Prairie sandreed	X	X
Caltha palustris	Marsh marigold	X	
Campanula rotundifolia	Harebell	X	X
Caragana arborescens	Common caragana		X*
Carex douglasii	Douglas' sedge		X
Carex filifolia	Threadleaf sedge		X
Carex oederi	Green sedge		X
Carex peckii	Peck's sedge		X
Carex pensylvanica	Pennsylvania sedge		X
Carex scirpoidea	Canadian singlespike sedge		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Carex sprengelii	Sprengel's sedge		X
Cerastium arvense	Field chickweed		X
Cerastium nutans	Nodding chickweed		X
Chenopodium fremontii	Fremont's goosefoot		X
Chenopodium hybridum	Maple-leaved goosefoot		X
Chenopodium leptophyllum	Narrowleaf goosefoot	X	X
Chrysopsis villosa	Hairy goldenaster		X
Cirsium flodmanii	Flodman's thistle		X
Cirsium undulatum	Wavyleaf thistle		X
Cirsium spp.	Thistle		X
Clematis ligusticifolia	Virgin's bower		X
Clematis virginiana	Virgin's bower	X	
Cleome serrulata	Rocky Mountain beeplant		X
Comandra pallida	Common comandra	X	X
Corispermum hyssopifolium	Hyssop-leaved bugseed		X
Cornus stolonifera	Red osier dogwood	X	X
Corylus cornuta	Beaked hazelnut	X	
Coryphantha vivipara	Pincushion	X	
Crataegus rotundifolia	Hawthorn	X	
Cymopterus acaulis	Plains springparsley		X
Cyperus schweinitzii	Schweinitz's flatsedge		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Deschampsia cespitosa	Tufted hairgrass		X
Descurainia pinnata	Western tansy mustard		X
Descurainia richardsonii	Grany tansy		X
Descurainia sophia	Flixweek		X
Distichlis stricta	Desert saltgrass		X
Dodecatheon pauciflorum	Shootingstar		X
Downingia laeta	Great Basin calicoflower		X
Elaeagnus commutata	Wolf willow	X	X
Elymus canadensis	Canada wild rye	X	X
Epilobium glandulosum	Northern willowherb		X
Equisetum hyemale	Common scouring rush	X	X
Equisetum laevigatum	Smooth scouring rush		X
Erigeron canadensis	Canada fleabane		X
Erigeron glabellus	Smooth fleabane	X	
Erigeron pumilus	Shaggy fleabane		X
Erysimum asperum	Western wallflower		X
Erysimum inconspicuum	Small-flowered prairie-rocket		X
Euphorbia esula	Leafy spurge	X*	
Festuca octoflora	Six-weeks fescue		X
Festuca ovina	Sheep fescue		X
Festuca rubra	Red fescue	X*	

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Festuca spp.	Fescue	X	
Fragaria spp.	Strawberry	X	
Franseria acanthicarpa	Bur-ragweed		X
Gaillardia aristata	Blanketflower		X
Galium boreale	Northern bedstraw	X	
Gaura coccinea	Scarlet beeblossom		X
Gentiana affinis	Pleated gentian		X
Geum triflorum	Three-flowered avens		X
Glaux maritima	Sea milkwort		X
Glycyrrhiza lepidota	Wild licorice	X	X
Grindelia squarrosa	Gumweed		X
Gutierrezia sarothrae	Broomweed		X
Habenaria hyperborea	Northern green orchard		X
Hackelia americana	Nodding stickseed		X
Hackelia floribunda	Manyflower stickseed		X
Helianthus laetiflorus	Showy sunflower	X	
Helianthus maximiliani	Narrow-leaved sunflower		X
Helianthus petiolaris	Prairie sunflower		X
Heliotropium curassavicum	Salt heliotrope		X
Heuchera richardsonii	Alumroot		X
Heuchera spp.	Alumroot		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Hordeum jubatum	Foxtail barley		X
Juncus balticus	Baltic rush		X
Juncus longistylis	Long-styled rush		X
Juniperus communis	Common juniper	X	X
Juniperus horizontalis	Creeping juniper	X	X
Koeleria gracilis	Prairie junegrass	X	X
Koeleria cristata	Junegrass		X
Lactuca pulchella	Blue lettuce		X
Lappula redowskii	Western blue bur		X
Lathyrus spp.	Vetch	X	
Lathyrus ochroleucus	Pale vetchling	X	
Lepidium densiflorum	Prairie peppergrass		X
Liatris punctata	Dotted blazingstar		X
Lillium philidelphicum	Western red lily	X	X
Linum lewisii	Wild blue flax		X
Linum rigidum	Yellow flax		X
Lithospermum incisum	Narrowleaf puccoon		X
Lobelia kalmi	Kalm's lobelia		X
Lonicera dioica var. *glaucescens*	Twining honeysuckle	X	
Lupinus pusillus	Dwarf lupine		X
Lupinus spp.	Lupine		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Lygodesmia juncea	Skeletonweed		X
Lygodesmia rostrata	Beaked skeletonweed		X
Maianthemum canadense	Canada mayflower	X	
Mammillaria vivipara	Purple cactus		X
Medicago sativa	Alfalfa		X*
Melilotus alba	White sweet clover		X*
Mentha arvensis	Wild mint		X
Mirabilis hirsuta	Hairy umbrella-wort		X
Muhlenbergia richardsonis	Mat muhly	X	X
Oenothera nuttallii	Nuttall's evening primrose		X
Opuntia fragilis	Little prickly pear		X
Opuntia polyacantha	Prickly pear cactus	X	
Orobanche fasciculata	Clustered broomrape		X
Orobanche ludoviciana	Prairie broomrape		X
Orthocarpus luteus	Yellow owl's clover		X
Oryzopsis hymenoides	Indian rice grass		X
Oryzopsis micrantha	Littleseed rice grass		X
Oxytropis sericea	White point-vetch		X
Oxtropsis spp.	Locoweed		X
Osmorhiza spp.	Sweet cicely	X	
Parnassia palustris	Northern grass-of-Parnassus		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Parthenocissus inserta	Thicket creeper	X	
Penstemon albidus	White beardtongue		X
Petalostemon candidum	White prairie clover		X
Petalostemon purpureum	Purple prairie clover	X	X
Petalostemon villosum	Silky prairie clover	X	
Petasites sagittatus	Sweet coltsfoot	X	
Phlox hoodii	Moss phlox		X
Plantago eriopoda	Redwool plantain		X
Plantago purshii	Pursh's plantain		X
Poa interior	Interior bluegrass		X
Poa pratensis	Kentucky bluegrass		X
Poa secunda	Alkali bluegrass		X
Poa spp.	Bluegrass	X	X
Polygala senega	Seneca snakeroot	X	
Polypogon monspeliensis	Annual beard-grass		X
Polygonum aviculare	Common knotgrass		X
Populus balsamifera	Balsam poplar	X	X
Populus deltoides var. *occidentalis*	Western cottonwood		X
Populus tremuloides	Trembling aspen	X	X
Populus spp.	Poplar	X	X
Potentilla anserina	Silverweed		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Potentilla bipinnatifida	Plains cinquefoil		X
Primula incana	Silvery primrose		X
Prunus virginiana	Chokecherry	X	X
Psoralea argophylla	Silverleaf Indian breadroot		X
Psoralea lanceolata	Wild lemonweed		X
Puccinellia nuttalliana	Nuttall's alkaligrass		X
Pyrola asarifolia	Bog wintergreen		X
Pyrola secunda	One-sided wintergreen		X
Pyrola spp.	Wintergreen		X
Quercus macrocarpa	Bur oak	X	
Ranunculus cymbalaria	Seaside buttercup		X
Ratibida columnifera	Upright prairie coneflower		X
Rhus radicans	Poison ivy	X	X
Rhus trilobata	Skunkbush sumac		X
Ribes oxyacanthoides	Canadian gooseberry		X
Ribes spp.	Currant	X	X
Rosa acicularis	Prickly wild rose	X	
Rosa arkansana	Prairie rose	X	
Rosa spp.	Rose	X	X
Rosa woodsii	Woods' rose	X	X
Rubus idaeus	Wild red raspberry	X	X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Rumex stenophyllus	Narrowleaf dock		X
Rumex venosus	Veiny dock	X	X
Sagittaria cuneata	Arumleaf arrowhead		X
Salicornia rubra	Red saltwort		X
Salix bebbiana	Long-beaked willow	X	X
Salix brachycarpa	Shortfruit willow		X
Salix interior	Sandbar willow	X	X
Salix lutea	Yellow willow		X
Salix spp.	Willow	X	X
Salsola kali	Prickly saltwort		X
Schizachne purpurascens	False melic grass	X	
Scirpus nevadensis	Nevada bulrush		X
Scirpus paludosus	Prairie bulrush		X
Scirpus validus	Softstem bulrush		X
Selaginella densa	Prairie spikemoss		X
Senecio canus	Silvery groundsel		X
Senecio pauperculus	Balsam groundsel		X
Senecio pseudaureus	Thin-leaved ragwort		X
Shepherdia argentea	Silver buffaloberry		X
Silene noctiflora	Night-flowering catchfly		X
Sisyrinchium montanum	Common blue-eyed grass		X

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Sium suave	Water parsnip		X
Smilacina stellata	False Solomon's seal	X	X
Smilax herbacea var. *lasioneura*	Carrionflower	X	
Solidago missouriensis	Missouri goldenrod	X	X
Solidago mollis	Velvety goldenrod		X
Solidago nemoralis	Grey goldenrod	X	
Solidago spp.	Goldenrod	X	X
Sonchus asper	Prickly sow-thistle		X
Spartina gracilis	Alkali cordgrass		X
Spartina pectinata	Prairie cordgrass	X	
Spergularia marina	Saltmarsh sandspurry		X
Sphaeralcea coccinea	Scarlet mallow		X
Spirea alba	White meadowsweet	X	
Sporobolus cryptandrus	Sand dropseed		X
Stellaria longipes	Longstalk starwort		X
Stipa comata	Needle-and-thread grass	X	X
Symphoricarpos occidentalis	Western snowberry	X	X
Thalictrum venulosum	Veiny meadow rue	X	
Thermopsis rhombifolia	Golden bean		X
Townsendia sericea	Low townsendia		X
Tradescantia occidentalis	Prairie spiderwort	X	

Table A.2: Plant Species Found Within the Lauder Sandhills (LSH) and the Great Sand Hills (GSH)

Note: * indicates species identified as introduced

Latin Name	Common Name	LSH	GSH
Tragopogon dubius	Yellow goat's beard		X
Triglochin maritima	Seaside arrow-grass		X
Typha angusifolia	Narrow-leaved cattail	X	
Typha latifolia	Common cattail		X
Urtica dioica	Stinging nettle	X	
Vicia sparsifolia	Common nettle		X
Viola adunca	Early blue violet		X
Viola nuttallii	Nuttall's yellow violet		X
Vitis riparia	Riverbank grape	X	
Yucca glauca	Yucca		X*

Appendix B: Absolute Dates for Archaeological Sites

Table B.1: Archaeological Sites Radiocarbon Dates

Table B.2: Archaeological Sites Optically Stimulated Luminescence (OSL) Dates

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C$%	Cal Yrs ± 2δ (AD unless stated)
FaOm-1 Bodo Bison Skulls Site	BGS 2654	Grekul 2007	290 ± 40	-18.6	1480 [1640] 1790
	BGS 2655	Grekul 2007	460 ± 40	-20.3	1410 [1440] 1480
	BGS 2656	Grekul 2007	330 ± 40	-19.7	1450 [1520, 1570, 1630] 1650
	BGS 2657	Grekul 2007	500 ± 40	-20.4	1330 [1430] 1450
	BGS 2553	Blaikie 2005	245 ± 35	-19.34	1453 [1520, 1587, 1625] 1647
	BGS 2554	Blaikie 2005	137 ± 35	-20.89	1644 [1667, 1782, 1794] 1948
	BGS 2555	Blaikie 2005	20 ± 35	-15.33	1654 [1675, 1776, 1801, 1940, 1946] 1950
	BGS 2556	Blaikie 2005	65 ± 35	-20.86	1667 [1688, 1729, 1810, 1923, 1948] 1952
	BGS 2557	Blaikie 2005	133 ± 35	-20.93	1645 [1668, 1781, 1796] 1949
	BGS 2558	Blaikie 2005	60 ± 40	-18.84	1656 [1679, 1740, 1753, 1756, 1804, 1935, 1947] 1951
FaOm-22 Bodo Overlook	Beta 214251	Gilliland 2007	70 ± 40	-20.6	270-210 BP, 140-20 BP, 0 BP
	Beta 214253	Gilliland 2007	930 ± 40	-20.1	930-750 BP
	Beta 214255	Gilliland 2007	620 ± 50	-19.3	670-530 BP
	Beta 214252	Gilliland 2007	80 ± 40	-20.7	270-200 BP, 150-20 BP, 0 BP
	Beta 214254	Gilliland 2007	1100 ± 40	-18.9	1070-940 BP
	Beta 214256	Gilliland 2007	1080 ± 40	-19.4	1060-930 BP
	Beta 222510	Gilliland 2007	1040 ± 40	-19.7	1040-1030 BP, 1000-920 BP
	Beta 222511	Gilliland 2007	1100 ± 40	-19.8	1070-940 BP
	Beta 209522	Gilliland 2007	2430 ± 40	-19.1	2720-2350 BP
	OxA-19986	Munyikwa et al. 2014	1137 ± 25	-18.9	783–788, 815–844, 859–983
	OxA-19898	Munyikwa et al. 2014	1140 ± 33	-18.4	780–792, 806–984

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C\%$	Cal Yrs ± 2δ (AD unless stated)
FbPf-1 Muhlbach	GSC 696	Gruhn 1971	1270 ± 150	-20.0	1522-918 BP
	UCIAMS114940	Graham 2014	1590 ± 15	-19.25	1532-1415 BP
	UCIAMS114941	Graham 2014	2335 ± 15	-19.12	2357-2336 BP
	UCIAMS114942	Graham 2014	2675 ± 20	-19.64	2844-2750 BP
	UCIAMS114943	Graham 2014	1565 ± 15	-20.26	1523-1410 BP
	UCIAMS114944	Graham 2014	1555 ± 15	-19.7	1523-1401 BP
	UCIAMS131378	Graham 2014	1660 ± 20	-19.02	1609-1529 BP
	UCIAMS131379	Graham 2014	1620 ± 20	-19.52	1563-1416 BP
	UCIAMS131380	Graham 2014	1645 ± 20	-18.83	1609-1445 BP
	UCIAMS131381	Graham 2014	1625 ± 20	-19.58	1567-1416 BP
	UCIAMS89684	Graham 2014	1685 ± 25	-17.61	1688-1543 BP
	UCIAMS89685	Graham 2014	1585 ± 20	-20.09	1535-1410 BP
	UCIAMS89686	Graham 2014	1600 ± 20	-19.36	1545-1414 BP
	UCIAMS89687	Graham 2014	1615 ± 20	-19.22	1559-1415 BP
FfPi-100 Fullerton	GSC 641	Taylor 1969	1230 ± 30	-25.0	**689-751, 760-882**
DlOx-5 Fincastle	Beta 201909	Bubel 2014	2540 ± 50	-18.7	**807-515 BC**
	Beta 201910	Bubel 2014	2490 ± 60	-19.5	**790-429 BC**
	Beta 214254	Bubel 2014	2490 ± 40	-19.4	**789-431 BC**
	Beta 214255	Bubel 2014	2610 ± 40	-19.1	**894-590 BC**
	Beta 214256	Bubel 2014	1310 ± 40	-17.5	**651-772 BC**
	Beta 241257	Bubel 2014	3100 ± 40	-18.4	**1449-1260 BC**
	Beta 241258	Bubel 2014	2680 ± 40	-19.0	**908-797 BC**

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C$%	Cal Yrs ± 2δ (AD unless stated)
FdOt-1 Anderson	GX6129-A	Quigg 1984	4345 ± 160	Unk	**3498-3437, 3378-2570, 2515-2501 BC**
	GX6129-G	Quigg 1984	4725 ± 150	Unk	**3908-3879, 3802-3082, 3068-3027 BC**
	GX6130-A	Quigg 1984	4370 ± 210	Unk	**3630-3580, 3534-2488 BC**
	GX6130-G	Quigg 1984	5460 ± 160	Unk	**4679-4636, 4619-3966 BC**
	Beta 387934	Wondrasek et al. 2017	890 ± 30	-19.5	1040 - 1220
	Beta 387935	Wondrasek et al. 2017	940 ± 30	-18.6	1020 - 1165
	Beta 387936	Wondrasek et al. 2017	920 ± 30	-19.3	1025 - 1190
	Beta 411515	Wondrasek et al. 2017	990 ± 30	-19.8	995 – 1050, 1085 – 1125, 1140 - 1150
	Beta 411512	Wondrasek et al. 2017	980 ± 30	-20.2	1015 – 1050, 1080 - 1150
	Beta 411513	Wondrasek et al. 2017	920 ± 30	-20.1	1025 - 1190
	Beta 411514	Wondrasek et al. 2017	920 ± 30	-19.7	1025 - 1190
	Beta 434274	Wondrasek et al. 2017	1160 ± 30	-18.9	775 - 980
	Beta 434273	Wondrasek et al. 2017	940 ± 30	-20.4	1020 - 1165
	Beta 375623	Wondrasek et al. 2017	1000 ± 30	-19.2	990 - 1045, 1095 - 1120, 1140 – 1145
	Beta 375622	Wondrasek et al. 2017	1060 ± 30	-19.3	900 – 925, 945 – 1020
	Beta 375625	Wondrasek et al. 2017	870 ± 30	-20.1	1050 – 1085, 1125 – 1140, 1150 – 1225
	Beta 375624	Wondrasek et al. 2017	860 ± 30	-19.1	1050 – 1082, 1150 - 1250
FbNr-1 Tschetter	S 669	Prentice 1983	1005 ± 75	-20.0	1060 [933] 800 BP
	S 1631	Prentice 1983	914 ± 45	-20.0	935 [832] 729 BP
	S 2225	Prentice 1983	1100 ± 100	-20.0	1160 [938] 720 BP
	NZA 15751	Leyden 2004	1035 ± 40	-18.2	Returned modern date

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C\%$	Cal Yrs ± 2δ (AD unless stated)
FbNs-1 Harder	S 490	Dyck 1977	3360 ± 120	-20.0	3909 [3626] 3369 BP
	S 668	Dyck 1977	3425 ± 105	-20.0	3979 [3690] 3459 BP
	S 3453	Morlan 1994	3420 ± 140	-15.5	4082 [3689] 3369 BP
	S 3444	Morlan 1994	4410 ± 150	-18.3	5459 [4986] 4572 BP
	S 3452	Morlan 1994	4190 ± 90	-15.9	4972 [4729] 4451 BP
	NZA 15746	Leyden 2004	4221 ± 45	-17.8	6510 – 6796 BP
FbNs-2 Rousell	S 670	Morlan 1992	1185 ± 70	-20.0	1280 [1080] 950 BP
FbNs-3 Carruthers	S 742	Morlan 1992	3050 ± 80	-20.0	3459 [3295] 3009 BP
FaNq-5 Moon Lake	S 403	Dyck 1970	4100 ± 90	-20.0	4859 [4606] 4409 BP
FaNr-2 Grandora	S 489	Dyck 1972b	3730 ± 80	-25.0	4404 [4089] 3869 BP
	S 542	Dyck 1972 b	1560 ± 60	-20.0	1570 [1472] 1330 BP
FbNs-15 Goosen Pasture	S 2690	Smith and Richards 1987	1095 ± 100	Unk	1270 [986] 790 BP
FaNp-19 Hartley	S 3382	Clarke 1995	1120 ± 60	-20.0	762 - 1013
	BGS 2663	Hanna 2007	709 ± 40	Unk	1239 – 1322 (p=0.772), 1350 – 1390 (p=0.223)
	BGS 2790	Hanna 2007	814 ± 40	Unk	1159 – 1284 (p=0.992)
ElNp-8 Fitzgerald	S 3547	Hjermstad 1996	1160 ± 170	-20.0	1310 – 1170 BP
	S3546	Hjermstad 1996	1270 ± 140	-20.0	1490 – 1210 BP
	Beta 69004	Hjermstad 1996	1340 ± 60	-20.0	1485 – 1355 BP
	Beta 69005	Hjermstad 1996	1490 ± 90	-20.0	1660 – 1480 BP
	Average	Hjermstad 1996	1362 ± 45	N/A	1303 – 1263 BP
	NZA 15750	Leyden 2004	1563 ± 45	-18.0	1341 – 1543 BP

Table B.1: Archaeological Sites Radiocarbon Dates

***Note:** *Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	δ^{13}C%	Cal Yrs ± 2δ (AD unless stated)
ElNs-10 Whiting Slough	ULA-6042	VanderZwan 2017	1330 ± 20	-19.1	**651-710, 746-764**
	ULA-6043	VanderZwan 2017	1320 ± 20	-19.7	**656-715, 744-765**
	ULA-6040	VanderZwan 2017	1325 ± 15	-19.4	**655-695, 703-707, 747-764**
	ULA-6053	VanderZwan 2017	3645 ± 20	-18.2	**2125-2091, 2044-1945 BC**
	ULA-6052	VanderZwan 2017	3700 ± 20	-18.0	**2190-2181, 2143-2029 BC**
EdOh-23	S 2348	Johnson 1983	1675 ± 115	-20.0	**87-106, 120-605**
EgNn-9	Beta 167308	Neal 2006	4600 ± 40	Unk	**3517-3395, 3386-3326, 3231-3225, 3220-3173, 3161-3118 BC**
EgNo-23	BGS 2365	Webster 2004	1880 ± 50	Unk	2000 – 1800 BP
	Beta 167311	Webster 2004	1860 ± 40	Unk	1990 – 1830 BP
	BGS 2363	Webster 2004	3348 ± 50	Unk	3830 – 3565 BP
	Beta 167310	Webster 2004	3430 ± 40	Unk	3890 – 3650 BP
	BGS 2364	Webster 2004	3440 ± 55	Unk	3980 – 3640 BP
	BGS 2386	Webster 2004	3530 ± 50	Unk	4085 – 3730 BP
	BGS 2366	Webster 2004	3540 ± 50	Unk	4086 – 3733 BP
	Beta 183521	Webster 2004	4140 ± 60	Unk	4870 – 4575 BP
EgNn-1 Melhagen	S 491	Ramsay 1991	1960 ± 90	-20.0	2148 – 1710 BP
	S 1640	Ramsay 1991	1919 ± 70	-20.0	2041 – 1700 BP
	S 1641	Ramsay 1991	1710 ± 45	-20.0	1770 – 1524 BP
	S 2855	Ramsay 1991	1905 ± 110	-20.0	2145 – 1567 BP
	S 2856	Ramsay 1991	1575 ± 115	-20.0	1770 – 1290 BP
	S 2857	Ramsay 1991	810 ± 205	-20.0	1173 – 500 BP

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C$%	Cal Yrs ± 2δ (AD unless stated)
EcNx-1 Gray Site	S 1449	Morlan 1993	2915 ± 85	-19.0	3349 [3068] 2849 BP
	S 1450	Morlan 1993	3415 ± 105	-19.0	3972 [3687] 3459 BP
	S 706	Morlan 1993	3485 ± 195	-19.0	4401 [3765] 3349 BP
	S 693	Morlan 1993	3550 ± 295	-19.0	4814 [3844] 3165 BP
	S 707	Morlan 1993	3750 ± 180	-19.0	4807 [4110] 3638 BP
	S 646	Morlan 1993	3755 ± 100	-19.0	4419 [4149] 3849 BP
	RIDDL 515	Morlan 1993	4420 ± 190	-17.5	5578 [4989] 4529 BP
	GX 3373	Morlan 1993	4340 ± 250	-19.0	5589 [4989] 4529 BP
	RIDDL 512	Morlan 1993	4510 ± 140	-17.5	5575 [5130] 4737 BP
	RIDDL 513	Morlan 1993	4600 ± 170	-17.5	5724 [5309] 4849 BP
	RIDDL 514	Morlan 1993	4600 ± 130	-17.5	5626 [5309] 4849 BP
	SFU 295	Morlan 1993	4750 ± 160	-19.0	5891 [5531] 4991 BP
	S 619	Morlan 1993	4955 ± 165	-19.0	6166 [5690] 5319 BP
	S 647	Morlan 1993	5100 ± 390	-19.0	6729 [5787] 4869 BP
	SFU 294	Morlan 1993	5150 ± 160	-19.0	6299 [5932] 5589 BP
	SFU 296	Morlan 1993	5320 ± 160	-19.0	6419 [6174, 6145, 6104] 5729 BP
	SFU 297	Morlan 1993	5620 ± 320	-19.0	7179 [6414] 5729 BP
FaNq-25 Gowen 1	S 1526	Morlan 1993	4730 ± 130	-20.0	5729 [5463] 5049 BP
	S 1527	Morlan 1993	5670 ± 135	-20.0	6843 [6461] 6309 BP
	S 1448	Morlan 1993	5760 ± 140	-25.0	6889 [6584] 6299 BP
	S 1488	Morlan 1993	6070 ± 200	-20.0	7403 [6913] 6459 BP
	S 1457	Morlan 1993	6150 ± 110	-20.0	7274 [7088] 6751 BP

Table B.1: Archaeological Sites Radiocarbon Dates

**Note: Bold dates have been calibrated by author.*

Site Borden/ Name	Sample #	Reference	Conventional Age (BP)	$\delta^{13}C\%$	Cal Yrs ± 2δ (AD unless stated)
FaNq-32 Gowen 2	S 2036A	Morlan 1993	5080 ± 150	-20.0	6189 [5795] 5484 BP
	S 2037	Morlan 1993	5670 ± 110	-25.0	6729 [6461] 6289 BP
	S 1970	Morlan 1993	5920 ± 130	-20.0	7159 [6774] 6449 BP
	S 1971	Morlan 1993	6080 ± 160	-20.0	7289 [6949] 6562 BP
	S 2036B	Morlan 1993	5910 ± 170	-20.0	7179 [6738] 6319 BP
	NZA 15746	Leyden 2004	5863 ± 55	-17.5	6795 - 6510 BP
DiMe-17 Jackson	Beta 82792	Nicholson 1996	Unk	-20.0	350 – 470 BP (410 ± 60 BP)
	Beta 82795	Nicholson and Hamilton 2001	Unk	Unk	270 – 390 BP (330 ± 60 BP)
	Beta 83864	Nicholson 1996	Unk	-20.0	230 – 370 BP (300 ± 70 BP)
	Beta 83865	Nicholson 1996	Unk	-20.0	240 – 340 BP (290 ± 50 BP)
	Beta 65952	Nicholson 1996	540 ± 60	-20.0	555 – 685 BP (620 ± 65 BP)
DiMe-25 Vera	Beta 96109	Nicholson and Hamilton 1997b	Unk	-20.0	280 – 400 BP (340 ± 60 BP)
	Beta 111141	Nicholson and Hamilton 1997b	Unk	Unk	200 – 300 BP (250 ± 50 BP)
DiMe-23 Twin Fawns	Beta 96111	Hamilton and Nicholson 2007	Unk	Unk	90 – 210 BP (150 ± 60 BP)
DiMe-29 Crepeele	TO 11881	Nicholson and Nicholson 2007	1620 ± 120	Unk	425 **(140 – 646)**

Table B.2: Archaeological Sites Optically Stimulated Luminescence (OSL) Dates

Borden/Site Name	Sample #	Reference	OSL Age
FaOm-22 Bodo Overlook	USU-901	Munyikwa et al. 2014	350 ± 310 AD
	USU-902	Munyikwa et al. 2014	290 ± 410 AD
	USU-903	Munyikwa et al. 2014	6960 ± 2380 AD
DlOx-5 Fincastle	UNL2543	Bubel 2014	5170 ± 0.32 BP
	UNL2544	Bubel 2014	4640 ± 0.25 BP
	UNL2545	Bubel 2014	3140 ± 0.17 BP
	UNL2546	Bubel 2014	2900 ± 0.1 BP
	UNL2547	Bubel 2014	2050 ± 0.13 BP
	UNL2548	Bubel 2014	1780 ± 0.13 BP
	UNL2549	Bubel 2014	1270 ± 0.06 BP
	UNL2550	Bubel 2014	170 ± 0.02 BP
Hartley Site FaNp-19	DUR 93TL170-1ASpfg	Clarke 1995	700 ± 360 AD

Appendix C: Archaeological Sites Absolute Dates Assessment

Table C.1: Archaeological Sites Absolute Dates Assessments

Table Legend:

Water = Groundwater impact on archaeological matrix, either witnessed by researchers or inferred through presence of mottling in soils

Accept = Acceptance of date as valid by original researcher

BC = Bone collagen

TD = Tooth dentine

Table C.1: Archaeological Sites Absolute Dates Assessments

<table>
<tr><th>Borden</th><th>Sample #</th><th>Year</th><th>What dated</th><th>RC/AMS</th><th>Treatment</th><th>Author calibrated</th><th>Blended</th><th>Water</th><th>Accept by author</th></tr>
<tr><td rowspan="10">FaOm-1</td><td>BGS 2654</td><td rowspan="4">2007</td><td rowspan="4">BC - bison</td><td rowspan="4">AMS</td><td rowspan="10">Unk</td><td rowspan="10">INTCAL98 Stuiver et al. 1998</td><td rowspan="3">No</td><td rowspan="10">Yes</td><td rowspan="4">Yes</td></tr>
<tr><td>BGS 2655</td></tr>
<tr><td>BGS 2656</td></tr>
<tr><td>BGS 2657</td><td>No?</td></tr>
<tr><td>BGS 2553</td><td rowspan="6">2005</td><td rowspan="6">BC - bison</td><td rowspan="6">AMS?</td><td>No</td><td>No</td></tr>
<tr><td>BGS 2554</td><td>Yes</td><td rowspan="5">Yes</td></tr>
<tr><td>BGS 2555</td><td>No</td></tr>
<tr><td>BGS 2556</td><td rowspan="3">Yes</td></tr>
<tr><td>BGS 2557</td></tr>
<tr><td>BGS 2558</td></tr>
<tr><td rowspan="11">FaOm-22</td><td>Beta 214251</td><td rowspan="9">2007</td><td rowspan="8">BC - bison</td><td rowspan="11">AMS</td><td rowspan="11">Unk</td><td rowspan="11">OxCal 4.2 with IntCal04 curve</td><td rowspan="8">No?</td><td rowspan="11">Yes</td><td rowspan="8">Yes</td></tr>
<tr><td>Beta 214253</td></tr>
<tr><td>Beta 214255</td></tr>
<tr><td>Beta 214252</td></tr>
<tr><td>Beta 214254</td></tr>
<tr><td>Beta 214256</td></tr>
<tr><td>Beta 222510</td></tr>
<tr><td>Beta 222511</td></tr>
<tr><td>Beta 209522</td><td>TD - bison</td><td>No</td><td>No</td></tr>
<tr><td>OxA-19986</td><td rowspan="2">2014</td><td rowspan="2">BC - bison</td><td rowspan="2">No?</td><td rowspan="2">Yes</td></tr>
<tr><td>OxA-19898</td></tr>
</table>

Table C.1: Archaeological Sites Absolute Dates Assessments

<table>
<tr><th>Borden</th><th>Sample #</th><th>Year</th><th>What dated</th><th>RC/AMS</th><th>Treatment</th><th>Author calibrated</th><th>Blended</th><th>Water</th><th>Accept by author</th></tr>
<tr><td rowspan="14">FbPf-1</td><td>GSC 696</td><td>1971</td><td>BC – burned bison?</td><td>RC</td><td rowspan="14">Unk</td><td>None by original author</td><td>No?</td><td rowspan="14">Yes</td><td>Yes?</td></tr>
<tr><td>UCIAMS114940</td><td rowspan="13">2014</td><td rowspan="13">BC - bison</td><td rowspan="13">AMS</td><td rowspan="13">OxCal 4.2 with IntCal13 curve</td><td rowspan="13">No</td><td>Yes</td></tr>
<tr><td>UCIAMS114941</td><td rowspan="2">No</td></tr>
<tr><td>UCIAMS114942</td></tr>
<tr><td>UCIAMS114943</td><td rowspan="10">Yes</td></tr>
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<tr><td>UCIAMS131379</td></tr>
<tr><td>UCIAMS131380</td></tr>
<tr><td>UCIAMS131381</td></tr>
<tr><td>UCIAMS89684</td></tr>
<tr><td>UCIAMS89685</td></tr>
<tr><td>UCIAMS89686</td></tr>
<tr><td>UCIAMS89687</td></tr>
<tr><td>FfPi-100</td><td>GSC 641</td><td>1969</td><td>Charcoal</td><td>RC</td><td>Unk</td><td>OxCal 4.3 with IntCal13 curve</td><td>No</td><td>No</td><td>Yes</td></tr>
<tr><td rowspan="7">DlOx-5</td><td>Beta 201909</td><td rowspan="7">2014</td><td rowspan="7">BC - bison</td><td rowspan="7">AMS</td><td rowspan="7">Unk</td><td rowspan="7">OxCal 4.3 with IntCal13 curve</td><td rowspan="7">No</td><td rowspan="7">Yes</td><td rowspan="4">Yes</td></tr>
<tr><td>Beta 201910</td></tr>
<tr><td>Beta 214254</td></tr>
<tr><td>Beta 214255</td></tr>
<tr><td>Beta 214256</td><td rowspan="2">No</td></tr>
<tr><td>Beta 214257</td></tr>
<tr><td>Beta 214258</td><td>Yes</td></tr>
</table>

Table C.1: Archaeological Sites Absolute Dates Assessments

Borden	Sample #	Year	What dated	RC/AMS	Treatment	Author calibrated	Blended	Water	Accept by author
FdOt-1	GX6129-A	1984	BC - bison	RC?	Unk	**OxCal 4.3 with IntCal13 curve**	Yes	Yes	No
	GX6129-G								
	GX6130-A								
	GX6130-G								
	Beta 387934	2017		AMS	Collagen extraction with alkali	IntCal13 Reimer et al. 2013	No	Yes	Yes
	Beta 387935								
	Beta 387936								
	Beta 411515								
	Beta 411512								
	Beta 411513								
	Beta 411514								
	Beta 434274								No
	Beta 434273								
	Beta 375623								
	Beta 375622								Yes
	Beta 375625								
	Beta 375624								
FbNr-1	S 669	1983	BC - bison	RC	Unk	CALIB Program Stuiver and Reimer 1986	No?	Yes	Yes
	S 1631								
	S 2225								
	NZA 15751	2004		AMS		INTCAL98 Stuiver et al.1998	No		No

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<table>
<tr><th>Borden</th><th>Sample #</th><th>Year</th><th>What dated</th><th>RC/AMS</th><th>Treatment</th><th>Author calibrated</th><th>Blended</th><th>Water</th><th>Accept by author</th></tr>
<tr><td rowspan="6">FbNs-1</td><td>S 490</td><td rowspan="2">1977</td><td rowspan="2">BC – charred bison</td><td rowspan="5">RC</td><td rowspan="2">Insoluble collagen extraction</td><td rowspan="5">CALIB Program Stuiver and Reimer 1986</td><td rowspan="2">Yes</td><td rowspan="6">Yes</td><td rowspan="6">Yes</td></tr>
<tr><td>S 668</td></tr>
<tr><td>S 3453</td><td rowspan="3">1994</td><td rowspan="4">BC - bison</td><td rowspan="3">Soluble collagen extraction</td><td rowspan="4">No</td></tr>
<tr><td>S 3444</td></tr>
<tr><td>S 3452</td></tr>
<tr><td>NZA 15746</td><td>2004</td><td>AMS</td><td>Unk</td><td>INTCAL98 Stuiver et al. 1998</td></tr>
<tr><td>FbNs-2</td><td>S 670</td><td>1972</td><td>BC - bison</td><td>RC</td><td>Unk</td><td>INTCAL98 Stuiver et al. 1998</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>FbNs-3</td><td>S 742</td><td>1972</td><td>BC - bison</td><td>RC</td><td>Unk</td><td>CALIB Program Stuiver and Reimer 1986</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>FaNq-5</td><td>S 403</td><td>1970</td><td>BC – burned bison</td><td>RC</td><td>Unk</td><td>CALIB Program Stuiver and Reimer 1986</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td rowspan="2">FaNr-2</td><td>S 489</td><td rowspan="2">1972</td><td>Paleosol</td><td rowspan="2">RC</td><td rowspan="2">Unk</td><td rowspan="2">CALIB Program Stuiver and Reimer 1986</td><td>N/A</td><td rowspan="2">No</td><td rowspan="2">Yes</td></tr>
<tr><td>S 542</td><td>BC - bison</td><td>Yes</td></tr>
<tr><td>FbNs-15</td><td>S 2690</td><td>1987</td><td>Unknown</td><td>RC?</td><td>Unk</td><td>CALIB Program Stuiver and Reimer 1986</td><td>No</td><td>No</td><td>Yes</td></tr>
</table>

Table C.1: Archaeological Sites Absolute Dates Assessments

Borden	Sample #	Year	What dated	RC/AMS	Treatment	Author calibrated	Blended	Water	Accept by author
FaNp-19	S 3382	1995	BC - bison	RC?	Unk	University of Washington Radiocarbon Calibration Program 2	No	Yes	Yes
	BGS 3663	2007				Brock U Radiocarbon Lab			
	BGS 2790								
ElNp-8	S 3547	1996	BC - bison	RC?	Roots manually removed	University of Washington Radiocarbon Calibration Program 2.0	No	No	Yes
	S 3546								
	Beta 69004								
	Beta 69005								
	Calculated average from above		N/A	N/A	N/A		N/A	N/A	
	NZA 15750	2004	BC - bison	AMS	Unk	INTCAL98 Stuiver et al.1998	No	No	
ElNs-10	ULA-6042	2017	BC - bison	AMS	HCl-NaOH-HCl	**OxCal 4.3 with IntCal13 curve**	No	Yes	Yes
	ULA-6043								
	ULA-6040								
	ULA-6053								No
	ULA-6052								Yes
EdOh-23	S 2348	1983	BC - bison	RC?	Unk	**OxCal 4.3 with IntCal13 curve**	No?	No	Yes
EgNn-9	Beta 167308	2006	BC - bison	AMS	Unk	**OxCal 4.3 with IntCal13 curve**	No	Yes	No

Table C.1: Archaeological Sites Absolute Dates Assessments

Borden	Sample #	Year	What dated	RC/AMS	Treatment	Author calibrated	Blended	Water	Accept by author
EgNo-23	BGS 2365	2004	BC – bison	AMS	Unk	CALIB Rev.4.3	No?	No	Yes
	Beta 167311								No
	BGS 2363						No		Yes
	Beta 167310								
	BGS 2364								
	BGS 2386								
	BGS 2366								
	Beta 183521								
EgNn-1	S 491	1991	BC - bison	RC	Unk	Stuiver and Becker 1986	No?	Yes	Yes
	S 1640								
	S 1641								
	S 2855								
	S2856								
	S2857								No
EcNx-1	S 1449	1978	BC – human	RC	Unk	CALIB Program Stuiver and Reimer 1986	No	No	Yes
	S1450								
	S 706								
	S 693								
	S 707								
	S 646								
	RIDDL 515	1986		AMS	Chisholm et al. 1983				
	GX 3373	1978		RC	Unk				
	RIDDL 512	1986		AMS	Chisholm et al. 1983				
	RIDDL 513								
	RIDDL 514								

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<tr><th>Borden</th><th>Sample #</th><th>Year</th><th>What dated</th><th>RC/AMS</th><th>Treatment</th><th>Author calibrated</th><th>Blended</th><th>Water</th><th>Accept by author</th></tr>
<tr><td rowspan="6">EcNx-1</td><td>SFU 295</td><td></td><td rowspan="6">BC - human</td><td>RC?</td><td>Chisholm et al. 1983</td><td rowspan="6">CALIB Program Stuiver and Reimer 1986</td><td rowspan="6">No</td><td rowspan="6">No</td><td rowspan="6">Yes</td></tr>
<tr><td>S 619</td><td rowspan="2">1978</td><td rowspan="2">RC</td><td rowspan="2">Unk</td></tr>
<tr><td>S 647</td></tr>
<tr><td>SFU 294</td><td rowspan="3">1986</td><td rowspan="3">RC?</td><td rowspan="3">Chisholm et al. 1983</td></tr>
<tr><td>SFU 296</td></tr>
<tr><td>SFU 297</td></tr>
<tr><td rowspan="5">FaNq-25</td><td>S 1526</td><td rowspan="5">1980</td><td rowspan="2">BC - bison</td><td rowspan="5">RC</td><td rowspan="5">Unk</td><td rowspan="5">CALIB Program Stuiver and Reimer 1986</td><td rowspan="2">No</td><td rowspan="5">No</td><td>No</td></tr>
<tr><td>S 1527</td><td rowspan="4">Yes</td></tr>
<tr><td>S 1448</td><td>Charcoal</td><td>N/A</td></tr>
<tr><td>S 1488</td><td>BC - burned bison</td><td rowspan="2">No</td></tr>
<tr><td>S 1457</td><td>BC - bison</td></tr>
<tr><td rowspan="6">FaNq-32</td><td>S 2036A</td><td rowspan="5">1980</td><td>BC - bison</td><td rowspan="5">RC</td><td>None</td><td rowspan="5">CALIB Program Stuiver and Reimer 1986</td><td>No</td><td rowspan="5">No</td><td rowspan="5">Yes</td></tr>
<tr><td>S 2037</td><td>Carbonaceous sediment</td><td rowspan="3">Unk</td><td>N/A</td></tr>
<tr><td>S 1970</td><td rowspan="4">BC - bison</td><td rowspan="4">No</td></tr>
<tr><td>S 1971</td></tr>
<tr><td>S 2036B</td><td>1N HCL</td></tr>
<tr><td>NZA 15776</td><td>2004</td><td>AMS</td><td>Unk</td><td>INTCAL98 Stuiver et al.1998</td><td>No</td><td>Yes</td></tr>
<tr><td rowspan="5">DiMe-17</td><td>Beta 82792</td><td rowspan="5">1996</td><td rowspan="5">BC - bison</td><td rowspan="5">AMS?</td><td rowspan="5">Unk</td><td rowspan="5">INTCAL98 Stuiver et al.1998</td><td rowspan="5">No?</td><td rowspan="5">Yes</td><td rowspan="5">Yes</td></tr>
<tr><td>Beta 82795</td></tr>
<tr><td>Beta 83864</td></tr>
<tr><td>Beta 83865</td></tr>
<tr><td>Beta 65952</td></tr>
</table>

Table C.1: Archaeological Sites Absolute Dates Assessment

Borden	**Sample #**	**Year**	**What dated**	**RC/AMS**	**Treatment**	**Author calibrated**	**Blended**	**Water**	**Accept by author**
DiMe-25	Beta 106109 Beta 111141	1997	BC - bison	AMS?	Unk	INTCAL98 Stuiver et al.1998	No?	Yes	Yes
DiMe-23	Beta 96111	2007	BC - bison	AMS	Unk	Calib Radiocarbon Program Stuiver and Pearson 1993	No	Yes	Yes
DiMe-29	TO 11881	2007	BC - bison	AMS?	Unk	Unknown **OxCal 4.3 with IntCal13 curve**	No	No	Yes