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Melisse R. Burns

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CHANGING TIMES, CHANGING ECONOMICS:
A FAUNAL RESOURCE HISTORY OF HOUSEPIT 7 AT
THE KEATLEY CREEK SITE

by
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B.A. The University of Montana, Missoula, 1999
presented in partial fulfillment of the requirements
for the degree of
Master of Arts
The University of Montana
December 2003

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The University of Montana Summer Field School conducted excavations at the Keatley Creek site during the summers of 1999, 2001 and 2002. The site is a large winter pithouse village located on the Canadian Plateau of British Columbia. Excavations focused on one very large housepit within the village core, Housepit 7. This house had been partially excavated in earlier seasons. One objective of this research was to gain a clearer understanding of the evolution of economic patterns over the long period that Housepit 7 was occupied, roughly 1700 to 800 years B.P. In order to refine the economic history, a trench was excavated through the northwest rim of the housepit, giving researchers a complete slice of history, beginning with the earliest construction phases of the house.

The extant economic profile for Housepit 7 and the Keatley Creek site suggested that the easy availability of and heavy reliance on salmon caused the emergence of the pattern of large villages and socioeconomic complexity seen at Keatley Creek, and was also the basis for the abandonment of Housepit 7 and the Keatley Creek village. The existing model proposes that large villages and associated socioeconomic complexity were given rise due to the ability of the inhabitants of the Mid-Fraser region to harvest a surplus of salmon on a yearly basis, and that the end of the big villages of the Mid-Fraser came about due to a catastrophic landslide that dammed the Fraser River, blocking salmon runs and causing an economic collapse.

However, the data from the faunal materials recovered from the 1999, 2001, and 2002 excavations display a gradual trend towards increased mammal consumption and greatly decreased salmon consumption throughout the life of the house. Additionally, the faunal data exhibits a corresponding shift in the richness of the diet, with the final phases of occupation displaying a far richer and more varied diet than found during the initial phases. These results suggest that the rise and fall of cultural complexity at the site may have been more involved than simply reflecting relative salmon abundance or lack thereof.

These new findings warrant a refinement of the established Housepit 7 economic profile; a revised model of Housepit 7 economics is proposed here. I examine the faunal and other types of data recovered from the recent excavations and compare them to excavation records and published manuscripts produced from previous field programs conducted at the Keatley Creek site. These data are collectively utilized to modify the extant economic profile. A discussion of research implications concludes this study.
TABLE OF CONTENTS

ABSTRACT ii

LIST OF FIGURES v

LIST OF TABLES vi

CHAPTER ONE: INTRODUCTION 1
   History of Research 2
   Research Problem 2
   Research Goals 5
   Significance of Research 6
   Thesis Outline 7

CHAPTER TWO: RESEARCH BACKGROUND 8
   Environmental Context 8
      Site Setting 8
      Physiography and Topography 10
      Faunal Overview 12
   Paleoenvironmental Summary: Climate, Fauna, and Flora 21
   Culture Chronology 27
      Canadian Plateau Culture Area 27
      Culture Chronology of the Mid-Fraser Region 28
   Pithouse Use and Culture Change 42
   A Year in the Life of a Complex Hunter-Gatherer 50
   Housepit Sites and Formation Processes 55
      Difficulties of Housepit Excavations 57
   Overview of the Keatley Creek Site 59
   Description of Housepit 7 61

CHAPTER THREE: RESEARCH METHODS 63
   Excavation Plans and Methods 63
   Analytical Methods 67
      Background to Zooarchaeology 67
      Requirements and Components of Study 70
      Specific Analyses 73
         Bone Weathering 73
         Heat Treatment of Bones 74
         Bone Breakage and Butchery 76
         General Taphonomy 78
   Laboratory Methods 79
   Radiocarbon Dating 80
CHAPTER FOUR: RESULTS  85
   Faunal Data  85
      Element Survivorship Analysis  96
      Rank Order Abundance Analysis  101
      Resource Depression Analysis  103
   Results Summary  106

CHAPTER FIVE: DISCUSSION  107
   The New Faunal Profile for Housepit 7  107
   A Comparison of the New and
      Established Economic Models for Housepit 7  117
   Discussion Summary  119

CHAPTER SIX: CONCLUSIONS  120
   Summary of Research  120
   Parallel Lines of Evidence  121
      Ethnobotanicals  121
      Lithics  122
      Prestige Artifacts  123
      Root Roasting Pits  123
      Environmental Conditions and Fire Frequency  124
   Conclusions and Research Implications  126

APPENDIX: MAPS AND FIGURES  128

BIBLIOGRAPHY  140
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-2 Reaction of Bone to Heating</td>
<td>75</td>
</tr>
<tr>
<td>4-1 Relative Percentages of Mammal and Salmon Bones in the Housepit 7 Rim</td>
<td>93</td>
</tr>
<tr>
<td>4-2 Number of Identified Economically Viable Species</td>
<td>93</td>
</tr>
<tr>
<td>4-3 Bone Modifications</td>
<td>94</td>
</tr>
<tr>
<td>4-4 Behrensmeyer Degree of Weathering</td>
<td>94</td>
</tr>
<tr>
<td>4-5 Bone Size Ranges</td>
<td>95</td>
</tr>
<tr>
<td>4-6 Heat Treatment of Bones</td>
<td>95</td>
</tr>
<tr>
<td>4-7 Salmon Element Volume Density</td>
<td>98</td>
</tr>
<tr>
<td>4-8 Percent MAU of Density Tested Salmon Elements</td>
<td>100</td>
</tr>
<tr>
<td>4-9 Salmon Survivorship of All Elements</td>
<td>101</td>
</tr>
<tr>
<td>4-10 Rank Order Abundances of Faunal Materials by Rim Level of Housepit 7</td>
<td>102</td>
</tr>
<tr>
<td>4-11 Mammal/Salmon Index</td>
<td>105</td>
</tr>
<tr>
<td>1-1 Plateau Geographical Area</td>
<td>129</td>
</tr>
<tr>
<td>1-2 Map of Lillooet Region</td>
<td>130</td>
</tr>
<tr>
<td>1-3 Map of Keatley Creek Site</td>
<td>131</td>
</tr>
<tr>
<td>2-1 Cross Section of Camelsfoot Range Topography</td>
<td>132</td>
</tr>
<tr>
<td>2-2 Formation Processes for Pithouses</td>
<td>133</td>
</tr>
<tr>
<td>2-3 Map of Keatley Creek Site Core</td>
<td>134</td>
</tr>
<tr>
<td>2-4 Housepit 7 Floor Features</td>
<td>135</td>
</tr>
<tr>
<td>3-1 Map of Housepit 7 Excavation Units</td>
<td>136</td>
</tr>
<tr>
<td>3-3 Profile of west wall, north trench of Housepit 7</td>
<td>137</td>
</tr>
<tr>
<td>3-4 Profile of NW Rim and Floors of Housepit 7</td>
<td>138</td>
</tr>
<tr>
<td>3-5 Model of Housepit 7 Occupations</td>
<td>139</td>
</tr>
<tr>
<td>TABLE</td>
<td>PAGE</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>2-1</td>
<td>Monthly Resource Use Calendar</td>
</tr>
<tr>
<td>3-1</td>
<td>Stratum Legend for Housepit 7 Excavations</td>
</tr>
<tr>
<td>3-2</td>
<td>Behrensmeyer Bone Weathering Stages</td>
</tr>
<tr>
<td>3-3</td>
<td>Calibrated Radiocarbon Dates from Housepit 7</td>
</tr>
<tr>
<td>4-1</td>
<td>Early Housepit 7 Faunal Remains</td>
</tr>
<tr>
<td>4-2</td>
<td>Rim 1 Faunal Remains</td>
</tr>
<tr>
<td>4-3</td>
<td>Rim 2 Faunal Remains</td>
</tr>
<tr>
<td>4-4</td>
<td>Rim 3 Faunal Remains</td>
</tr>
<tr>
<td>4-5</td>
<td>Rim 4 Faunal Remains</td>
</tr>
<tr>
<td>4-6</td>
<td>Mean Volume Bone Density and Bone Mineral Content of Salmon Elements</td>
</tr>
<tr>
<td>4-7</td>
<td>Number of Identified Salmon Specimens (NISP) from the Housepit 7 Rim</td>
</tr>
<tr>
<td>4-8</td>
<td>Rank order salmon bone densities compared with element survivorship (%MAU) in the Housepit 7 Rim</td>
</tr>
<tr>
<td>4-9</td>
<td>Mammal/Salmon Index</td>
</tr>
</tbody>
</table>
CHAPTER ONE

INTRODUCTION

The Keatley Creek site (EeRI 7) is one of the largest, most complex, and best studied winter housepit villages in the Mid-Fraser canyon region of the Canadian Plateau (Figures 1-1, 1-2, 1-3). Research conducted by Hayden suggests that the archaeological record of Keatley Creek represents an example of the emergence of socio-economic and political complexity that occurred at approximately 1000-2000 B.P. throughout the Mid-Fraser region, termed the “Classic Lillooet” period (Hayden 1997a, 2000b; Hayden and Ryder 1991).

Recent work at the Keatley Creek site by Prentiss and colleagues (Lenert 2001; Prentiss et al. 2000, 2002, 2003b) has redefined the cultural chronology of the site, and has focused on the evolution of cultural and economic patterns at the site over its long period of occupation, from c.1700 to 800 B.P. (Prentiss et al. 2002), at which point the village seems to have been abandoned.

Hayden has argued that the Classic Lillooet period was characterized at Keatley Creek by a dense settlement pattern, ranked society (Hayden 1998, 2000c; Schulting 1995), intensification of select resources, particularly salmon (Kusmer 2000a), and participation in wide-spread exchange networks (Hayden and Schulting 1997). The objective of this research is to test Hayden’s hypothesis regarding household economy and resource choices at Keatley Creek by examining the history of the occupation of Housepit 7 with faunal data collected during the University of Montana’s 1999, 2001, and 2002 field investigations.
HISTORY OF RESEARCH

Research conducted by Hayden and Kusmer at Keatley Creek has been pivotal in expanding the breadth of knowledge of household economies and faunal resource utilization in big villages in the Mid-Fraser region of the Canadian Plateau (Hayden 1997a, 2000d; Hayden et al. 1986; Lepofsky et al. 1996). Keatley Creek is the largest known pithouse village on the Interior Plateau (Pokotylo and Mitchell 1998), containing over 100 pithouse depressions, some of which are over 25 m in diameter. Hayden and his research team excavated 21 residential sized depressions and 13 storage pit or roasting hearth depressions between the years of 1986-1999. Additionally, the floors of several housepits were uncovered, including the floor of Housepit 7, a large house measured to 19 m in diameter (Pokotylo and Mitchell 1998). Hayden and Kusmer concluded that the floor deposits of Housepit 7 indicate that the house was occupied by those of a high socioeconomic status whose food economy was largely focused on the acquisition and consumption of high grade salmon species, such as spring salmon (*Oncorhyncus tshawytscha*) (Hayden 1997, 2000d; Kusmer 2000a; Lepofsky et al. 1996). They go on to postulate that it was a crash in salmon resources that caused Housepit 7 to be abandoned (Hayden 1997).

RESEARCH PROBLEM

Kusmer argues that the winter economic strategy of the inhabitants of Housepit 7 remained unchanged over the span of the occupation of the house. The subsistence strategy Kusmer outlines is a heavy concentration on dried salmon and perhaps some dried artiodactyl meat, supplemented by very limited winter hunting of artiodactyls and various other small mammals (Kusmer 2000a). This type of pattern is supported by
Langemann’s data (1987) and by stable carbon isotope analyses indicating that a marine source (likely salmon) contributed 70% of the protein to regional prehistoric diets (Chisholm 1986; Chisholm et al. 1982; Lovell et al. 1986). According to Hayden and Ryder (1991), it is the easy availability and heavy reliance on salmon that caused both the emergence of the pattern of large villages and socioeconomic complexity seen during the Classic Lillooet phase as well as the abandonment of Housepit 7 and the Keatley Creek village. The model they proposed is that large villages and associated socioeconomic complexity were given rise to due to the ability of the inhabitants of the Mid-Fraser region to harvest a surplus of salmon on a yearly basis. This predictable surplus could create a situation in which those people with access to or control of prime fishing sites could take advantage of the surplus to their own benefit. Termed aggrandizers, these people would be “Triple-A personality types” (Hayden 1997) in that they are ambitious, aggressive, and accumulative. These aggrandizers would use the surplus from the fishing site they controlled in two ways: first to create debt relations with others who would have a more restricted access to the salmon resources, and secondly to attract followers to assist in catching more fish to create more surplus in order to share in some of the wealth (Hayden 1997). Since ethnographic accounts suggest that many of the prime resource collection sites (including fishing sites, lithic quarries, and hunting grounds) in the area were owned or controlled by family groups (Hayden 1997), this situation is plausible. As more followers are attracted to a prime resource locale, the households and villages would grow. The households that were more successful in creating surplus and managing debt relations would have greater wealth and clout within the community, leading to the ranking of individual households within the village. Status differences would be
displayed by a differentiation in the size of houses (i.e. large houses belonging to more prestigious corporate groups), a greater number and variety of prestige goods being held by higher ranked households, and differentiation in the types of resources available to those of different ranks, with more high ranked resources such as three and four year spawning salmon being found in the more prestigious households, and mainly two year spawning salmon being found in the lower ranked houses. Since the entire community would be based on the controlled access to the prime resource collection areas, the stability of the village would depend on the continued availability of resources and the defense of collection sites (Hayden 1997). According to this model, the end of the big villages of the Mid-Fraser came about due to a catastrophic landslide that dammed the Fraser River, blocking salmon runs and causing an economic collapse (Hayden and Ryder 1991).

If this hypothesis is correct, we should expect the archaeological record to display several characteristics. First of all, we should find both small houses and large houses appearing early on in the Classic Lillooet period, displaying differential household ranking. We should also find that all households should display intensification of salmon resources, but with an early differentiation in the type of salmon being found in houses. The large pithouses should have mainly three and four year spawning salmon, while the small houses should have almost exclusively two-year spawners. The archaeological record within households should also reflect restricted access to other resources, such as lithic quarries and hunting grounds, with the availability of mammals mainly being allotted to the inhabitants of the big houses. Finally, we should see an accumulation of greater numbers of prestige goods in large houses beginning early on in the Classic
Lillooet period. Under Hayden’s hypothesis all of these archaeological markers should remain stable throughout the big village sequence.

Contrary to this hypothesis, ethnographic accounts by James Teit (1906) indicate that a greater variety of animals were utilized during late prehistoric and early historic times than Kusmer and Hayden argue for during the Keatley Creek occupations. But, Hayden argues that this pattern can be attributed to hunting and gathering behaviors adapted after the collapse of salmon fisheries following the catastrophic landslide (Hayden and Ryder 1991; Kusmer 2000a).

This research tests this hypothesis with recently recovered Housepit 7 faunal data. Excavations by Prentiss in 1999, 2001 and 2002 have greatly expanded the faunal data set for Housepit 7 to include, among other data, a complete excavation of a stratified rim sequence that details the life of the house from its earliest conception (Prentiss et al. 2002). When these data are combined with Hayden and Kusmer’s data for the house floors, the opportunity arises to test Hayden’s hypothesis that salmon was the economic base for the social complexity and the big village pattern that occurred in the Mid-Fraser region.

RESEARCH GOALS

The goal of this research is to test Hayden’s economic model of the rise and collapse of the Keatley Creek village by critically examining Hayden and Kusmer’s Housepit 7 faunal data as well as recent data from Prentiss (Prentiss et al. 2000, 2002a, 2003b). According to Hayden (1997, 2000d), data collected from Housepit 7 supports his belief that salmon formed the economic basis for the development and growth of large pithouse villages in the Lillooet Region and that this economy was largely unchanged
throughout the life of the village until its collapse. Faunal data from excavations in 1999, 2001 and 2002 are synthesized for the purpose of constructing a new economic sequence for Housepit 7. This new model will be compared to Hayden’s economic chronology. If this new model duplicates Hayden’s model, it will then be argued that Housepit 7 did have an economy centered on salmon fishing that remained consistent throughout the life of the house. If the new economic chronology of the occupation of Housepit 7 disputes Hayden’s model, new implications will be discussed.

**SIGNIFICANCE OF RESEARCH**

This work attempts to create a clearer picture of the economic lifespan of Housepit 7 by integrating new data and by testing Hayden’s economic chronology for the house. This effort may result in new insights into how economic resources have affected the evolution of complex hunter-gatherer cultures in the Mid-Fraser region.

Housepit 7 has been the focus of intensive study, and as such has been the source for many of the theories explaining the life and behavior of complex hunter-gatherers at Keatley Creek and for the Mid-Fraser region as a whole. Hayden has used the data from the floors Housepit 7 as an example of how economic resources affect cultural and social behaviors as well as political institutions, an approach known as “cultural ecology” (Steward 1968). I assert that it is essential to take this approach a step further. In order to form a truly holistic picture of how subsistence economics impacted the evolution of hunter-gatherers at Keatley Creek, we must evaluate the entire history of the occupation, not just its final moments.
THESIS OUTLINE

This thesis is organized in the following manner. Chapter 2, Research Background, provides a backdrop for understanding the environmental context of the geographic area as well as a basis for evaluating the research problem. Chapter 3, Research Methods, discusses the data collection and analytic methods utilized in this study. Chapter 4, Results, presents the body of faunal and environmental data collected. In Chapter 5, Discussion, these data sets will be evaluated and compared to the existing economic profile for Housepit 7. Finally, Chapter 6, Conclusions, reviews the research and concludes with a consideration of research implications.
CHAPTER TWO

RESEARCH BACKGROUND

This chapter places the research problem into context by overviewing the physiographic, environmental and paleoenvironmental setting of the area surrounding the Keatley Creek site as well as the pertinent culture history of the region. Also included in this chapter is a discussion of commonly utilized area fauna, a discussion of the relationship between pithouse-use and culture change, a brief reconstruction of the yearly subsistence cycle for complex hunter gatherers in the Lillooet region, an explanation of housepit formation processes, and an overview and description of the Keatley Creek site and Housepit 7.

ENVIRONMENTAL CONTEXT

As with any area, the topography, climate and drainage of the Plateau region have profoundly affected the demographic and economic choices of human populations in the area (Nelson 1973). Generally, the climate and topography as well as variations in altitude, temperature and precipitation (both seasonal and regional variation) have strongly influenced the composition and distribution of plant and animal communities relied upon by inhabitants as vital resources throughout the region. Throughout time, the Plateau has been a constantly changing and shifting environment (Chatters 1998), creating a mosaic of habitats for humans and for the resources upon which they depend for food, shelter, clothing, implements, medicine and ceremony.

Site Setting

The Keatley Creek site is located at the base of the foothills of 14 Mile Mountain and Mt. Cole at the eastern edge of the Clear Range Mountains. Although the site is
spread over a considerable distance, approximately 800 meters over two terraces, the core of the site is situated in a large protected depression at the back edge of a glacial moraine terrace that rises approximately 370 meters above the Fraser River in the mid-Fraser Canyon region of south-central British Columbia. The Mid-Fraser Canyon region is typified by having sharply demarcated environmental zones with clearly defined boundaries (Alexander 1992; Hayden 1992). There are grasslands that abruptly cease just at the edge of terraces situated above the Fraser River. Similarly, montane forests suddenly appear on mountain slopes rising from the river terraces. Upon moving to higher elevations, one discovers alpine meadows that promptly appear where the treeline stops (Hayden 1992).

Keatley Creek, also known as 15 Mile Creek, is some 350 kilometers upstream from the mouth of the Fraser River, and about 25 kilometers upstream of the modern community of Lillooet (Hayden 2000a; Hayden 1992). The site is positioned near the upper reaches of the Fraser River Piedmont that consists of basal glacial till with a covering of steppe-like flora, including bunch grass, sagebrush, rabbit brush, cactus and scattered Ponderosa pine (Baker 1970). Keatley Creek itself has cut through these deposits on the southern edge of the core of the site.

A range of grasses and sagebrush (*Artemisia tridentata*) dominate the vegetation of the site today. The slopes surrounding the site are forested with Ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*). These forests continue upslope, grading into sub-alpine meadows (Lepofsky et al. 1996). These types of flora typify the biogeoclimatic zones encountered with increased elevation in the region, for example, the
Ponderosa Pine zone and the Interior-Douglas Fir zone, followed by a mix of alpine and sub-alpine vegetation (Meidinger and Pojar 1991). The proximity of these biotic zones to the Keatley Creek site increased accessibility to numerous edible plant and animal resources (Alexander 1992). The Fraser River would provide ready access to anadromous salmon (*Oncorhyncus* sp.), while the extensive plateau grasslands supply a grazing habitat for deer (*Odocoileus* sp.), bighorn sheep (*Ovis Canadensis*), and elk (*Cervus elaphus*). The forests and sub-alpine meadows create habitat for other large game such as moose (*Alces alces*) and black bear (*Ursus americanus*). Additionally, a variety of small fur-bearers and game birds, such as rabbit (*Lepus* spp.), red squirrel (*Tamiasciurus hudsonicus*), beaver (*Castor canadensis*), and sage grouse (*Centrocercus urophasianus*), and California quail (*Callipepla californica*) would have been readily accessible to occupants of the site (Kusmer 2000a; Alexander 1992; Lepofsky et al. 1996). In addition to the faunal resources available, floral resources include berries such as rosehips (*Rosa* spp.), currants (*Ribes* spp.), and saskatoons (*Amelanchier alnifolia*), as well as edible roots such as balsamroot (*Balsamorhiza sagittata*), members of the lily family, and many *Lomatium* species (Lepofsky et al. 1996). The general area in which the Keatley Creek site is situated consists of multiple sets of forested ridges and either woodland or grassy valleys. No site on the Fraser River is far from a full range of resource habitats (Chatters 1998).

**Physiography and Topography**

The Keatley Creek site is located along the Fraser River valley, which cuts between the mountains of the Clear Range to the east and the Camel’s Foot Range and the Coast Mountains to the west. The Middle Fraser Canyon region, the area in which
the site is located, is the most rugged region found on the Interior Plateau (Hayden 1992), and differences of elevation between the Fraser River and the surrounding mountains can be extreme. The Fraser River lies in an erosional gorge, a deep and winding trench that is a precipitous 250-meter plunge down from the valley terraces (Hayden 2000a; 1992). Within a scant few kilometers, elevations in the Lillooet area can vary more than 2,000 meters between the Fraser River and the surrounding crests. The Coast Mountains are typified by a rugged topography with alpine glacial features above 1800 meters and summits soaring to 2700 meters above the Fraser River (Ryder 1978). The Clear and Camel’s Foot ranges are gentler than their western counterparts, comprised of dissected plateaus with rolling or gently sloping surfaces terminating in broad rounded summits and ridges separated by shallow valleys (Ryder 1978). Along the plateau margins are found the most severe dissections where tributary valleys and steep gullies descend 1000 meters to meet the Fraser River.

The prominent features of the Fraser Valley landscape are complex benchlands composed of river terraces, alluvial fans, kame terraces, ground moraine or till and small areas of bedrock (Ryder 1978). These benchlands vary in elevation of 10 to 250 meters above the river, and are often interrupted by ravines and scarp slopes. The benchlands are not continuous, however. They are broken occasionally where mountain slopes descend directly down to meet the river (Ryder 1978). Near the Keatley Creek site, which is situated on the eastern plateau above the Fraser River between Gibbs Creek and Black Hill Creek, the river sits deep within a steep-sided “inner gorge” overlooked by the benchlands.
The benchlands that the Keatley Creek site sits upon are underlain by till that lies above older drift (Ryder 1978; Ryder and Church 1986). In general, the surface here undulates, but has areas that are generally flat or gently sloping. The wide slopes above the Keatley Creek benchlands are comprised of either bedrock outcrops or colluvium and till (Ryder 1978). Slopes that are underlain by till are less compact, and are often marked by long, parallel gullies—a commonality near the Keatley Creek site.

**Faunal Overview**

This section will present a brief ecological and behavioral statement for the species of fauna most integral to the prehistoric diet in the vicinity of Keatley Creek based on data from excavations and ethnographic studies in the area. The species are listed in the order of their frequency of occurrence in faunal assemblages at the Keatley Creek site (Kusmer 2000a).

**Salmon (Oncorhyncus sp.)**

Dependence on local salmon resources has been identified as one of the central characteristics of the culture defined by the Plateau Pithouse Tradition on the Canadian Plateau (Richards and Rousseau 1987). There are five species of these anadromous fish that make their way up the river systems of Northwest North America each year to spawn. Each of these species exhibits unique characteristics such as fat content, season of spawning, fish size, and difficulty to catch that influence the desirability of the species to native inhabitants and dictates how the species was utilized (Berry 2000).

Pacific salmon spawn between the ages of two and eight years, depending on the species. Pink salmon (*Oncorhyncus gorbuscha*) are the earliest spawning salmon, and are also the most abundant of the seven species of Pacific salmon (Heard 1991). Pink
salmon have the simplest life cycle within the genus. Upon emergence, the fry migrate quickly to the sea and grow rapidly as they make extensive feeding migrations. After eighteen months in the ocean, the fish make their way back to their river of origin to spawn and die. By contrast, Spring or Chinook salmon (*Oncorhyncus tshawytscha*) is the latest spawning species (Romanoff 1985). The Spring salmon, like all salmon species, is anadromous and semelparous (dying after spawning once). However, Springs display a very broad array of tactics including variation in age at seaward migration, variation in length of residence in freshwater, estuarine and oceanic locales, and variation in age and season of spawning locales (Healey 1991). In the Fraser River, the Spring makes two equal sized spawning runs in July and September, with a smaller run peaking in August.

The younger spawning salmon are generally smaller with a lower fat content, and thus ethnographically generally undesirable in the taste category, but were also the easiest to catch, since they ran along the banks of streams and rivers, and were also the easiest to dry and store, because of their lower fat content. On the other hand, the older spawning salmon, such as the Spring, were much larger and oilier than the younger spawning salmon, making them the more palatable choice. However, their high oil content made them difficult to dry and store, and their powerful build means that they were more difficult to catch, generally swimming in the deeper and/or swifter parts of the waterways (Romanoff 1985).

**Deer (Odocoileus sp.)**

The most common form of deer found throughout the Canadian Plateau is the Mule deer (*Odocoileus hemionus*) (Maser 1998), and considering that the other common form of deer, the Whitetail deer (*Odocoileus virginianus*) is a relative new-comer to
northwest America (Foresman 2001), it is likely that the mule deer was the primary type of deer hunted during the height of occupation at the Keatley Creek site.

The mule deer is a medium-sized artiodactyl often found in open montane and sagebrush habitats, preferring to browse the edges of ecotones between forest and grasslands (Maser 1998; Cowan and Guiguet 1965). They are distributed throughout British Columbia from the Rockies to the summit of the Cascade and Coast Ranges and north to the Arrow Lakes in great numbers (Cowan and Guiguet 1965). Mule deer are intermediate feeders, eating approximately equal proportions of woody browse and herbaceous forbs. The preferred types of browse are aspen, willow, red dogwood, serviceberry, bitterbrush and mountain juniper, although Douglas fir is also consumed when other browse is scarce (Cowan and Guiguet 1965). Many types of herbaceous plants are also sought after by Mule deer, as well as grasses such as wheatgrasses, Junegrass, and bluegrass. In general, browse use dominates the yearly diet accounting for 50% or more of intake, with forbs contributing 30% and grasses making up the difference (Foresman 2001).

Mule deer are generally solitary animals, usually congregating for rutting which takes place in October to late November, with the largest concentration in early November (Cowan and Guiguet 1965). Gestation averages 210 days, with fawns being born in June. Sexual maturity is reached during the second autumn, or at 1.5 years. As with most of the deer family, the main cause of death is winter starvation, with disease and predation from mountain lion and coyote following.
Dog (*Canis familiaris*)

Dog remains are very common in some housepits at Keatley Creek, and especially within Housepit 7. In Canada, dogs were the only known domestic animal during prehistoric times (Crellin 1994; Crellin and Heffner 2000). Their roles in society likely included use as food, clothing, protection, status items, hunting and transportation aides and characters in myth and ritual (Driver 1976).

The domesticated dog in Canada was probably descended from the coyote (*Canis latrans*), a medium-sized dog-like carnivore with a sharp-pointed face, sharp prominent ears and a long bushy tail (Cowan and Guiguet 1965). A thorough study of the prehistoric cultural significance of dogs was undertaken by Crellin (1994), and included osteological examinations of the specimens recovered from the Keatley Creek excavations in 1988 and 1989. Crellin’s research shows that dogs had a complex relationship with prehistoric humans, usually being exploited as pack animals, but also serving as ritual sacrifices, items of status display, and feast items.

Beaver (*Castor canadensis*)

Beavers are large aquatic rodents that live in the vicinity of fresh-water bodies in forested country, preferring slow flowing streams and lakes of all sizes (Cowan and Guiguet 1965). These animals have unusually dense coats that are valuable to humans as pelts and long incisors that have long been used by native peoples as woodworking tools.

Beavers eat a variable and wide variety of plants, including the leaves and bark of aspen, willows and poplar, the bark of trees such as Douglas fir and western hemlock, and the roots and stems of yellow pond lily, pond weeds, cattail, and some sedges (Cowan and Guiguet 1965; Maser 1998). Beavers do not hibernate, but collect large
stores of food during the months of September and October for underwater storage and use throughout the winter. These stores usually consist of short segments of palatable trees that the animals embed in stream or lake bottoms that will remain fresh even when the water surface freezes over.

The breeding season takes place between January and March, peaking in early February, with a litter of two to four kits arriving from late April to early July following an approximate 90 day gestation period (Cowan and Guiguet 1965; Maser 1998). The kits nurse for six weeks and remain with the family group until sexual maturity during their second summer. The life span of the beaver can approach twenty years (Maser 1998), with the most frequent cause of early death being predation by large carnivores and disease (Cowan and Guiguet 1965).

**Snowshoe hare (*Lepus americanus*)**

The snowshoe hare is of the typical hare form with disproportionately long legs. The most distinctive feature of these hares is that during the summer, its coat is relatively light reddish brown, but during the winter the coat becomes pure white when the hare is found at higher, mountain elevations (Maser 1998). The snowshoe hare prefers semi-open forest with openings such as clearings, lake-shores, muskegs and riparian thickets that provide deciduous vegetations while dense clumps of conifers provide shelter from weather and predators (Cowan and Guiguet 1965). These hares do not burrow, but form nests in thickets beneath the lower branches of small trees or shrubs.

Snowshoe hares are primarily active in early evening and during the night, but will come out during the day when there is foggy or rainy weather (Maser 1998). During the spring, summer and autumn, these hares feed on a wide variety of herbaceous plants.
including grasses, clover and false dandelions as well as on some woody plants such as young spruce and fir and young leaves and twigs of salal. During the winter months, the diet consists mainly of the needles and tender bark of conifers such as spruce and fir, as well as the leaves and green twigs of salal, willow, and any herbaceous vegetation that remains green (Maser 1998).

Snowshoes typically have two to three litters per year with litter size ranging from one to seven leverets (Maser 1998). The young are born from the middle of April through the middle of August following a gestation period of 36 days, with the young born early in the summer having the best chance of survival the following winter. Young are born fully furred with their eyes open, and begin feeding on greens almost immediately (Cowan and Guiguet 1965). Snowshoe hares reach full maturity at the age of five months (Maser 1998). They have a long list of predators, including almost all the local carnivorous mammals as well as larger hawks and owls (Cowan and Guiguet 1965; Maser 1998).

Bighorn sheep (*Ovis Canadensis*)

Bighorn sheep range throughout the mountainous regions of the western North American continent. They occur in scattered patches around southern British Columbia with a wider distribution in the north of the province. Bighorn sheep are fairly common in the area of Keatley Creek, with a herd in the mountain area north of Lillooet and west of the Fraser River typically consisting of approximately 400 head (Cowan and Guiguet 1965). Rocky terrains with steep cliffs associated with meadows or grasslands are required components of the bighorn sheep habitat (Jones et al. 1983).
The sheep is primarily a grazing animal, preferring to feed on the grasses and forbs located within its mountain range. Various species of bluegrass, Junegrass and wheatgrass are typically consumed, and in alpine regions the dwarf willow is also a dietary staple. Browsing is often resorted to, but generally the use of conifers such as Douglas fir indicates a scarcity of more suitable feed (Cowan and Guiguet 1965).

Seasonal home ranges are dictated by snow and food, and the sheep are known to move up to 32 km between summer and winter ranges. However, animal will live in the same area year-round if possible (Erikson 1972; Klaver 1978). Winter and summer home range sizes vary from 60 to over 202 hectares based on sex (Tilton 1977).

Mating occurs from October through December depending on the location of the range, with late November and early December being the most common breeding period. The gestation period averages 180 days with lambs being born in late May and early June (Cowan and Guiguet 1965). Ewes mature at two to three years, and rams at around three years. The maximum age for bighorn sheep is 14 years, with earlier deaths caused by predation mainly by coyotes and mountain lions, winter exposure, disease and parasites.

Elk (*Cervus elaphus*)

Elk are large cervids, second in size only to moose. They are highly adaptable, but prefer parkland areas where clumps of conifers provide shelter and groves of deciduous tress interspersed with grasslands provide food (Cowan and Guiguet 1965). A cohesive herd will have a central area that it uses to the exclusion of other individuals or herds, although the area is not actively defended (Maser 1998).

The diet generally consists of 80% grass and herbs, although shrubs and deciduous tress are also browsed (Cowan and Guiguet 1965). In late June, animals move
to summer ranges, leaving the grasslands and passing through transitional, low-elevation forested stands of pine and aspen, prior to reaching higher elevation forests of Douglas fir, lodgepole pine, Engelmann spruce, and subalpine fir (Edge et al. 1987; Knight 1970).

The elk will spend summer and early autumn here, spread out among more open clearings feeding on forbs (asters, daisies, dandelions, and elk thistle) and grasses. In autumn, elk will move into more timbered stands before again migrating downslope to valley grasslands, where they herd in large numbers for the winter. Winter ranges are dominated by bluebunch wheatgrass and fescues. In spring there is new growth on the winter ranges, but by April the animals are again moving toward their summer ranges. Elk use the same winter and summer ranges year after year, with calves learning the migration routes from their mothers (Foresman 2001).

Elk mate during autumn, with estrus occurring in late September to early October, gestation lasting from 255-275 days, and parturition occurring in early June (Cowan and Guiguet 1965; Maser 1998). Males reach sexual maturity at two years, although they rarely mate until ages four or five, while females normally have their first calf at three years of age (Cowan and Guiguet 1965). The predominant causes of death are winter starvation, predation by wolves, mountain lions and grizzly bears, and parasites.

**Grouse (Tetraonidae)**

The most common grouse type in the Mid-Fraser region is the sage grouse (*Centrocercus urophasianus*). As the name implies, the sage grouse are found in sagebrush habitat, and consume a fairly soft diet of sagebrush buds and leaves supplemented with insects during the summer brood-rearing period. Males gather in spring to display and court (Wassink 1995).
Moose (*Alces alces*)

The moose is the largest of the American cervids, with the males weighing 900 to 1,200 pounds and standing 66 to 80 inches in height at the shoulder. It is a forest animal, preferring the young growth of deciduous trees and shrubs that grow in forest areas, particularly those that have been burned over. The British Columbia moose (*Alces alces andersoni*) has extended its range south since 1920, but were previously found throughout mainland British Columbia north of the Hazelton-Prince George line (Cowan and Guiguet 1965).

The majority of moose move into the mountains and high alpine meadows during the summer, although some remain for the entire year at low elevations, with bulls being more migratory than the cows. The food preference is for willows, aspen, red dogwood, birch and balsam fir, although lodgepole pine is also consumed when other food sources are scarce. A variety of aquatic plants such as pondweeds, waterlilies and horsetails also form a portion of the diet (Cowan and Guiguet 1965).

Breeding takes place from late September to early October, with the young arriving in the first half of June following a gestation period of 240 to 250 days. Sexual maturity is reached at the age of 18 months (Cowan and Guiguet 1965).

Mountain goat (*Oreamnos americanus*)

The mountain goat is a mountain antelope that is found widely throughout the mountains of British Columbia. It inhabits the roughest possible terrain, generally at altitudes above the timber-line (Cowan and Guiguet 1965). It will occasionally roam beyond easy reach of cliffs and broken rock, but prefers to stay close to such escape terrain. Heavy winter snow will occasionally force mountain goats down to lower terrain
as its survival depends on the availability of areas with low snowfall and gentle winds, usually on exposed south or west slopes.

The diet of the mountain goat is varied, and includes a wide variety of grasses and forbs as well as almost all the tree and shrub species except spruce. They frequently use dry alkaline earth licks and will travel as much as two or three miles through timbered areas to reach these licks (Cowan and Guiguet 1965). Females and young typically move in large or small groups, while males tend to be more solitary. Breeding occurs during November with a gestation period of six months, followed generally by the birth of a single kid, but twins do occur. Predation does not seem to be a major cause of mortality, and most deaths seem to be caused by snow slides, harsh winter conditions and food shortages (Cowan and Guiguet 1965).

**PALEOENVIRONMENTAL SUMMARY: CLIMATE, FAUNA AND FLORA**

According to Chatters (1998), climatic transitions occurred synchronously throughout the Plateau region at 9500-9000 B.P., 6500-6300 B.P., 4500 B.P. and 2800-2000 B.P. These shifts in climate may have been quite gradual, while the biotic changes that accompanied the climate changes could have occurred in a more abrupt manner. To date, there has not been a focused paleoecological study conducted in the Keatley Creek region. Therefore, the following summary is based on data and conclusions gathered and presented for the more generalized area of the Canadian Plateau by Hebda (1982), Chatters (1998) and Chatters and Pokotylo (1998).

**12,000 B.P.**

According to Hebda (1982), the earliest Holocene climate (prior to 11,000 B.P.) was likely cool or cold and dry. Based on the discovery of a potential relationship
between a mastodon and a human at Sequim, Washington on the Olympic Peninsula, it is believed that late Pleistocene megafauna may have lived on the Canadian Plateau around 12,000 B.P. (Hebda 1982). However, at this time, there is little data to elaborate on environmental conditions and human populations during this time period.

**11,000-9,500 B.P.**

During this period, pollen diagrams indicate that the dominant species of flora was *Populus*, most likely aspen (*Populus tremuloides*), along with lodgepole and western white pine (*Pinus cortata* and *Pinus monticola*). Treeless vegetation was considerably restricted, although some parklands and closed forests in wetter areas were likely composed of sagebrush and aspen (Hebda 1982). Hebda posits that pine was likely late on the scene during this period and may have grown of upper mountain slopes, such as those found close to the Keatley Creek site. Lower slopes and valley bottoms were likely composed of grassland or shrub-grassland featuring flora such as *Artemisia* spp. and *Shepherdia* spp. From 11,000-9,500 B.P., the Fraser River would have continued its erosional process through the thick deposits of glacial outwash. Lake levels would have been low, and the climate generally cool and moist (Hebda 1982).

There is little evidence for human occupations on the Canadian Plateau during this time period. However, this general lack of information may in fact be due to the active nature of the terrain in the area that became largely unstable during the process of deglaciation, possibly sealing evidence of the presence of humans. Therefore, this lack of information for this period should not be viewed as a lack of human activity. The information that we do have indicates that early human populations on the Canadian Plateau were likely large game hunters while also catching some fish. Faunal remains
suggest that the main dietary staples were deer, elk and fish (Chatters and Pokotylo 1998).

9,500-6,400 B.P.

The period of 9,500 to 6,400 B.P. is marked by an upswing in the levels of effective precipitation falling on the uplands of the Northern Plateau (Chatters 1998). As a result, lower elevation forest boundaries began shifting downslope. The boundary between the transitional woodlands and sage-grasslands was between 1200-1000 meters (Hebda 1982). During the earliest part of this period, Douglas fir occurred in dense stands punctuating the landscape. However, as the forests enlarged they coalesced, initially broadening but then quickly eclipsing forest-edge habitat (Chatters 1998). At this time, it is believed that human diets would have been broad-based, with a wide variety of resources being consumed. These probably would have included deer, carnivores, rabbits, beaver, muskrats, marmots, waterfowl, small birds, salmon, freshwater fish, turtles, and a variety of plant resources (Chatters and Pokotylo 1998).

After 8,000 B.P., we see the establishment of the maritime climate pattern, making the climate both cooler and wetter (Chatters 1998). Toward the end of this period, winters would become warmer and moister. Lakes were probably small during this phase, and may have been seasonally dry (Chatters 1998; Hebda 1982). These climatic shifts would have encouraged ungulate productivity and population growth as well as the expansion of root plants, such as balsamroot, biscuitroot, and camas (Chatters and Pokotylo 1998). The climate also favored increased production of grass, hemlock and *Artemisia spp.*, and pollen analysis points to the appearance of cedar at this time. On
the other hand, Douglas fir pollen counts decreased during this period (Chatters 1998; Hebda 1982).

**6,400-4,500 B.P.**

The earliest part of this period was warm and moist, but did not last long. Temperatures on the Northern Plateau began to decrease at about 6,400 B.P., eventually cooling the climate and causing forest expansion and closure while killing off the grass understory in Douglas fir and Ponderosa pine forests (Chatters 1998; Hebda 1982). Late during this moist period lake levels rose and wetlands developed in poorly drained areas (Hebda 1982).

It is around 5,500 B.P. that we see a pivotal change occur in the conditions that promote salmon productivity within the Fraser system, notably a late spring freshet and cooler average water temperatures (Chatters 1998; Chatters and Pokotylo 1998). Subsistence during this period intensified their focus on a widely based economy that included ungulates, small game, and various plants. Around 5,500 B.P. we see salmon and freshwater mollusks becoming increasingly important dietary staples (Chatters and Pokotylo 1998).

**4,500-2,800 B.P.**

At 4,500 B.P., we see a rapid decline in regional temperatures, causing glacial advances in high mountain ranges, downslope movement of sub-alpine conifer forests, and a decrease in average river temperatures (Chatters and Pokotylo 1998), as well as a synchronous decrease in the frequency of fires from 3,500 to 2,400 years B.P. (Hallett et al. 2003). Precipitation levels continued to be high, and snowpacks were retained for longer amounts of time. Watersheds became closed under dense forest canopies. These
last two factors likely resulted in a general cooling of the Fraser River system as well as a reduction in the levels of mud in the water, creating excellent conditions for salmon productivity. During this time period, Douglas fir forests were at their peak, and we see the initial spread of hemlock east of the Fraser River (Hebda 1982).

The colder summers and winters of this period would have shortened the resource-productive season. Due to the ideal combination of cool, wet conditions, salmon productivity reached its peak, although its seasonality was likely the most restrictive of any time during the Holocene. The runs would likely have been both brief and intense (Chatters and Pokotylo 1998). On the negative side, the expansion of forests and resultant reduction in grasslands would have decreased deer and elk populations (Kuijt 1989; Stryd and Rousseau 1996). However, while deer and elk may have been scarce, Chatters (1998) notes that populations of mountain goats (*Oreamnos americanus*), bighorn sheep (*Ovis canadensis*) and possibly caribou (*Rangifer tarandus*) may have been positively affected by an expanded alpine zone. The lack of diverse fauna resulting from the climatic shift of the period likely resulted in the necessity for human groups to focus on the development of storage technologies in order to survive the long winters.

Faunal assemblages from the period of 4,500 to 2,800 in the Plateau region are dominated by salmon and supplemented by small forest-dwelling mammals such as rodents and lagomorphs, and the first evidence for root procurement and processing occurs at approximately 3,500 B.P. (Peacock 1998; Rousseau et al. 1991). According to Hebda (1982), by the end of this period we see the emergence of modern biotic assemblages.
2,800-1,500 B.P.

Chatters (1998; Chatters and Pokotylo 1998) has found evidence that suggests a minor warming and drying event in the early part of this period resulting in a recession of glaciers and the appearance of modern vegetation patterns. Additionally, recent research conducted by Hallet et al. (2003), indicates that there were frequent summer fires between 2,400 and 1,300 years B.P., most likely caused by prolonged summer droughts. The climatic shift likely caused forests to open and move farther upslope, increasing the occurrence of forest edge habitats, popular for a wide range of faunal species (Chatters 1998).

With the opening of the forests, people would have been able to expand their food gathering range into the uplands, focusing part of their subsistence efforts on the collection of various roots. Evidence of this activity during this interval is seen in root-roasting ovens becoming a commonality in the highland valleys above the Fraser River (Pokotylo and Froese 1983). Despite this new focus on root resources, salmon remained a major dietary staple.

1,500-200 B.P.

Although the major floral and faunal zones had reached their modern extent and composition by this period, minor fluctuations did occur with short-term climatic fluctuations. Two short-lived climatic shifts did occur, which likely had small effects on regional flora and fauna. The first event was a general warming trend throughout the world, known as the Little Climatic Optimum, or the Medieval Warm Period, lasting from circa 700-1400 B.P. (Hughes and Diaz 1994; Jones et al 1999). The drier and warmer conditions associated with this event might have temporarily expanded the forest
edge grassland habitat while alternating sea temperatures in the Pacific Northwest may have resulted in a reduction in the availability of salmon. The current fire-regime operating in British Columbia seems to have been established just after this climatic event, after 1300 years B.P. (Hallett et al. 2003). The second climatic event was the Little Ice Age, a worldwide climatic event that occurred roughly 550-100 B.P. caused an advance of highland glaciers. However, it is thought that it had little effect on the vegetation and animals of the Canadian Plateau (Chatters 1998).

**CULTURE CHRONOLOGY**

This section presents an overview of the culture history of the south-central Canadian Plateau in general and of the Keatley Creek site specifically. The culture history for the area begins at the time of déglaciation, approximately 12,000-11,000 B.P., and will end with the advent of the time of European contact, ca. 200 B.P. There is a brief summary of the available archaeological data for this region and a review of the “prehistoric culture analytic units” (Fladmark 1982) for the Mid-Fraser Canyon, the area in which the Keatley Creek site is located.

**Canadian Plateau Culture Area**

The Canadian Plateau culture area of British Columbia is situated between the Coast Range and the Rocky Mountains, south of the curve in the Fraser River near Prince George, British Columbia, and 50 miles north of the United States border. In order to provide a clearer picture of this area, the region has been sub-divided into micro-regions. This study focuses on the Middle Fraser Canyon Region, the region that contains the Keatley Creek site, and includes the Fraser River valley and its associated drainages stretching from Big Bar to Lytton, British Columbia.
Culture Chronology of the Mid-Fraser Region

Although little archaeological research was conducted in the Mid-Fraser region until the 1960’s, several research projects and investigations over the last thirty years have produced a reasonably detailed synthesis of the prehistory of the Plateau (Hayden 2000a). David Sanger (1967, 1969, 1970) produced the first major regional culture chronology, dividing the archaeological record into four broad periods fittingly dubbed the Early Period, Lower Middle Period, Upper Middle Period and the Late Period. Sanger’s chronological sequence was refined by Arnoud Stryd and Michael Rousseau (1996) who reworked the culture history to include three time periods, the Early Period (11,000-7,000 B.P.), the Middle Period (7,000-3,500 B.P.) and the Late Period (3,500-200 B.P.). This study utilizes the chronology developed by Stryd and Rosseau (1996) as the basis for a review of the Mid-Fraser region culture historical sequence. Included in the discussion of each period will be a brief introduction of the cultural traditions, phases, and horizons belonging to each time period.

**Early Period: 11,000-7,000 B.P.**

The early prehistoric period in the area begins following the deglaciation of the Plateau and comes to a close after the Hypsithermal Period (Hebda 1982). There is very little evidence for human occupation in the Plateau region before 7,000 B.P., although the environment would likely have been able to support such occupations (Rousseau 1991, 1993, Rousseau et al. 1991; Sanger 1967; Stryd and Rousseau 1996). There is only one possible indicator of human occupation at the Keatley Creek site during the Early Period, a basally edge-ground fragment of a point that is sketchily dated at best, and could in fact be from the Middle Period (Hayden 2000a).
This dearth of archaeological data makes interpretations of human behavior during this earliest period of human occupation on the Canadian Plateau practically impossible. However, the remains of an individual discovered at the Gore Creek site in the Thompson River drainage (located south of our main study area) was dated to approximately 8,500 B.P. Carbon isotope analysis of the individual produced an interesting glimpse of the faunal resource choices made by this early inhabitant of the Plateau. Results from these tests showed that the bulk of this individual’s subsistence was that of terrestrial fauna, with only 8% of the diet being a product of marine resources (Chisholm 1986; Chisholm and Nelson 1983).

Pokotylo and Mitchell (1998) speculate that Early Period peoples of the Canadian Plateau might have spent most of their time in upland areas where they would be able to rely on a more steady diet of terrestrial fauna. As most of the archaeological tests and studies conducted in the Plateau region have focused on the river drainages and lowland areas, this could explain the lack of Early Period sites discovered to date. Perhaps after a more thorough investigation of upland sites in the Plateau takes place, a clearer picture of Early Period life and subsistence may emerge.

**Middle Period: 7,000-3,500 B.P.**

The Middle Period begins at 7,000 B.P., and persists until the start of the Late Period at 3,500 B.P. The Middle Period is largely marked by a resource tradition focused on terrestrial fauna supplemented by small game and later by a widely diversified diet. Cooler and wetter conditions prevailed during this time period, accompanied by a general expansion of mesic grasslands at both lower and higher elevations (Hebda 1982). There is localized but strong evidence for the use of the Keatley Creek area during this time
period (Hayden 2000a). The Middle Period as a classificatory unit has been further broken down into one tradition and three phases, largely based on tool traditions and dietary resources that prevail during each phase.

**Nesikep Tradition: 7,000-4,500 B.P.**

The Nesikep Tradition is believed to be the result of several human adaptive patterns that appeared congruently with the advent of the cool and wet conditions brought on by the Neoglacial (Pielou 1966) occurring during at the start of the Middle Period (Stryd and Rousseau 1996). The subsistence economy during the Nesikep Tradition seems to be a natural outgrowth of the terrestrial based diet that Pokotylo and Mitchell (1998) argued for during the Early Period, tempered by changing resource availability in a new climate. According to Sanger (1969, 1970), the Nesikep diet is focused mostly on deer and elk, but rabbits, rodents, small birds, mollusks, salmon, freshwater fish and plants are secondary staples. Stryd and Rousseau (1996) argue that the Nesikep Tradition is composed of two cultural phases, the Early Nesikep and Lehman phases, although other researchers (Pokotylo and Mitchell 1998; Prentiss and Chatters 2003) also include the Lochnore Phase as the final period of the Nesikep Tradition.

**Early Nesikep Phase: 7,000-6,000 B.P.**

The Early Nesikep Phase is defined by its technologies. The characteristic tool of this phase is a corner-notched, lanceolate, hafted biface that is barbed in outline and exhibits curved or straight margins and lenticular cross-section (Stryd and Rousseau 1996). The other tools that are distinctive of the Early Nesikep Phase are microblades and wedge-shaped microblade cores, ground rodent incisor tools, bone needles and points and antler wedges (Stryd 1972; Stryd and Rousseau 1996). The subsistence economy for
this phase is largely based on deer, although elk, salmon, trout and birds are also commonly associated with Early Nesikep archaeological deposits. There is no evidence for salmon intensification during this time period (Pokotylo and Mitchell 1998).

**Lehman Phase: 6,000-4,500 B.P.**

The hallmark of the Lehman Phase is the Lehman projectile point, a point that is pentagonally shaped and obliquely oriented with well-defined v-shaped corner or side notches (Pokotylo and Mitchell 1998; Stryd and Rousseau 1996). Contrary to what is seen during the Early Nesikep Phase, there is no microblade technology associated with the Lehman Phase. Subsistence choices seem to be trending toward a greater focus on marine resources, although the bulk of the diet is still comprised of terrestrial fauna, mainly deer, elk, birds, rabbit and small mammals.

There are two prominent occurrences of Lehman artifacts being recovered from the Keatley Creek site. The first was the excavation of a Lehman point fragment associated with an Early Prehistoric Period point base and other less diagnostic tool types from the loess deposits underlying the rim of Housepit 5. The second discovery was of another Lehman point that was recovered along with microblades and several Lochnore style points from the base of the south and southwest portions of the rim of Housepit 7 (Hayden 2000a).

**Lochnore Phase: 5,500-3,500 B.P.**

There is some contention among Plateau researchers regarding exactly what the Lochnore phase represents. Hayden (2000a) argues that Lochnore marks the emergence of moderately successful mass harvesting and storage of salmon, the basis of the Plateau Pithouse Tradition. Other researchers such as Rousseau (Rousseau et al. 1991; Stryd and
Rousseau 1996) suggest that the Lochnore peoples were foragers relying on a river and forest-oriented resource strategy that developed as a result of Salishan speakers from the Northwest Coast moving inland along the Fraser River. Pokotylo and Mitchell (1998) argue that such a migration could have been spurred on by the increased availability of salmon brought on by the Neoglacial climate shift.

It should be noted that Lochnore overlaps with Lehman both temporally and spatially, with current evidence pointing to a coexistence of the two phases on the Canadian Plateau between 5,500-4,500 B.P. (Pokotylo and Mitchell 1998). There are a variety of hypotheses for this technological and cultural overlap and the subsequent disappearance of the Lehman cultural pattern. Stryd and Rousseau (1996) have proposed that the Lehman phase represents Non-Salishan speakers who came into contact with the Lochnore phase, ancestral Salishan peoples. Another hypothesis addressing the question of the overlap of the Lehman and Lochnore traditions is that the Lochnore peoples were related to the Old Cordilleran phase, a Middle Holocene marine resource pattern that occurred on the Northwest Coast near Vancouver, British Columbia (Sanger 1969). Some researchers propose that the Salishan Lochnore groups may have subsequently absorbed the Lehman groups, both culturally and socially, creating a new cultural shift that gave rise to the Plateau Pithouse Tradition (Richards and Rousseau 1987; Stryd and Rousseau 1996). However, other researchers (Prentiss and Chatters 2003; Prentiss and Kuijt 2004) have suggested that Lochnore is simply the end of the Nesikep Tradition, and unrelated to the rise of the Plateau Pithouse Tradition.

There is just as much debate among researchers over the subsistence economy of the Lochnore peoples. As stated previously, Hayden (2000a) has argued on the basis of
the data from the Baker site (Wilson et al. 1992) that this phase marks the advent of the mass salmon harvesting and storage pattern typified later by the Plateau Pithouse Tradition, albeit on a smaller and less refined scale. Hayden believes that the technological breakthroughs associated with the harvest and storage of salmon on a large scale originated in the Interior, later spreading westward to the Coast.

Other researchers counter that the Lochnore phase represents a residentially mobile forager economy relying on a diverse diet (Pokotylo and Mitchell 1998; Stryd and Rousseau 1996). They argue that the foragers likely obtained resources by utilizing a “mapping on” approach, whereby a group of people changes location frequently to position themselves near productive resource patches. The economy would likely have been immediate return, with little storage of resources and most food being consumed without much delay.

Common tool technology during the Lochnore phase includes microblades, crescents, Lochnore points, bone awls and unipoints, unilaterally barbed antler harpoon-like darts and rodent incisor tools. Some ornamental items that have been associated with this phase are animal tooth pendants, eagle claw pendants, shell beads, and ochre (Pokotylo and Mitchell 1998; Stryd and Rousseau 1996; Wilson et al. 1992). However, some of these items were recovered from the Baker site, where the relationship to Lochnore has been questioned, and it has been suggested by Wilson that the site is more likely associated to Pithouse I, in Columbia Plateau culture chronology (Wilson et al. 1992). Residentially, the Lochnore groups apparently employed two types of housing. Some lived in non-pithouse sites that bear the hallmarks of game processing stations or briefly occupied camps, while it appears that others during the Lochnore time period may
have occupied pithouses, such as those found at the Baker site, dated to ca. 4,500 B.P. and classified as a Pithouse I site (Wilson et al. 1992).

The Lochnore diet seems to have been broadly based, with the faunal remains from occupations of this phase including deer, beaver, hare, elk, bear, porcupine, goose, duck, mollusks, salmon and freshwater fish. While there has been some evidence for limited storage of salmon, such as at the Baker site, the level of intensity for such storage is not well understood at this time (Stryd and Rousseau 1996).

There is definitive evidence for a Lochnore Phase human presence at the Keatley Creek site. Lochnore point fragments have been discovered in redeposited contexts from Housepit 5 (Hayden 2000a). Additionally, as previously discussed, in situ Lochnore points have been recovered from the south and southwest rim base of Housepit 7, and the 1999 Housepit 7 excavations uncovered several Lochnore points from the extreme outer limit of the base of the northwest rim of Housepit 7 (Prentiss et al. 2000). However, it is unknown at this point whether any Lochnore groups constructed pithouses at the Keatley Creek site, although the discovery of Lochnore age housepits at the Baker site on the neighboring Thompson River drainage (Wilson et al. 1992) does not rule out the possibility that similar pithouses may have been constructed at Keatley Creek.

**Late Period: 3,500-200 B.P.**

The Late prehistoric period is broken down into three cultural horizons of the Plateau Pithouse Tradition: the Shuswap horizon, the Plateau horizon, and the Kamloops horizon (Hayden 2000a; Richards and Rousseau 1987). It is during the Late Period that Hayden sees the rise of what he terms the “Classic Lillooet” period, which begins with the establishment of large houses and villages late in the Shuswap horizon and ending
when these villages and large structures were abandoned around 1,100 B.P. (Hayden 2000a, 2000b, 1997; Hayden and Ryder 1991).

The Plateau Pithouse Tradition during the Late Period is characterized by logistically organized, semi-sedentary hunter-gatherers residing in winter pithouse villages. The main staple of the diet for much of the year was salmon caught in the nearby Fraser River or its tributaries. The increased importance of salmon during this time period may have had a profound impact on the way that people and groups interacted with each other, spurring changes in subsistence and political economics that may have resulted in the creation of what we have come to term complex hunter-gatherers (Hayden 1997; Richards and Rousseau 1987).

Although the climate around Lillooet was generally cool and wet toward the end of the Middle Period, the start of the Late Period ushers in the start of an essentially modern climate pattern (Hayden 2000a; Mathewes and King 1989; Stryd and Rousseau 1996). Kuijt (1989) and Stryd (1973) have postulated that the increased reliance on salmon and the rise of semi-sedentism seen occurring at the beginning of the Late Period is an adaptive response to the cool, wet conditions brought on by the Neoglacial maximum from 4,000-3,200 B.P. Kuijt (1989) argues that the rise in importance of salmon fisheries could be due to a drop in the ungulate populations during the Neoglacial. While the availability of ungulates may have decreased due to unfavorable climatic conditions during the Neoglacial, salmon was able to fill the dietary gap when harvested intensely. Prentiss and Chatters (2003) offer another viewpoint on the rise of semi-sedentism, logistical collecting and intensive marine harvesting. They argue that the emergence of this pattern was not unique to the Mid-Fraser area, indeed that groups
throughout the entire Northwest Coast and Plateau regions exhibit similar survival responses to changing environmental conditions during this period.

**Shuswap Horizon: 3,500-2,400 B.P.**

The first of the three cultural horizons occurring during the Plateau Pithouse Tradition on the Canadian Plateau is the Shuswap horizon. It is during the Shuswap horizon that we see the first widespread use of permanent, seasonal use pithouses (Hayden 2000a; Richards and Rousseau 1987). These pithouses are built in a circular or oval shape, averaging approximately 10 meters in diameter and having steep walls. Some characteristics of pithouses during Shuswap times are side entrances, flat, rectangular floors, hearths, and internal storage and cooking pits. The pithouses seem to have been supported by a post-support and beam superstructure, judging by the large internal potholes used during this period. The superstructure was likely covered with woven mats and earth, although Richards and Rousseau (1987) have suggested that not all pithouses during this horizon were earth covered based on the shallowness of deposits and the lack of roof-like material on the rims at many sites.

According to Hayden (2000a, 2000d), the rise of the “Classic Lillooet” period took place late during the Shuswap horizon. This “Classic” period is typified by a dense settlement pattern, ranked society (Hayden 2000c, 1998; Schulting 1995), intensification of selected resources, especially salmon (Kusmer 2000a), and the participation in widespread exchange networks (Hayden and Schulting 1997). Hayden supports this hypothesis with test excavation data collected during the 1980s from pithouses at the Keatley Creek site. As touched on previously, Hayden also posits that the initial changes leading to the Classic Lillooet culture may have actually begun during the Lochnore
phase (Hayden 2000a). This is supported by data from the Baker site, a cluster of housepits dated to 4,950-3,950 B.P. According to Hayden, the Baker site housepits seem to exhibit inter-household variability in social equality that may be indicative of hierarchical logistically organized households. However, the vast majority of Lochnore deposits represent groups relying on a mobile forager economy. Therefore, the data from the Baker site is quite unique when compared to other late Lochnore settlements, and may in fact represent one group’s early “experimentation” with housepits.

Based on an analysis of the faunal record from Shuswap horizon sites, it seems that the dietary economy of this period was broadly based and included ungulates, bears, small mammals, birds, mollusks, salmon and trout (Richards and Rousseau 1987; Wyatt 1971). It seems that although salmon was more heavily relied upon than in previous periods, it did not become a crucial dietary staple until later on during the Plateau horizon, and particularly during the Kamloops horizon (Chisholm 1986).

The characteristic technologies of the Shuswap horizon include hafted bifaces and unformed unifacial and bifacial flake tools (Sanger 1970). The lithic technologies during the Shuswap horizon are more simply made than those found later during the Plateau and Kamloops horizons, and the general absence of groundstone technology and curated scrapers during this time period seems to suggest an expedient lithic technological focus (Richards and Rousseau 1987). The hafted bifaces typical during the Shuswap horizon were likely atlatl dart or spear points, and are similar in design to some Northern Plains point types, such as the Hanna, Duncan, McKean and Oxbow points. These similarities in point styles may be indicative of a regional exchange of ideas between the Plains and Plateau areas (Richards and Rousseau 1987).
The regional exchange of goods and ideas is evident during the Shuswap period. The most obvious trade connection with the Canadian Plateau is the Northwest Coast. Borden (1970) argues that the stylistic similarities found between Shuswap and Locarno Beach phase points are evidence of the exchange of ideas and goods between the Coast and the Plateau. Indeed, it is during this time period that we begin to see *Olivella* and *Dentallium* shells appearing in the archaeological records of the Interior, while at the same time we see the coastal appearance of nephrite, a type of raw material native to the Mid-Fraser region that is used for stone tools.

According to Hayden (2000a) the full extent of the Keatley Creek site’s core area was occupied during the Shuswap horizon. He cites significant evidence for extensive site occupation at Keatley Creek during this time period. Almost all of the large housepits as well as some of the medium sized housepits that Hayden has tested or excavated have contained exclusively Shuswap style points at the basal rim levels.

**Plateau Horizon: 2,400-1,200 B.P.**

The Plateau horizon is the second cultural horizon to take place during the Plateau Pithouse Tradition. Richards and Rousseau (1987) have characterized the economy of the Plateau horizon as a collector system, after Binford’s (1980) definition. Groups seem to have resided seasonally in winter pithouses that were built in optimal locations for accessing a variety of resource patches, and they utilized a delayed return consumption strategy including the widespread use of food storage. Common dietary resources for the Plateau horizon include a variety of ungulates, plants, birds, as well as riverine and lacustrian species.
The Plateau horizon occurred synchronously with the environmental shift from cool and wet conditions to warm and dry conditions (Hebda 1982). Several prominent changes in material culture appear during this time period, including the expansion in size of housepit clusters, the size of housepits begins to vary, exotic trade goods appear in the archaeological record, and salmon gains increased importance as a dietary staple, with isotopic analysis of human remains showing that approximately 60% of dietary protein was derived from salmon (Chisholm 1986). Hayden (2000a, 1997) and Hayden and Spafford (1993) have argued that when compared to the Shuswap horizon, the Plateau horizon represents an upswing in the degree of social complexity for groups in the Mid-Fraser canyon area. It is during the late Plateau horizon that Richards and Rousseau (1987) argue that the emergence of socially complex, hierarchically organized societies and the big village pattern emerged. Obviously, this viewpoint is counter to that of Hayden, who, as previously discussed, sees the emergence of the “Classic Lillooet” cultural pattern occurring during the Shuswap horizon at the latest.

The domiciles constructed during the Plateau horizon seem to have been mat-lodge pithouses that were generally smaller in size than those constructed both before this time period, in the Shuswap horizon, as well as afterwards during the Kamloops horizon (Hayden 1997, 2000d). Pithouses from the Plateau horizon generally average 6 meters in diameter, and were circular or oval in shape, basin shaped in profile, and lacking a raised earth rim. Common characteristics of Plateau pithouses are steep, semi-subterranean walls, flat floors, and having few storage or refuse pits (Hayden 1997; Lepofsky et al. 1986; Richards and Rousseau 1987; Wilson 1980). Some houses contain large post-holes indicative of a post-supported superstructure. Both side and roof
entrances are found in houses of this time period (Eldridge and Stryd 1983; Hayden 1997; 2000a).

The tool technology for the Plateau horizon is significant in that we see the size of projectile points decreasing as the age of the bow and arrow is ushered in near the end of the time period (Hayden 2000a; Richards and Rousseau 1987). Other technological hallmarks of the Plateau horizon are Plateau horizon points, key-shaped scrapers, and antler digging sticks (Hayden 2000a). The trade networks established during the Shuswap horizon seem to have continued to flourish and were likely expanded. Nephrite, copper jewelry, incised decorations, non-local argillite and chert, and Dentallium and Olivella shells have all been discovered in the archaeological record of the Mid-Fraser canyon, strongly suggesting the existence of regional trade networks stretching from the Canadian Plateau to both the Northwest Coast and the Rocky Mountains (Reeves 1974; Richards and Rousseau 1987).

According to Hayden (2000a), the Keatley Creek village reached its maximum site size and population during the Plateau horizon. Hayden argues that the big houses at the site continued to be occupied during this time period, while most of the site’s smaller housepits were also constructed. When compared with the Shuswap horizon, indications are that during the Plateau horizon at the Keatley Creek site, there were larger populations, more socio-economically diverse households, greater socioeconomic inequality, increased production of prestige and exchange items, and more intensive use of salmon.
Kamloops Horizon: 1,200-200 B.P.

The Kamloops horizon is the third cultural horizon of the Plateau Pithouse Tradition, and the final time period prior to the start of the Historic period. The economic strategies employed by people during the Kamloops horizon remains much the same as in the previous Plateau and Shuswap horizons. Groups retained the same storage and delayed-return tactics previously noted, but relied much more heavily on the mass harvesting of salmon. Salmon increased in importance during this period as it became a primary dietary staple and as people began using salmon, along with deer and dogs, as a ritual, feasting, and trade item. According to Hayden, these food resources, along with other material goods, were carefully hoarded and utilized by the people and groups participating in a complex, hierarchically organized culture system that was geared towards demonstrating wealth and power, attracting supporters, and incurring debts. In this regard, the Kamloops horizon most clearly demonstrates the essence of Hayden’s Classic Lillooet cultural pattern, although he argues for its emergence during the Shuswap time period (Hayden 1997; 2000a).

Housepits seem to have varied in size during the Kamloops horizon, with the largest housepits being utilized intensively at the outset of the time period. After approximately 1,200 B.P., nucleated villages in the Mid-Fraser region seem to disappear, and smaller housepits become much more common (Hayden 2000a). Also during this time period, there is a continuation of the regional trade networks between the Interior and the Coast, with direct evidence of the participation of the inhabitants of the Keatley Creek village participating in this network (Hayden and Schulting 1997).
The major lithic technological feature of the Kamloops horizon is the Kamloops point, a small side-notched point likely used with bow and arrow (Hayden 2000a). Other technological hallmarks of this period are groundstone tools, antler, tooth, and bone tools, carved or ground trade or prestige items made of nephrite, slate, and steatite, and a lack of microblade technology (Richards and Rousseau 1987). James Teit (1909a) also documented the presence of birch bark containers and woven baskets during the Kamloops period.

The Keatley Creek site was seemingly abandoned midway through the Kamloops horizon, though the exact date is contested. Hayden (2000a) estimates that the abandonment dates for the Bell and Keatley sites are ca. 1,100 uncalibrated B.P., while Prentiss et al. (2002) argue for the later date of ca. 800 cal. B.P. Hayden’s excavations at the site have uncovered only a few multi-notch points to indicate the use of the Keatley Creek site during the late Kamloops horizon, from circa 400-200 B.P. (Hayden 2000a). To date, there is no firm evidence that the site core was reoccupied as a winter village after abandonment, although some peripheral structures were used even during the historic period.

PITHOUSE USE AND CULTURE CHANGE

The archaeological record makes it clear that pithouses were very rare or absent from the Canadian Plateau prior to approximately 4,400 B.P. (Stryd and Rousseau 1996), and became prominent at the start of the Shuswap horizon at 3,500 B.P. According to native informants, the decision of where to build a housepit was determined by both social and environmental considerations. Typically, housepits were situated near a source of fresh water with ready access to trees for use as construction materials as well
as firewood (Alexander 2000). Also important was selecting a sheltered location with a warm, southern exposure and dry, well-drained soil that would be easy to dig. Other placement considerations would likely have included access to hunting or other resource procurement areas, and defensive capabilities. In the Mid-Fraser region, these needs were usually met by building the housepits on the Fraser River terraces, and the largest villages have been found at the lower reaches of small river tributaries near the terrace/forest ecotone (Alexander 2000).

Archaeologists have speculated that people were drawn to village life for the social and economic support that it offered residents, as well as the protection it afforded from raids (Alexander 2000). Ethnographic accounts (Teit 1900, 1906, 1909a) illustrate a regional social pattern that centered on the winter village; a pattern that archaeologists believe may have been present during the prehistoric period. Generally, pithouses were used during the cold, winter months, although ethnographies suggest that the very young, very old and the ill may have resided in the pithouses year-round (Post and Commons 1938; Nastich 1954; Teit 1909a). The first extreme cold or snow, generally in late November, signaled the move into the pithouses until February or late March when the warm weather and first growth of plants appeared (Teit 1900, 1906, 1909a). However, Nelson (1973) has suggested that the spring abandonment of pithouses could have been more dependent on the amount of stored food remaining than on the weather.

At the time of contact, some pithouses were isolated, while others were built in small clusters of three or four houses (Teit 1900). Villages such as Keatley Creek demonstrate a much different prehistoric settlement pattern with over 100 housepits (Alexander 2000). According to Sanger (1970), village sites were often continuously
used by groups employing an aggregated housepit pattern, increasing the likelihood of stratification.

The lifespan of a pithouse is approximately twenty years, after which the house must be torn down or abandoned (Alexander 2000). The most common cause of housepit decay seems to have been wood rot, even in the dry areas of the Interior Plateau. Other factors that led to abandonment were infestations by insects, rodents or snakes (Kennedy and Bouchard 1978). If a pithouse was to be rebuilt in the same location as an old house, the previous structure was generally burned or dismantled (Alexander 2000). Although burning would have been the fastest method, it would likely have destroyed usable timbers, and may have endangered any surrounding structures.

According to Stryd (1971, 1973), the appearance of pithouses signals a change in decision making. Prior to 3,500 B.P., Stryd describes the lifeway of the Interior Plateau as adaptively flexible, and after 3,500 B.P. the lifeway is described as adaptively efficient. The pre-3,500 B.P. flexibility was focused on the individual search for and collection of a variety of specific subsistence resources, including anadromous fish, freshwater fish, terrestrial game, and vegetation that were immediately consumed. Obviously, this type of economy would require a high degree of mobility, as well as the utilization of single-use habitation sites. Storage technologies during this period were rare and not well developed. When Stryd’s “adaptive efficiency” emerges after 3,500 B.P., there is a marked shift in strategy to the use of pithouses as a “home base” for multiple, seasonal logistical resource procurement expeditions. It is likely that small procurement camps, though difficult to detect archaeologically, were scattered around the landscape from 3,500 to 200 B.P. The pithouses provided a stable base to this type
procurement system because they were able to serve as storehouses for the logistically procured resources, which were utilized and shared between households during the lean winter months.

Therefore, pithouses with their comparatively long lifespan and the role as home-bases create an image of permanence and stability, and suggests that households under this new economic regime were able to produce and store a sufficient amount of surplus to ensure a reliable source of winter food (Stryd 1973). This shift to semi-permanent structures may have been the result of changing environmental conditions. Prior to 4,500 B.P., environmental conditions were unsuitable or too unstable to allow large, dependable salmon runs to be established (Fladmark 1975; Kuijt 1989; Mathewes 1985). However, the start of the Neoglacial at roughly 4,000 B.P. triggered climatic cooling and an increase in moisture (Pielou 1966); conditions that would have increased the productivity of salmon runs, providing a stable food resource for inhabitants of strategically placed villages, allowing an increase in sedentism (Alexander 2000).

The climax of this pattern of “adaptive efficiency” occurred between 2,000 and 1,000 years ago with the appearance of nucleated large winter villages such as Keatley Creek (Stryd 1971). Stryd explains the appearance of these large villages as the result of a gradually increasing adaptive efficiency. Advances in specialization and technological development would have resulted in increased levels of production, larger surpluses, and larger dependent populations. Larger surpluses and populations would have then created a need for even greater efficiency and higher levels of production, surplus and population. According to Stryd, in a state of primary efficiency, the cultural system would reach optimal levels of integration that were centered on the need to maintain this
high level of efficiency. The nucleated winter village pattern may be evidence of large populations and the ability to support those populations with a predictably high level of social interaction. This type of phenomenon has been documented at Keatley Creek by Hayden and Schulting (1997) within their larger study of prestige goods from around the Canadian and Columbian Plateaus and the Northwest Coast.

Recent work conducted at the Keatley Creek site by Prentiss and colleagues (Lenert 2000; Prentiss et al. 2000, 2002, 2003b, 2003c) has produced data that suggests that the Classic Lillooet period may have occurred in two phases. During Phase I, from circa 1700-1200 cal. B.P., aggregated villages suddenly appear, and are characterized by a wide range of housepit sizes with little evidence for inequality, and the intensive use of pink salmon and public root roasting pits. After a break in occupation sequence, Phase II begins shortly after 1200 cal. B.P. and continues until the abandonment of the Keatley Creek village at circa 700-800 cal. B.P. (Prentiss et al. 2003c). This Phase is marked by the abandonment of small housepits and significant increases in the degree of social stratification and in the occurrence of prestige artifacts, mammalian prey, and hunting-related lithic tools. This chronology suggests that the initial process of packing and intensification may have been a response to the desire to control resource locations, but produced little change in social relations. It was not until later during Phase II that we see the full expression of Hayden’s Classic Lillooet culture period (Hayden 1998, 2000c; Schulting 1995).

Fladmark (1982) has suggested, based on published pithouse radiocarbon dates, that there was a climax in the size and number of pithouse settlements between 2,000 and 1,000 B.P. during the Plateau and early Kamloops cultural horizons. Fladmark notes a
peak in cultural depositions that occurs between 1,500 and 1,000 B.P. that seem to coincide with the height of primary riverine efficiency. Several other researches concur that there was a considerable change in social organization and the degree of trade and exchange during the period from 2,000-1,000 B.P. (Fladmark 1982; Hayden et al. 1985; Richards and Rousseau 1987; Stryd 1971). Additionally, it seems that housepit size increased during this time period, with the largest pithouses being found in the Mid-Fraser region. Some researchers have argued that the occurrence of regionally supersized housepits may be indicative of the presence of “corporate group” households, that is, large co-operative living structures that house a group of hierarchically organized, nuclear families with some degree of centralized administration and socioeconomic inequality (Hayden and Cannon 1982).

The decline of the nucleated housepit village pattern is evident after the early parts of the Kamloops horizon, as the living pattern shifts towards the occupation of dispersed winter settlements at circa 1,000 B.P. This dispersal of village populations was most likely accompanied by a decline in the primary riverine efficiency that had peaked just prior to this period, as well as a decrease in sociocultural integration (Stryd 1971). This idea is upheld by Hayden and Ryder (1991), who have documented the post-1,000 B.P. breakdown of the intense social integration that had operated during the Plateau and early Kamloops eras.

Several hypotheses have been offered to explain the drastic decline of what had been such an apparently successful social system. Stryd (1971) has argued that village abandonment could have been precipitated by the over-exploitation of riverine and terrestrial resources within the ecotones in which the villages were located. This type of
regional resource decimation could have created a situation in which it became impossible to maintain the degree of social integration that the cultural system demanded. Stryd maintains a functionalist perspective that the high level of exploitation needed to maintain the cultural system was such that it placed severe demands on the culture system itself, whereby a decrease in the exploitative efficiency that affected the whole system was necessary, precipitating a population dispersal (Stryd 1971:11).

A conflicting explanation for the abandonment of Keatley Creek and other large villages in the Mid-Fraser region has been offered by Hayden and Ryder (1991). They argue that a massive landslide known as the Texas Creek Landslide may have temporarily dammed the Fraser River, thereby blocking the upstream migration of salmon to the large villages, resulting in an economic and cultural collapse due to the loss of the primary basis of the operating subsistence system in place at the time. However, a controversial study by Kuijt (2001) has suggested that there is little evidence that the Texas Creek Landslide could have created such a devastating effect on the local economies. Kuijt argues that the landscape north of the slide area lacks the lacustrian deposits that one would expect had a large-scale backup of the Fraser River occurred for any significant amount of time.

Between the period following the cultural collapse at ca. 1,000 B.P. and the beginning of the historic period at 200 B.P., adaptive specialization and the focus on riverine salmon resources were maintained, albeit to a much lesser degree. There seems to have been an increase in the number of villages present on the landscape, although they were decreased in size from earlier in the Kamloops horizon, and it seems that regional social interaction was similarly curtailed (Stryd 1971). We may infer that with
the disappearance of the big village pattern, there was an accompanying disappearance of many of the aspects of life in the large villages, including corporate group households.

Therefore, it seems that the cultures of the Mid-Fraser region utilized a subsistence system primarily based on salmon fishing throughout the Late Prehistoric Period, from 3,500-200 B.P. Based on an overview of the works of Stryd (1971), Fladmark (1982) and Richards and Rousseau (1987), the evolution of the big village pattern may have occurred in the following manner: at the start of the Shuswap horizon around 3,500 B.P., we see the appearance of pithouses that are dispersed on the landscape accompanied by a change in human behavior to what Stryd (1971) has described as primary riverine efficiency, or a primary economic reliance on a riverine resource, namely salmon. This shift in economic focus could be attributed to changing environmental conditions after 4,500 B.P. creating favorable conditions for abundant and predictable salmon runs post-4,000 B.P. (Alexander 2000). The shift to pithouse dwellings could suggest that as people came to rely more heavily on the river resources, a more permanent form of settlement was needed. Nucleated pithouse village appear during the Plateau and early Kamloops periods, between 2,000 and 1,000 B.P., suggesting that populations were aggregating at this time. After 1,000 B.P., the large villages are suddenly abandoned and pithouses again become dispersed across the landscape.

It should be noted that the changes in settlement patterns noted here for the Mid-Fraser River region occurred contemporaneously with changes in other areas of the Northwest. The neighboring Thompson River drainage, located south of our study area, seems to have experienced a similar shift in residential patterns over time, from small
nuclear dwellings to large, multi-family households (Mohs 1981). Thus, it seems that the patterns of cultural, social, and economic change that occurred in our study area did not function in a vacuum, and that a wider synthesis of research regarding the economic and residential patterns of the Canadian and Columbian Plateaus and the Northwest Coast could be a valuable future research problem.

A YEAR IN THE LIFE OF A COMPLEX HUNTER-GATHERER

This section presents a brief ethnographic reconstruction of the yearly food gathering cycle used by native peoples in the Mid-Fraser region of British Columbia. Although during the ethnographic period the most important resource for people in the Interior Plateau was salmon, many other resources were needed around the year to fill out the diet, as well as to be the primary food staple during times when fresh or dried salmon were not available for consumption (Hayden 1997). The general ethnographic and archaeological patterns that are presented here in terms of resource use and group movements are largely applicable to the entire Interior Plateau culture region, although the timing of the events and the importance of various resources would vary according to latitude and regional environmental conditions (Alexander 1992b).

Alexander (1992b) compiled a useful ethnographic timetable of events for cultural and resource gathering activities in the Mid-Fraser region, which is helpful as a starting point upon which more detailed descriptions can be expanded. I include only those descriptions relevant to our immediate study area in and around the Keatley Creek area. The exact timing of these events would likely vary from year to year according to specific climatic conditions in each season. This seasonal table is presented in the format of “moons” or months, as described by native informants in ethnographies, and
summarizes the main environmental cues and subsistence activities that the Shuswap and Lillooet attributed to each moon. The first moon here is during the month of November, due to the fact that according to Teit, the Shuswap, Lillooet and Thompson all began their year in November (1900, 1906, 1909a), although the natural event that signaled the start of the new year varied.

Table 2-1: Monthly Resource Use Calendar

<table>
<thead>
<tr>
<th>Moon</th>
<th>Lillooet (Fountain to Anderson Lk) (Teit 1906:223-4)</th>
<th>Shuswap (Dawson 1892:40)</th>
<th>Shuswap (On Fraser R. north of Pavilion) (Teit 1909a: 517-8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Nov.)</td>
<td>Gets cold. Enter winter houses.</td>
<td>Return from hunt.</td>
<td>Deer rut. Some enter winter houses.</td>
</tr>
<tr>
<td>2 (Dec.)</td>
<td>Winter solstice.</td>
<td>Remain at home.</td>
<td>First real cold.</td>
</tr>
<tr>
<td>3 (Jan.)</td>
<td>Coldest weather, ice on rivers.</td>
<td>Midwinter</td>
<td>Sun turns.</td>
</tr>
<tr>
<td>4 (Feb.)</td>
<td>Leave winter houses.</td>
<td></td>
<td>Chinook winds; snow begins to melt.</td>
</tr>
<tr>
<td>6 (Apr.)</td>
<td>Trees and bushes leaf.</td>
<td>Grass</td>
<td>Grass grows fast. Snow leaves high ground. Dig roots.</td>
</tr>
<tr>
<td>7 (May)</td>
<td>Small fish; first salmon; strawberries ripe.</td>
<td>Root digging</td>
<td>Fish at lakes.</td>
</tr>
<tr>
<td>8 (June)</td>
<td>Service and most other berries ripen.</td>
<td>Strawberry</td>
<td>Serviceberries ripen.</td>
</tr>
<tr>
<td>9 (July)</td>
<td>Pick berries. Warmest berry</td>
<td></td>
<td>Salmon arrive.</td>
</tr>
<tr>
<td>10 (Aug.)</td>
<td>A lot of salmon come; fish.</td>
<td>Salmon</td>
<td>Fish salmon all month.</td>
</tr>
<tr>
<td>11 (Sep.)</td>
<td>Prepare salmon oil.</td>
<td>Salmon get bad.</td>
<td>Cache fish. Leave rivers to hunt.</td>
</tr>
</tbody>
</table>

(From Alexander 1992)
As can be seen from the table, the first part of the year from November to February or March was spent in pithouses in the winter villages, such as Keatley Creek (Figure 2-1). After the first snows or snow accumulations in November, families and small groups would return to the villages where they had stored dried goods for the winter months, such as salmon, deer meat, fat, berries and roots (Hayden 1997). While in the pithouses, the time was spent on feasting, dancing, making crafts or on creating or repairing clothing, tools, and fishing nets for use during the busy food gathering months. When the weather was not too cold, small resource gathering expeditions would take place to ice fish or to hunt deer forced down to lower altitudes by heavy snow.

During November, people would often hunt and fish near villages while winter dwellings were cleaned out and prepared. The hunting would be good, as the animals would have their heaviest fat covering at this time (Alexander 1992b). December was mostly spent indoors living on stored foods, particularly salmon. The weather became very cold, and hunting was largely abandoned except in a few instances when grouse or hares could be found near the pithouses. The coldest month was January, during which almost all outdoor activities stopped. Hunting was poor as the ungulates were likely to be lean. In February, the weather began to warm and plants would start to sprout. The timing of the move out of the pithouses depended on the severity of the weather, but was usually at the end of February or the beginning of March. Travel became easier, making game easier to hunt. Late February usually marked the leanest time of the year, when stored foods ran low or even ran out (Teit 1909a). If the warm weather was late in arriving, hunting or fishing was not an option and starvation could become a distinct possibility (Lane 1981).
The second part of the year lasted from late March until mid-May, and was spent on the river terraces. People moved out of the pithouse villages and broke into smaller family groups for most of the rest of the year. At this time of year when food was short, people were anxious to gather early plants and roots from along moist stream banks such as berry shoots, onions, balsam root, cow-parsnip, fireweed, and lodgepole pine cambium for immediate consumption (Hayden 1997). Other people went to the river to catch the sparse early run of “spring” or Chinook salmon. As the snows melted at higher elevations, people gradually moved upslope to the intermediate grasslands to hunt and to collect berries, lily roots, and “mountain potatoes”. Many of these plants would be dried and brought back to the pithouses for storage.

In mid to late May, small family groups would begin making short trips into the mountains for hunting and plant gathering, following the deer and ripening plants upslope (Alexander 1992b). From this time until late July, groups would be very mobile, traveling upslope to gather roots and hunt, and then moving back downslope to store food in the pithouses and to gather ripe berries on the upper edge of the terraces to be dried and stored for winter consumption.

Beginning in late July, food-gathering efforts became almost totally focused on catching salmon when the largest salmon runs of the year took place (Alexander 1992b). During the historic period, many people would stay in fishing locales for as much as a month. The most productive fishing locales were where rocks jutted into the river or where its flow was restricted, such as at the Six Mile Fishery located just a few kilometers downstream from Keatley Creek (Hayden 1997). The length of time spent catching salmon in the summer would vary based on how long the good runs lasted, and
how long it took to catch and dry enough food for winter storage. Ethnographically, a woman could process between 50 to 60 salmon per day, leaving them to dry for three to four days. In the Lillooet region, each family required hundreds of dried salmon to last out just one winter in their pithouse, and if the runs were particularly good, people would generally try to catch excess salmon for long term storage to hedge against a possible bad run the next year (Hayden 1997).

By the time September arrived, the salmon runs were slackening and generally poor, and family groups would return to the alpine and montane parkland areas to hunt deer and other ungulates (Alexander 1992b). Between September and October when cold temperatures and snow would drive the hunters back down to lower altitudes, the deer were a prime resource as their fat stores would be the highest of the year and their fur would be in prime condition (Hayden 1997). Ethnographically, almost all families would move into the mountains immediately following the end of the salmon runs, staying for one to two weeks. The intensity of the hunts and the duration of the stay in the mountains most likely depended on the relative success or failure of the salmon runs just prior. Groups of men could continue to hunt into October and early November, although game would begin moving downslope by October (Alexander 1992b; Lane 1981). By the time November arrived, people would move back to the river terraces and their pithouses for the winter as the weather turned increasingly cold and stormy.
HOUSEPIT SITES AND FORMATION PROCESSES

Pithouses were constructed by a group of people brought together for the task much the same way as in a communal barn-raising – the future inhabitants of the site asked for assistance from friends and family in exchange for food (Teit 1900). Most of the materials needed for construction would have been collected in advance, or if the house was being rebuilt, salvaged from the previous structure (Alexander 2000).

The first step of construction would be to determine the size of the structure. Based on ethnographic accounts and archaeological data, the size range for Lillooet and Shuswap pithouses has been estimated at 3.7-15 meters in diameter, although the houses at the Keatley Creek site are in general somewhat larger than average, and seem to have peaked in size between 12 and 16 meters in diameter (Alexander 2000). Once the size of the housepit was determined, ethnographic accounts state that the circular outline of the pithouse depression was marked and then excavated by loosening the soil with digging sticks and baskets (Teit 1900). The soil collected into the baskets was then dumped around the perimeter of the depression, where it could be easily collected at a later time for redistribution on the roof of the structure (Figure 2-2). The depth of the finished depression generally varied from approximately 1.2-1.8 meters (Boas 1891; Ray 1939; Surtees 1975), although environmental conditions, such as winter temperatures and water tables, would have played a large part in determining the depth of housepits (Alexander 2000; Gilman 1983).

After the process of excavating the pit, the roof superstructure would be constructed. Four major support posts would be placed into pits in the corners of the floor and tamped into place. These posts were generally cedar or hemlock (Alexander
2000), and served as the supports for the four hip rafters that ran from the outer edge of the depression to join the square or rectangular hole at the apex of the roof (Sanger 1970). The hip rafters were covered by a series of supportive and insulative layers: first by poles, then with bark, grass, mats, moss, boughs, and/or hides, and finally with dirt or sod being placed on the top of the roof (Alexander 2000). The roof opening served as a light source, a smokehole, and as an entrance in some houses, with access to this “doorway” provided by a notched log ladder secured at the base by being dug into the floor and extending through the top of the roof. However, additional or even primary doorways were sometimes built into the side of the structure, that allowed easy access for women, the elderly, and allowed an easier method for hauling in heavy loads, such as firewood.

As previously discussed, a pithouse would generally be occupied for a period of approximately twenty winters before damage to the superstructure, dry rot or infestations would require a new house to be built (Alexander 2000). Generally, if infestations or structural damage to the posts were not severe, the old structure would be stripped of reusable posts before the structure was burned. The destruction of old housepits often occurred at the end of the winter season before its inhabitants left the village for the spring and summer. When the occupants returned to the housepit site in the fall, they would remove the burnt remains of the structure from the depression, casting the debris around the perimeter of the pit, forming a rim spoil. Since garbage from within the pithouse likely ended up in a “dump” zone (per Binford 1978) on the roof of the pithouse, all the accumulated refuse from the previous twenty years of occupation would be removed with the burned debris and deposited on the rim. Consecutive phases of occupation and rebuilding of the housepit would result in a doughnut shaped rim
completely surrounding the pithouse. These rims exhibit an exquisitely formed alternating sequence of initial layers of deconstructed materials followed by a loose, jumbled mass of powdery sediment, characteristic of previous pithouse roofs and floors, and then a series of garbage dumps, to be followed again by deconstruction materials (Lenert 2000).

The last stage in the life of a housepit is its final abandonment. When a housepit was abandoned, it was not generally burned down, but instead left intact (Alexander 2000). However, excavations at the Keatley Creek site demonstrate that these pithouses were burned upon abandonment (Hayden et al. 1986). The dry environmental conditions that prevail in the Mid-Fraser Region have wonderfully preserved the archaeological record of the Keatley Creek housepits, and the resulting stratigraphic record is detailed and distinctive. Upon excavation, the initial layers are composed of slumped earth that overlies roof collapse materials, which cover the final occupation floor. The final occupation floors contain a variety of features, including postholes, storage pits, trash pits, and hearths, and are can be underlain by older occupation surfaces.

**Difficulties of Housepit Excavations**

Housepit sites of British Columbia make remarkable objects of research due to the vast wealth of data they contain regarding the prehistoric lifeways of their inhabitants. However, housepit sites are also notoriously complex and difficult both to excavate and interpret. Fladmark (1982) has gone so far as to state that housepit sites are the worst possible contexts for the purpose of excavating high confidence, unmixed assemblages. The practice of their inhabitants of using the same cultural depressions over as great a time span as 2,000-3,000 years creates a complex archaeological deposit that can “pose
an interpretive challenge exceeding the capabilities of the most experienced researcher” (Fladmark 1982). Several researchers have discussed a variety of prehistoric activities that could cause mixed age cultural deposits to create problems during excavation and interpretation (Fladmark 1982; Von Krogh 1980; Wilmeth 1977). Fladmark (1982) summarized these observations in the following list:

1. Excavation of housepits into pre-housepit cultural horizons.
2. Deposition of fill from pit excavation, containing older materials, onto house roofs.
3. Mixing of housepit and pre-housepit materials by trampling in house floors.
4. Use of the roof as a tool manufacture and maintenance area.
5. Use of the roof as a dumpsite for hearth contents.
6. House abandonment and: a) slumping of roof materials into the pit; b) slow size-sorted filtering of materials through the roof back onto the floor; c) slow collapse of the roof accompanied by natural Aeolian or fluvial deposition; d) burning of the structure and collapse of the charred roof and its contents into the pit.
7. Slumping of the housepit wall, and thus of older cultural materials onto the house floor at any time before, during, or after 2-6 above.
8. Reoccupation and partial or complete re-excavation of the housepit, and the repetition of the entire cycle. Potentially this could occur many times in the life of a housepit, as they were often the preferred sites for reoccupation due to the ability to skip the step of the initial pit excavation.
9. Final abandonment and the partial in-filling of the housepit depression. This may also include later, intermittent non-housepit occupations. Also may include the deliberate filling of the depression with cultural garbage, coupled with natural sedimentary and perturbatory processes.

Fladmark goes on to argue that the end result of even one of these factors, or a combination of them, could result in a situation in which the profile of an excavation may visually appear to exhibit a logical profile of cultural strata that is easily interpretable, even though the actual contents are highly mixed and displaced. Therefore, the reliability of chronological cultural deposits from housepits is low, as even the stratigraphic association of two or more dates will not prove their contemporaneity (Fladmark 1982). These concerns are well to keep in mind during the Results and Discussion portions of
this study, as the data presented will largely rely upon the ability to create a cultural and economic chronology for Housepit 7.

Contrary to Fladmark’s observations, Hayden and his research team (1997; Hayden et al. 1986) as well as Prentiss and his research team (Lenert 2000; Prentiss et al. 2000, 2002, 2003b), have been able to demonstrate that marked distinctions between the pithouse floor, roof, and rim deposits at Keatley Creek do exist. Hayden and his colleagues have proved that inter-household patterns at Keatley Creek are discernible from housepit floor deposits, and that inferences can be made regarding household organization. Many of the problems previously cited by Fladmark have been tempered through extremely careful excavations and analyses conducted by Hayden and Prentiss.

Despite the rigorous data collection and analysis techniques employed during the excavation of Keatley Creek by Hayden in the 1980s, there have been some lingering problems, namely the nature and interpretation of rim deposits (Hayden 2000c; Hayden et al. 1986). Hayden has argued that the rim deposits are central to understanding the early site occupations and the cultural differences between the early and late occupations. The 1999, 2001 and 2002 excavations at the Keatley Creek site conducted by Prentiss (Lenert 2000; Prentiss et al. 2000, 2002, 2003b) have largely focused on the excavation and interpretation of the rim deposits from Housepit 7. The data collected during these excavations have helped to clarify the chronology of occupations in Housepit 7.

**OVERVIEW OF THE KEATLEY CREEK SITE**

This section will provide a brief description of the Keatley Creek site. Briefly discussed are the types of cultural features prominent at the site, the size of the site, and the locations within the site where major cultural features occur.
Of the three surviving large housepit sites near Lillooet, British Columbia, the Keatley Creek site is both the largest and also has the largest maximum sizes of structures, up to 21 meters in diameter (Hayden 2000a). In all, there are 119 housepit size depressions at Keatley Creek and approximately the same number of smaller identifiable external features that include cache pits and roasting pits (Figure 2-3). Most of the structures less than five meters in diameter (rim crest to rim crest) are unlikely to have been residences, although excavations of some of these depressions have proven otherwise (Hayden 1997, 2000a). The vast majority of the depressions over five meters in diameter were likely residential structures, but the unlikelihood of the contemporaneous occupation of all of these structures makes population estimates difficult. To complicate the matter, some of the residential sized depressions have proved upon excavation to be otherwise. For example, three tested structures located on the terraces above the site core appear to be ritual in nature, and at least one depression located in the creek bed proved to be a very large roasting pit.

As previously described, the vast majority of the depressions are located in the site core, a densely occupied area located north of the creek bed and covering a 9.9 acre area (Hayden 2000a). The peripheries of the site extend up onto the rim of the kame terrace on the riverside, up onto two small terrace remnants on the mountain side, as well as in the creek bed and down the creek to the point where the creek exits the mountains (see Figure 1-3). Scattered housepits and cache pits are also situated on the terraces south of the creek, and lithic concentrations continue sporadically along the creek bluffs out onto the river terrace. At its maximum, the Keatley Creek site extends approximately 400 meters from the base of the mountains towards the Fraser River (Hayden 2000a).
DESCRIPTION OF HOousepit 7

This section will provide a description of Housepit 7 at the Keatley Creek site. Included are overviews of the location, size, previous excavations, and major conclusion derived from the research of Housepit 7.

Housepit 7 is a large winter housepit located at the base of a hill in the southeastern edge of the village core area of the Keatley Creek site (Figure 2-3). The excavations of this housepit began in 1986 with a trench of the housepit, and subsequently the final occupation floor was systematically excavated during following filed seasons. Housepit 7 is approximately 19 meters in diameter, rim crest to rim crest, and is roughly circular in shape. This housepit features a very prominent rim with no visible evidence of a side entrance.

From the data collected during these excavations, Hayden (Hayden et al. 1996; Hayden and Spafford 1993) estimates that Housepit 7 may have housed at least 45 people who were organized into eight or fewer domestic units. He posits that the structure may have reached its maximum size during the Plateau horizon based on the pattern of remodeled postholes and intact rim deposits. Hayden believes that Housepit 7 was continuously occupied from the time of the Shuswap horizon until its abandonment early during the Kamloops horizon (Hayden 2000a; Hayden and Spafford 1993). There is also evidence of occupations of the area in and around Housepit 7 that either predates its construction or that were buried at some point by structural changes to the house. This evidence includes three excavated sub-housepits, housepits located beneath the floors and rims of Housepit 7, on the northern edge of Housepit 7 (Prentiss et al. 2000, 2002, 2003b).
The archaeological deposits recovered by Hayden from Housepit 7 contained an abundance of artifacts, botanical remains, and faunal remains. The final occupation floor contained large storage pits, multiple hearth features and a great deal of fire-cracked rock (Figure 2-4). Also uncovered were a wide array of prestige items indicative of household wealth, including exotic types of faunal remains. The results from the rigorous household archaeological research performed at Housepit 7 have upheld Hayden's theory that Housepit 7 was a prehistoric household that operated as a co-residential corporate group that may have served as a powerful social and economic force within the Keatley Creek winter village community (Hayden 2000a; Hayden and Cannon 1982; Hayden and Spafford 1993).
CHAPTER THREE
RESEARCH METHODS

This chapter will present the methods used to collect and analyze the data utilized in constructing a faunal rim sequence for the lifespan of Housepit 7 comparative to Hayden’s (1997, 2000d) faunal model for the same housepit. The implications resulting from the testing of these two models will be used to suggest an economic chronology for the Keatley Creek site. In this section, a description of the excavation plans and techniques will be reviewed first, followed by the presentation of analytical methods, laboratory techniques, and notes on radiocarbon dates.

EXCAVATION PLANS AND METHODS

This section will provide a brief overview of the excavation plan utilized during the 2001 field investigation at Keatley Creek, as the main body of data analyzed in this report was collected during that season. The 2001 excavation collected data from Housepit 7 designed to provide tests of the hypotheses in three areas: dating, subsistence, and technology. Specific studies included stratigraphic and horizontal excavation, analysis of housepit stratigraphy, radiocarbon dating, zooarchaeological and paleoethnobotanical analyses, bone chemistry, and functional and technological lithic artifact analyses (Prentiss et al. 2002).

All new excavation research focused on archaeological deposits associated with Housepit 7. Past research had established this house structure as the best representative of the first large houses in the village and consequently the keystone for arguments regarding the development of social complexity in the village (Hayden 1997, 2000a, 2000b; Prentiss et al. 2002). The study of stratigraphy was designed to define the cultural
processes associated with the construction and initial occupation of the house and how this differed from the three smaller house floors (Sub-housepits, or SHP) now known to be stratified at deeper levels (Prentiss et al. 2000). Stratigraphic analysis was facilitated by completion of excavations begun during the 1999 field season, providing a complete profile of sediments associated with northern and northwestern sectors of Housepit 7 and the earlier housepits (Prentiss et al. 2003c). More specifically, the horizontal excavation of the northwest side of Housepit 7 was expanded to complete the excavation of Sub-Housepit #3 (not discussed in this study) and to increase the sample of Housepit 7 materials. Additionally, a 50 centimeter wide by 6 meter long trench was excavated west from the northwest corner of the latter excavation block, connecting to the 1999 northwest Housepit 7 rim trench (Prentiss et al. 2000), the data from which is included in this study. Finally, a small horizontal excavation consisting of three 50x50 cm subsquares exposed a portion of the Housepit 7 rim on the far northwestern outer rim slope, north and south of the previously mentioned rim trench. The result of this excavation process for the purposes of this study was the complete profiling of the roof, rim and floor deposits of the northwest side of Housepit 7 (Figure 3-1).

A datum point was established two meters south of the southwestern corner of Unit U on the southwestern rim of Housepit 7, corresponding with Brian Hayden’s original grid system for the Keatley Creek site. The project maintained the basic excavation units at Keatley Creek as 2x2 meter squares. Each square was subdivided and excavated in 50 cm by 50 cm subsquares, numbered 1-16. Each subsquare was individually hand excavated using trowels and dustpans, as well as smaller tools such as
spoons and bamboo sticks when deemed necessary. All sediments were excavated in natural strata and were then screened through 1/8-inch wire mesh.

Previous excavations at Keatley Creek had identified several distinct sedimentary strata including surface, roof, rim spoil, rim slump, dump, floor, and various subfloor pit features (see table below). Where applicable, strata designations were consistent with previous strata designations used previously at Keatley Creek. Upon encountering a stratum change, the new stratum was excavated in 10 cm intervals or until a new stratum was encountered.

Table 3-1  **Stratum Legend for 1999-2002 Excavations of Housepit 7**

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Surface: contemporary surface layer; dark gray brown sandy silt with rich organic humus with pebble and gravel size clasts; 10 YR 4/2</td>
</tr>
<tr>
<td>II</td>
<td>Major Kamloops occupation horizon: Housepit 7 floor; gravel size clasts; 10 YR 4/2</td>
</tr>
<tr>
<td>XIII</td>
<td>Rim spoil of Housepit 7: loose aggregate of sandy silt with varying amounts of charcoal; hydrophobic silt/sand mixed with organics; redeposited Plateau/Kamloops Horizon occupation material; loose; not sorted; clusters of cultural materials (fire-cracked rock, faunal remains) common; 10 YR 3/1, 10 YR 3/2, 10 YR 3/3, 10 YR 4/2, 10 YR 4/3, 10 YR 4/4, 10 YR 5/2, 10 YR 5/3, 10 YR 5/4, 10 YR 6/3, 10 YR 6/4, 7.5 YR 4/3, and 7.5 YR 5/4.</td>
</tr>
<tr>
<td></td>
<td>* XIII-A: Chronologically the most recent rim spoil deposit; dark gray brown sandy silt with abundant charcoal</td>
</tr>
<tr>
<td></td>
<td>* XIII-B: Rim spoil; dark gray sandy silt</td>
</tr>
<tr>
<td></td>
<td>* XIII-C: Rim spoil; dark gray sandy silt with abundant charcoal</td>
</tr>
<tr>
<td></td>
<td>* XIII-D-1: Rim spoil; gray brown sandy silt with abundant charcoal and unburned wood</td>
</tr>
<tr>
<td></td>
<td>* XIII-D-2: Rim spoil; dark gray sandy silt</td>
</tr>
<tr>
<td></td>
<td>* XIII-E: Chronologically earliest rim spoil; dark gray brown sandy silt; redeposited floor material</td>
</tr>
<tr>
<td></td>
<td>* XIII-F: Rim spoil; substantial amount of charcoal and unburned wood; dark gray brown sandy silt</td>
</tr>
<tr>
<td></td>
<td>* XIII-1: floor-like deposit; loose dark gray sandy silt</td>
</tr>
<tr>
<td></td>
<td>* XIII-2: rim spoil; dark gray brown sandy silt, large pebble size clasts; substantial unburned wood and charcoal</td>
</tr>
<tr>
<td>XXIII-1</td>
<td>Culturally redeposited glacial till with cultural materials; compact brown silty clay with abundant pebble and granule size clasts; unsorted matrix; 10 YR 5/3</td>
</tr>
<tr>
<td>XXIII-2</td>
<td>Occupation surface, very thin, organic; dark gray brown sandy silt; 10 YR 5/3</td>
</tr>
<tr>
<td>XXIII-3</td>
<td>Culturally deposited brown sandy silt with pebble and granule size clasts; 10 YR 5/3</td>
</tr>
<tr>
<td>XXIV</td>
<td>Sub-housepit 4 floor occupation sediment; very dark sandy silt; contains pebble and gravel size clasts; 10 YR 3/1</td>
</tr>
<tr>
<td>XXVI</td>
<td>Sediment dumps; varies from loose to compact aggregates and rock piles; 10 YR 3/3, 10 YR 4/2, 10 YR 4/3, 10 YR 5/3</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>XXVII</td>
<td>Early extension of HP7 floor; dark gray brown sandy silt mixed with pebbles and gravel size clasts; 10 YR 4/2</td>
</tr>
<tr>
<td>XIX-1</td>
<td>Floor of Sub-housepit 1; slightly compact, pale brown silt; gravel size clasts; 10 YR 4/2</td>
</tr>
<tr>
<td>XIX-2</td>
<td>Initial roof collapse layer; associated with Sub-housepit 3; dark gray brown sandy silt with gravel size clasts; 10 YR 4/2</td>
</tr>
<tr>
<td>XIX-3</td>
<td>Floor of Sub-housepit 3; Plateau Horizon occupation; brown sandy silt with pebble size clasts; 10 YR 6/3, 10 YR 6/4</td>
</tr>
<tr>
<td>F 36-1</td>
<td>Feature 36 located in subsquares DDD-4 and DDD-5: refuse dump deposits; loose dark brown sandy silt, varying in texture and compactness, product of Housepit 7 expansion; 10 YR 3/2, 10 YR 4/3, 10 YR 5/3, 10 YR 6/3</td>
</tr>
<tr>
<td>F 36-2</td>
<td>Feature 36 located in subsquares DDD-4 and DDD-5: refuse dump deposits; loose dark gray brown silty sand; high charcoal and unburned wood content; 10 YR 3/2, 10 YR 4/2, 10 YR 4/3, 10 YR 6/3</td>
</tr>
<tr>
<td>F 36-3</td>
<td>Feature 36 located in subsquares DDD-4 and DDD-5: refuse dump deposits; high rock content; 10 YR 3/2, 10 YR 4/3</td>
</tr>
</tbody>
</table>

(Data from Prentiss et al. 2002)

The excavation of floor sediments proceeded in arbitrary 5 cm levels, and included point proveniencing and individual bagging of artifacts and bone greater than 1 cm in diameter. Articulated fish were collected in aggregate.

One-liter soil samples for flotation and additional sedimentary analyses were also regularly collected during excavation. One sample was systematically taken from each 5 cm level in each subsquare of housepit floors. At least four columns of soil samples were also collected from other strata in each square. This means that for each group of four subsquares in a given square, one square was chosen for collection of soil samples from each natural stratigraphic layer.

Detailed profiles were drawn of at least two walls in every square. Sediments larger than 1 cm in diameter were individually drawn and general sedimentary zones noted. Profiled walls, exposed floor deposits, and plan views of each subsquare were photographed with black and white and color slide film. Radiocarbon samples were
collected from the Housepit 7 rim deposits and from an early floor deposit below the north rim.

**ANALYTICAL METHODS**

**Background to Zooarchaeology**

Faunal analysis, or zooarchaeology, is the study of animal remains from archaeological sites. The goal of zooarchaeology is to gain a better understanding of the relationship between humans and their environment, and particularly between humans and other animal populations (Reitz and Wing 1999). Therefore, the analysis of faunal remains from Housepit 7 is an excellent way to assess the subsistence behaviors of the inhabitants of this house structure, and can serve as the basis for building an economic sequence comparable to the sequence already established by Hayden (1997, 2000d) for Housepit 7.

Zooarchaeology is characterized by its broad interdisciplinary character, applying many physical, biological, ecological, and anthropological concepts and methods to the study of animal remains (Reitz and Wing 1999). Traditionally, most zooarchaeological studies have focused on zoogeographical relationships, environmental evolution, and the impact of humans on the landscape from the perspective of animals. The more recent anthropological interests in nutrition, resource use, economies, and other aspects of human behavior have also been approached with zooarchaeological methods.

Basic biological principles and topics are central to zooarchaeological study. "Biological research includes exploration of extinctions and changes in zoogeographical distributions, morphological characteristics, population structure, the history of
domestication, paleoenvironmental conditions, and ecological relationships of extant fauna using subfossil materials to provide historical perspective” (Reitz and Wing 1999).

The main purpose of zooarchaeological research is to gain an understanding of the interactions that take place between humans and animals, and the consequences that result from this relationship for both humans and their environment (Reitz and Wing 1999). Most animal remains result from complex human and non-human behaviors with resources in the environment, cultural perceptions regarding these resources, and the technology used to exploit these resources. Explaining cultural change and continuity in the faunal record is complicated both by the interactions presented above, as well as by the effects of geology, biology and history. Therefore, it is important to consider the many uses of animals and the many ways by which animal remains can become a part of the archaeological record.

The primary use of animals by humans is for nutrition. The nutritional uses of plants and animals are the basis of subsistence strategies as well as the foundation of economic and other cultural institutions. While associating archaeologically recovered animal remains with nutrition is a primary goal, many such remains may leave little or ambiguous evidence. Many tissues other than muscle, such as viscera, brains, and eggs are often used for food but leave little evidence of their usage (Reitz and Wing 1999). Ethnographic observations, when compared to evidence from the archaeological record or coprolites, indicate that what is edible and what is not edible cannot be assumed (Price 1985; Sobolik 1993, Szuter 1994).

Almost the entire carcass of an animal has economic value, with much of the carcass being utilized for its non-nutritional value. Wool, hair and hide can provide
clothing, shelter, carrying devices and cordage. They may also be used to construct a variety of tools, some being quite complex such as watercraft or traps. Some elements of a carcass may be used for tools after the food value is depleted, and in some cases, such as with clams, the value of the shell is much greater than the nutritive value provided by the clam meat (Reitz and Wing 1999). Other important animal byproducts often exploited are oils, fats, gelatins and glue. Many of these uses for animal products leave little or no evidence in the faunal record, or may be very difficult to distinguish from other, more obvious types of processing behaviors (Schmid 1972). However, these types of economic uses are important in understanding the relationships between humans and their environment, as well as in understanding the formation of the archaeological record.

Other prominent uses of animals by humans include that of domesticate labor as well as cultural and symbolic associations. Animal labor is often an important component in human economics. Animals can assist in plowing fields, hunting, fishing, trading, and serving as guardians or protectors of property. Animals can in fact be so important in these roles that they may not be slaughtered until they are very old, if at all (Reitz and Wing 1999).

Animals are also often used to signify a variety of cultural attributes including social affiliations and belief systems. The result of such symbolic associations may mean that an animal is represented in a faunal assemblage for non-nutritional and non-technological reason, or may also mean the animal is absent from the faunal assemblage although it was culturally important (Reitz and Wing 1999). Animals as sociofacts or ideofacts may be represented in a faunal assemblage by whole animals, parts of the animal, or images of the animal kept so that the individual, household, or community can
benefit from the association with the animal special powers (i.e. a “lucky rabbit’s foot”) (Hesse and Wapnish 1999; Reitz and Wing 1999).

**Requirements and Components of Study**

The basis of a zooarchaeological study is a sound understanding of animal biology, beginning with basic biological and ecological concepts. These include skeletal biology and morphology of tissues such as teeth, bone, shell, and crustacean exoskeleton recovered from archaeological sites (Reitz and Wing 1999). It is also important to be familiar with animal behavior and ecology, particularly with regard to predator-prey relationships, biogeography, ecosystems, population ecology, and the habits and habitats of the animals with which humans in a geographical area interact (Tchernov 1992).

The first step in a successful zooarchaeological study is the accurate identification of the biological component of an archaeological faunal assemblage by identifying the species, types of bones represented, sex, and age of a specimen (Hesse and Wapnish 1999). This is usually accomplished by utilizing a reference collection of animal bones, preferably compiled from non-archaeological sources in order to minimize the weathering and destruction of bones that takes place when they are exposed to the elements.

For this study, the faunal remains were analyzed in the Simon Fraser University Zooarchaeology Laboratory, utilizing the comparative collection curated there. If the bones had identifiable features, they were compared to the laboratory collection in an attempt to determine the genus and/or species name and the age of the specimen. Assigning sex to the remains largely proved to be impossible, due to the high degree of bone breakage present in the vast majority of the recovered assemblages. When
taxonomic genera of mammal remains were unidentifiable, an animal size class was assigned based on the observed relative density and thickness of bone fragments. However, if no size class could be determined, the fragments were labeled simply with the name of its class, (i.e. “mammalia” for mammals or “gastropoda” for snails).

Salmon species were identified by taking an x-ray of a sample of salmon vertebrae from throughout the rim, and then counting the number of annual growth rings found in each vertebra. The rings are a result of different rates of growth between the winter and summer, creating rings that may be seen on vertebrae (Casteel 1976). By counting these rings, it is possible to identify the species of the salmon based on the different spawning ages of each species. Two year spawning salmon (two growth rings) represent pink salmon, while spring salmon, for example, spawn at three to eight years (Cannon 1991).

The second level of information collected from the bones are details providing insight into the natural and human processes affecting the state of bone preservation, also known as site formation processes or bone taphonomy. The taphonomic history of a site may shed light on how bones arrived in the assemblage to begin with, as well as what has happened to the bones in the interval between death and archaeological excavation. Taphonomic factors that are looked for include natural processes such as weathering, gnawing by carnivores or by rodents, trampling by humans or other animals and root etching, as well as evidence of human caused bone destruction such as butchery, cutmarks, bone abrasion, deformation, crushing, breakage, and heat treatment (Hesse and Wapnish 1999).
The taphonomic analyses for this study were based on the criteria suggested by Hill and Walker (1972), Munthe and McLeod (1975) and Lyman (1994). Visual analysis established whether the following attributes were present on each specimen: cracks and/or flaking due to weathering, fractures, crushing, abrasion, cut marks or other evidence of butchery, color due to heat treatment, root etching, distortion or deformation, and the presence or absence of animal gnawing marks. Other taphonomic data recorded includes bone weight in grams and bone size measured in centimeters. These factors help to develop a taphonomic history of the bones from the death of the animal to the retrieval of the bones during excavation.

After assessing the history of the assemblage and recording the biological data, researchers interpret the results using information from a variety of sources and multiple lines of evidence, including faunal data sets, ethnographic analogy, modern experimental studies, and the cultural contexts of the materials (Reitz and Wing 1999). Ethnographic analogy is widely utilized in archaeology to broaden our understanding about the myriad of ways that humans and animals interact and the consequences of those actions (Hudson 1993; Reitz and Wing 1999; Wylie 1985). Experimental and ethnoarchaeological studies contribute to the understanding of depositional, spatial, temporal, and social factors that can impact archaeological deposits (Brain 1981). The cultural context of an assemblage is key in understanding and interpreting archaeological data. This is due to the fact that activities involving animals can be quite different depending on whether the context excavated is a midden, house, storage structure, kill site, or butchery site (Reitz and Wing 1999).
Specific Analyses

The following are brief descriptions of the specific analytical methods and procedures employed during this study to determine the types and frequencies of the taphonomic processes observed on the bones recovered from the 1999, 2001 and 2002 excavations of Housepit 7 at Keatley Creek. Reviewed are analytic procedures for observing and quantifying bone weathering, heat treatment of bones, bone breakage and butchery, and other taphonomic processes such as gnawing and root etching.

Bone Weathering

The first type of analysis deals with the degree of bone weathering. If bones are highly weathered, much less information can be obtained from the assemblage than if they are lightly weathered. This is due to the fact that as weathering advances, bone features are progressively lost and the bone eventually falls to pieces. The bone weathering stages created by Behrensmeyer (1978) were utilized to estimate the degree of weathering to which the excavated bones had been subjected. Bones recovered during excavation are very unlikely to fall into weathering stage 0, but should the bones fall into stages 1-3, this would indicate that the bones in the assemblage have been weathered relatively little, and are in fairly good shape. If this is the case, other types of taphonomic analysis and bone identification activities can easily proceed with a high degree of confidence in accurate results. Should the bones fall into weathering stages 4-5, much more caution should be used in identifying and analyzing the sample, as many of the necessary bone features used in classifying bones to a species, age, and sex may be lost.
### Table 3-2  Behrensmeyer Bone Weathering Stages

<table>
<thead>
<tr>
<th>Weathering Stage</th>
<th>Description</th>
<th>Range in Years Since Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Greasy, no cracking or flaking.</td>
<td>0-1</td>
</tr>
<tr>
<td>1</td>
<td>Cracking parallel to fiber structure, perhaps with mosaic cracking of bone.</td>
<td>0-3</td>
</tr>
<tr>
<td>2</td>
<td>Flaking of outer surface, cracks are present and crack edge is angular.</td>
<td>2-6</td>
</tr>
<tr>
<td>3</td>
<td>Rough fibrous texture; weathering penetrates 1-1.5 mm maximum. Crack edges are rounded.</td>
<td>4-15</td>
</tr>
<tr>
<td>4</td>
<td>Coarsely fibrous and rough surface; splinters of bone loose on surface; weathering penetrating inner cavities.</td>
<td>6-15</td>
</tr>
<tr>
<td>5</td>
<td>Bone falling apart in situ, large splinters present, bone very fragile.</td>
<td>6-15</td>
</tr>
</tbody>
</table>

(after Behrensmeyer 1978)

### Heat Treatment of Bones

The next type of taphonomic analysis is the degree of bone heating, in which excessive heat has modified or damaged the bone. Excessive heat may involve high temperature, temporarily long exposure to heat, or both (Lyman 1994). It has been determined that there are two general stages in the burning of bone. First, as the collagen is carbonized, the bone turns black. If the heating continues, the black carbon is oxidized and the bone turns white while also taking on a chalky consistency. Bones in the black stage as labeled as being “carbonized”, while those in the white stage are labeled as “calcined” (Brain 1981). Some researchers suggest that a specimen’s color may be used as an indication of the range of temperatures to which a bone may have been heated (Shipman et al. 1984). The color and consistency of the bone is important in determining
under which circumstances and what type of taphonomic agent may have been responsible for burning the bone. It has been observed that “natural conditions will regularly carbonize bones but will rarely calcine them. When large portions of the surface area of a bone are calcined, one can safely infer (anthropogenic) prolonged fires under high temperatures” (David 1990).

We can also determine when a bone was burned relative to the time of the animal’s death from bone color. Based on conclusions from experiments conducted by Buikstra and Swegle (1989), it was determined that the color of a heat treated bone indicates that when fleshed or green bone is burnt, the bone often turns white, blue, and/or gray. On the other hand, if dry bone is burnt, it turns a light brown or tan color.

Based on the relative proportions of different colored bones present in an archaeological assemblage, one is able to determine how humans were processing animals and their bones, and to an extent how the human inhabitants of a site were utilizing those animals.

**Figure 3-2: Reaction of Bone to Heating**

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>grass fire</th>
<th>camp fire</th>
<th>Cremation pyres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(&gt; 65 Celsi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>hydroxyapatite</td>
<td>cracking</td>
<td>larger crystal size</td>
</tr>
<tr>
<td>Color</td>
<td>yellowish</td>
<td>red-brown</td>
<td>black</td>
</tr>
<tr>
<td>Degrees</td>
<td>0 100 200 300 400 500 600 700 800 900 1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Lyman 1994)
Bone Breakage and Butchery

The way in which an animal's skeletal elements come apart or are taken apart can tell us much about the manner of the animal's death and the use to which humans or other animals put its carcass (Lyman 1994). Humans exploit animals mainly to extract resources from them, either for food or for materials for tools or clothing. As a result of this exploitation, animal skeletons are disarticulated and bones are broken or otherwise modified.

According to Binford (1978), "butchering is in reality a task of dismemberment. Through it the anatomy of a large animal is partitioned into sets of bones that may be abandoned, transported, or allocated to different uses." Binford also states that "butchering is not a single act but a series of acts beginning when the animal is killed and continuing at varying junctures until the animal is totally consumed or discarded."

Therefore, the creation of a complete picture of the taphonomic processes occurring between an animal's death and its recovery in an archaeological context can be somewhat complicated when skeletal elements have been processed in several ways. It may be that the end product has been so heavily processed or fragmented that earlier types of processing will be impossible to discern.

When analyzing bones for evidence of butchery, the primary signs to look for are cut marks and scratches that are V-shaped to U-shaped in cross section, elongated, have multiple fine parallel striae on the walls of the mark, and which may sometime display "shoulder effects", or small striae parallel to the main striation (Shipman and Rose 1984). When a likely cut mark has been identified, if possible, the anatomical location and orientation of the cutmark should be examined in order to rule out the possibility that
marks were created by trampling or other non-intentional factors, as well as to provide additional insight into factors such as bone freshness at time of butchery, the butcher’s handedness, and the type of meat cut the butcher was producing (Lyman 1994). A second line of evidence for butchery is the presence of percussion marks on bones generated by the use of hammerstones to break apart the bone. In this instance, bone flakes and broad, accurate flake scars would be looked for (Lyman 1994). Recording the frequency of cut marks and other butchery marks on bones is an important variable in understanding human behaviors and may point towards specific economic or hunting strategies.

Bone fragmentation or breakage goes hand in hand with butchery, as it may result from continued human processes to extract certain resources from a carcass, such as bone marrow or small pieces of bone for use as tools. Eight types of bone fractures have been identified and can be used by researchers to assist in the identification of the agent of the breakage (i.e. breakage by blunt force or by sharp instruments) as well as the time of breakage (Marshall 1989; Shipman et al. 1981). Two other important analyses when dealing with fragmented bones are the extent and the intensity of fragmentation. The extent of bone fragmentation is the proportion of the total number of identified specimens (NISP) of an assemblage represented by whole, unbroken, complete skeletal elements (Lyman 1994). Whereas the intensity of fragmentation refers to the size of the fragments, measured in centimeters. An assemblage comprised of very intensively broken skeletal elements will have many small fragments, whereas an assemblage of less intensively broken skeletal elements will have much larger fragments, given that fragments compared are of similar size (Lyman 1994).
Studies of how bones are broken are generally geared towards determining the taphonomic agent responsible for the fragmentation. However, when combined with other taphonomic analyses, studies of butchery and bone breakage can significantly contribute to an understanding of human-animal interactions and human behaviors regarding animal use.

**General Taphonomy**

The last types of taphonomic agents that bones are analyzed for are a variety of naturally occurring processes including root etching, animal gnawing, distortion and crushing. These natural processes can have the effect of damaging or destroying bones in an archaeological assemblage and of obscuring evidence of human activities such as butchery. Their presence can be an indicator of the level of assemblage preservation as well as the paleoenvironmental conditions of the site.

Root etching is produced by humic acid excreted by plant roots or fungi, creating wavy, dendritic, sinuous or spaghetti-like patterns etched into the surface of the bone where individual roots contacted the bone surface (Lyman 1994). Gnawing marks on bones can be created by carnivores, such as *Canis sp.*, producing u and v-shaped pitting, punctures, or crenulations, on bones. Rodents produce a second type of gnawing, with specimens exhibiting multiple parallel incisor grooves, usually along bone margins (Lyman 1994). Finally, evidence of deformation such as crushing, distortion, or bone movement is the result of post-depositional or post-burial processes such as freeze-thaw cycles, water movement, sedimentation and the like. These processes also have the effect of removing some bones from the assemblage, and destroying others (Lyman 1994).
LABORATORY METHODS

The faunal remains from the University of Montana excavations at Housepit 7 were either removed directly from excavation units or recovered from the screens. All bones recovered during excavations were immediately bagged separately from other materials recovered. All bags of faunal materials were labeled with the provenience information of the unit, stata, and level from which the bones were removed.

The faunal remains were then transferred to the zooarchaeology laboratory at Simon Fraser University for analysis. As stated previously in this chapter, each bone was initially analyzed and recorded on the basis of skeletal element represented, species, age, and sex. Large or complete bones had detailed measurements of bone features taken in order to compare with the reference collection. Taphonomic indicators were recorded for each bone including maximum size in centimeters, color, degree of weathering, and the presence or absence of fractures, crushing, abrasion, cut marks, deformation, root etching, and animal gnawing was ascertained under microscope. Drawings were made of bone tools as well as of bones exhibiting extensive culturally produced taphonomy such as cut marks. The bones from the 2001 and 2002 excavations were also weighed in order to produce a rough estimate of the quantity of bones recovered per each level of the Housepit 7 rim sequence. In order to identify the species for the salmon bones recovered, complete vertebrae were x-rayed in the Simon Fraser University Archaeology lab according to the procedures presented by Casteel (1976), and discussed previously during this chapter. Culturally significant bones and all bone tools were photographed in the Simon Fraser University archaeology lab with black and white film, color slide film, and digital camera. Following the conclusion of the analysis, all faunal materials were sent to
the Secwepemc Museum in Kamloops, British Columbia for storage with the rest of the materials recovered from the Keatley Creek site.

**RADIOCARBON DATING**

A vital component in the construction of a new economic sequence for Housepit 7 is the interpretation of radiocarbon dates taken from biological samples recovered from the 1999, 2001, and 2002 University of Montana excavations. Radiocarbon assays have been included in this study to absolute-date the occupation phases observed in the Housepit 7 rim, and to provide the necessary framework from which hypotheses about changing resource-use patterns may be constructed. It is necessary to note that any set of radiocarbon dates, including those used for this research, are subject to a degree of variability. The traditional way of dealing with dates is to select only those that agree with one’s prior positions on chronological issues of a research problem (Schiffer 1987). A second manner used by researchers to deal with variability is to use statistical techniques to isolate central tendencies that have cultural meaning. Schiffer argues that although they are useful, statistical methods cannot detect bias in a statistically manipulated set of dates due to the fact that all dates are viewed as being equally instructive about human behavior. He goes on to state that selecting only those dates that fit the researcher’s preconceived notions or hypotheses is a much too subjective manner of conducting studies. Therefore, these typical methods of dealing with dates must at best be regarded as unproductive tools for archaeological interpretation.

Due to the ability of radiocarbon dates to introduce a potential source of error to a researcher’s interpretation of the archaeological record, caution must be utilized when collecting and using radiocarbon data. Radiocarbon dates refer to non-cultural events, i.e.
the death of an organism or the year in which a tree ring was formed; however, the dates are used to identify when a cultural event took place (Dean 1978). A disparity in the timing of these two events is what introduces the possible source of error. Therefore, in order to interpret these dates one must identify and account for both the cultural and non-cultural formation processes that are associated with the dated sample as well as the archaeological deposit that produced it (Schiffer 1987).

The dates used in this study were assayed from wood charcoal collected in situ from hearth or posthole features whenever possible. The interpretations of the resulting assays bear in mind the possibility that the death of the trees used in these hearths may have occurred years before they became culturally significant items. Whenever possible, calibrated dates have been used in order to permit the direct evaluation of actual time spreads by aligning the radiocarbon time scale with that of the calendar (Bartlein et al. 1995; Little 2002).

Radiocarbon assays are treated as conventional and calibrated ages in years before present (B.P.), using the year A.D. 1950 as the base date. Calibration of the dates was accomplished using the HTML Calib 4.3 computer program (Stuvier et al. 1999). The relative acceptability of each assay was evaluated according to several specific criteria, the most important criterion being the ability to assign the sample to a specific stratum. This was accomplished by field observations noting that the strata from which samples were removed are relatively undisturbed, with older strata appearing to lie below younger strata. The assays should then reflect this condition, the older dates falling in lower strata and younger dates being found in successively higher strata, within the limits of radiocarbon dating accuracy.
Charcoal for radiocarbon dating was collected from the excavations of Housepit 7 during the 1999, 2001 and 2002 field seasons. Charcoal was mainly collected from in situ hearth and posthole features, though large fragments of charcoal were occasionally retrieved from house floors. In all, seventeen radiocarbon dates were obtained and analyzed for the Housepit 7 sequence (Prentiss et al. 2003c). Standard collection and processing procedures were followed in order to minimize assay rejection.

Accurate proveniences for the samples have been firmly established (Prentiss et al. 2003c). Sets of early calibrated dates were collected from the floor of and the fill inside the Sub-housepit 3 depression, from a hearth at the base of the Housepit 7 rim, and from the fill of a cache pit created early during the life of Housepit 7 (Feature 36). Dates from the middle period of Housepit 7’s life are uncalibrated dates from hearths on the floor of Sub-housepit 1, under the northwest rim of Housepit 7, as well as calibrated dates from Sub-housepit 4, located under the outer northwest rim of Housepit 7. Late occupation dates for Housepit 7 were obtained from a hearth located on the outer rim, above Sub-housepit 4. The dates for abandonment of the site come from Hayden’s uncalibrated dates for the final Housepit 7 and Housepit 3 floors (Hayden 2000d), although these dates have been calibrated by Prentiss et al. (2003c). The radiocarbon assays presented do not definitively date every unit of the stratigraphic sequence, but they do provide a firm temporal basis for the sequence, with each occupation phase being dated and documented. These radiometric dates enable researchers to match cultural historical periods to the stratigraphic units analyzed, making it possible to formulate interpretations regarding the cultural meaning of the areas under investigation. The dated stratigraphic sequence of the Housepit 7 rim represents the new comparative occupation
chronology for Housepit 7. The radiocarbon dates included are assumed to be correct, as there is no reason at this time to believe that they may be otherwise.

All of the dates were converted from radiocarbon age to calibrated calendar years according to the Stuvier et al. (1998) decadal atmospheric/inferred atmospheric curve (Stuvier et al. 1999). These dates were not adjusted for the possibility of laboratory systematic offset or lab error before calibration. It is assumed that the radiocarbon laboratories calculated the conventional radiocarbon ages for their standard dates using the accepted Libby half-life of 5568 years (Stuvier and Polach 1977). Thus, no corrections to the dates were made before using CALIB. Table 3-3 presents both conventional dates expressed in $^{14}$C years B.P. ± one $\sigma$ and calibrated date ranges at two $\sigma$ (Prentiss et al. 2003c).

During the University of Montana excavations of the Housepit 7 rim sequence, several broad rim construction phases were identified and dated (see Figures 3-3, 3-4 and 3-5) (Prentiss et al. 2003c). These construction units begin with Early Housepit 7 (EHP 7), which dates to 1710-1299 cal B.P., and from which 2,392 bones were recovered. The second rim level is Rim 1, lying stratigraphically just above the Early HP 7 materials. However, only 26 bones were recovered from Rim 1, making the faunal data collected from this rim level difficult to analyze and compare with the rest of the rim sequences, a fact to keep in mind throughout the analysis in the next chapter. The next phase of rim construction, Rim 2, included 1,159 bones. Rim 2 lies just above the SHP 1 floor, which has been dated to 1345-1176 cal B.P. Rim 3 included 1,161 bones, and dates to approximately the same time period, 1306-1060 cal B.P., and lies just above the SHP 4 floor on the northwestern outer rim. The final rim sequence, Rim 4, contained 2,302
bones, and spans the range of 1303 to the abandonment of Housepit 7, which likely occurred between 877 and 795 cal B.P. (Prentiss et al. 2003c). These rim units will be utilized in the following chapters to provide a general timeline for the history of subsistence economies within Housepit 7.

Table 3-3: Calibrated Radiocarbon Dates from Housepit 7

<table>
<thead>
<tr>
<th>Lab #</th>
<th>Standard Age B.P.</th>
<th>Calibrated Mean B.P.</th>
<th>2σ Range B.P.</th>
<th>H.P. Assoc.</th>
<th>Rim Assoc.</th>
<th>Provenience</th>
<th>Ref.</th>
<th>Arbitrary I.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFU 742</td>
<td>740 ± 70</td>
<td>747</td>
<td>877-617</td>
<td>7</td>
<td>Final occ.</td>
<td>Roof beam on floor</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>SFU 796</td>
<td>1000 ± 85</td>
<td>939</td>
<td>1166-712</td>
<td>7</td>
<td>Final occ.</td>
<td>Populus branch on floor</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>SFU-1</td>
<td>1080 ± 85</td>
<td>984</td>
<td>1173-795</td>
<td>7</td>
<td>Final occ.</td>
<td>Roof beam on floor</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>SFU 1001</td>
<td>1080 ± 85</td>
<td>984</td>
<td>1173-795</td>
<td>7</td>
<td>Final occ.</td>
<td>Charcoal on floor</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>T-15205 A</td>
<td>1236 ± 71</td>
<td>1134</td>
<td>1303-965</td>
<td>7</td>
<td>Rim 4</td>
<td>F. 34 hearth in rim</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Beta 139441</td>
<td>1270 ± 60</td>
<td>1176</td>
<td>1292-1060</td>
<td>SHP 4</td>
<td>Pre-3</td>
<td>F. 14 hearth on floor</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>A11796</td>
<td>1305 ± 50</td>
<td>1197</td>
<td>1306-1088</td>
<td>SHP 4</td>
<td>Pre-3</td>
<td>F. 14 hearth on floor</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>T-15208 A</td>
<td>1332 ± 41</td>
<td>1241</td>
<td>1306-1176</td>
<td>SHP 1</td>
<td>Pre-2</td>
<td>F. 41 hearth on floor</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>T-15202 A</td>
<td>1360 ± 44</td>
<td>1263</td>
<td>1345-1181</td>
<td>SHP 1</td>
<td>Pre-2</td>
<td>F. 38 hearth on floor</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>T-15207 A</td>
<td>1361 ± 41</td>
<td>1263</td>
<td>1345-1181</td>
<td>SHP 1</td>
<td>Pre-2</td>
<td>Charcoal on floor</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>T-15204 A</td>
<td>1489 ± 41</td>
<td>1405</td>
<td>1511-1299</td>
<td>7</td>
<td>Rim 1</td>
<td>F. 36A, wood in posthole</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Beta 139440</td>
<td>1580 ± 60</td>
<td>1470</td>
<td>1607-1333</td>
<td>SHP 3</td>
<td>EHP 7</td>
<td>F. 16 hearth</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>A-11794</td>
<td>1580 ± 80</td>
<td>1500</td>
<td>1689-1311</td>
<td>SHP 3</td>
<td>EHP 7</td>
<td>F. 16 hearth</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>A-12475</td>
<td>1695 ± 45</td>
<td>1614</td>
<td>1710-1518</td>
<td>7</td>
<td>EHP 7</td>
<td>F. 53 hearth, base of rim</td>
<td>4</td>
<td>27</td>
</tr>
</tbody>
</table>

*lab numbers not provided in reference publication from Prentiss et al. (2003c) (References: 1. Hayden (2000b); 2. Prentiss et al. (2000); 3. Prentiss et al. (2002); 4. Prentiss et al. (2003b)
CHAPTER FOUR

RESULTS

This chapter presents the faunal data collected during the 1999, 2001 and 2002 Keatley Creek excavation seasons. Several analyses will be presented in this chapter that will be utilized to construct a model for the economic life of Housepit 7. These analyses include a general comparison of mammal and salmon bones, a study of the richness of each rim level, taphonomic analyses to better understand both cultural and non-cultural processes affecting bone survivorship, and a study of density dependent element survivorship. At the end of this chapter I will present a rank order abundance analysis and a resource depression analysis to examine the possibility that changes in human subsistence occurred within the housepit. These data sets will be integrated along with the radiocarbon sample data and reviewed in Chapter 5 to create a new picture of economic changes throughout the life of Housepit 7 for the purpose of testing Hayden and Kusmer’s established economic model for the development and growth of large pithouse villages in the Lillooet Region and more specifically for the Keatley Creek site. The new model will be compared to Hayden’s economic chronology. If this new model duplicates Hayden’s model, it will then be argued that Housepit 7 did have an economy centered on salmon fishing that remained consistent throughout the life of the house. If the new economic chronology of the occupation of Housepit 7 disputes Hayden’s model, new implications will be discussed.

FAUNAL DATA

The goal of this section is to present the record of animal use by humans as deposited in the northwestern rim of Housepit 7 and excavated during the 1999, 2001,
and 2002 field seasons. The goal of this research is to determine the quantities of various species of fauna that were being consumed by inhabitants of Housepit 7 during its main occupation sequence, as well as how those animals were processed. Radiocarbon dating of the rim provided a stratigraphic occupation sequence for Housepit 7 and identified five major house occupation/construction time zones. These time zones were named Early Housepit 7 and Rims 1-4, and were utilized as the basic analytical units for this study.

There were multiple steps to the faunal analysis, as outlined in Chapter 3. Initial faunal analyses resulted in a breakdown of bones according to whether they were mammalian or salmonid. Further analysis of the more complete bones produced data detailing species, age, sex, and elements represented. Taphonomic processes were also recorded for each bone including evidence of heating, breakage and butchery, weathering, and other destructive processes such as animal gnawing and root etching. Figures 4-1 through 4-6 and Tables 4-1 through 4-5 present the data from these initial analyses, organized by rim level.
### Table 4-1: Identified Species and Elements - Early Housepit 7

<table>
<thead>
<tr>
<th>Unit</th>
<th>Seq.</th>
<th>Stratum</th>
<th>Lev.</th>
<th>Identification</th>
<th>Elements</th>
<th>NISP</th>
<th>MNM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDD</td>
<td>3</td>
<td>XXIII-1</td>
<td>1</td>
<td>Aves</td>
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87
Table 4-1: Identified Species and Elements - Early Housepit 7

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<td>NN</td>
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<tr>
<td>DDD</td>
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<td>Odocoileus sp.</td>
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<tr>
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<td>Spermophilus lateralis</td>
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Table 4-2: Identified Species and Elements - Rim 1

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<td>Odocoileus sp.</td>
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<tr>
<td>DDD</td>
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<td>XIII-2-15</td>
<td>Onchorynchus sp.</td>
<td>2 spines</td>
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Totals: | 2 | 2 |
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<th>Lev. Identification</th>
<th>Elements</th>
<th>NISP</th>
<th>MNI</th>
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<tr>
<td>DDD 3</td>
<td>XIII B-13</td>
<td>1</td>
<td>Aves</td>
<td>vertebra</td>
<td>1</td>
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<td>DDD 4</td>
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<td>2</td>
<td>Onchorhyncus sp.</td>
<td>salmon</td>
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<td>DDD 4</td>
<td>XIII B-15</td>
<td>2</td>
<td>Polygyra sp.</td>
<td>shell</td>
<td>1</td>
</tr>
<tr>
<td>GGG 14</td>
<td>XIII E-12</td>
<td>3</td>
<td>Castor canadensis</td>
<td>thoracic vertebrae, 115 rib/spines</td>
<td>116</td>
</tr>
<tr>
<td>GGG 14</td>
<td>XIII E-13</td>
<td>3</td>
<td>Premocharus</td>
<td>4 molar fragments</td>
<td>4</td>
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<tr>
<td>GGG 15</td>
<td>XIII E-12</td>
<td>1</td>
<td>Odocoileus sp.</td>
<td>3 vertebrae, 3 spines</td>
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<tr>
<td>HHH 13</td>
<td>XIII E-13</td>
<td>3</td>
<td>Aves</td>
<td>vertebra</td>
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<td>HHH 13</td>
<td>XIII E-14</td>
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<td>Polygyra sp.</td>
<td>shell fragment</td>
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**Table 4-3: Identified Species and Elements - Rim 2**

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<td>DDD 3</td>
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<td>2</td>
<td>right carpopetacarpus, right humerus</td>
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<td>DDD 4</td>
<td>XIII B-15</td>
<td>2</td>
<td>domestic dog</td>
<td>right fibula</td>
<td>1</td>
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<tr>
<td>GGG 14</td>
<td>XIII E-12</td>
<td>2</td>
<td>lower right third incisor, lower right first incisor, lower left first incisor, lower left second incisor</td>
<td>6</td>
<td></td>
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<tr>
<td>GGG 16</td>
<td>XIII E-14</td>
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<td>lower left second premolar</td>
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<td>GHH 13</td>
<td>XIII E-12-2-2</td>
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<td>premolar, 1 st mandibular molar, lower right third incisor</td>
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<tr>
<td>HHH 13</td>
<td>XIII E-12-2-2</td>
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<td>left posterior rib head, 6 rib fragments</td>
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<tr>
<td>GGG 13</td>
<td>XIII E-12</td>
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<td>Castor canadensis</td>
<td>3 tooth fragments</td>
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<td>GGG 13</td>
<td>XIII E-13</td>
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<td>beaver</td>
<td>4 molar fragments</td>
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<td>XIII E-14</td>
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<td>upper 1st incisor</td>
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<tr>
<td>HHH 14</td>
<td>XIII F-1</td>
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<td>Margaritifera falcata</td>
<td>clam</td>
<td>shell fragment</td>
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<td>XIII E-12</td>
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<td>proximal 3rd phalanx</td>
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**Totals:**

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89
Table 4-4: Identified Species and Elements: Rim 3

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<td>Canis familiaris</td>
<td>3rd phalanx</td>
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<td>domestic dog</td>
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<td>XIII E-1</td>
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<td>1 rib, 4 vertebrae, caudal vertebra, thoracic vertebra</td>
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<td>1 thoracic vertebra</td>
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Totals: 249 27
### Table 4-5: Identified Species and Elements - Rim 4

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<th>MNI</th>
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</table>
| RRR  | 1    | XIII-A  | 1        | Aves

**bird**

bone fragment

| FFF  | 1    | XIII C/F-1 | 1 | Canis familiaris

**canine**

| FFF  | 1    | XIII-F | 1 | domestic dog

cranial fragment

| FFF  | 1    | XIII-F | 1 | zygomatic arch fragment

| FFF  | 1    | XIII-F | 1 | maxilla and/or mandible fragments

| FFF  | 1    | XIII-F | 1 | petrosal fragment

| FFF  | 1    | XIII-F | 1 | incisor fragment

| FFF  | 1    | XIII-F | 1 | premolar fragment

| FFF  | 1    | XIII-F | 1 | tooth enamel fragment

| RRR  | 1    | XIII-C | 1 | patella

| BBB  | 1    | XIII-E | 1 | Castor canadensis

**incisor fragment**

| BBB  | 1    | XIII-L | 1 | beaver

**mandible/maxilla fragment**

| CCC  | 1    | XIII-A | 1 | tooth enamel fragment

| FFF  | 1    | XIII C/F-1 | 1 | molar fragment

| GGG  | 1    | XIII G | 1 | phalanx

| HHH  | 1    | XIII C/F-1 | 1 | rear 3rd phalanx

| QQQ  | 1    | XIII-B | 1 | distal tooth enamel

| QQQ  | 1    | XIII-C | 1 | tooth enamel

| FFF  | 1    | XIII-B | 1 | Margaritifera falcata

**valve fragment**

| III  | 1    | XIII C/F-1 | 1 | clam

**shell fragment**

| QQQ  | 1    | XIII-A | 1 | shell fragment

| BBB  | 1    | XIII-A | 1 | Odocoileus sp.

**femur fragment**

| BBB  | 1    | XIII-A | 1 | deer

**tibia fragment**

| EEE  | 1    | XIII-A | 1 | vertebra fragment

| FFF  | 1    | XIII C/F-1 | 2 | right 1st phalanx, 4 tooth enamel fragments

| FFF  | 1    | XIII C/F-1 | 1 | distal metacarpal process

| FFF  | 1    | XIII-F | 1 | 4 antler fragments

| FFF  | 1    | XIII-F | 1 | 2 scapula fragments

| FFF  | 1    | XIII-F | 1 | 2 long bone fragments

| FFF  | 1    | XIII C/F-1 | 2 | proximal phalange process

| III  | 1    | XIII C/F-1 | 2 | distal metacarpal fragment

| JJJ  | 4    | XIII C/F-1 | 1 | left naviculo-cuboid

| III  | 1    | XIII-A | 1 | tooth enamel

| RRR  | 1    | XIII-A | 1 | left radius, left lunate, left scaphoid, metapodial fragment, cranial fragment

| XXX  | 1    | XIII-A | 1 | atlas vertebra, 2 distal condyles

| BBB  | 1.5  | XIII-A | 1 | Oncorhyncus sp.

**salmon**

vertebra fragment

| BBB  | 1    | XIII-E | 1 | vertebra fragment

| FFF  | 9    | XIII C/F-1 | 2 | 1 vertebra

| FFF  | 9    | XIII C/F-1 | 2 | 1 vertebra

| FFF  | 14   | XIII C/F-1 | 1 | 37 vertebrae, 13 rib/spines

| FFF  | 14   | XIII C/F-1 | 2 | vertebra fragment

| FFF  | 14   | XIII C/F-1 | 1 | 1 vertebra

| FFF  | 15   | XIII C/F-1 | 1 | 1 vertebra

| FFF  | 15   | XIII C/F-1 | 1 | vertebra fragment

| FFF  | 15   | XIII C/F-1 | 1 | 5 vertebrae, 3 rib/spines

| FFF  | 16   | XIII-F | 1 | vertebra fragment

| FFF  | 16   | XIII-F | 1 | vertebra fragment

| FFF  | 16   | XIII-F | 1 | vertebra fragment

| GGG  | 13   | XIII-G | 1 | 1 vertebra

| HHH  | 14   | XIII-F | 1 | 1 rib/spine

| III  | 1    | XIII C/F-1 | 2 | 7 vertebrae

| III  | 1    | XIII C/F-1 | 1 | 27 vertebrae

| KKK  | 3    | XIII-A | 1 | unidentified

| PPP  | 1    | XIII-A | 1 | 4 thoracic vertebrae, 5 vertebrae

| PPP  | 1    | XIII-A | 2 | 2 vertebrae

| RRR  | 1    | XIII-A | 1 | thoracic vertebra, 1 vertebra

| UUU  | 3    | XIII-A | 1 | precaudal vertebra

| XXX  | 1    | XIII-A | 1 | 3 vertebrae, spine

| JJJ  | 4    | XIII C/F-1 | 1 | Oreamnos americanus

**mountain goat**

scapula head, rib fragment, long bone fragment

| FFF  | 9    | XIII C/F-1 | 1 | Ovis canadensis

**bighorn sheep**

right naviculo-cuboid, right proximal metatarsal, phalanx fragment, tooth fragment

91
Table 4-5: Identified Species and Elements - Rim 4

<table>
<thead>
<tr>
<th>Code</th>
<th>Site Code</th>
<th>Site</th>
<th>No.</th>
<th>Species</th>
<th>No. of Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFF</td>
<td>XIII C/F-1</td>
<td>1 Polygyra sp.</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FFF</td>
<td>XIII D-1</td>
<td>1</td>
<td>2 shells</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>FFF</td>
<td>XIII B-1</td>
<td>1</td>
<td>20 shells</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>HHH</td>
<td>XIII B-2</td>
<td>1</td>
<td>12 shells</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>HHH</td>
<td>XIII B-3</td>
<td>1</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>HHH</td>
<td>XIII C/F-1</td>
<td>1</td>
<td>9 shells</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>HHH</td>
<td>XIII C/F-1</td>
<td>2</td>
<td>2 shells</td>
<td>2</td>
<td></td>
</tr>
<tr>
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<td>XIII F-1</td>
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<td>25 shells</td>
<td>25</td>
<td></td>
</tr>
<tr>
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<td>XIII F-1</td>
<td>2</td>
<td>5 shells</td>
<td>5</td>
<td></td>
</tr>
<tr>
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<td>XIII F-1</td>
<td>2</td>
<td>7 shells</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>HHH</td>
<td>XIII F-1</td>
<td>1</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 1-4</td>
<td>2</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-4</td>
<td>1</td>
<td>5 shells</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-4</td>
<td>1</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-3</td>
<td>2</td>
<td>62 shells</td>
<td>62</td>
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<td>NNN</td>
<td>XIII 2-3</td>
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<td>121</td>
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<tr>
<td>NNN</td>
<td>XIII 2-4</td>
<td>1</td>
<td>9 shells</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-4</td>
<td>2</td>
<td>5 shells</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-2</td>
<td>1</td>
<td>2 shells</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-2</td>
<td>2</td>
<td>22 shells</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>NNN</td>
<td>XIII 2-3</td>
<td>1</td>
<td>1 shell</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Totals: 512 NISP 342 MNI
Figure 4-1

Relative Percentages of Mammal and Salmon Bones in the Housepit 7 Rim

- Early HP7
- Rim 1
- Rim 2
- Rim 3
- Rim 4
- Mammal
- Salmon

Figure 4-2

Number of Identified Economically Viable Species
Figure 4-3

Bone Modifications

![Bone Modifications Chart]

Figure 4-4

Behrensmeyer Degree of Weathering

![Behrensmeyer Degree of Weathering Chart]
Figure 4-5: Bone size ranges

Bone Size Ranges in Centimeters

Figure 4-6: Heat treatment of bones
Element Survivorship Analysis

In order to control for the differences in densities between salmon and mammal bones to ensure that noncultural factors, such as crushing, have not skewed the relative frequencies of mammal and salmon bones recovered from the rims, I have undertaken a density structured element survivorship analysis. This type of analysis, developed by Butler and Chatters (1993), ranks salmon bones according to their relative densities. The denser a bone is, the more likely it is to resist destruction from non-cultural agents, while a less dense bone (such as salmon crania) is more likely to be damaged or destroyed. Since mammal bones are much more robust and denser than fish bones, it is necessary to ensure that the patterns observed in the rim data are not the result of higher rates of salmon bone destruction in the upper rim levels. If we find a low correlation between bone density and element survivorship, we may be confident that the trends observed are real. To do this analysis, I will compare the rank order density values (Butler and Chatters 1993) with rank order survivorship (%MAU) of salmon remains in the Housepit 7 rim.

Table 4-6 lists the mean volume density and bone mineral content of salmon elements subjected to photon absorptiometry to measure the mineral content of each bone (Butler and Chatters 1993). The samples analyzed were from 10 Chinook salmon (Oncorhynchus tshawytscha) carcasses. It is assumed that density values obtained from these samples may be applied to prehistoric samples and other salmonid species for two reasons. First of all, skeletal elements of salmonid species are very similar; and secondly, the carcasses used represented a wide size range, encompassing the sizes of all anadromous Pacific salmon species (Butler and Chatters 1993).
Table 4-6: Mean volume bone density (VD) and bone mineral content (BMC) of salmon elements (Butler and Chatters 1993).

<table>
<thead>
<tr>
<th>Element</th>
<th>N</th>
<th>VD (g/cm$^3$) S.D.</th>
<th>BMC (g) S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular</td>
<td>10</td>
<td>0.20</td>
<td>0.23</td>
</tr>
<tr>
<td>Ceratohyal</td>
<td>8</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>Dentary</td>
<td>10</td>
<td>0.19</td>
<td>0.12</td>
</tr>
<tr>
<td>Exoccipital</td>
<td>9</td>
<td>0.11</td>
<td>0.17</td>
</tr>
<tr>
<td>Maxilla</td>
<td>10</td>
<td>0.20</td>
<td>0.24</td>
</tr>
<tr>
<td>Opercle</td>
<td>7</td>
<td>0.07</td>
<td>0.02</td>
</tr>
<tr>
<td>Otolith</td>
<td>10</td>
<td>1.41</td>
<td>0.07</td>
</tr>
<tr>
<td>Pterotic</td>
<td>8</td>
<td>0.12</td>
<td>0.17</td>
</tr>
<tr>
<td>Coracoid</td>
<td>10</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>Pectoral fin ray</td>
<td>9</td>
<td>0.29</td>
<td>0.03</td>
</tr>
<tr>
<td>Basipterygium</td>
<td>10</td>
<td>0.11</td>
<td>0.05</td>
</tr>
<tr>
<td>Vertebra type-1</td>
<td>8</td>
<td>0.27</td>
<td>0.09</td>
</tr>
<tr>
<td>Vertebra type-2</td>
<td>10</td>
<td>0.31</td>
<td>0.12</td>
</tr>
<tr>
<td>Vertebra type-3</td>
<td>10</td>
<td>0.34</td>
<td>0.16</td>
</tr>
<tr>
<td>Vertebra type-4</td>
<td>10</td>
<td>0.30</td>
<td>0.08</td>
</tr>
<tr>
<td>Hypural</td>
<td>10</td>
<td>0.14</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Density of most of the postcranial elements, and in particular the vertebrae, far exceed that of the cranial elements, except for the otolith. Within the cranium, density of the jawbones (angular, maxilla, dentary) is higher than flat bones such as the hyoid and gill cover (ceratohyal, opercle) and the spongy bones of the neurocranium (exoccipital,
pterotic). With the paired fin elements, the densities of the coracoid and basipterygium are relatively low, while the pectoral fin ray has a density as high as that of the vertebrae (Butler and Chatters 1993). So, all things being equal, the vertebrae should survive destruction much better than most cranial bones. If cranial bones or other low-density bones are found in the Housepit 7 rim assemblage, we can assume a fairly good state of assemblage preservation.

Figure 4-7: Salmon element volume density (VD), excluding otolith, which has a VD of 1.41 (Butler and Chatters 1993).

There is an expectation that there will be a low correlation between bone density and element survivorship throughout the Housepit 7 rim due to the fact that the specimens recovered from all excavation levels were well preserved, with many fragile neurocranial elements being found nearly complete, suggesting that bone destruction since the time of deposit has been minimal.
Table 4-7: Number of identified salmon specimens (NISP), Housepit 7 Rim

<table>
<thead>
<tr>
<th>Element</th>
<th>NISP - Early HP?</th>
<th>NISP - Rim 1</th>
<th>NISP - Rim 2</th>
<th>NISP - Rim 3</th>
<th>NISP - Rim 4</th>
<th>Single Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular*</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Ceratohyal*</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Coracoid*</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pectoral fin rays*</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Basipterygium*</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Vertebral 1*</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Vertebral 2*</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Vertebral 3*</td>
<td>23</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>Vertebral 4*</td>
<td>15</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Urohyal</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
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<td>Symplectic</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
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<td>Interhyal</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pharyngobranchial</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Mesocoracoid</td>
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<td>1</td>
<td>0</td>
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<td>Sphenotic</td>
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<td>0</td>
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<td>Basibranchial</td>
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<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<td>Radial</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Ribs/Spines</td>
<td>520</td>
<td>2</td>
<td>355</td>
<td>108</td>
<td>17</td>
<td>X</td>
</tr>
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<td>Misc. Cranials</td>
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<td>0</td>
<td>19</td>
<td>6</td>
<td>0</td>
<td>X</td>
</tr>
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<td>Unid. Vertebrae</td>
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<td>0</td>
<td>75</td>
<td>72</td>
<td>99</td>
<td>72</td>
</tr>
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<td><strong>Total</strong></td>
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<td><strong>478</strong></td>
<td><strong>192</strong></td>
<td><strong>122</strong></td>
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</table>

*Elements included in element survivorship analysis.

Table 4-8: Rank order salmon bone volume densities compared with element survivorship (MAU) in the Housepit 7 rim.

<table>
<thead>
<tr>
<th>Element</th>
<th>VD Rank</th>
<th>Early HP?</th>
<th>Rank</th>
<th>Rim 1</th>
<th>Rank</th>
<th>Rim 2</th>
<th>Rank</th>
<th>Rim 3</th>
<th>Rank</th>
<th>Rim 4</th>
<th>Rank</th>
</tr>
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<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Vert. 3</td>
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<td>2</td>
<td>49.3</td>
<td>2</td>
<td>n/a</td>
<td>25.8</td>
<td>5</td>
<td>100.0</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
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<td>91.7</td>
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</tr>
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<td>Vert. 4</td>
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<td>6</td>
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<td>6</td>
<td>96.9</td>
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<td>1</td>
</tr>
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<td>Fin ray</td>
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<td>0</td>
<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>17.6</td>
<td>7</td>
<td>90.8</td>
<td>3</td>
<td>0</td>
<td>3.07</td>
</tr>
<tr>
<td>Vert. 1</td>
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<td>100.0</td>
<td>1</td>
<td>0</td>
<td>n/a</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
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<td>7.11</td>
<td>n/a</td>
<td>100.0</td>
<td>1</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
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<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Dentary</td>
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<td>0</td>
<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Hypural</td>
<td>10</td>
<td>0</td>
<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Pterotic</td>
<td>11</td>
<td>0</td>
<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
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</tr>
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<td>Exoccipital</td>
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<td>7.11</td>
<td>n/a</td>
<td>0</td>
<td>8.11</td>
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<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Basipterygium</td>
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<td>4.33</td>
<td>0</td>
<td>n/a</td>
<td>50.0</td>
<td>2.5</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
</tr>
<tr>
<td>Opercle</td>
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<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
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<td>0</td>
<td>4.33</td>
<td>0</td>
<td>n/a</td>
<td>50.0</td>
<td>2.5</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
<td>3.07</td>
</tr>
<tr>
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<td>0</td>
<td>n/a</td>
<td>8.11</td>
<td>0</td>
<td>4.08</td>
<td>0</td>
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rs=0.04
rs=-0.20

99
As shown in Table 4-8, the correlation between density and survivorship is low and insignificant for all rim levels that were tested (Early HP 7: $r_s=0.28$, Rim 2: $r_s=0.27$, Rim 3: $r_s=0.04$, Rim 4: $r_s=-0.20$, with $P=0.503$ where $\alpha=0.05$), which supports the expectations. Rim 1 was not tested in this analysis due to the fact that none of the bones recovered from that context were included in the density analysis conducted by Butler and Chatters (1993). Therefore, we can conclude that the differential proportions of salmon bones present in the various rim levels of Housepit 7 cannot be explained by differential destruction based on element density, but rather are a result of human activities taking place within the house.

**Figure 4-8: Salmon element survivorship (% MAU), including elements with density values.**
Rank Order Abundance Analysis

The next analysis performed on the faunal materials applies the Diet Breadth or Optimal Diet Model (Madsen and Schmitt 1998; Stevens and Krebs 1986). This model is derived ultimately from economic theory and is grouped under the rubric of “Optimal Foraging Theory,” which is used to explain behaviors such as differential transport, field processing, differences in resource utilization, and the transition to agriculture (Madsen and Schmitt 1998). I will utilize this model to determine whether variations in human subsistence strategies took place throughout the life of Housepit 7.

The Diet Breadth model predicts that a forager will pursue and take a prey type (to be included in the diet) only if the return rate (the amount of energy acquired from consumption of the prey minus the amount of energy needed to pursue, attack, and
process the prey), is as high or higher than the average return of searching for and
handling other higher ranked potential prey types (Madsen and Schmitt 1998).
Therefore, the model predicts that a prey type will be included in the diet only when the
abundance of higher ranked types decreases to the point where it is economically viable
to take prey types with lower return rates. This usually means that the body size of an
individual prey item is correlated with its return rate; in other words, bigger body equals
higher rank. However, when resources are collected in mass, this change in abundance
can dramatically affect the diet rank. When mass collecting is used, such as when mass
quantities of fish are caught in nets, population density may, to a large part, determine the
overall return rate for a resource (Madsen and Schmitt 1998).

Figure 4-10: Rank order abundances of faunal materials by rim level at Housepit 7.
Generally, “when the abundance of many lower ranked resources increases, particularly mass collected resources, so too does their ranking in the diet as they become higher ranked prey types. It follows then, that higher ranked food types can be displaced from the diet with no change in their actual abundance” (Madsen and Schmitt 1998:447).

Figure 4-10 presents the ranks of mammal, salmon, and other bones recovered from the various rim contexts in Housepit 7. I have excluded Rim 1 due to the fact that only two bones from that level were included in the NISP tallies. Remains of small, burrowing animals are likely intrusive, and are not included in the analysis. Although each stratum contains the remains of large mammal, small mammal, and salmon, the frequencies of particularly the large mammal and salmon seems to have an inverse relationship, suggesting that a prominent shift in human subsistence may have occurred ($r_s=0.175$ with $P=1.00$ where $\alpha=0.05$).

**Resource Depression Analysis**

The next analysis explores the possibility of resource depression at Keatley Creek. There is evidence from other parts of the world that human foragers can greatly affect the animal and plant populations that they exploit (Broughton 1997; Butler 2000). It is reasonable to hypothesize that growing populations constrained in a relatively sedentary adaptation might deplete local food resources, forcing human foragers to adapt their prey choices by shifting resource selections. To explore a possible change in resource selection, I again draw on the prey choice model to derive expectations about resource selection and subsistence change that might result from changes in foraging pressure.
The theory here is that during the initial phases of human occupation, foragers will exploit the highest ranked resources. As human population size increases, predation pressure increases and the supply of locally available, high-ranked resources declines (Butler 2000). While foragers could theoretically travel to distant locations to procure higher-ranked resources, the overall declines in mobility and the increase in territoriality that comes with population growth creates a situation in which mobility may not be an option. Also, if population growth occurs on a regional scale, higher-ranked resources may be depleted on a region-wide scale. Furthermore, even if higher-ranked resources were available in distant areas, the costs of transporting those resources over long distances would need to be measured against the costs of using local, lower-ranked resources. Therefore, it is predicted that as the availability of high-ranked resources declines, human foragers would shift to collecting lower and lower ranked resources (Butler 2000).

Our expectations at Keatley Creek, based on Hayden’s conclusions, would be that salmon, which in this case would be the highest ranked species due to the effects of mass collecting, should remain fairly steady throughout the life of Housepit 7, that is, the ratio of salmon to mammal (high-ranked resource to low-ranked resource), should remain unchanged.

The mammal/salmon index in table 4-9 provides a ratio of mammals to salmon. The larger the ratio, the greater the contribution of mammals to the diet: [sum of] NISP mammal/[sum of] NISP mammal + [sum of] NISP salmon. I tested to ensure that the ratios obtained for the rim assemblages were not affected by sample size; the two variables are not related ($r_s=-0.40, P=0.900$ where $\alpha=0.05$).
Table 4-9: Mammal/Salmon Index

<table>
<thead>
<tr>
<th>Rim Level</th>
<th>Mammal/Salmon Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early HP 7</td>
<td>0.029</td>
</tr>
<tr>
<td>Rim 2</td>
<td>0.064</td>
</tr>
<tr>
<td>Rim 3</td>
<td>0.239</td>
</tr>
<tr>
<td>Rim 4</td>
<td>0.297</td>
</tr>
</tbody>
</table>

Figure 4-11: Mammal/Salmon Index

Therefore, we find that the expectations for Keatley Creek were not met, but instead match the resource depression model outlined by Butler (2000).
RESULTS SUMMARY

The 1999, 2001 and 2002 University of Montana investigations of Housepit 7 at the Keatley Creek site unearthed a complex timeline of the life of Housepit 7 spanning hundreds of years. The data recovered included a wide variety of faunal remains documenting a history of household economics. The earliest rim sediments from Early Housepit 7, Rim 1, and Rim 2 display a subsistence pattern heavily focused on the consumption of salmon. The later rim deposits from Rim 3 and Rim 4 show a marked trend toward increasing reliance on mammalian resources and a general broadening of the diet. The observed trends in the faunal data seem to be real, and are not a result of differential levels of density mediated destruction in the upper rim levels, nor does there appear to be a marked difference in weathering throughout the Housepit 7 rim.
CHAPTER FIVE
DISCUSSION

In this chapter, I construct a new economic chronology for Housepit 7 by integrating the various sets of faunal data. There will be a discussion about possible cultural and non-cultural influences on the economics within Housepit 7. The chapter will conclude with a comparison of the new economic sequence and Hayden’s established economic profile.

THE NEW FAUNAL PROFILE FOR HOUSEPIT 7

The University of Montana investigations at Housepit 7 uncovered a complex rim sequence comprised of the refuse from hundreds of years of occupation of the housepit. These rim levels were so well preserved that even individual basket load dumps could be identified. When dated, it was found that these rim deposits tracked the life of the house from its earliest conception to its final abandonment. This rim sequence was able to give us a snapshot of the entire life span of Housepit 7.

The earliest Housepit 7 rim level is known as Early Housepit 7 (EHP7). This rim context dates to 1710-1299 cal B.P., with the earliest date occurring at 1710-1518 cal. B.P. Although earlier dates were collected by Hayden for Housepit 7, those dates are derived from materials excavated in unconsolidated rim or pit fill that are, by definition, secondary contexts (Hayden 2000b). Therefore, the set of dates stated above, which were recovered from features in sediments at the base of the rim, are the most dependable early dates for Housepit 7.

Almost 60% of the 2,392 bones recovered from EHP 7 were salmon bones, with the majority of the remainder of the bones being mammal bones. The faunal assemblage
from this rim level was moderately rich, with six individual non-intrusive species being identified, excluding likely intrusive species such as deer mouse (*Peromyscus maniculatus*) and non-cultural species such as land snails (*Polygyra sp.*). All of the salmon that were x-rayed from EHP 7 were pink salmon (*Oncorhyncus gorbuscha*). Therefore, although the diet for the earliest inhabitants of Housepit 7 was focused on salmon, within this rim level we see the greatest dietary balance with a wide range of small and large mammals making a significant contribution to the faunal profile.

The faunal deposits within EHP 7 were shown to be well preserved, with over 70% of the bones having a Behrensmeyer weathering score of either 1 or 2. Additionally, non-cultural bone modification occurred in less than 1% of the bones. A high percentage of the bones were fractured, almost 95%, indicating that the bones had been heavily damaged during processing, consumption, or post consumption pre-burial. Very few of the bones had obvious cutmarks, crushing, or abrasion. The correlation between salmon bone density and element survivorship for EHP 7 is low and insignificant (*r_s*=0.28, *P*=0.503). Throughout the Housepit 7 assemblages it was observed that the majority of bones that had been heat-treated were mammal bones, while the majority of unheated bones (yellow bones), were salmon bones. This characterization holds true for EHP 7, where nearly 60% of the bones recovered were salmon bones, and approximately 55% of the bones recovered were unheated. Of the remaining bones, there is a fairly even distribution of heating, ranging from 300-1000 degrees Celsius. Over 70% of the bones recovered fell into the smallest size range, which is not surprising given the large percentage of salmon bones recovered. The mammal bones excavated were heavily broken, and no bones larger than 5.9 centimeters in maximum length were found. The
taphonomic analysis for the bones recovered form EHP 7 displays bones that are well
preserved yet highly processed, with the majority of bones having been broken regardless
of species, and the bones being heat treated according to type, with mammal more likely
to have been heated than salmon.

Rim 1 is the next level of rim construction for Housepit 7, lying stratigraphically
just above EHP 7, and dating to sometime between 1299 and 1345 cal. B.P. As was
stated previously, only 26 bones were recovered from Rim 1, making the faunal data
collected from this rim level difficult to analyze and compare with the rest of the rim
sequence. I have included analysis for Rim 1 when possible, but excluded it from some
analyses due to a lack of specific types of identified bones needed to complete the
analysis (ex. bone density analysis).

We see a change in Rim 1 from EHP 7 with over 75% of the bones recovered
coming from mammals, and the entire remainder from salmon. However, due to the very
small sample size from this context, it is difficult to draw conclusions from these data.
The faunal assemblage from Rim 1 was the least rich of all the rim levels, with only two
species being positively identified – deer and salmon.

The taphonomic analysis of the Rim 1 assemblage indicates that the bones from
this context have a slightly higher degree of weathering than in the other rim levels, with
50% of the remains having a Behrensmeyer score of 2 and 50% with a score of 3.
However, these scores still indicate very good overall bone preservation. Due to the fact
that none of the elements required for the salmon element survivorship analysis were
recovered from Rim 1, it was impossible to complete this study. Non-cultural bone
modification did not seem to be a factor in Rim 1. However, over 90% of the bones were
broken and nearly 20% displayed crushing. Approximately 90% of the bones recovered were less than one centimeter in maximum size. These data may indicate that mechanical destruction could account for the low numbers of salmon bones recovered from this context. Additionally, as the majority of remains recovered were mammalian, the very small size of the bones correlates with the indications of a very high degree of processing taking place in this context. This conclusion is supported by the heat treatment data which shows that over 65% of the bones from Rim 1 were burned either gray or completely calcined, indicating that the bones were heated to very high temperatures between 600 and 1000 degrees Celsius.

A much larger sample of bones was recovered from Rim 2, making it easier to analyze and draw conclusions from. A total of 1,159 bones were recovered from Rim 2, which lies just above the SHP 1 floor dated to 1345-1176 cal B.P. We see a classic picture of salmon intensification in this context with nearly 76% of the remains coming from salmon and another 23% from various mammals. As we saw with EHP 7, all of the salmon vertebrae that were analyzed for species were found to be pink salmon (*Oncorhyncus gorbuscha*). The richness score for Rim 2 is the same as that for EHP 7, with six non-intrusive species being identified, making this context a moderately rich one, although still heavily weighted toward salmon consumption.

Taphonomic analysis of the Rim 2 faunal assemblage displayed a high degree of preservation, with 80% of the remains falling into the Behrensmeyer 2 category, and the remaining 20% split between the 3 and 4 scores. Non-cultural bone modification had a very small impact on this context, with only 1% of bones displaying root etching. As with the previous rim levels, bone breakage was significant, affecting over 98% of the
assemblage. Crushing was most prominent in Rim 2 with almost 57% of the bones showing signs of having been crushed. However, this context also displayed the largest range of bone sizes. Although the majority of bones were under 1.0 cm in size, nearly 25% of the bones were larger than 1.0 cm, and the largest bone recovered from the UM excavations, over 12.0 cm in size, came from Rim 2. The correlation between salmon bone density and element survivorship in this context was again low and insignificant ($r_s=0.27$, $P=0.503$). Bone heating was fairly minimal in this rim level, with over 80% of the bones left unheated, and the remaining 19% of the bones fairly evenly distributed between the remaining color categories. In all, within Rim 2 we get a taphonomic picture of a bone assemblage that is well preserved although it has been moderately to heavily processed, with many bones being broken and crushed, but relatively few that have been heated, and a higher proportion of large bones than found in other areas of the rim.

The next rim level is Rim 3, which lies just above the SHP 4 floor on the northwestern outer rim of Housepit 7, and has been dated to 1306-1060 cal. B.P. This rim context included 1,161 bones. We see a major shift in economic focus from Rim 2 to Rim 3 with over 62% of the faunal remains being mammalian and only 33% coming from salmonids. There is also an increase in the richness of this rim level, with eight non-intrusive species being positively identified, and a heavier focus on large game being seen with three large game species occurring. In the previous rim levels only one large game species was identified per context.

There are some corresponding shifts in the taphonomy of Rim 3 as well. The bones recovered from this context show a similar distribution of weathering to what we have seen previously, with nearly 95% of the remains having a Behrensmeyer score of
either 2 or 3. However, there is a greater range of weathering displayed in Rim 3, with bones falling into each of the five weathering categories. Non-human modifications remain low for Rim 3, with less than 1% displaying affects from these factors. Bone breakage remains high, with over 95% of bones having been broken, although crushing is greatly reduced from the previous rim level. The remains from Rim 3 are slightly smaller than seen in either EHP 7 or Rim 2, with over 78% being less than 1.0 cm in maximum size, and fewer remains than in previous contexts being found that are larger than 2.9 cm.; the largest bone recovered from Rim 3 was over 9.0 cm long. Once again, we see that the correlation between salmon bone density and element survivorship for Rim 3 is low and insignificant ($r_s=0.04$, $P=0.503$).

In the heat treatment data that we see the largest taphonomic shift, with a much greater distribution of burned bone being recovered. Unlike the earlier rims, the percentage of yellow bone in Rim 3 is reduced to less than 25%, with the remaining bones distributed between the other colors, and the highest percentage observed, nearly 38%, being completely calcined. Therefore, there at first appears to be a shift in the animal processing techniques utilized in Rim 3. However, this change actually seems to be a result of the shift in the type of animals being taken, with the differences in processing techniques for mammals versus salmon becoming more apparent here with the accompanying shift in diet.

The final rim level, Rim 4, contained 2,302 bones, and spans the time range of 1303 to the abandonment of Housepit 7, which likely occurred between 877 and 795 cal B.P. (Prentiss et al. 2003c). In Rim 4 there is a continuation of the many of the trends that we saw beginning in Rim 3. Over 75% of the bones recovered from Rim 4 were
mammalian, a mere 7.5% were salmon, with the remaining 17.5% of bones came from various other species, including birds and mussels. This represents an astounding drop in the significance of salmon to the diet compared to the earlier rim contexts. Once again there is an increase in the richness of the faunal assemblage, with nine non-intrusive species having been identified. The number of identified large game species remains the same within this level as was seen in Rim 3.

The taphonomy of the faunal remains recovered from Rim 4 seemed to differ somewhat from the previous rims. The bones from this context were weathered to a slightly greater degree, with just over 92% of the bones being weathered to Behrensmeyer stages 1, 2, and 3, and nearly 7% displaying a Behrensmeyer score of 4. Although these scores indicate a good general level of bone preservation, the increased occurrence of bone splintering and wear could be attributed to the proximity of the Rim 4 deposits to the ground surface, increasing the likelihood of weathering.

Non-human bone modifications were also more frequent within this context, with 8.5% of the remains displaying root etching, and 0.3% of the assemblage showing evidence of rodent gnawing. While these numbers are still fairly low, they are the highest levels of non-human modifications encountered during this study. The correlation between salmon bone density and element survivorship is once again low and insignificant, and in fact is a negative correlation ($r_s=-0.20$, $P=0.503$). There is a shift in the level of cultural bone modification, with only 78% of the bones from this context displaying breakage, a drastic drop from earlier rims. The amount of crushing remains much the same as in Rim 3 with approximately 14% of the assemblage being affected. About 1% of the bones from Rim 4 showed evidence of cut marks, the highest percentage
found throughout the rim. There is a fairly wide range of bone sizes recorded for Rim 4, which is comparable with the other rim contexts; 75.9% of the remains were less than 1.0 cm in size, and the largest bone was between 8.0-8.9 cm in maximum size.

There is an interesting change in bone heating occurring within this rim level. In the other rims the percentage of heated and unheated bones seems to be respectively tied with the percentages of salmon and mammal bones. However, within Rim 4 this does not seem to be the case. Here we find that although only 7.5% of the assemblage was composed of salmon bones, 63.6% of the bones remained unheated. When this heat treatment data is combined with the reduction in bone breakage, there is an indication that there may have been a shift away from more destructive processing techniques during this time period, such as heavy breakage and intensive heating of bones.

When applying Optimal Foraging Theory and in particular the Prey Choice Model to the data obtained from the Housepit 7 rim construction sequence, there are some interesting results. Examining the rank order abundances of the various prey types obtained from Housepit 7, we find that salmon and mammal resources seem to display a fairly inverse relationship, with the rank of salmon falling steadily throughout the life of Housepit 7. The resource depression analysis confirms these results, displaying that the economic importance of mammalian resources increases dramatically over the course of the occupation of Housepit 7, while the use of salmon markedly decreases. The results from these two analyses strongly support the hypothesis that there was a prominent shift in dietary economics over the life of the house, with salmon having a lower and lower significance in the diet of the inhabitants of Housepit 7 and mammals, especially large game, taking on increased importance.
When examining the taphonomic data sets for the rim construction levels, some interesting patterns become apparent. In general, we find that mammal bones in particular were subjected to heavy processing including bone breakage and intensive heating. Throughout most of the Housepit 7 rim, the percentage of heat-treated bone is highly correlated with the percentage of mammal bone present in each rim context. This fact can account for the seeming shift in processing that is seen in Rim 3, when the amount of burned bone increases dramatically from the previous rim levels. When correlated with the number of mammal bones present within this context there does not seem to be any real shift in processing, rather the numbers reflect a shift in diet. The one exception to this pattern is in Rim 4, where an actual change in processing does seem to take place. Here we find that although a very high percentage of mammal bones were recovered (over 75% of the assemblage) the percentage of burned bones is quite low, with only 36.4% of the assemblage having been heated.

Along with the heat treatment of the bones, another major constant throughout the life span of house is the very small size of the bones. A high frequency of fracturing persists throughout the Housepit 7 rim, even in the upper rim levels where the number of salmon bones cannot account for the number of bones recovered that are less than 1.0 cm in size. This indicates that either natural or cultural processes were significantly fragmenting and reducing the size of the bones found in the northwest rim of Housepit 7. However, as with the data for bone heating, we see a shift in Rim 4 occur with a dramatic drop in the percentage of fractured bones, down from over 90% breakage in all previous rim levels to only 78% breakage in this context. When combined with the data for bone
heating, there is a strong case for a shift in processing occurring during the late stages of occupation at this housepit.

I hypothesize that the data for EHP7, Rim 1, Rim 2 and Rim 3 may suggest extensive bone breakage for the purposes of grease production. The calorific value of fat is much higher than that of protein or carbohydrate, by a ratio of 9:4, and bone marrow and cancellous bone are both excellent sources of bone grease (Outram 2000). As noted in Binford’s (1978) study of the Nunamiut, the intensity of bone marrow and grease exploitation is often closely linked to the levels of subsistence stress. In sedentary winter villages such as Keatley Creek where people would intensively rely upon animal products with few sources of carbohydrates, fat sources would be especially important. This is due to the fact that protein is not easily metabolized in the absence of carbohydrate or fat, and eating lean meat in large quantities can lead to severe illness without the inclusion of fat in the diet (Speth and Spielmann 1983).

Ethnographic accounts indicate that when processing bone for grease production the articular ends and axial elements would be smashed into very small pieces and then either boiled in water to allow the fat to float to the top to be skimmed off or directly heated over a fire to facilitate in further cracking and breakup of the bone for easier fat extraction (Binford 1978; Outram 2000). The resulting bone fragments would create an assemblage largely composed of shaft splinters and small chunks, comminuted cancellous bone, and bones displaying the effects of intensive heating. In short, this type of processing could have lead to the type of deposits recovered from Housepit 7. Therefore, the drop in bone breakage and heat treatment seen in Rim 4 could be a result of a decreased need for heavy extraction of marrow and grease from bones, perhaps due
to a general rise in the quality and breadth of the diet, including increased consumption of carbohydrates such as roots and other plant foods, and a lowered level of subsistence stress.

A COMPARISON OF THE NEW AND ESTABLISHED ECONOMIC MODELS FOR HOUSEPIT 7

The established economic model for Housepit 7 is based upon the excavation of its final occupation and roof surfaces. The hypothesis presented by Hayden and Kusmer is that the density and diversity of faunal remains in the housepits at Keatley Creek correlates with the size of the housepit (Kusmer 2000b). The larger the housepit is, the denser and richer the faunal deposit. Additionally, it is maintained that salmon were the primary dietary element, although in the larger houses mammal makes up a greater portion of the diet than in small or medium sized houses. It is hypothesized that differential access to salmon species took place due to the fact that four and five year spawning salmon were found in much higher proportions in large houses than in medium and small sized houses, where mainly two year spawning salmon (*Oncorhyncus gorbuscha*) were recovered. Hayden further argues that a catastrophic reduction in the availability of salmon resources caused Housepit 7 and indeed the entire Keatley Creek site to be abandoned (Hayden 1997).

The new economic model presented here indicates that the differences in subsistence noted by Hayden could be accounted for temporally. That is, the faunal deposits are richer based on the time period in which the deposits were created, with mammal resources contributing to a larger portion of the diet during the later stages of occupation at the site, and salmon having primary importance during the earlier stages of
occupation. The presence of salmon species other than pink salmon (*Oncorhyncus gorbuscha*) occurs only on the final occupation floors excavated by Hayden. All of the salmon remains recovered from the University of Montana excavations of the Housepit 7 rim that were examined for species type proved to be two-year spawning pink salmon. Thus it seems likely that the presence of many of the four and five year spawners at Keatley Creek may be a result of those deposits being created during the final occupation phase at the site, and not a consequence of differential access to resources.

As for the abandonment of the site, the general trend of decreasing importance of riverine resources throughout the Housepit 7 rim makes it unlikely that the house would have been abandoned due to a lack of available salmon. On the contrary, along with the increased consumption of mammalian resources during the late stages of the rim, we also observe indications of decreasing subsistence stress, possibly indicating a healthier and better-fed population. It is likely that a shift towards increased mammal consumption would likely have meant an increase in pursuit and labor times as opposed to the mass harvest of the greater numbers of salmon seen in the earlier occupation levels. However, it seems the additional work required in pursuing a more land-based consumptive pattern may have paid off with a broader and healthier diet of a wide range of resources including large and small game, salmon, and perhaps also increased levels of roots and other plants. However, the increased pursuit times and larger ranges that would be required for a diet focused on game resources may have made semi-sedentary villages maladaptive. While the village would be a good place to defend resources and a valuable base of operations when harvesting large quantities of salmon, if the primary resource focus shifted away from the river, the village would become less and less important.
With people ranging farther away from the village in the pursuit of game and other terrestrial resources, the strain and extra effort of constantly having to bring resources back to the village over long distances could quickly become tiresome and a waste of energy and resources. As salmon resources continued to decline in importance, it is arguable that increasing numbers of people would decide to abandon the village in favor of a more mobile hunter-gatherer lifestyle, eventually leading to total village abandonment. Therefore, I argue that the abandonment of Housepit 7 may be better linked to changing resource use patterns rather than a clear-cut case of resource depression.

DISCUSSION SUMMARY

My argument here is that the economics of Housepit 7 were dynamic – changing and adapting throughout the occupation of the house. Although during the earliest period of occupation the diet was fairly narrow and focused on the consumption of salmon, the later stages of occupation were marked by increasing dietary breadth, a significant rise in the importance of mammalian resources, and an increase in the overall quality of the diet.

However, it must be kept in mind that this research is based on the excavation of a single trench in a single house at a single site. Obviously, further testing of this faunal profile by considering other houses and other sites would be very beneficial. In particular, the examination of other archaeological sites in the area would contribute much to an understanding of the economics of the region as a whole.
CHAPTER SIX
CONCLUSIONS

SUMMARY OF RESEARCH

This study was undertaken to test Hayden’s hypothesis regarding household economy and resource choices at Keatley Creek by examining the history of the occupation of Housepit 7 utilizing faunal data collected during the University of Montana’s 1999, 2001, and 2002 field investigations. A complete profile of the Housepit 7 rim has been analyzed, expanding the extant economic model for Housepit 7 to include all occupation phases for the house. The new model is based on reliably dated charcoal samples from hearths and floors, and spans the latter portion of the Plateau horizon and extends into the first half of the Kamloops horizon.

We find that the initial stages of the occupation of Housepit 7 are characterized by a heavy reliance on riverine resources, and in particular pink salmon (Oncorhyncus gorbuscha), which was the only species of salmon recovered throughout the northwest rim; no three to five year spawning salmon were found during these excavations. Small mammals contributed a small part of the diet during the early occupation. Mammal resources were heavily processed by bone breakage and heating, perhaps in order to extract further resources from the bones such as marrow and grease. However, moving into the later stages of occupation, we find that ca. 1300 B.P. there is a shift in diet with less salmon being consumed and large game becoming a much more prominent factor in the diet. In the last rim level prior to abandonment, mammals are the primary focus of the diet, and there is a downgrade in the level of processing, with a much lower
percentage of mammal bones being broken or heated, indicating a drop in the level of
dietary stress.

PARALLEL LINES OF EVIDENCE

The economic hypothesis advanced by Hayden was based on several lines of
evidence comprised of the fauna, which has been the focus of this research, as well as
data obtained from research into the use of ethnobotanicals, lithics, and prestige artifacts.
I will briefly address these other lines of evidence as related to the University of Montana
excavations of Housepit 7, as well as evidence from root roasting pits and fire history,
presenting a possible explanation for the economic changes observed during the
occupation of the house.

Ethnobotanicals

The overall quantity of organic matter recovered from the Housepit 7 rim samples
is notable, and exhibits some distinct trends (Lyons 2003). The predominant pattern
throughout the rim deposits is one of a gradual increase of botanical content. There is a
general increase between rims in the numbers of charred and uncharred seeds, seed
richness, and densities of seeds and charcoal (Lyons 2003). The plant assemblage
recovered from Rim 1 is slightly richer but still similar to that observed in Rim 2. There
is a clearer increase between Rim 2 to Rim 3, followed by a major shift in Rim 4, which
appears to represent a period of unprecedented deposition of plant remains, both in terms
of diversity as well as volume (Lyons 2003). This pattern parallels the evidence from the
faunal record, indicating that some of the factors that favored an increased reliance on
mammalian resources also favored the collection of plant resources.
Lithics

Lithic analyses revealed temporal variations in patterns of tool production, use, and discard (Prentiss et al. 2000). The first major change observed throughout the lifespan of Housepit 7 is technological. Although Sub-Housepit 3 contained one large dart point, all the subsequent strata from the rims contained smaller arrow points (Prentiss 2002). By the latest rim contexts, arrow points of the Kamloops horizon type predominate. From this evidence, it would seem that bow and arrow technology became prominent at approximately the same time as the aggregation of housepits at Keatley Creek occurred.

The second observed change in lithic patterns is with the organization of lithic technology (Prentiss 2002). The early Housepit 7 and pre-Housepit 7 technologies reflect the typical Plateau winter-village pattern of expedient flake tool production from small hand-held and bipolar cores along with frequent use of sandstone abraders. Bifaces and formal unifaces are present in small quantities. However, there is a shift in this pattern that occurs during the later rim phases of Rims 3 and 4. In these contexts we find that while flake tool production continues, there is a substantial increase in the production of formal bifaces and unifaces such as endscrapers (Prentiss 2002). Bifaces such as knives, preforms and projectile points as well as hide scrapers would be integral components of a hunter’s tool kit (Teit 1900, 1906, 1909a). These two lines of evidence directly correlate with the expanded emphasis on hunting that was observed in the faunal record.
Prestige Artifacts

Another line of evidence that displays variation throughout the life of Housepit 7 is prestige objects, which are objects utilized to display the greater status of wealthy or powerful individuals (Hayden 1997). At Keatley Creek, prestige objects include beads, pendants, pipes, mauls, and nephrite tools. Within Housepit 7, these items cluster heavily in Rim 4, but rarely occur in other stratigraphic contexts (Prentiss 2002). This same pattern has been recognized on dated housepit floors. Late floors, such as Housepit 7, contain a much higher quantity of prestige items than are found on earlier dating small house floors, or on comparatively dated medium sized house floors (Prentiss 2002). This may suggest that the cultural importance of overt displays of wealth did not emerge until the final phases of the Housepit 7 occupation.

Root Roasting Pits

It has been argued that the intensification of root foods is inextricably linked to other significant social and economic changes in Plateau prehistory (Lepofsky and Peacock 2004). By 2400 B.P., people in the region began to intensify their use of root foods through technological strategies such as pitcooking roots in earth ovens. The cooking of roots increases nutritional value of roots that are inedible when raw, increases palatability of edible raw roots, and facilitates preservation for storage (Lepofsky and Peacock 2004).

After 2400 B.P., ovens continued to be used throughout the late prehistoric although use was not consistent. Relatively more ovens were in use between 2400 and 1500 B.P. than were utilized from 1500 B.P. to 800 B.P (Lepofsky and Peacock 2004). Between 2400 and 1500 B.P. both large and medium sized ovens were used, with a
tendency towards the utilization of larger (> 5m diameter) ovens (Lepofsky and Peacock 2004). This suggests that large groups may have come together to process root foods in the upland meadows. Between 1500 and 800 B.P., the number of upland root ovens declines, but the size of the ovens remains constant. If all other factors remain equal, this suggests that while there was a relative reduction in overall root use, large groups continued to come together to process root foods (Lepofsky and Peacock 2004). Ovens are first associated with large villages at about 1400 cal. B.P. Those found at the Keatley Creek site are initially large, but the sparse sample from Keatley indicates that the size of the ovens declines over time (Lepofsky and Peacock 2004). After 800 B.P., the frequency of dated ovens increases to resume pre-1500 B.P. levels, and the size of ovens decreases dramatically. It is not clear whether there was an actual downshift in the use of roots, or if more ovens were used to compensate for the smaller size of the ovens. The shift in oven size and number is temporally correlated with the appearance of smaller pithouses and smaller communities in the region (Lepofsky and Peacock 2004).

Environmental Conditions and Fire Frequency

A series of data sets indicate that the Mid-Fraser villages aggregated under conditions of drought while housepit occupations in upstream locales were more frequent during wetter periods (Prentiss et al. 2003a). Assessment of fire frequency and intensity provides a simple indication of drought periods. Fire frequency in multiple locales in southeastern and southwestern British Columbia (Hallett et al. 2003a; Hallett et al. 2003b) indicate that two peaks in fire frequency occurred at ca. 1300-1700 and ca. 700-1100 cal. B.P. A study of fire intensity, measured in charcoal concentrations per fire event, demonstrates particularly significant fires at ca. 1400-1600 cal. B.P. and slightly
less intense fires periodically through 800 cal. B.P. in the Lower Fraser Valley and Vancouver Island.

When combined with information on plant succession suggesting increases in drought adapted species prior to or associated with major fires and sedimentation rates, these data suggest that two major droughts occurred in the greater Pacific Northwest region associated with global climatic events. The first occurred at ca. 1400-1700 cal. B.P. loosely corresponding with the late Roman drought, while the second occurred between 1100 and 700 cal. B.P. corresponding with the peak Little Climatic Optimum and the famous Medieval Droughts. The latter drought may have been the most intense.

During approximately the same time period, we also see a general decline in salmon occurring within the Columbia River system (Chatters et al. 1995). Further, data on sardine scale frequencies from cores in the eastern Pacific provide evidence for a warm ocean at ca. 1600-1400 and 900-1050 cal. B.P. Numbers of other fish appear to have peaked between 1450 and 1250 cal. B.P. (Finney et al. 2002)

While the conditions of drought and increased fire frequency can actually improve forage conditions for deer and increase production of berries and geophytes by preventing forest incursion (Carlson et al. 1993; Klinger et al. 1989; Prentiss et al. 2003a; Taper and Gogan 2002), it can have disastrous effects on salmon populations (Chatters et al. 1995). Warm, sediment choked water delays spawning runs, adversely affects egg survival, displaces fry, and increases the frequency and severity of disease in adults. Warm ocean conditions can also impact salmon populations through reductions in nutrients and thus prey and by increasing numbers of competitors such as tuna (Chatters
et al. 1995). With dramatic reductions in numbers of spawning salmon, normally poor fishing years can become disastrously poor.

CONCLUSIONS AND RESEARCH IMPLICATIONS

By looking at the faunal data and the parallel lines of evidence, we see some general trends emerge. The environmental data point to a period of drying and lowered frequency of salmon runs and lowered availability of roots during the height of the occupation of Housepit 7 and the Keatley Creek village. The other lines of evidence support these findings, with a trend toward increasing utilization of mammalian and large game resources, seen in both the faunal and lithic data, and a drop-off in the utilization of salmon. There also seems to be a general rise in the level of dietary richness throughout the life of Housepit 7, seen both in the ethnobotanical and faunal data. During the last stages of occupation, we see a decrease in the level of bone processing, indicating a general reduction in dietary stress for the inhabitants of the house. This final period of occupation is also marked by a rise in the numbers of prestige goods, indicating that Rim 4 may mark a shift not only in dietary economics, but also in wealth and status competition.

The trend of increasing dietary stability while decreasing the reliance on salmon suggests that the abandonment of Housepit 7 and Keatley Creek may not have been a response to catastrophic landslides that reduced salmon stocks as suggested by Hayden and Ryder (1991), as the process of decreasing riverine reliance had been taking place throughout the life of the house. Rather, the abandonment of the Mid-Fraser villages seems to be part of a similar pattern of abandonments elsewhere in the Fraser-Thompson
and Columbia Plateau (e.g. Chatters 1995; Galm and Masten 1985; Kuijt 2001; Prentiss and Kuijt 2004).

The analysis of the faunal remains from the Housepit 7 stratigraphic sequence at Keatley Creek provided a new picture of resource use throughout the course of the life of the house. When compared to and articulated with the data from ethnobotanicals, lithics, and prestige objects, we come away with a deeper understanding of the dynamics of economic and cultural change at Keatley Creek. It is also demonstrated that faunal data in general can be utilized to help reveal large-scale socioeconomic patterns and cultural processes. While this study was undertaken with relatively few extant Mid-Fraser faunal studies available, it is hoped that this work will serve as a useful comparative data set for future work examining other large villages in the Mid-Fraser region.
Figure 1-1: Map of the Plateau geographical area (from Hayden 1997).
Study Area
British Columbia, Canada

LEGEND
- Small- and Medium-Sized Villages
- Large-Sized Villages
- Destroyed Villages
  - 0 - 1500 m
  - 1500 - 2000 m

Scale
0 1 2 Km
North

Figure 1-2: Map of the Lillooet Middle Fraser region with associated large prehistoric villages (from Prentiss et al. 2003a).
Figure 1-3: Contour map of the Keatley Creek site. The core area of the site covers an area of approximately 5 ha, while outlying housepits and cache pits cover an additional 8 ha (from Hayden 1997).
Figure 2-1: Cross section of the topography around the Keatley Creek site, from the Camelsfoot Range through the Clear Range and the Hat Creek Valley. Note that vertical scale is exaggerated (from Hayden 1997).
Formation Processes for Earth-Roofed Pithouses

Figure 2-2: Formation processes for pithouses such as those found at Keatley Creek (from Hayden 1997).
Figure 2-3: Map of the Keatley Creek site core. As can be seen, Housepit 7 is located in the northern portion of the site, and is one of the largest housepits found at the site (from Hayden 1997).
Figure 2-4: Map of the excavated Housepit 7 floor including features (from Hayden 1997).
Figure 3-1: Excavation map of the northwest quarter of Housepit 7 (from Prentiss et al. 2003a).
Figure 3-3: Profile of the west wall of the north trench (Units N and O), depicting the Housepit 7 rim sequence (from Prentiss et al. 2003a).
Figure 3-4: Profile of the north wall of the northwest rim of Housepit 7 (includes portions of units BBB, FFF, HHH, GGG, and NN. This illustrates the sequence of rim construction for the housepit (from Prentiss et al. 2003a).
Figure 3-5: Model of the patterns of change in the Housepit 7 occupations and construction sequences (from Prentiss et al. 2003a).
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148
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