Emergence of large housepits| Climatological factors contributing to changes in diameter and size variability of housepits in the mid-Fraser and south Thompson River valleys

Jesse W. Adams
The University of Montana

Follow this and additional works at: https://scholarworks.umt.edu/etd
Let us know how access to this document benefits you.

Recommended Citation
Adams, Jesse W., "Emergence of large housepits| Climatological factors contributing to changes in diameter and size variability of housepits in the mid-Fraser and south Thompson River valleys" (2004). Graduate Student Theses, Dissertations, & Professional Papers. 2213.
https://scholarworks.umt.edu/etd/2213

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.
The University of Montana

Permission is granted by the author to reproduce this material in its entirety, provided that this material is used for scholarly purposes and is properly cited in published works and reports.

**Please check "Yes" or "No" and provide signature**

Yes, I grant permission  

No, I do not grant permission

Author's Signature:  

Date: 8/11/2004

Any copying for commercial purposes or financial gain may be undertaken only with the author's explicit consent.
The Emergence of Large Housepits:
Climatological Factors
Contributing to Changes in Diameter and Size Variability of
Housepits in the Mid-Fraser and South Thompson River
Valleys.

by
Jesse Adams
B.A. University of Nebraska, 2001

Presented in partial fulfillment of the requirements
For the degree of
Masters of Arts
The University of Montana
March 2004

Approved by:
Chairperson
Dean, Graduate School
Date
The Emergence of Large Housepits: Climatological Factors Contributing to Changes in Diameter and Size Variability of Housepits in the Mid-Fraser and South Thompson River Valleys.

Director: William C. Prentiss

The University of Montana 2002 Field School conducted archeological investigations at the Keatly Creek site, a pithouse village on the Canadian Plateau. Research objectives were many; among them was the excavation of a new dated floor for Housepit 7. Falling into a previously noted period of increased housepit size, occurring around 1500 BP, it appeared that Housepit 7 fit into the pattern of large constructed living structures. The goal of this thesis is to develop an explanation for the pattern. The study relies on data from numerous reports containing housepit dates and size measurements, both in the Mid-Fraser and the Thompson River Valleys of the Canadian Plateau.

This study is guided by the question, "What could have caused people to congregate into larger housepits at this period in time?" The study is accomplished in two phases. The first step is to determine whether the aggregation process actually occurred. Secondly the implications of this pattern for understanding interior British Columbia prehistory were considered. Explanations are sought by exploring potential changes in resource abundance and availability. Climatological data suggest an increase in forest fire frequency, reflecting drought, around the same time as increased housepit size. Models to explain human group reactions to changes in resources availability are then explored.

Given the association of increased housepit size and more frequent forest fire activity reflecting drought, a study to test whether they were related is undertaken. I examine the changes in climate affecting the availability of food resources, as well as the data on housepit size variance through time. Two models, explaining human group aggregation are selected and tested to see if either of them is able to be supported by the data. Results of the research support the idea that housepit size increased due to aggregation occurred in order to organize labor as a response to patchy resources.
Table of Contents

Abstract ................................................................. ii.

List of Tables .......................................................... iv
List of Figures ............................................................ v

Chapter 1: Introduction .................................................. 1

Chapter 2: Background ................................................... 6
  Housepit Formation Processes ......................................... 7
  Physical Landscape .................................................... 8
  Climate Chronology .................................................. 9
  Cultural Chronology .................................................. 13
  Subsistence – Seasonal Round ......................................... 17

Chapter 3: Analysis ....................................................... 19
  Theoretical ............................................................ 19
  Data ................................................................. 24
  Analysis ............................................................. 28

Chapter 4: Discussion ................................................... 32

Chapter 5: Conclusions .................................................. 39

References ................................................................... 41
List of Tables

Table 1: All data used including housepit locale, number, date, diameter, and reference .......................... 48
List of Figures

Figure 1: Forest fire frequency data.........................................................49
Figure 2: All data (housepit diameters and dates).................................50
Figure 3: Housepit dates and diameters -- Mid Fraser River Valley.........50
Figure 4: Housepit dates and diameters -- South Thompson River Valley...51
Figure 5: Housepit variability over time.................................................52
Figure 6: Housepit and the square roots of their diameters ....................53
Chapter 1: Introduction

The 2002 field season at the Keatley Creek Site continued a long-standing series of research-oriented excavations. The site still offers extensive potential for the study of complex hunter-gatherer groups. Beyond studies designed to infer social structure, Keatley Creek offers numerous other research possibilities. Some of these other hunter-gatherer studies include house pit construction (MacDonald 2000a, b), plant utilization (Hayden 1997), and numerous organic analyses (Lepofsky 2000, Crellin and Heffner 2000), among others.

Positioned near the Mid-Fraser river canyon, the site is also exemplary of numerous other sites located on the Canadian Plateau (Hayden, 1997). Keatley Creek along with many other sites in the area, such as the Bell Site and the Bridge River site are considered pithouse villages. Pithouse villages consist of a cluster of “shallow, circular depressions, which form(ed) the basis for semi-subterranean houses” (Sanger 1968). These circular depressions were then constructed into shelters with the addition of thick, upright, wooden posts, angled towards the center. Across these were lain smaller diameter poles that served as the base for any number of roofing materials used, including grass mats, debris, and earth. As a whole, the housepit villages of the Canadian Plateau, scattered along numerous major and tributary rivers, are similar in location and makeup to those found at Keatley Creek.

The Canadian Plateau of south-central British Columbia, specifically the Fraser and South Thompson River Valleys, saw the appearance of winter pithouse villages around 3500 years ago (Sanger 1968). Most of these early houses were small to medium
in diameter, being no more than 15 meters across (Sanger 1968). However, pithouses increased in diameter suddenly around 1500 BP. Archeologically, large housepits seem to be distinctively different when compared with smaller diameter housepits. Inequality in the access of resources (Hayden 1997), the quality of resources availability (Hayden 1997, 2000b), and differences in the distribution of prestige items (Hayden 1997), all lead to the conclusion that there is a distinct social difference between the varying sizes of housepits.

According to Teit (1900:192), pithouse dimensions are a reflection of the size of the family that inhabited the structure. On the Canadian Plateau there are various sizes of housepits. Following Teit, a larger diameter structure would house a larger family or multi-family units while, logically, a smaller housepit would house a smaller family. There are in fact certain advantages and disadvantages associated with house size, specifically with large diameter housepits.

Larger, more populated houses are the result of population aggregation. Advantages exist for a nucleated group, such as an increase in craft specialization, communication, an increase in social/political cohesion, and defense (Chatters 2004). On the other hand, the aggregation of human groups also has disadvantages. According to Chatters (2004) “...the costs of nucleation are high...”, and include an increase in the expense of transporting goods, the heavy impact on local available resources, a strain on local building materials and fuel, an increase in potential interpersonal conflict, and a greater risk of communicating and spreading disease (Chatters 2004).

The Plateau of South-Central British Columbia saw another change, this one climatic, around the same time. An extensive drought, spurred on by various atmospheric
conditions, including a drop in annual precipitation and a change in prevailing winds, created an environment of dry vegetation. Lake cores and soil studies have shown an increase in forest fire activity due to the dry conditions in this period (Hallet et al. 2003, 2004). These fires would have drastically affected the area vegetation, effectively influencing all local organisms' subsistence strategies. The effects would have been widespread and would have included local human populations.

In this study, a potential relationship between the increase in drought, marked by a high frequency of local forest fires, and the increase in pithouse size and variation around 1500 BP will be explored. Extensive literature exists explaining why groups, such as those of the Mid-Fraser and South Thompson River Valleys, aggregate during periods of environmental change. For this thesis I examine two opposing theoretical views that seek to explain this phenomenon: Lewis Binford's (2001) packing model and the aggrandizer theory supported by Brian Hayden (1997).

Binford's packing model seeks to explain the aggregation of human groups using environmental changes as a stimulus. According to Binford, a regional increase in population reduces the subsistence range and thus, mobility, of local groups (Binford 2001). However, population pressure promotes a constrained mobility rather than simply an increase in human numbers as environmental conditions resulting in patchy resources requires groups to pack. Packing, or the patterned reduction on subsistence range arising from a regional increase in population (Binford 2001:442), is more density dependent than based on positive reproductive success (Binford 1968). As population density increases, groups feel pressure from other neighboring groups. Under densely populated conditions people pack around those resources they can depend on to reduce risk.
Groups aggregate around key resources forcing other groups to alter their mobility patterns and aggregate around other key resources. As a "universal conditioner of change" (Binford 2001:442), packing can potentially be used to explain the phenomenon seen in the Mid-Fraser and South Thompson River Valleys.

The aggrandizer model supported by Hayden (1995) could potentially be applicable here as well. Hayden’s model is based on an egalitarian society, in which during optimal resource conditions individuals are able to acquire more than enough food to meet their own needs, with an extra surplus accumulated. The theory states that this surplus will require someone to maintain it, however, the high costs of acquiring control over the surplus must be outweighed by some benefit. The benefit of controlling the surplus comes from gift giving. In the giving of gifts, the aggrandizer thereby instigates an obligatory return of the gifts, more than likely with interest. Requiring repayment not only gleans the accumulation of wealth through interest but also creates allies. This creates an economic organization where cooperation among members keeps the aggrandizer wealthy and in power while forcing others into a system of economic indebtedness.

Both of these models will be tested against the collected data, including changes in housepit size as well as the climate data, in order to develop a clearer picture of the cultural changes that occurred on the Canadian Plateau. Testing the theoretical models used here will require defining what we would expect to see in the archeological record if these models in fact represent the human behavior being observed. In order to do this the data collected will be looked at in terms of how well it does or does not support either
model. Of major concern in this study, and the behavior tested here, is how human
groups react to a climatic change affecting available resources.

A brief background of major environmental as well as cultural conditions and
changes on the Canadian Plateau is provided in chapter Two. This will give a base for
understanding the pattern of human occupation in the area leading up to the period of
interest. Chapter Three is the data used for this study. The chapter provides the
uncalibrated housepit dates BP, diameters, and their locations organized by drainage.

Chapter Four reviews the models used in the study and outlines test expectations.
This is followed by the analysis of the data. A discussion of the results is next in Chapter
Five. The discussion includes the models used as well as the actual testing of the models
using the accumulated data. Finally, Chapter Six presents the conclusions of this study
including a discussion of research recommendations. The reason as to why housepit size
changed 1,500 years ago is currently unclear. It is the goal of this thesis to determine if
an increase in housepit size can be explained by a climatic change causing group
aggregation.
Chapter 2: Background

This chapter provides a brief introduction to background information pertaining to the Canadian Plateau, in particular the Mid-Fraser and the South Thompson River Valleys. A generalized chronology has been presented here along with more localized chronologies for each of the river valleys. Of importance here is the progression of human occupation and the changes in the environment in which those groups lived. Understanding human occupation of the area will allow us to paint a broad picture of settlement patterns, subsistence strategies, and social structure before dealing with the more specific problem of changes in housepit sizes. Knowledge of the Canadian Plateau’s past environment allows us to understand the ecological landscape, how and when it changed, and to what degree those changes affected human occupants.

The Plateau of British Columbia offers a vast wealth of archeological information. The majority of archeological data from the Plateau area has been derived from the excavation, and study of housepits (Pokotylo and Mitchell 1998). The settlement patterns involved with these housepits have revealed a great deal about the occupants of the area, offering information on a variety of aspects of complex hunter-gatherer existence. Housepit research has revealed information on hierarchy and wealth differentiation, subsistence strategies, lithic procurement, and trade networking. Researchers such as Stryd (1972, 1973, 1974), Richards and Rousseau (1987, 1992), and Hayden (2000) have based their research on housepit excavations. Along with an understanding of complex hunter-gatherer lifeways, their work has resulted in numerous local and regional chronologies of Plateau occupation.
Housepit Formation Processes

Housepits are the archeological remnants of a pithouse. Visually housepits are merely a circular depression with an associated raised rim. However, excavations reveal the complexity of housepits, with numerous occupation floors and a host of construction and deconstruction episodes. Pithouses were constructed in a number of ways and they varied due to size, region, and numerous other contributing factors (for more detail see Hayden 1997). Most pithouses have an excavated, semi-subterranean pit, over which was constructed a roof. The roof was supported by large timbers, buried in the ground around the depression and angled to meet, or nearly meet, at some central point above the house floor. Timbers were then placed perpendicular to the support beams, to be covered by some sort of insulating material such as smaller timbers, woven grass mats, the excavated material from the floor depression, or a combination of these materials.

The roof supporting timbers were solidly placed into the ground, sometimes being supported by large, buried boulders. Where the timbers met the ground, a build-up of material accumulated, creating what is referred to as the rim. The rim is often studied in order to attain a better understanding of the evolution of the construction, occupation, and destruction of the housepit. The rim would have been initially built during initial construction and simply added to, throughout the life of the housepit. The roof, having been built from wood and other plant materials, would have collapsed from time to time due to decomposition, or would have been intentionally burned in order to get rid of parasites and/or rotten, structurally unsound wood (Hayden 1997). The living floor would have become hard packed from everyday tromping. Periodically the floor would
need to be dug out, as debris such as chipped stone flakes and silt filtering through the roof would accumulate (Hayden 1997). All of the excess material would have been dumped out onto the rim. The rim, then would have received all of the excavated materials from both the roof and the floor, leaving behind a stratigraphic record of the construction and deconstruction of the pithouse.

Other features of the pithouse, including hearths and storage pits, offer clues into Canadian Plateau life. These features occurred more regularly and with more frequency in larger pithouses as opposed to smaller diameter pithouses (Hayden 1997). Hearths were used for cooking food resources collected throughout the year as well as being a source of heat. Storage pits offer an insight into seasonal subsistence strategies. Storage pit technology allowed for a mass surplus of salmon to be acquired and not go to waste, offering a continuous food source through sparse winter months. More information on hearths and storage pits is available in Hayden (1997).

Pithouses generally did not stand-alone -- rather they were clustered into villages of varying size. Although sites do exist with only a single housepit, sites exist with upwards to 120 housepits creating a dense landscape of rimmed depressions, as is the case at the Keatley Creek site. It is within these dense villages that housepit size variance is of interest.

**Physical Landscape**

Of particular interest here is the research based on the housepit villages in the valleys of the Mid-Fraser and the South Thompson rivers, within which the vast majority
of housepit occupation occurred. The Mid-Fraser River flows south, lying between the wet Coastal Mountain Range to the west and the dry Rocky Mountain Range to the east. The South Thompson River bisects the Rocky Mountains and has a westerly flow. The rivers intersect and eventually empty into the Pacific Ocean at the present-day city of Vancouver. Through time, these fast flowing rivers have carved for themselves immense valleys into the underlying bedrock. Being primary channels for the annual salmon runs from the Pacific Ocean to inland spawning grounds, both of these rivers are rich in aquatic resources. Human occupants of the area have exploited these resources for thousands of years. Being such a major contributor to human subsistence, people have focused their resource acquisition efforts, technological innovations, and population aggregations around these major rivers leaving behind evidence of their existence in the archeological record.

**Climate Chronology**

A broad and generalized climate chronology has been established for South Central British Columbia (see Chatters 1999; and Hallet, et al 2003). However, this chronology is in the thousands of years and too broad in scope for any kind of applicability for the interests of this study. The widely accepted, broad climate history for the Plateau is provided here. A more detailed study (Hallett 2003a), based on forest fire frequencies, has been carried out and the results of that research are provided giving far more insight into the intricacies of climate change in British Columbia.
The area of interest was long under the weight and climatic conditions of extensive glacial activity. Although glacial retreat exposed grasslands as early as 11,500 BP (Clague 1981, Hebda 1982, Mathewes 1985, Mathewes and Rouse 1975) archeological data does not reflect significant human habitation until around 6500 BP (Pokotylo and Mitchell 1998). This postglaciation environment, was more conducive to human occupation. The climate of the Canadian Plateau between 11,500 and 7,800 BP (Pokotylo and Mitchell 1998) was warmer and drier than the previous period of glacial advances, causing the last of the continental glaciers to retreat north. An even warmer period followed, between 7,800 and 5,100 BP (Pokotylo and Mitchell 1998) with a higher level of precipitation, much more like that of our modern climate (Bennet, et al 2001). Then a final generalized climatic period was recognized between 5100 and the present, during which modern temperatures and precipitation rates were established to the levels existing today.

A much more detailed climatological chronology has been set forth in studies by Hallett and others (2003a); Hallett and others (2003b); and Bennett, et al (2001). These studies use lake cores and soil charcoal from various locations in south-central British Columbia. The collected core samples were examined stratigraphically, showing the constant and episodic deposition of charcoal, in order to establish a chronology of fluctuating forest fire activity. The observed fire frequency was used as an indicator of temperature and precipitation levels which reflected the overall climate in which the occupants of the Mid-Fraser and South Thompson River valleys had existed. For a more detailed explanation of how the soil charcoal and lake sediment dates were acquired see Hallett, et al (2003); Bennett, et al (2001); and Hallett, et al (2003).
Forest fire activity was observed through charcoal deposits. Peaks of forest fire frequency were seen after removing what has been termed background charcoal accumulation, or CHAR. Background charcoal has been related to various factors, such as the standing biomass, fuel load and fire severity, and the effects of sedimentation processes (Hallett, et al 2003a,b; Millspaugh and Whitlock 1995; Clark and Patterson 1997; and Long, et al 1998). Factors such as local wind, erosion, and fluvial processes effect charcoal deposition (Clark 1988). Using the peaks of carbon concentration filtered out of the background CHAR in Hallett’s (2003a) data set high frequencies of forest fire activity can be identified (see Figure 1).

Allowing for a more finely defined chronology, CHAR studies are very useful for this study, especially concerning the time period in question. Results from CHAR data show that between 3500-2400 BP a decrease in forest fire frequency occurred (Hallett, et al 2003a,b). This corresponds with a regional cool and humid climate following glacial advances (Hallett, et al 2003a,b). After the cooler period, recognizable peaks in charcoal deposition became more numerous, reflecting a rise in forest fire activity. Fire activity increased between 2400 and 1300 BP, which has been termed the Fraser Valley Fire Period (Hallett, et al 2003a,b). Following 1300 BP forest fire frequencies increased once again after a 200 to 500 year wetter period. Numerous dry periods occurred prior to and after the Fraser Valley Fire Period, according to papers presented by Chatters (1995), Chatters et al (1995), and Finney et al (2002), between 1100 and 800 BP evidence of another dry period exists. However due to its coinciding with the observed cultural phenomenon of increased housepit size the Fraser Valley Fire Period is the fire period of interest here.
For this study, attention is focused on the period referred to as the Fraser Valley Fire period, between 2400 and 1300 BP. There are numerous lines of evidence offering insight into why this period experienced drought like conditions, including atmospheric conditions; while other evidence supports the extent and effects of the drought including the effects of increased dry fuel conditions, and erosion.

This period was caused by an enhanced Azores high-pressure circulation which resulted in the North Atlantic Ocean flow and circulation to increase, which had a significant effect on inland precipitation rates (Hallet, et al 2003a). Due to the changed atmospheric conditions, inland areas saw a change in precipitation levels, contributing to a drier environment.

Another atmospheric occurrence that had a substantial effect on the paleoclimate of the study area is the movement of large air masses aloft. In particular the Pacific high, which brings dry air masses to North America, blocks the more moist Aleutian low fronts (Hallett, et al 2003a) effectively creating the potential for extended drought (Ager 1993). These atmospheric conditions, along with a more active sun (Hallett, et al 2003a), would have impacted climate to such a degree as to cause an increase in aridity on the Canadian Plateau. The North Atlantic trends correlate well with the studies of CHAR from the Fraser Valley in particular the Fraser Valley Fire Period. Both records show evidence of increased forest fire frequencies indicating a precipitation deficiency, which must be preceded by summer drought (Agee 1993; Veblen and Alaback 1996). The Canadian Plateau during the Holocene saw an Eastern Pacific high that expanded due to greater-than-present summer insolation (Hallett, et al 2003a). Forest fires increased due to the
rise in summer temperatures and decline in precipitation. Thompson et al (1993) observed, around 1500 BP, a climate wherein drought became more frequent and severe.

Changes in atmospheric patterns would have effectively created increased dry fuel conditions along with a rise in dry lightning occurrences (Rorig and Ferguson 1999). Dry fuels would have a greater probability of igniting and providing fuel from lightning strikes and human lit fires, enhanced by a swell in population and aggregation.

Another line of evidence supporting a rise in forest fire frequency and drought is found in episodes of erosion (Hallett, et al 2003a). Heightened forest fire activity effectively removes soil-supporting vegetation allowing for free slopes to erode much more frequently. According to Hallett, et al (2003a) an increase in local erosion occurred between 4300-3600 BP and 2400-1300 BP.

Given all lines of evidence presented here Hallett, et al (2003a) recognized two periods of increased forest fire, drought, and blocked high-pressure circulation systems. These periods are between 6500-3500 and 2400-1300 BP. Evidence provided by Chatters et al (1995) shows a third more recent drought period between 1100 and 800 BP.

**Cultural Chronology**

A generalized chronology for the Canadian Plateau has been established reflecting the numerous cultural changes recognized to have occurred in the area. The first evidence of settlement does not appear until around 6500 BP, marked by an early projectile point technology. Not until later, however, do we begin to see a substantial, widespread habitation of the Plateau. This period has been coined the Nesikip Tradition
and lasted from 5550-4050 BP (Pokotylo and Mitchell 1998). This Tradition has been divided into two phases; the Early Nesikip Phase [5050-3550 BP] and the Lehman Phase [3550-2450 BP]. During the Early Nesikip Phase people were mainly utilizing a broad based subsistence strategy while the heavy exploitation of salmon resources typically associated with people of the area, does not appear to have been taking place yet. The Lehman Phase is distinguished from the Early Nesikip by the introduction of two previously unknown projectile points; Lehman obliquely notched points and lanceolate knives with straight, cortex-covered bases (Pokotylo and Mitchell 1998). According to Rousseau (1991), the migration of Salishan speaking groups from the coast and onto the Plateau area ended the Nesikip Tradition, and introduced the Lochnore Phase.

The Lochnore Phase represents these new groups, which lasted from about 6000-4000 BP. Subsistence during the Lochnore Phase is once again characterized as a broad based “forager” strategy (Rousseau et al 1991), as defined by Binford’s 1980 “forager-collector” typology. Disagreement with this aspect of the chronology exists as Prentiss and Kuijt (2004) argue the collector strategy did not arise on the interior Plateau during the Lochnore Phase. Instead they argue that is was spread to the interior around 4000 BP by groups from the central or northern Northwest Coast. A new cultural tradition emerged, following the Lochnore Phase, called the Plateau Pithouse Tradition, marked by the intensive harvesting of salmon and the introduction of storage.

The Plateau Pithouse tradition has been divided into three horizons -- Shuswap [3500-2400BP], Plateau [2400-1200BP], and Kamloops [1200-200 BP]. Each of these horizons is distinguished from the next by changes in projectile point technology and other tool production techniques and styles. A common theme throughout the Plateau
Pithouse tradition is the construction and use of semi-subterranean pithouse dwellings for all year occupation. Changes in pithouse sizes occurred during the Plateau Horizon, when large diameter houses, reaching upwards to 25 meters in diameter, appear. The Plateau Pithouse tradition is a regional synthesis of local variability, while the Mid-Fraser and South Thompson River Valleys both follow this basic outline they both have their own localized chronologies.

A Mid-Fraser sequence was established by Stryd (1973), and then, later by Richards and Rousseau (1987), documenting the progression of peoples in and out of the area over time. An early chronology, established by Arnoud Stryd offered one main difference to the general chronology. Stryd (1973) divided the occupation of the Mid-Fraser Nesikip Tradition into two separate traditions, the microlithic period [5000-800 BC] and the non-microlithic period [800 BC – AD 1858]. However, this chronology is no longer used and has been revised by Richards and Rousseau (1987) into three phases, the Kettlebrook, the Lillooet, and the Fountain Phases. The Kettlebrook Phase represents the earliest human occupation of the Valley and has been minimally studied, therefore being the least understood.

The Lillooet Phase, being well represented by numerous archeological sites, has offered a much more thorough understanding of human occupation in the Mid-Fraser Valley than during earlier periods. Distinguishing characteristics of this phase are the presence of a distinct projectile point technology (corner notched points), large diameter housepit’s, and burials (Pokotylo 1998). Other characteristics of this phase are dentalium beads, cairn burials, steatite disk beads, and the rare, ground, slate knife. The succeeding Fountain Phase is distinguished by the occurrence of Kamloops points, zoomorphic hand
mauls, pectin shells, bird bone beads, and flaked stone spokeshaves (Pokotylo and Mitchell 1998). Other artifacts associated with this phase includes a steatite antler carving complex, tubular steatite pipes, flaked and drilled slate pendants, notched flaked stone drills, spall tools, metapodial awls, mica-flakes, and a possible weaving complex.

A slightly different chronology has been developed for the South Thompson River, which includes the Thompson River Valley and Shuswap Lake area. An early chronology was offered by Wilson (1980), which was later revised, again, by Rousseau and Richards (1985) expanding the South Thompson chronology back about 4000 years. R.L. Wilson’s (1980) chronology included only a 2000-year culture history of the Kamloops area. Another three-phase distinction by Richards and Rousseau has been established which includes the Shuswap, Thompson, and Kamloops Phases. Much like the Lillooet Phase of the Mid-Fraser, the Shuswap Phase [3500-2400 BP] marks the initial period of winter semi-subterranean dwellings and the intense utilization of salmon resources (Pokotylo and Mitchell 1998). Though salmon became the primary resource at this time, other resources, such as birds, mammals, and freshwater mussels supplemented their subsistence. The Thompson Phase [2400-1200 BP], replaced the Shuswap with smaller diameter houses but larger sized villages, storage pits, and a broader range of economic activity (Pokotylo 1998). These groups seem to have moved to more upland locations, where more and more plant products were being exploited. Larger diameter housepits, burials, small Kamloops points, and a reduction in upland resource use mark the Kamloops Phase, which lasted from A.D. 750 – 1750.

Richards and Rousseau (1987) have offered a synthesis covering the entire Northern Plateau for the duration of the Plateau Pit House tradition. The region wide
synthesis unites all of the regional chronologies, marked by the intense utilization of salmon and a unique pattern of pithouse settlement (Pokotylo and Mitchell 1999). The synthesis divides the regional chronology into three phases, the Shuswap (3500-2500 BP), the Plateau (2500-1200 BP), and the Kamloops (1200-200 BP).

*Subsistence – The Seasonal Round*

There are many sites such as the Keatley Creek, Bridge River, and Bell sites in the Mid-Fraser River Valley and the Van Male, Baker and Gore sites in the South Thompson River Valley just to name a few. Archeological study of these and other sites along with a long and extensive ethnographic study of local peoples by Teit (1900, 1906, 1909) early in the 1900’s, has resulted in a substantial base of information on which to build and explore more detailed aspects of housepit village life in these valleys. Winter housepit villages were utilized as part of a seasonal pattern of mobility based on the availability of subsistence resources. Summer brought multiple annual salmon runs, making the intensive harvesting of fish a lucrative endeavor. People would live in the pithouse villages during the summer as they collected, dried, and stored fish (Alexander 1992). Although the housepits were still being occupied, other mobile groups lived in fishing or hunting camps. Once the salmon runs ended, and the collected fish had been stored for winter use, groups would head up into the mountains to hunt game and acquire lithic material for tool manufacturing. Before winter set in, a migration back down toward the river valley would occur as groups would make repairs on last years pithouses for this year’s winter. The pithouses would serve as a permanent residence for the harsh
winter months, unlike the tendency for a nomadic existence with mobile camps common
during the fall and again in the spring. All activities, such as food preparation, and tool
production, would take place either on the roof, or inside the pithouse. Dried and stored
salmon, and various mammals, and fresh water foods, were used until the spring came.
Spring brought another trip to the mountains in order to quarry stone and hunt large
mammals, after which the pattern would repeat itself. The pithouse thus not only served
as a shelter, but as a place of habitation wherein long months of cold weather would be
waited out, food would be processed, and stone tools would be crafted in preparation for
upcoming warmer harvesting periods.
Chapter 3: Analysis

This chapter will introduce the theoretical, methodological, and substantive aspects of this study. The theoretical explanation will describe the two models tested in this study. Included with this are the expectations of what we should see archeologically for either model to be considered valid. Then this chapter will explain the actual manipulation of the data. The data and analysis sections outline information sources, all statistical manipulations, and conclusions.

Theoretical

This study provides a test of two models concerning human subsistence strategies in relation to use and control over resources and what people do when those subsistence strategies change. More specifically Lewis Binford’s model of population packing and Brian Hayden’s aggrandizer model will be examined.

Brian Hayden’s (1997) aggrandizer model was chosen as it has been used in explaining group organization at the Keatley Creek site, for which there is an abundance of data, and where there has been an in depth study of large diameter housepits. Binford’s (2001) model was selected as it has offered an alternative explanation to Hayden’s, emphasizing the effects of population density. A crowded population could be seen, perhaps not as an increase in numbers, but a decrease in available landscape, thus increasing localized density.

The first model examined is Lewis Binford’s population packing model (2001). Binford’s model deals with large-scale landscapes and the restriction of movement across
them, called “packing”. Packing occurs when resources become patchy and population densities increase as groups pack around abundant and available resources. Packing thus creates a situation where people group around key accessible resources in order to increase their chances of success, despite increased competition.

A drastic change in resource availability would force the once stable subsistence strategies to become adapted to resource insecurity. People would group, or pack, around available resources or those who have the ability to obtain them (Binford, 2001). Reduced resource availability, due to more densely populated areas, would require that groups be more efficient at acquiring the patchier resources available to them. Those who were able to acquire the patchy resources would potentially now need a larger work force to obtain resources that were no longer as readily available, whether that means they were able to utilize and protect local food or they could afford to be more mobile. A larger work force would require a more closely organized system in order to successfully obtain more distant and/or more difficult to acquire resources. The reorganization of labor could potentially allow for the patchy resources, to once again be securely acquired.

Archeologically, preceding any sort of human behavioral reaction, we would expect to see an environmental impact of such significance to have made resources less accessible, reliable, and more patchy. We would then expect to see a human reaction in subsistence strategies in order to reduce resource acquisition stress. Thus groups would pack around more reliable resources. However, packing could also be applied on a small scale. Packing within a group could occur on a pithouse level, with people being forced to group around the key resource of labor allowing for the successful, reliable acquisition of food. To support Binford’s model, the data would have to reflect a situation where
groups altered their organizational strategies, such as changes in labor-based kin relationships in order to increase available work forces, as a reaction to resource patchiness.

Group reorganization would be seen through a number of different archeological indicators, including a change in housepit size, and an intensification in the density of every day use items on housepit floors. Packing would be seen, archeologically, as a change in social organization allowing for more successful acquisition of resources. It would seem people would pack around those resources which they had the best access to the largest quantities of food. This would be reflected by larger houepits and housepit villages.

Drought decreased the reliability of certain resources from others that were not as affected by changes in the environment. Fish populations in the major rivers would have been effected by drought, thus affording only certain, highly productive, and regionally important, sections of the river to be reliable fish collecting areas. The major salmon runs (Kew 1992) vary on two to four year cycles, depending on species. These runs are, on average over time, consistent and usually only vary in the short term, but recover quickly to any potential changes such as catastrophic land slides, drought, or flooding (Kew 1992). Other animal food sources would not have fared so well during times of drought. Tree cover, which generally supports ungulate populations, having been burned in some areas would have become more patchy. More patchy stands would mean an increase in forest margin area where ungulates, such as deer, concentrate (Alexander 1992). With a broader, more distributed landscape of forest margin areas, deer populations would have also increased. Other frequently used plant resources such as
berries and roots, among others (Turner 1992), would have also increased in abundance (Alexander 1992). Given the more widespread deer, root, and berry populations and the changes in reliability of salmon populations; a more sedentary lifestyle, focusing on the procurement of fish, would seem a good subsistence strategy. We would also seek to find some sort of group reorganization on the village or housepit level that dated to, or slightly after the environmental impact as a reaction to new resource conditions.

With Brian Hayden’s model of aggrandizers, we would expect to see something much different. One of Hayden’s most important criteria is all individuals initially having equal access to resources (Hayden 1995). With equal access to resources, there is an ability to acquire sufficient food to meet individual needs while creating a surplus.

A surplus, one of the keys in Hayden’s model, would be a stored accumulation of goods not in current use. An opportunity for control over the groups surplus, should a sufficiently motivated individual choose to do so, could present itself. The individual would have to take steps to acquire control over those surplus resources, therefore initiating a number of differences in resource distribution. By controlling resources aggrandizers create a hierarchical dynamic with a few having access to more resources, and power over those with fewer resources. More resources, or wealth, could also initiate control over labor. Control over resources comes at a cost, yet would inevitably result in the adequate benefits to make the venture worthy.

A surplus allows for extra resources to be used as gifts. By giving away resources, one can establish alliances for later exchanges of wealth, military protection, and the obligatory return of gifts with interest (Hayden 1997). Having an abundance of resources would also allow for the attraction of productive supporters or mates through
lavish displays of wealth (Hayden 1997). Because of the distribution of wealth, there could potentially be more cooperation between members of a community to more effectively operate economic organizational strategies and thus a better system of resource distribution. This would however, be contingent on the surplus holder’s (aggrandizer’s) intentions.

Hayden’s theory deals with the control over excess resources and would be difficult during a time of resource shortage. Archeologically we would expect to see a situation wherein sufficient resources were available, so that an amount could be set aside as a surplus, reflected in widely distributed storage technologies. There would not necessarily be a drastic change in the availability of resources, merely a noticeable few controlling those available. We would also expect, given few individuals would be holding and responsible for an unequal amount of resources, there would be an unequal distribution of wealth in the archeological record with the majority of resources and wealth being associated with a few individuals. Group aggregation could potentially occur as people cooperate in order to pay back debt to the aggrandizer. Aggregation would thus occur after a substantial debt was obtained, being a reaction to the increase in control over abundant resources an aggrandizer would have. Thus aggregation would occur during times of adequate resource availability.

These models describe human behavior as it occurs when human groups are confronted with a change in resource abundance. The differences lie in whether or not people are reacting by aggregating in response to a change in resources, or if they are accepting an unequal distribution of wealth demanded by motivated individuals who acquire control over surplus resources.
Data

This study is an attempt to understand the observed phenomena of changing housepit diameter and size variability through time. In order to explore housepit diameter changes a database of housepit size and associated dates was necessary. Housepit diameter reflects living space and thus occupation potential, as a larger housepit has the potential to accommodate a larger number of people than a smaller domicile, respectively. Uncalibrated dates were used in this study only because they are the basic untransformed estimate of time since occupation.

Data for this study comes from two distinctly different areas. The first data set originated from excavations and surveys of archeological sites. In this set are actual housepit diameters, in meters, from the Mid-Fraser and South Thompson River Valleys along with each housepit’s respective radiocarbon date. The second data set comes from paleo-climatological observations and interpretations. Climatological information was derived from cores taken from soil and lake charcoal deposits. These data permit us to measure the frequency of forest fire activity on the Canadian Plateau of British Columbia. Forest fire frequency data is an indicator of drought affecting the area and thus the environmental conditions under which people existed.

The data for housepit diameter with radiocarbon dates were obtained using site reports, excavation records, and various literatures from numerous sites of the Mid-Fraser and South Thompson River Valleys. Housepit diameter is measured as the distance in meters from rim crest to rim crest. Using this measurement, housepits are categorized as
being either small, medium, or large (Stryd 1973, Goodale and Lenert 2001). Traditionally, as defined by Stryd (1973), large housepits have a diameter greater than 15 meters, while medium housepits range between 10 and 15 meters in diameter. Small housepits on the other end of the spectrum have diameters less than 10 meters. However, these broad categories lacked sufficient detail for a chronological study of changes in housepit size. Therefore, actual numerical values for housepit diameters were sought and used.

The dates obtained from housepits along the Mid-Fraser and South Thompson rivers are very important to this study. However, the accuracy of these dates is always a problem. Throughout this study, the most reliable and accurate dates were sought. Variables such as human error in recording provenience, the use of correct carbon collecting techniques, and the actual reliability of the dated material itself given the intricate history of pithouse existence are out of the control of the researcher here. Efforts were made (including the rejection of dates which seemed inconsistent with the accepted chronology of the area) to identify the most reliable radiocarbon dates. Some dated materials were not included based on their location within the housepit, such as those mixed in with rim deposits, potentially not reflecting an actual living surface. Other dates were thrown out based on their large standard deviation, ± 200, lacking the accuracy necessary to pinpoint an occupation event, to make sure that all radiocarbon dates were as accurate as possible.

Radiocarbon dates were obtained using several published and unpublished sources. The dates for these sites were carefully selected as to best and most accurately reflect a period of actual occupation, rather that a single episode of housepit formation
such as roof construction or floor clearing. Therefore, no radiocarbon dates from rim material were used, as these dates could potentially reflect any number of stages in the formation process and thus offer a date of construction as opposed to a period of last occupation, making them unreliable. Dates from housepit floors, materials on housepit floors, storage features and hearths or other in situ features best reflect an actual occupation period for when the houses were used (see Table 1). Uncalibrated dates were preferred for they are the actual date received from the laboratory using the accepted Libby half-life of 5730 years (Elert 2003).

Sites for the Mid-Fraser Canyon include the Keatley Creek Site (EeRl-7), the Bell Site (EeRk-4), Gibbs Creek (EeRk-7), the Mitchell Site (EeRl-22), the East Site (EeRl-40) and the East Seton Lake Site (EeRl-21). Housepit 7 from The Keatley Creek Site (EeRl-7), a 19-meter housepit, considered large by Stryd’s (1973) classifications, had a date of 1695 ± 45 BP (Prentiss, et al 2003) representing the most recently collected material from Housepit 7.

The Bell Site (EeRk-4) resulted in fourteen uncalibrated dates (Stryd 1973). Housepit 5, the only small housepit at the site, had a diameter of 9.30 meters and a radiocarbon date of 1380 ± 65 BP. The excavation of eight medium sized housepits resulted in datable material. Housepit 4 had a diameter of 12.10 meters and a date of 1010 ± 80 BP. Housepit 6 resulted in a date of 1590 ± 90 BP and had a diameter of 11.80 meters. Housepit 7, with a diameter of 11.55 meters, had a date of 1325 ± 80. Housepit 13 had a radiocarbon date of 1100 ± 80 BP with a diameter of 14.4 meters. Housepit 14 with a diameter of 11.6 meters had a radiocarbon date of 1575 ± 45. Housepit 15 dated to 935 ± 80 BP and had a diameter of 11.2 meters. Housepit 21 had a diameter of 11.2
meters and dated to 1470 ± 140 BP. The final medium housepit date comes from housepit 22. This housepit dated to 1215 ± 90 BP and had a diameter of 12.0 meters. There were five large diameter housepits at the Bell site. Housepit 1 (a rim-to-rim diameter of 16.7 meters) resulted in a radiocarbon date of 1495 ± 80 BP. Housepit 2 had a date of 1295 ± 80 BP and had a diameter of 14.8 meters. Housepit 8 had a date of 1365 ± 80 BP and a diameter of 19.2 meters. Housepit 19 had a diameter of 16.8 meters and material dating to 1515 ± 90 BP. The final housepit at the Bell Site with both a recorded diameter and a radiocarbon date was housepit 23, dated to 1560 ± 90 BP, with a diameter of 17.2 meters.

The Gibbs Creek Site (EeRk-7) offered two radiocarbon dates, one from a medium diameter and one from a small diameter housepit. The medium sized housepit (Housepit 1) with a diameter of 10.6 meters had a radiocarbon date of 920 ± 90 BP. Housepit 3 was 6.25 meters in diameter and had a date of 1515 ± 80 BP.

The Mitchell Site (EeRl-22) produced three dates for a single house, Housepit 1. With a diameter of 10.65 meters, Housepit 1 would be considered a medium sized house. Three dates have been reported from this housepit, however the date of 2775 ± 75 BP seems most accurate given its lower spread. The East Site (EeRl-40) resulted in only a single datable housepit. A radiocarbon date of 395 ± 80 was obtained for Housepit 1. This was a small Housepit with a diameter of 9.25 meters. The East Seton Lake Site (EeRl 21) recorded a single housepit as well. This housepit had a diameter of 10 meters and dated to 1280 BP.

The South Thompson River Valley sites used were the Kamloops Reserve Site (EeRb-3), Harper Ranch (EeRa-9), The Van Male site (EeRb-10), and the unnamed sites
EdRa-22 and EeRa-4. There are no documented sites that contain large diameter housepits, as seen in the Mid-Fraser. The Kamloops Reserve Site (EeRb-3) excavation resulted in a single date from Housepit 19, a small housepit with a diameter of 5.0 meters. The date from this house is 1920 ± 100 BP.

Harper Ranch (EeRa-9) had two housepits with datable material, Housepit 4 and Housepit 7 (Wilson and Carlson 1980). Housepit 4, a small house, had a diameter of 9.0 meters and had a date of 1950 ± 130 BP. The small sized Housepit 7 (5-7 meters in diameter) had a date of 1950 ± 130 BP.

The Van Male Site (EeRb-10) resulted in dates for two housepits. Housepit 9, a 10 meter house had a date of 2950 ± 120 BP. Housepit 10 had a date of 2950 ± 150 and a diameter of 9 meters.

EdRa-22, an unnamed site, had three datable housepits as well: Housepit 1, Housepit 6, and 15. With a diameter of 6.5 meters, the small Housepit 1 had a date of 1995 ± 190 BP. Housepit 6 had a diameter of 5.5 meters and dated to 385 ± 90 BP. Housepit 15, was dated to 1200 ± 85 and had a diameter of 5.0 meters. The final site of the South Thompson with datable material was EeRa-4. With a diameter of 6.5 meters, Housepit 1 dated to 2080 ± 80 BP.

Analysis

Considering both models it is important to understand the past environmental conditions on the Canadian Plateau. In order to show levels of resource stress I will use charcoal accumulation data as an indicator of forest fire frequency and thus temperatures and precipitation levels as they refer to drought. High levels of charcoal will show a
period of frequent forest fire activity and thus an increase in drought like conditions. Lower levels of charcoal will show a decrease in forest fire activity and thus wetter, cooler conditions less prone to drought.

Housepit diameters and their dates of occupation also were necessary for this study. Housepit diameters were collected as data reflecting the size of group residing under a single roof. Thus, taking Teit’s (1900:192) argument of housepit size reflecting family size, larger housepits would represent larger families or larger related groups combining their efforts to acquire resources. Housepit diameters combined with dated floors allows for a clear picture of house size variability through time. The housepit diameters and dates were combined in order to get a regional picture and then separated by river drainage in order to see any localized variation between data sets.

Statistical tests and mathematical alterations were made to the housepit dates and diameters data set in order to 1) see the actual date of peak housepit size and housepit size variation, 2) to see the differentiation of housepit size and housepit variation from this peak date, and 3) to test the statistical significance of these tests.

Looking at the data concerning forest fire frequency through time (Figure 1) it appears there are a number of peaks and valleys representing greater and lesser forest fire activity. Interestingly, this graph shows a substantial peak of forest fire activity around 1500 BP. This graph took lake and soil core information reported in Hallet et al (2003). Data for this graph filter out normally occurring accumulation of charcoal in lakes and on the ground surface, and shows more intense periods of fire activity (Hallett et al, 2003).

With the data collected from numerous sources, housepit diameters in meters and uncalibrated radiocarbon dates were acquired. These data allowed for the making of
Figure 2, which shows all housepit dates and diameters for the study area, while Figures 3 and 4 break up these data for the Mid-Fraser Canyon and the South Thompson River Valley, respectively.

Figure 2 shows a cluster of varying housepit sizes between about 1000 and 2000 years BP, with a few outliers. There is, however, no distinctive pattern visible with the 27 housepits used here. Figure 3 shows the Mid-Fraser Canyon data. This graph with a total of 20 points reveals very little beyond the same clustering and varying between 1000 and 2000 BP. The data for the South Thompson River Valley, presented here in Figure 4, has only 7 points and therefore shows very little beyond a potential increase in size through time. However given the limited sample, little can be said about this data set.

The entire data set was used to create Figure 5. All of the radiocarbon dates were recoded by subtracting them from 1500 BP, the date observed in Figure 1 of forest fire frequencies as a significant period of fire activity, as well as the date when the most large housepits seem to have occurred. The absolute value of this number resulted in the number of years away from the 1500 BP date each housepit was. Recoding was carried out in order to place the date of 1500 BP as 0, or as the time with the most variation in housepit size. Every date from this 0 point of the greatest variation would be in terms of how many years away from this point, both before and after the date, the housepits were.

The number of years away from 0 combined with housepit diameter resulted in the variation of housepit size away from 1500 BP. The diameters were graphed against these recoded dates to make Figure 5. Figure 5, showing as time goes on, in either direction from 1500 BP, houses are decreasing in both size and variation. A correlation coefficient was also run using this data set. The Pearson's r correlation coefficient (two tailed)
resulted in a score of -.374. This test indicates a whether the relationship between two data sets is significant or not, this data set in particular reflected a significant relationship. The calculated value is significant at the .1 level for 25 degrees of freedom.

Another statistical evaluation of the data was conducted, resulting in Figure 6. This graph was completed using the data for all of the housepits recorded. Due to the negatively accelerating nature of the graph of housepit diameters and their corresponding uncalibrated dates the square root of the diameters were calculated to create a more lineal graph. The square root of the diameter was then graphed against its corresponding date. This graph shows, much more clearly than Graph 2, an increase in housepit size and variability around 1500 BP.

In summary the graphical and statistical data in combination with the forest fire data, shows an interesting trend. With a peak of forest fire activity and the increase in housepit diameter and size variability both occurring around 1500 BP there seems to be a significant relationship.
Chapter 4: Discussion

This study attempts to offer a more clear understanding of group aggregation on the Canadian Plateau of Central British Columbia around 1500 BP. Two alternative models were tested in order to explain the occurrence of group aggregation within these valleys. Of significant interest here are the differences we can see within the Plateau, in particular the Mid- Fraser and South Thompson River valleys. Models concerning the impacts of fluctuations in resource availability accompanied by the correlating data on the environmental conditions experienced at this same time offered the best explanation for the observed increase and variation in housepit size.

The observation has been made that there are large housepits and a greater variation in housepit size around 1500 BP. However we can ask why would this happen when there are a number of disadvantages to constructing a larger housepit? MacDonald's paper (2000a) provides a solid mathematical explanation as to how efficiently body heat can be used to warm the volume of space in a small housepit. This then begs the question if small housepits can be sufficiently warmed using only body heat and large housepits, given their increased height and volume are more difficult to heat (MacDonald 2000a), why would people choose to aggregate together in large houses? Another paper by MacDonald (2000b) gives the ideal structural layout for houses of varying sizes. Included in this are ideal roof pitch angles and amounts of necessary materials required, among other things. The main implication drawn from his paper, having to do with this study concerns the observation that large housepits require more materials and labor in their construction (MacDonald 2000a). Again the question of why
people would choose to construct large houses despite the high costs and seemingly low benefits? Although neither of these works specifically addresses reasons behind group aggregation resulting in the building of large housepits, they do offer two lines of evidence indicating that large housepits, structurally speaking, do not offer much of an adaptive advantage. These studies on the contrary show that large housepits would have been more labor intensive and material costly structures that required other, outside, methods of heating.

Therefore it seems there must be some other explanation required for people to construct large housepits. This reason would, presumably, have to outweigh the more costly aspects of large housepit construction. This combined with Chatters (2004) argument on the numerous difficulties encountered when people nucleate, namely a necessary increase in food gathering territory, depletion of local food and material resources, and an increase in health risks definitely creates a situation wherein aggregation would be costly. Given that these costs were no doubt recognized, and aggregation still occurred, a better explanation is needed.

Clues as to why this aggregation occurred were examined with respect to environmental conditions, specifically climatic changes that may have effected group subsistence decisions. Hallett’s (2003a, 2003b) studies of climate on and surrounding the Canadian Plateau are useful here. Both of these papers, as discussed earlier, point towards an increase in forest fire frequency between 2400 and 1300 BP with a peak around 1700 BP (Hallett 2003a, 2003b), while Chatters et al (1995) offer an even later drought around 900 BP.
Forest fires are good indicators of climatic conditions associated with a localized drought (Hallett 2003a). A sufficient amount of dry materials would be necessary in order to provide enough fuel for a forest fire to become intense and widespread enough to be distinguishable in the geological record. No doubt, such conditions would have greatly affected the availability and abundance of the resources local populations relied upon for subsistence. A decrease in resources would have presumably forced groups to reorganize their, up until now sufficient, subsistence strategies in order to deal with the new environmental conditions. It is here that a model outlining human reactions to climatically driven resource depletions is applicable.

It is apparent around 1500 BP a separate phenomena occurred; housepits increased in diameter and variability in size. Given the timing of the housepit size change and the increase in forest fires, it is highly likely that they may be related, one potentially having been a factor in causing in the other. Groups of the Canadian Plateau subsisted, using a strategy of resource acquisition based on seasonal mobility. However, once the availability of resources changed and the seasonal round, previously described, altered, a new adaptive strategy was necessary.

Lewis Binford’s packing model (Binford 2000), and Brian Hayden’s aggrandizer model (Hayden 1997), have been proposed as possible explanations of group aggregation. This study appears to have sufficient data to successfully test whether either of these models will work to explain why groups on the Canadian Plateau began to gather together into larger housepits and, thus, more densely populated living quarters.

First Hayden’s aggrandizer theory was tested. This model is based on a few premises. Foremost of all there must be a surplus of goods within an egalitarian society.
This surplus is a reflection of a group’s ability to acquire enough resources to meet and exceed individual needs. By meeting all of an individuals resource needs, extra resources can be controlled by an ambitious individual, without others feeling threatened. Therefore, there must be an individual with the ambition, skills, and the ability to acquire control over those surplus resources. Maschner argues “In all communities, at least a few individuals can be found who are motivated primarily by their own self interests (Maschner 1995:379).” It would seem the people of the Mid-Fraser and South Thompson River Valleys would be no different than any other group in this regard and be fully capable of producing individuals with the motivation and intention of personal gain. Once individual control over surplus (due to an abundance of resources) has occurred the aggrandizer affords the attained heightened position by establishing an obligatory return of gifts with interest, and attracting supporters or mates through gift giving and lavish displays of success (Hayden 1997). Basically aggrandizers worked on a system of generosity to support their control over resources.

The data presented here, however, does not fit this model well. There is no doubt that such an individual, one with a high level of personal interest, could have existed (Hayden 1997). However there is no evidence that a surplus of resources, enough to allow for an individual to gain substantial control over, existed at the same time that the strain on resources occurred. On the contrary, forest fire data points to the fact there was a change in the availability of resources due to drought. A larger housepit would denote an organizational strategy that required more people to cooperate under a single roof. This occurrence is not easily explained by a theory where a few individuals attained and wielded power over the villages, which would appear archeologically as a centralized
accumulation of wealth. Especially since a hierarchy of wealth within the houses has been noted archeologically, within each of the large housepit floors (Hayden 1997). It would seem that individuals, whose position and wealth was derived by the control over the excess would require a surplus to work with. The droughts occurring around 1500 BP offer little evidence to support a hierarchy entrenched in controlling an overabundance. It would seem more likely that a society with aggrandizers would level off in terms of wealth during a drought, as resources are strained and acquiring those resources becomes increasingly difficult. Potentially, people would fend for themselves. They certainly would not have begun to build large housepits, as those who previously had sufficient wealth to do so are now in the same subsistence level as everyone else. If they did aggregate in order to deal with the stresses of resources shortages, this would occur as a byproduct of wealth differentiation and only a select few would have accompanied the aggrandizers, being the only ones who could afford to build small housepits into large housepits, and archeologically there are too many large housepits occurring to explain centralized wealth. The packing model, supported by Binford seems to explain things a little more clearly.

Binford (2000: 461) argues, "...habitat changes...are themselves driven by climatic change. It is the synergistic interactions between prior conditions, unfolding thresholds, and changes in habitat that condition organizational restructuring and result in a proliferation of new forms of complexity in cultural systems." Lewis Binford's packing model deals with human aggregation in terms of population densities. According to this model once populations reach a certain density in an area, people will begin to pack around critical resources as their once more widespread range of mobility is encroached
upon by outside groups. This will inevitably reduce their range of subsistence and they then become packed around those resources. Dealing with a change in resource reliability on the Canadian Plateau required a change in subsistence strategies based on labor organization, in order to acquire necessary food and building materials. Within pithouses and villages people packed in order to gain hold of access, ownership, and the abilities to obtain key resources. Thus organized labor became the vital. Increasing labor cooperation meant decreasing stress and risk in the security of obtaining adequate resources. Labor relationships drove nucleation into larger housepits.

An increase in housepit size would logically mean that more people could live within a single dwelling, while an increase in house size variability would mean an unequal distribution of resources, which includes human labor. According to Teit (1900:192) and Dohm (1990), pithouse dimensions are a reflection of the size of the family that inhabited the structure. Dohm's (1990) research on Pueblos of the American Southwest has suggested population aggregation is a useful determinant in the roofed area of houses. It would then appear these bigger houses were built in order to accommodate a larger number of people than previously was necessary. The difficulties that come with a more densely populated area leading to group aggregation, in this case reflected by housing structures, have already been discussed. The argument has also been made, given the climate of the time; there was a significant strain on available and necessary resources.

Arguably the data concerning group aggregation in the Mid-Fraser and South Thompson River valleys exemplifies this model. On a village scale, due to patchy or spatially variable resources created by drought like conditions, people began to pack into
large houses in order to better their chances at successfully acquiring needed resources. Packing in this instance, increases the level of security by organizing people into a more economically advantageous situation where resources can be more successfully and reliably obtained. Whether these houses are kin-based or not, a larger labor base is reflected in these houses as groups are organizing a cooperation based system to ensure sufficient resource acquisition. There is also evidence of household packing with the variation in size of housepits. Not everyone would be able to pack into large houses and given the lack of reliability in resources small housepits may have had an advantage over large housepits. Therefore, people would pack or organize labor, around the resources available to them. According to Romanoff (1992) people, using productive fishing areas such as those at Bridge River, could only fish for 30 minutes at a time. Thus more people would be required to effectively utilize such locations, both for fishing and processing the fish (Romanoff, 1992), as other resources in the area became less reliable. Equal in importance is the access provided by the rock outcroppings would be unaffected by droughts or forest fires, giving them a high level of importance during such times.
Chapter 5: Conclusions

With the pattern recognized through this study, the reasons behind an increase in housepit sizes are presented. Droughts, affecting resource availability and reliability, being recognized by a rise in forest fire activity, altered the subsistence strategies of people living in the Mid Fraser and South Thompson River Valleys. Social organization had, until resource availability was altered, allowed for sufficient acquisition of resources. However, a new strategy was required to provide the adequate acquisition of resources. The same number of people attempting to access a strained resource base equates to an increase in population density with respect to those resources desired. With a rise in density, people began to pack, around reliable food sources. People packed around those resources which people had current adequate access to, such as fishing access on the Mid-Fraser. A new strategy to decrease the risk of inadequate resource accumulation, inherent in a drought-ridden environment, involved the reorganization of labor. The restructuring of labor has been observed by an increase in the space within which people lived. Housepit size and housepit size variability increased as restructured labor groups nucleated. Interestingly this means the first large housepits, those over fifteen meters in diameter, appear around 1500 BP.

Given the set-backs of large housepit aggregation including social tensions, group health problems, and adequate house heating, it is apparent that the economic security gleaned from nucleation decreased resource acquisition stress enough to outweigh these negative aspects. Therefore, large diameter houses were constructed in order to house a
larger, restructured labor force in order to deal with patchy resources and increased population density.

For the most part this paper shows that human groups do react to and change their subsistence strategies and organizational methods based on environmental conditions. Thus Binford's Packing Model is supported by the data. The information produced from this study not only offers support for Binford's Packing Model, but establishes a methodology for further investigations with access to new data from the Mid-Fraser and South Thompson River Valleys and other river valleys of the Canadian Plateau, as well. It could also potentially support environmental impacts to resource availability as being substantial forces affecting other observations of house structure size variability. Supporting data for this study could possibly include a detailed analysis of changes in resource access. For example the question of whether or not dependencies on certain resources change due to population pressures restricting access to those resources, could be explored.

This study could be improved with the greater availability of housepit dates and diameters. An improved methodology of recordation, consistent with all sites would be helpful. A widely accessible, large database of useful information could offer ease of research, and offer more comprehensive results. Despite limitations, this study produced positive results. Further testing would require a more extensive data base of radiocarbon dated housepits with their respective diameters.
References

Agee, J.

Alexander, Diana


Arnold, Jeanne

Bennet T, Jospeh R; Brian F. Cumming, Peter R Leavitt, Marian Chiu, John P. Smol, and Julian Szeicz.
2001 Diatom, Pollen, and Chemical Evidence of Postglacial Climate change at Big Lake, South-Central British Columbia, Canada. Quaternary Research 55:332-343.

Binford, Lewis R.


Chatters, James C.
Chatters, James C. (cont.)

Chatters, James C., Virginia L. Butler, Michael J. Scott, David M. Anderson, and Duane A. Neitzel

Chatters, James C., and Daniel Leavell

Clague, John J.

Clark, J.S.

Clark, J.S., and W.A.Patterson I.

Crellin, David and Ty Heffner
2000 The Dogs of Keatley Creek. In Brian Hayden (Ed), The Ancient Past of Keatley Creek, Volume 1: Taphonomy, pp 151-166. Archeology Press, Department of Archeology, Simon Fraser University, Burnbary.

Dohm, Karen
Elert, Glenn

Finney, Bruce P., Irene Gregory-Evans, Marianne S.V. Douglas, and John P. Smol

Fladmark, Knut R.

Fladmark, Knut R., and Alexander Driver.

Goodale, Nathan, and Mike Lenert

Hallett, Douglas, J.; D.S Lepofsky, Rolf W. Mathewes, and Ken P. Lertzman
2003a 11,000 Years of Fire History and Climate in the Mountain Hemlock Rainforests of Southwestern British Columbia Based on Sedimentary Charcoal. Canadian Journal of Forest Research 33: (292-312).

Hallett, Douglas, J.; R.W. Mathewes, and P.C. Walker
2003b A 1,000-Year Record of Forest Fire, Drought, and Lake Level Change in Southeastern British Columbia. The Holocene 13:5.

Hayden, Brian


2000a Dating Deposits at Keatley Creek. In Brian Hayden (Ed), The Ancient Past of Keatley Creek, Volume 1: Taphonomy, pp 35-40. Archeology Press, Department of Archeology, Simon Fraser University, Burnbary.

2000b Prestige Artifacts at Keatley Creek. In Brian Hayden (Ed), The Ancient Past of Keatley Creek, Volume 1: Taphonomy, pp 189-202. Archeology Press, Department of Archeology, Simon Fraser University, Burnbary.
Hebda, Richard J.

Kew, Michael

Lamb, H.H.

Lepofsky, Dana
2000 Socioeconomy at Keatley Creek: The Botanical Evidence. In Brian Hayden (Ed), *The Ancient Past of Keatley Creek, Volume 1: Taphonomy*, pp 75-86. Archeology Press, Department of Archeology, Simon Fraser University, Burnaby.

Long, C.J.; C. Whitlock, P.J. and S.H. Millspaugh

Maschner, Herbert D.G.

Mathewes, Rolf W.

MacDonald, Richard
MacDonald, Richard (cont.)
2000b Structural Strategies for Pithouses on the Keatley Creek Site. In Brian Hayden (Ed), *The Ancient Past of Keatley Creek, Volume 1: Taphonomy*, pp 221-238. Archeology Press, Department of Archeology, Simon Fraser University, Burnaby.

Millspaugh, S.H., & C. Whitlock

Mohs, Gordon

Pokotylo, D.C., & D. Mitchell

Prentiss, William C., Ian Kuijt

Prentiss, William C., Michael Lenert, Thomas Poor, Nathan B. Goodale, and Trinity Schlegel

Richards, Thomas H., & Michael K. Rousseau
1987 *Late Prehistoric Cultural Horizons on the Canadian Plateau*. Simon Fraser University, Department of Anthropology. Publication 16, Burnaby, B.C.

Romanoff, Steve

Rousseau, Michael K
Rousseau, Michael K., Robert J. Muir, & Diana Alexander
1991 Results of the 1990 Archeological Investigation Conducted in the Oregon Jack Creek Locality, Thompson River Region, South-Central B.C. (Manuscript on File, Archeology Branch, Victoria B.C.)

Rorig, M.L., & S.A. Ferguson

Sanger, David

Stryd, Arnoud H.


Stuvier, M, & H.A. Polach

Teit, J.A.


Thompson, R.S.; C. Whitlock, P.J. Bartlein, S.P. Harrison, & W.G. Spaulding
1992 Climate Changes in the Western United States since 18,000 Yr BP. In H.E. Wright et al (Eds), *Global Climates Since the Last Glacial Maximum*, pp 468-513. University of Minnesota Press, Minneapolis.
Turner, N.J.

Veblen, T.T., & P.B. Alaback

Wilson, Robert L., & Catherine Carlson
1980    The Archeology of Kamloops. Department of Archeology, Simon Fraser University, Publication No 7, Burnaby, BC.
Table 1.

Table 1 is a collection of all data used in this study including housepit designation, uncalibrated date of the house, rim to rim diameter, and the source of the data.

<table>
<thead>
<tr>
<th>Site</th>
<th>HP #</th>
<th>Uncalibrated Date BP</th>
<th>Diameter (m)</th>
<th>Reference #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mid Fraser River Valley</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EeRI7</td>
<td>7</td>
<td>1695</td>
<td>19</td>
<td>1,3</td>
</tr>
<tr>
<td>EeRI21</td>
<td>1</td>
<td>1280</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>EeRI22</td>
<td>1</td>
<td>2775</td>
<td>10.65</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRI 40</td>
<td>1</td>
<td>395</td>
<td>9.25</td>
<td>7</td>
</tr>
<tr>
<td>EeRk 7</td>
<td>1</td>
<td>920</td>
<td>10.6</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 7</td>
<td>3</td>
<td>1515</td>
<td>6.25</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>1</td>
<td>1495</td>
<td>16.4</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>2</td>
<td>1295</td>
<td>15.1</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>4</td>
<td>1010</td>
<td>12.1</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>5</td>
<td>1380</td>
<td>9.3</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>6</td>
<td>1590</td>
<td>11.8</td>
<td>6,7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>7</td>
<td>1325</td>
<td>11.55</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>8</td>
<td>1365</td>
<td>18.9</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>13</td>
<td>1100</td>
<td>13.2</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>14</td>
<td>1575</td>
<td>12</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>15</td>
<td>935</td>
<td>11.2</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>19</td>
<td>1515</td>
<td>16.2</td>
<td>6,7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>21</td>
<td>1470</td>
<td>10.45</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>22</td>
<td>1215</td>
<td>11.8</td>
<td>7,8</td>
</tr>
<tr>
<td>EeRk 4</td>
<td>23</td>
<td>1560</td>
<td>16.25</td>
<td>7,8</td>
</tr>
<tr>
<td><strong>South Thompson River Valley</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EeRb3</td>
<td>10</td>
<td>1920</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>EeRb10</td>
<td>9</td>
<td>2950</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>EeRb10</td>
<td>10</td>
<td>2900</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>EdRa9</td>
<td>4</td>
<td>1950</td>
<td>9</td>
<td>5,9</td>
</tr>
<tr>
<td>EdRa9</td>
<td>7</td>
<td>1950</td>
<td>6</td>
<td>4,9</td>
</tr>
<tr>
<td>EdRa22</td>
<td>6</td>
<td>385</td>
<td>5.5</td>
<td>9</td>
</tr>
<tr>
<td>EdRa22</td>
<td>15</td>
<td>1200</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>

1. Hayden, 2000
4. Richards and Rousseau, 1982
5. Rousseau, 2002
6. Stryd, 1973a
7. Stryd, 1973b
8. Stryd, 1980
Figure 1.
This figure represents the chronological accumulation of charcoal, taken from soil and lake cores. The peaks are increases in charcoal depositions, reflecting an increase in forest fire activity, with the normal “background” charcoal being filtered out.
Graph created using data from Hallett et al (2003a).
Figure 2.
Figure 2 is a representation of all accumulated data on housepit sizes and dates. There is no obvious pattern noticeable here beyond a potential increase in variation and size between 1000 and 2000 BP.

Figure 3.
Figure 3 shows the dates and diameters of pithouses in the Mid-Fraser River Valley. As with Figure 2 there is no apparent recognizable pattern here beyond a potential increase in variability and size between 1000 and 2000 BP.
Figure 3 shows the dates and diameters of pithouses in the South Thompson River Valley. Even more so than with Figures 2 and 3, this figure shows little. The limited data only offers a vague notion that size increases through time.
Figure 5 shows the data used in Figure 2 with recoded dates as a collection of deviations from the height of forest fire activity, 1500 BP. With 0 representing 1500 BP and all other dates being years from 1500 BP. The graph shows a significant decrease in housepit variability and size with distance from 1500 BP.
Figure 6 shows the data used in Figure 2 with all of the square roots of the diameters and graphed against their respective dates.