VARIABILITY IN LATE PREHISTORIC PREY-USE STRATEGIES OF THE SOUTHEASTERN COLUMBIA PLATEAU: A TEST USING THE HARDER SITE FAUNAL ASSEMBLAGE

By

VAUGHN R. KIMBALL

A thesis submitted in partial fulfillment of
the requirements for the degree of

MASTER OF ARTS

WASHINGTON STATE UNIVERSITY
Department of Anthropology

MAY 2005

To the Faculty of Washington State University:

The members of the Committee appointed to examine the thesis of VAUGHN R. KIMBALL find it satisfactory and recommend that it be accepted.

Chair

William

Robert E. Ackerman

ACKNOWLEDGEMENTS

Without the help of several individuals this thesis would not have been possible. Dr. Karen Lupo's comments on drafts of this thesis greatly improved its quality. She also gave me encouragement and sound advice during the course of my graduate work that helped me tremendously. Dr. William Andrefsky introduced me to Plateau archaeology and prehistory and taught me a lot about how to pursue research questions. This has been and will continue to be invaluable to me. Dr. Robert Ackerman's meticulous editing and insightful comments also improved the quality of this work.

I would like to thank all of the faculty and staff of the Washington State University Department of Anthropology, as well as my fellow graduate students. Dr. Kohler and Dr. Lipe in particular were always willing to spend time on my questions or concerns whether regarding course work, my research, or my career goals. Annette Bednar never tired of my questions and was always willing to help with the logistics of completing my degree and submitting this thesis. Although there is not time or space to name them all here, I was fortunate to work with a group of students who became my friends and always showed interest in my work and success. I will watch their careers with interest.

I am grateful to my parents, Randy and Carol Kimball, who from the time I was very young, taught me to ask questions and encouraged my intellectual development. Finally, I owe the greatest debt of gratitude to my wife and best friend, Tavia Kimball. She has been and continues to be willing to do whatever it takes to support me in reaching my educational and career goals. I am forever in her debt. Any errors in this thesis are solely the fault of the author.

VARIABILITY IN LATE PREHISTORIC PREY-USE STRATEGIES OF THE SOUTHEASTERN COLUMBIA PLATEAU: A TEST USING THE HARDER SITE FAUNAL ASSEMBLAGE

Abstract

by Vaughn R. Kimball, M.A.
Washington State University
May 2005

Chair: Karen Lupo

The economic pattern on the Columbia Plateau during the ethnographic period known as the winter-village pattern consisted of a suite of characteristics including pithouse villages, seasonal mobility, and reliance on the storage of surplus salmon and plant (especially root) resources. Over the past three decades of archaeological research on the Columbia Plateau, the question of how the winter-village pattern appeared and became established has become an important one. Various models have been suggested to explain the phenomenon. Most of these models focus on the appearance of one or two characteristics followed by gradual introduction of the other characteristics, and an increasing reliance on salmon and storage technology. Others recognize continuous variation and fluctuations in prey-use strategies over time. None of these models have incorporated faunal assemblage data from the southeastern region of the Plateau. In this study, analyses of faunal assemblages from the southeastern region of the Plateau demonstrate that it may have been characterized by a prey-use strategy distinct from other parts of the Plateau. Furthermore, temporal fluctuations appear to support models that emphasize the dynamic nature of prey-use strategies over the past 4,000 years of Plateau prehistory, rather than the gradualist models that suggest steadily increasing reliance on one resource. Several avenues for future research on the establishment of the winter-village pattern in the southeastern region of the Plateau are also suggested.

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

Dedicated to my girls, Olivia and Avery,

who bring so much meaning to my life

Chapter 1

The Winter Village Pattern and the Southeastern Columbia Plateau

The residential and subsistence pattern on the Columbia Plateau at the time of ethnographic contact has been characterized as semisedentary, and consisted of a seasonal round in which people dwelt in large groups along the rivers during the winter. In the spring and summer, they would leave the river bottoms and go into the uplands to gather berries and important root crops such as camas, and hunt for game. During the summer and into the fall, they would take advantage of runs of anadramous fishes up the rivers. During the winter months stored surpluses of dried fish and processed camas were used, and augmented by continued hunting of large and small game (Chatters and Pokotylo 1998; Kroeber 1939; Nelson 1969; Walker 1998a). This pattern has been referred to as the "ethnographic winter village" pattern, and the date of its onset as well as its origins are important questions for archaeologists working on the Columbia Plateau.

Over the past three to four decades, numerous models have been developed which seek to explain the development of the winter village pattern in the Southern Plateau. Researchers have approached the question using a variety of tools available to anthropologists and archaeologists, including linguistics (Nelson 1973), analysis of artifact assemblages (Chatters 1995), analysis of faunal assemblage structure (Chatters 1995; Lohse and Sammons-Lohse 1986), and ethnographic analogy (Ames and Marshall 1980).

One characteristic that all of these models have in common is that the introduction, development, or intensification of a specific subsistence strategy, plays an important role in each model. However, it is recognized by many researchers that variations in resource availability existed from region to region within the Plateau (Ames et al. 1998; Chatters 1995; Chatters and Pokotylo 1998). Even though a wide variety of methods have been used to develop and evaluate these models, none have included analyses of faunal assemblages from the southeastern region of the Plateau. An analysis of faunal assemblages from the southeastern region of the Columbia Plateau was therefore undertaken in this study in order to better understand the dynamics of prey-use strategies over the past 4,000 years of prehistory, and to examine the applicability of the Winter Village Pattern models to this specific sub-region of the Plateau.

There were two main components to my research. The first was a survey and analysis of the faunal data that has been collected from sites within the Southeastern Plateau. This was undertaken to determine whether or not there is evidence in the zooarchaeological record of the southeastern Plateau to support any of these models, and to evaluate the applicability of the models to this region given the possibility that people relied on a subsistence strategy that may have been distinct prehistorically from the rest of the Plateau.

Based on the results of this analysis, hypotheses to explain the observed variability were developed. The second component of my research was an analysis of the faunal assemblage from the Harder site (45-FR-40). The results of the analysis were used to expand the sample of faunal data from this region, and to test the validity of the hypotheses that I developed based on the regional data. The Harder site was selected because its location *and* the time to which part of the assemblage is dated, makes the assemblage optimal for testing the hypotheses in question. Its location allowed me to expand the sample to represent a region from which no faunal assemblages had been completely identified. The time period to which it dates also allowed me to test the temporal patterns in the assemblage which suggest that specific periods of time were characterized by higher utilization of fish.

Chapter 2 of this thesis is a brief overview of the various models for the beginning of the establishment of the Winter Village Pattern. Chapter 3 discusses the potential impact of regional resource variation on prey-use strategies and discusses how diversity and abundance indices can be used in quantifying faunal data to measure temporal changes in prey-use strategies as well as regional variability. Chapter 4 consists of my analysis of the Harder site faunal assemblage. Chapter 5 presents the results of the analysis of faunal assemblages from the region, which is augmented by the data from the Harder site faunal assemblage.

There are three basic conclusions from this analysis. First, the results of my analysis tend to support those models that emphasize fluctuations through time in prey-use strategies on the Plateau (Chatters 1995, Nelson 1973). This is in contrast to other models that posit gradually increasing reliance on storage technology, fish, and/or root resources (Ames and Marshall 1980, Lohse and Sammons-Lohse 1986, Schalk 1983a). Second, the data also appear to support the assertion that significant differences in regional resource availability existed. Finally, temporal patterns in the faunal data seem to be linked to alluvial cycles on the Clearwater River. While this assertion is tentative given the limitations of this sample, the patterns present possible questions for future research.

Chapter 2

Establishment of the Ethnographic Winter Village Pattern

Over the past three to four decades, numerous models have been proposed which seek to explain the development of the winter village pattern on the Southern Columbia Plateau. Researchers have approached the question using a variety of tools available to anthropologists and archaeologists including linguistics (Nelson 1969; 1973), analysis of artifact assemblages (Chatters 1995; Nelson 1969, 1973; Schalk 1981), faunal assemblage structure (Chatters 1995; Lohse and Sammons-Lohse 1986), and ethnographic analogy (Ames and Marshall 1980). One point of disagreement among these models is the nature of the subsistence strategy that gave people the ability to establish and support a semisedentary life way. A second, related issue concerns the timing of pithouse construction, whether or not pithouses demonstrate the emergence of semisedentism, and whether or not pithouse construction continued uninterrupted from the time of its first introduction until ethnographic contact.

I begin this chapter by defining the winter village pattern. I then discuss the different models that purport to explain the establishment of the winter village subsistence and settlement pattern on the Southern Plateau. This is followed by a review of the question of whether or not semisedentism, as evidenced by the presence of pithouses, persisted without interruption from ~5,000 B.P. to the ethnographic period.

The Winter Village Pattern

At the time of ethnographic contact, the residential and subsistence pattern on the Columbia Plateau was characterized as semisedentary. As defined by most researchers beginning with Kroeber (1939), it consisted of three major components. First, permanent base camps or villages were maintained in lowland, usually riverine settings and occupied by the entire group during winter months. Second, there was a seasonal scheduling of resources in which salmon and edible roots such as camas were collected during the spring and summer months, while large and small game were hunted in the fall and winter. Third, salmon and roots were collected *en masse*, processed and stored, and used throughout the winter months.

Models for the Establishment of the Winter Village Pattern

Nelson (1973) was the first to offer an explanation for the establishment of the winter village pattern. He argued that it was introduced onto the Columbia Plateau when Salishan immigrants from the Northern or Canadian Plateau, began to slowly colonize the northwestern Columbia Plateau between 3,000 and 2,000 years ago. Nelson did not suggest a dramatic or substantial displacement of earlier Columbia Plateau groups, which consisted primarily of Sahaptin speakers. Instead he argued for a combination of diffusion and migration. The model states that some traits such as projectile point styles, and especially technology that allowed for the intensification of fishing, were introduced by the immigrating population and diffused through the rest of the Southern Plateau. This diffusion was enhanced by a very gradual expansion of Salishan speakers from British Columbia and the northwestern part of the Plateau, and intermarriage with the southern Sahaptin speaking groups. Through diffusion and migration, fishing and storage technologies spread throughout the Columbia Plateau, and allowed for a more efficient exploitation of salmon.

Nelson (1969, 1973) suggested that four lines of evidence supported this hypothesis. At that time, the earliest pithouse villages that had been found occurred in the Okanogan Highlands approximately 3,000 to 2,500 years ago. These villages appeared to be distributed throughout the Plateau by 2,000 years ago. Second, a specific type of semi-subterranean pithouse seems to have spread south and east with the winter village site type. The pithouse is described as typically measuring five to ten meters in diameter and one to two meters deep, with the interior being lined with wooden planks or stone slabs in some areas. Third, trade goods from the Canadian Plateau were introduced at approximately the same time, specifically *dentalium* shell, and jade and mussel shell adzes. Finally, he cites linguistic evidence that suggests that Salishan speakers were first established in the Okanogan Highlands approximately 3,000 years ago, and that the language then spread south and east to its historic distribution until approximately 1,000 years ago. Nelson's hypothesis fell out of favor (Ames and Marshall 1980; Chatters 1995) as increasingly older house pits were found in the southern Columbia Plateau such as those at Alpowa (Brauner 1976) and Hatwai (Ames et al. 1981) (see Figure 2.1).

Like Nelson (1973), Schalk (1977,1981) argued that salmon played an important role in the establishment of the winter village pattern. However, his model does not rely on diffusion and immigration. He emphasizes the importance of site location to explain the development of a salmon based subsistence economy. He cites faunal remains from the Upper Mid-Columbia to argue that salmon became an increasingly important resource in that region until 3,000 BP, after which time the fishery based collector strategy spread rapidly downstream (Schalk 1984, as cited in Chatters 1995). Schalk (1977, 1981) points out that salmon can be most effectively and optimally exploited when two conditions are met. First, population density must reach a critical level in order to have the cooperative

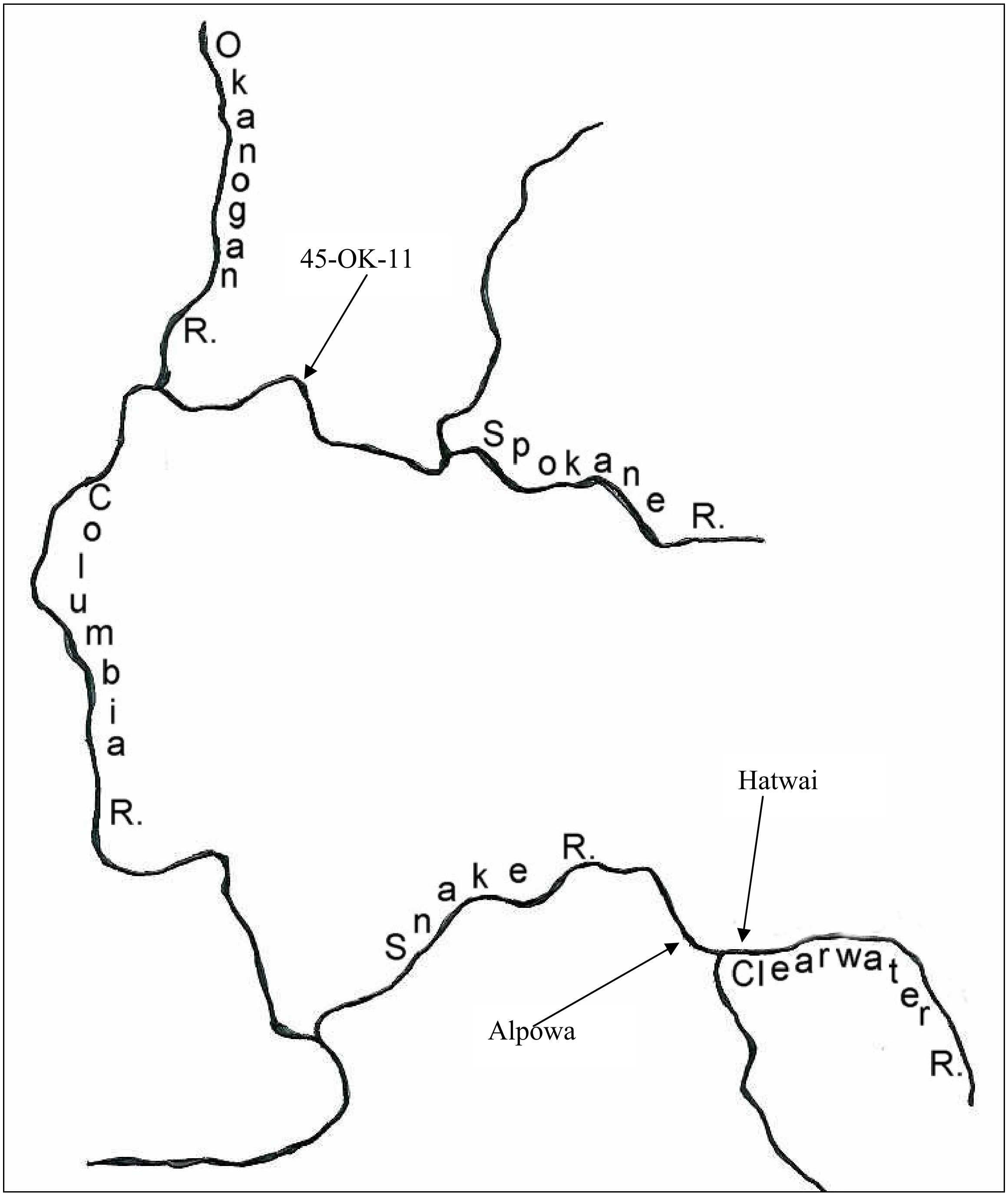

Figure 2.1 Location of major sites mentioned as part of the description of winter village pattern models.

labor to construct and use the necessary technology (i.e., weirs and nets) and process surplus amounts of salmon. Second, storage technology must be developed to make use of the surplus. He argues that once the labor force and technologies associated with fishing and storage were available, surplus salmon resources were able to sustain higher populations through the winter. The spread of salmon intensification is seen as being related to population increase and the establishment of villages, characteristics which persisted until European contact (Shalk 1983a). Not only is this model similar to Nelson's (1973) in that salmon is the critical resource for the establishment of the winter village pattern, but Schalk's dates for the spread of salmon intensification are remarkably similar to Nelson's dates for the spread of the winter village pattern.

Ames and Marshall (1980) also argue that the earliest villages were positioned to optimize important resources. However, rather than emphasizing the importance and spread of the salmon fishery, their model emphasizes the importance of plants and suggests that the initiation of villages was accompanied by the intensification of roots. They use Nez Perce ethnographic and linguistic evidence to demonstrate that villages were strategically located in such a way as to maximize early spring access to plant (especially root) resources. The most significant distinction and an important point in their argument is that, "….roots provided the critical storable resource necessary for villages, with supplemental protein coming from fish and mammals…." (Ames and Marshall 1980:45). Ames and Marshall (1980) agree with Schalk's (1977) assertion that population must meet a "critical mass" in order for salmon intensification to be viable. However, they argue for the necessity of a storable resource which *does not* require a significant labor pool to effectively exploit and store, in order to sustain an increasing population, so that the critical level can be reached. In Schalk's (1977, 1981, 1983a) model, population itself is the catalyst for the intensification and subsequent storage of resources, and the use of winter villages is seen as the continuation of an already established semi-sedentary system. Ames and Marshall (1980) on the other hand argue that a new technology (storage) applied to an already established food source (roots) was the catalyst for the winter village pattern, and that salmon intensification was adopted later in time. According to this model, only *after* the intensification of a *storable* resource like roots would winter villages have been able to be established. The subsequent increase in population would make salmon intensification a practical strategy, and the final piece of the ethnographic pattern would be in place.

Lohse and Sammons-Lohse (1986) also believe that site location was the key to an increasing population that led to the winter village pattern. They argue that between 5,000 and 4,000 years ago Columbia Plateau groups were able to establish a semisedentary pattern by using a “site positioning strategy” whereby prime locations with optimal access to both riverine (primarily shellfish) and upland resources were occupied first. They cite as evidence 45-OK-11 (see Figure 2.1) and other house pit communities which appear to have been occupied year round, date between 5,200 and 4,000 BP, and exhibit economies that were broad based, but also relied heavily upon large game and mussels. According to their model the other components of the winter village pattern including intensification of root collection, salmon fishing, and storage, only occurred later in response to increasing population pressure. They argue that fishing and root collection served as only supplementary contributions to the diet during this period, and that the subsistence strategy exemplified at these early sites is indicative of Cascade (Lower Snake River) and Kartar (Middle Columbia River) phase economies. Intensification of fish and roots coupled with the use of storage technologies are seen as being indicative of the later Tucannon (Lower Snake) and Hudnut (Middle Columbia) phase economies.

Pithouses and the Establishment of the Winter Village Pattern

One point that is common to these models is that they regard the presence of house pits as indicating at least the beginning of the establishment of the winter village pattern (Ames and Marshall 1980; Lohse and Sammons-Lohse 1986; Nelson 1973; Schalk 1983a). Ames (1991) recognized however, that the initial construction of pithouse villages (as represented by pithouses at Hatwai, Alpowa, and 45-OK-11) did not necessarily represent the establishment of a pattern that continued uninterrupted from 4,500 BP through to the ethnographic period. He identified four episodes of house pit construction between 5,500 and 250 BP along the lower Snake and Clearwater rivers, and the upper mid-Columbia in eastern Washington. He argued that there were varying levels of semisedentism in each of these episodes, based on differences in abundance of house pits, mobility patterns, and mean house pit size. These episodes were identified primarily on the basis of C^{14} dates taken from the fill and floors of excavated house pits. Ames (1991) used these pithouse dates to illustrate the likelihood that there were distinct episodes of pithouse construction, which represented an increase in sedentism, that were interrupted by episodes of decreased use of pithouses and, by extension, more mobile lifeways.

Chatters (1989,1995) also developed a model to explain the development of the winter village pattern. Much like those developed by Ames and Marhsall (1980), Lohse and Sammons-Lohse (1986), and Schalk (1977), Chatter's model incorporates subsistence to explain the emergence of this pattern, but also includes paleoclimatic data, and the episodic nature of pithouse construction in his explanation. He conducted an analysis similar to that of Ames (1991) based on C^{14} dates, but was more careful about his selection of dates, using only those from house floors or floor features. Using this method, he identified two separate episodes of housepit construction between 4,500 and 2,000 years ago. Pithouse I, the first episode, lasted from approximately 4,500 to 3,800 years ago, and the second, Pithouse II, from 3,100 to 2,200 years ago. Furthermore, he coupled this with data from the faunal assemblages of sites located in the Columbia Plateau, to demonstrate that the subsistence strategies represented by these two episodes of housepit construction were distinct. Chatters (1995) argued that Pithouse I would have been characterized by a broader, more forager-like (*sensu* Binford 1980) subsistence strategy than Pithouse II, which he argued represented a more collector-like strategy. He argued that the forager pattern was reflected in faunal assemblages with higher richness values, while the collector pattern was reflected by less diverse faunal assemblages. The episodic nature of pithouse construction coupled with differences between the subsistence strategies of Pithouse I and Pithouse II, suggest temporal discontinuity between the construction of the earliest pithouses and the establishment of the ethnographic winter village pattern. In other words, the earliest pithouses (circa 5,000-4,500 B.P.) do not necessarily signal the beginning of what would later become the winter village pattern (Chatters 1989).

Chatters (1995) goes one step further by suggesting that a fundamental change in the environment led to the apparent demise of Pithouse I and created selective pressure that would have favored the collector strategy represented by Pithouse II. He uses a wide array of evidence including palynology, glacial advances, and rock spall, to illustrate two climatic trends that support his model. First, he shows that during Pithouse I (4,500-3,900 BP) there was an increase in available moisture while temperatures remained warmer than after 3,900 BP. The combination of increased moisture and warm temperatures created a rich environment that made it possible for people to maintain semisedentary villages while pursuing the forager like strategy represented at sites like 45-OK-11. After 3,900 BP, available moisture remained high but temperatures began to get cooler. Shell growth rates of mollusks further demonstrate that the environment became markedly seasonal in a short amount of time beginning at ~3,900 BP. These data are essential to this model because he argues that the forager strategy represented by Pithouse I was no longer viable under the cooler, more seasonal environmental regime, and that there was selective pressure for the development of the collector strategy represented by Pithouse II. More recently Chatters argued (2004) that Pithouse II appeared as a "full blown" collector system and therefore may have been, as Nelson (1973) originally hypothesized, introduced from other areas such as the Canadian Plateau or the Northwest Coast where it had already developed (see also Prentiss and Chatters 2003).

Subsistence Resources and the Winter Village Pattern

Another characteristic that each of these models has in common is their reliance on the use, intensification, or introduction of a particular subsistence related resource as part of the impetus for the establishment of the pattern. Nelson's (1973) model suggests the introduction of a technology that allowed for the more efficient utilization of salmon, and Schalk (1977, 1983a) emphasizes the intensification of salmon. Ames and Marshall (1980) focus on the importance of plant resources, while Lohse and Sammons-Lohse

(1986) argue that fresh water bivalves and large game were pivotal in sparking the development of this pattern. However, regional variations in resource abundance and use existed throughout the Plateau ethnographically and probably prehistorically as well (Chatters and Pokotylo 1998). Regional resource variability may be important to consider therefore in an analysis of these models within the specific context of the Southeastern Plateau.

Chapter 3

Environment, Resources, and Regional Resource Variation

The Southern Columbia Plateau contains many different habitats that offer diverse economic opportunities for the human populations living within them. Many plant and animal resources were seasonally available to prehistoric populations. The region is characterized as bunchgrass steppe, with blue-bunch-wheat grass *(Agropyron spicatum)*, and Idaho fescue *(Festuca idahoensis)* (see Figure 3.1). In terms of the flora, species diversity is low, with secondary plants such as rabbit brush *(Chrysothamnus nauseosus)*, and hackberry *(Celtis douglasii)* being present.

Regional Subsistence Resources

Plants. Camas *(Camasia quamash)* meadows are common, and were an important food resource to prehistoric people on the Columbia Plateau, that were gathered, roasted, and stored for consumption over the winter. Bitteroot (*Lewisia rediviva*), wild carrot (*Perideridia gairdneri*), false onion (*Triteleila hyacinthina*), and several species of lomatiums (*Lomatium sp.*) were also important root crops (Hunn et al. 1998). Green shoots, stems, and leaves of various species were also eaten in the spring. These included the budstalks and leafstalks of cow parsnip (*Hearcleum lanatum*), the budstalks of balsamroot (*Balsamorhiza sp.*), and the young leaves and sprouts of other lomatiums (Hunn et al. 1998). Black huckleberries (*Vaccinium membranaceum*) and chokecherries (*Prunus virginiana*) were the primary fruits eaten by Columbia Plateau groups, and were commonly harvested in the summer (Hunn et al. 1998).

Mammals. Mammals in the region prehistorically included nine species of ungulate. Elk *(Cervus canadensis)*, mountain sheep *(Ovis canadensis)*, mule deer

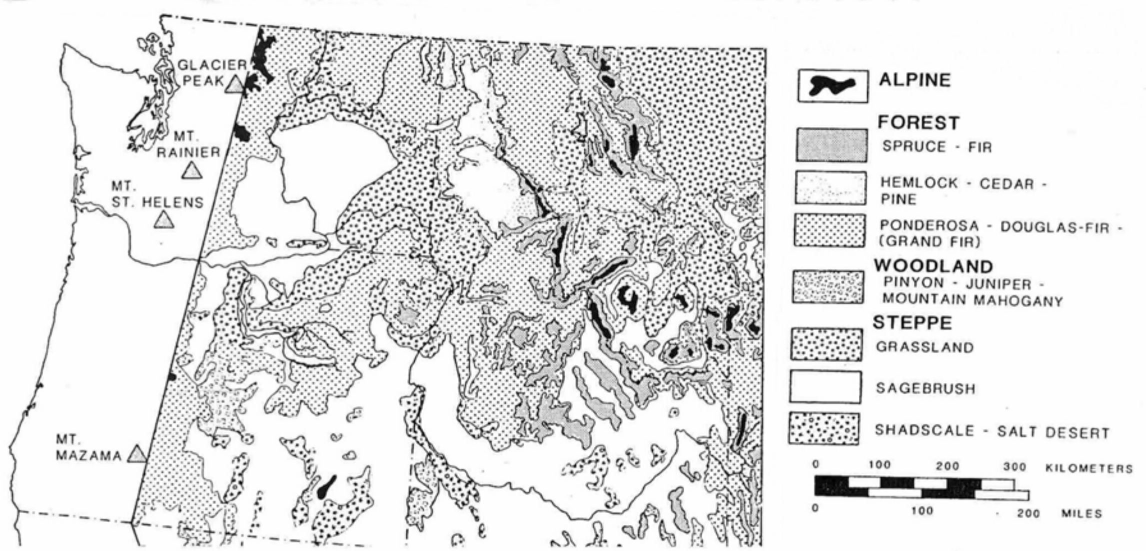

Figure 3.1 Generalized vegetation map of the interior Pacific Northwest. The Southern Plateau consists of the Columbia River basin in Washington east of the Cascades, parts of northern and western Idaho, and northeastern Oregon (adapted from Mehringer 1985).

(Odocoileus hemionus), white-tailed deer *(O. virginianus)*, pronghorn antelope *(Antilocapra americana)*, and bison *(Bison bison)* are the six ungulate species most likely to have been important to human foragers prehistorically (Chatters 1998). Other species that may have been used as food resources include large rodents and lagomorphs. Lagomorphs include snowshoe hares *(Lepus americanus)*, and two species of jackrabbits; white tailed *(Lepus townsendii)*, and black-tailed *(Lepus californicus)*. Various species of cottontail rabbit *(Sylvilagus sp.)* also occur in shrub steppe, riparian zones, and woodlands. Three species of marmot are also available; the yellow-bellied *(Marmota flaviventris)*, the hoary marmot *(M. caligata)*, and the woodchuck *(M. monax)* (Chatters 1998).

Fish. In addition to the mammalian resources, numerous species of fish would have been important economically. Chinook *(Oncorhynchus tschawytscha)* and sockeye salmon *(O. nerka)*, and steelhead *(O. mykiss)* are principal anadramous fishes in the Columbia River system. Spring, summer and fall runs of chinook salmon occur. From mid-summer to early fall, sockeye migrate and enter small streams above lakes to spawn. Steelhead runs occur during both winter and mid-summer in the Columbia and Snake rivers. Other anadramous fish include white sturgeon *(Acipensa transmontanus)* and pacific lamprey *(Entosphemus tridentate)* (Chatters 1998). Suckers and other freshwater fish varied as an important food resource in different parts of the southern Plateau (Hewes 1998).

Invertebrates. Two species of edible bivalves predominate in the Columbia Basin and were used prehistorically. The freshwater pearl mussel (*Margaritifera falcata*) often occurs in dense concentrations and prefers swift, clear, cold streams with coarse textured stream beds (i.e. sand and gravel). *Gonidea angulata* prefers slower water and warm temperatures, and tolerates higher amounts of sediment load in the water and finer textured beds (Chatters 1998). This wide variety of resources from mammals to mussels would have been available prehistorically, and plays an important role in all of the models which posit an explanation for the establishment of the winter village pattern.

The Winter Village Pattern in the Southeastern Plateau

Ethnographic descriptions of the seasonal round for Southeastern Plateau groups during the ethnographic period seem to conform to this general pattern. During late winter and early spring when food stores were low, the Nez Perce would use communal drives to hunt big game in the river valleys. Where snow was deep, they used snow shoes to pursue game. They also made trips down the Snake and Columbia Rivers to intercept early salmon runs (Walker 1998). The Cayuse, Umatilla and Walla Walla also used deep snow hunting techniques (i.e., snowshoes and communal drives) in the late winter and early spring to supplement their dwindling food stores (Stern 1998).

In addition to animal resources, all of these groups also targeted spring plant foods. The Umatilla held the *wawínam* feast in spring to celebrate the return of the wild celery (*Lomatium grayi*), which was followed by other species of Lomatium that were gathered as well (Stern 1998). The Nez Perce began collecting root and vegetable crops during early spring (Ames and Marshall 1980; Walker 1998b). Spring was also when the first salmon runs began, with some continuing through the fall. Most of the salmon that was caught was dried, smoked, and stored for winter consumption (Hewes 1998; Hunn et al. 1998).

By midsummer, a large proportion of the population moved to higher elevations to collect root and berry crops. Berries were often dried and then mixed with other foods, while camas, the principal root crop, was roasted in pits and dried to be stored for use through the winter months (Hunn et al. 1998). Dried, stored camas was often reconstituted by soaking in water or cooking in a soup. Salmon fishing continued through the summer and many groups would move to summer fishing grounds. The Cayuse, for example, often crossed the Blue Mountains to fish the Grande Ronde during the summer (Stern 1998).

In the fall big game hunting resumed, but was often assisted by the use of fire (Stern 1998; Walker 1998b), and most of the salmon, roots, and other crops that were acquired were added to winter stores. By November, the people of the Southeastern Plateau had usually settled back into their winter villages.

Evidence for Regional Resource Variation

Descriptions of the groups that occupied the region during the ethnographic period conform generally to the winter village pattern. Nevertheless, it is important to recognize that evidence for significant variations in resource availability and use have been observed both ethnographically, and in the archaeological record. For example, salmon appears to have been more important economically in the more arid Central Columbia Basin (Spier and Sapir 1930), while game and roots were more important in the Blue Mountains (Marshall 1977). It has also been recognized by some researchers that artiodactyls, especially deer, were probably more abundant, and emphasized prehistorically in the more mountainous fringes of the Plateau than in the central basin (Chatters and Pokotylo 1998). This might be expected given the geography of the region. Within the Southeastern Plateau, sites to the east are further from the rainshadow of the Cascades, are closer to the foothills of the Rockies, and have a greater amount of precipitation than sites in the central basin (Chatters 1998).

With the influence of the rainshadow effect we might expect to find higher biomass for the eastern portion of the Plateau and a higher abundance of large game. These expectations conform to the modern distribution of artiodactyls in the region. The modern ranges of elk, white-tailed deer, mule deer, and pronghorn antelope all indicate that these species are more abundant in the foothills and mountains of the Plateau than within the central basin (Ingles 1965). The Blue Mountains in particular are recognized as being the most productive in the region for game, (Matzke 1985; as explained in Chatters 1998) because their multiple ridges create extensive steppe-forest ecotones; ideal habitat for many species of artiodactyls. Furthermore, as Ames et al. (1998) point out, deer, not salmon, are by far the most commonly represented prey from archaeological sites in the Southeastern Columbia Plateau.

The Salmon Fishery and the Establishment of the Winter Village Pattern

To some extent, the models which advocate salmon intensification as a key component for the proliferation of pithouse villages and the ethnographic pattern rely on assumptions about how far this pattern extends into prehistory (Nelson 1973; Schalk 1977, 1981, 1983a). Estimates for the consumption of fish by native Plateau people during the ethnographic period range from 300 to 600 pounds per person per year (Hewes 1998). These estimates emphasize the significance of salmon and make it tempting to assign its intensification a causal status.

Artifacts representing fishing technology, especially netsinkers, have been found at many sites on the lower Snake and Clearwater Rivers in the Southeastern Columbia Plateau (including but not limited to Ahsahka, Clearwater fish hatchery, Spalding, Alpowa, Hatiupuh, Wawawai, and Strawberry Island), but many of these sites lack corroborating faunal evidence in the form of fish remains. Strawberry Island is the only site located on the lower Snake and/or Clearwater rivers in which fish comprise more than 50% of the identifiable vertebrate taxa (see Table 5.1). These data suggest the possibility that reliance upon fish was not as important as in other regions of the Plateau prehistorically.

Further analysis of faunal assemblages from this region of the Plateau is particularly needed for two reasons. First, while Chatters found intriguing differences between faunal assemblages dated to Pithouse I versus Pithouse II, it may be problematic that the only faunal assemblage from the lower Snake and Clearwater that was included in his analysis was from Hatiupuh house 2. Because of this, a significant region of the Plateau may not have been adequately represented in his sample. Second, many archaeologists recognize that the Southeastern region of the Plateau may have been characterized prehistorically by a subsistence strategy different from that of other subregions within the Plateau (Ames et al., 1998). These two facts emphasize the need and possible utility of examining in more detail faunal assemblages from the lower Snake and Clearwater regions of the Plateau.

Quantifying Subsistence Data using Optimal Foraging Theory

Many archaeologists use methodology guided by rationale derived from Optimal Foraging Theory (OFT) to test hypotheses regarding temporal and spatial variability in prey-use patterns from other parts of North America. Supporters of the method emphasize its propensity for generating testable models (Broughton and O'Connell 1999). One model derived from OFT is the prey-choice model. The model assumes all resources can be ranked along a single dimension of profitability and that foragers will select resources efficiently. Prey rank is determined by its post-encounter return rate or the ratio of the calories gained by acquiring the prey item against the cost of pursuing and processing the prey after it has been encountered. Prey ranks are thus independent of encounter rates, but prey selection is not (Stephens and Krebs as explained in Broughton 1994). Foragers are assumed to add resources into their diet in order of rank. High-ranked resources are those that yield high calories per pursuit cost. The prey-choice model predicts that high-ranked prey will be taken whenever encountered, while low-ranked prey may or may not be taken depending on the encounter rates of higher-ranked prey.

In general, larger-sized prey animals tend to be higher ranked than smaller-sized animals (Broughton 1994). Prey rankings have in some cases been determined experimentally and empirically by actually measuring pursuit and handling costs compared to caloric returns (Simms 1987), but these data are limited so many archaeologists use proxy measures of prey-rank. The most common proxy measure of prey rank is body size (Broughton 1994). The relationship between body size and the critical variables that affect prey rank are depicted in Figure 3.2.

As shown in Figure 3.2(a), there is a more or less direct correlation between body size and the energetic gain per prey item. Figure 3.2(b) shows that there are upper and lower limits on the size of the prey that can be efficiently exploited. Figure 3.2(c) illustrates the hypothetical relationship between prey rank and body size. For most of the range of sizes of prey, rank increases with body size.

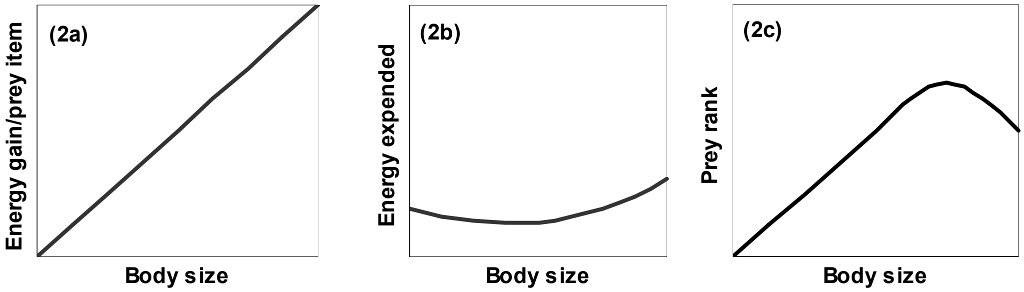

Figure 3.2 The hypothetical relationship between (a) prey body size and energy gain: (b) prey body size and energy cost: and (c) prey body size and prey rank (adapted from Brougton 1994).

The diet breadth model is based on the same principles as the prey choice model with an important addition: it predicts that as foraging efficiency decreases, diet breadth increases (Kelly 1995). When encounter rates for high-ranked prey decrease, foragers will incorporate increasingly more low-ranked resources into the diet until their caloric needs are met, thus increasing the overall breadth of the diet. Conversely, as higher-ranked resources become available, lower-ranked resources will be dropped from the diet. The concept of diet breadth is valuable to archaeologists exploring changes in subsistence through archaeological assemblages because it can be observed in the archaeological record in the form of plant and animal remains.

In zooarchaeological assemblages, relative abundance indices (Broughton 1994; Butler 2000; Janetski 1997) and taxonomic measures of diversity (Grayson and Delpech 1998; Jones 2004; Nagaoka 2001) have been effectively utilized to quantify subsistence variability and change. Analysis of these measures is frequently guided by rationale derived from the prey choice and diet breadth models.

These measures are used in Chapter 5 to analyze temporal and regional variability in prey utilization strategies on the Southeastern Plateau over the past 4,000 years. The analysis is based on faunal assemblages from 10 sites located along the Lower Snake and Clearwater Rivers, augmented by the faunal assemblage from the Harder site. The results of the analysis of the faunal assemblage from the Harder site are presented in the following chapter.

Chapter 4

The Harder Site Faunal Assemblage

The Harder site is located on the north bank of the Snake River approximately 5 miles south of Kahlotus Washington (Figure 4.1). It was excavated in the summer of 1957 by a crew from what was then known as Washington State College and headed by Dr. Richard D. Daugherty. Two large pithouse depressions measuring roughly 12 meters in diameter were chosen for excavation from a group of 24. The descriptive archaeology of the artifact assemblage was completed by Monte Kenaston as his Master's thesis, and was also published in the Washington State University Laboratory of Anthropology Reports of Investigations series (Kenaston 1966). Only a very limited proportion of the faunal assemblage from the excavation was ever analyzed and identified (Kenaston 1966:78-81).

I selected the Harder site faunal assemblage for analysis because of its location on the Snake River between the mouth of the Palouse River and Strawberry Island, and because the earlier of two occupations dates to approximately 1,500 B.P. Data from the assemblage is used in Chapter 5 of this thesis in conjunction with a regional data set taken from other sites in the Southeastern Plateau to evaluate the models discussed in Chapter 2. Further analysis of these data reveals important patterning in resource use in this area which may have implications for our understanding of how these models apply to this specific region.

Site Description

The 24 depressions at the Harder site were located on the lower of two alluvial terraces along the Snake River. The terrace was approximately 50 feet wide and extended along the pre-reservoir flood plain for about 2 miles. The pithouse depressions appeared to be spatially organized into two distinct groups, each running parallel to a cut bank that had been created as the river eroded away the terrace (Figure 4.2). The geoarchaeologist working on the project, Roald Fryxell, thought that there was evidence to suggest that the group of depressions closest to the river (Figure 4.2, labeled I to X) were older than those that were further from the river (Figure 4.2, labeled 1 to 14). However, all of the pithouses from the presumed older group had been partially destroyed by erosion and the two depressions chosen for excavation (Figure 4.2 housepits 3 and 4)

Sensitive Data
For more information, contact Department of Anthropology, Washington State University, Pullman, WA 99164-4910, 509-335-3441

Figure 4.1 Location of the Harder site along the Lower Snake River (from Kenaston 1966).

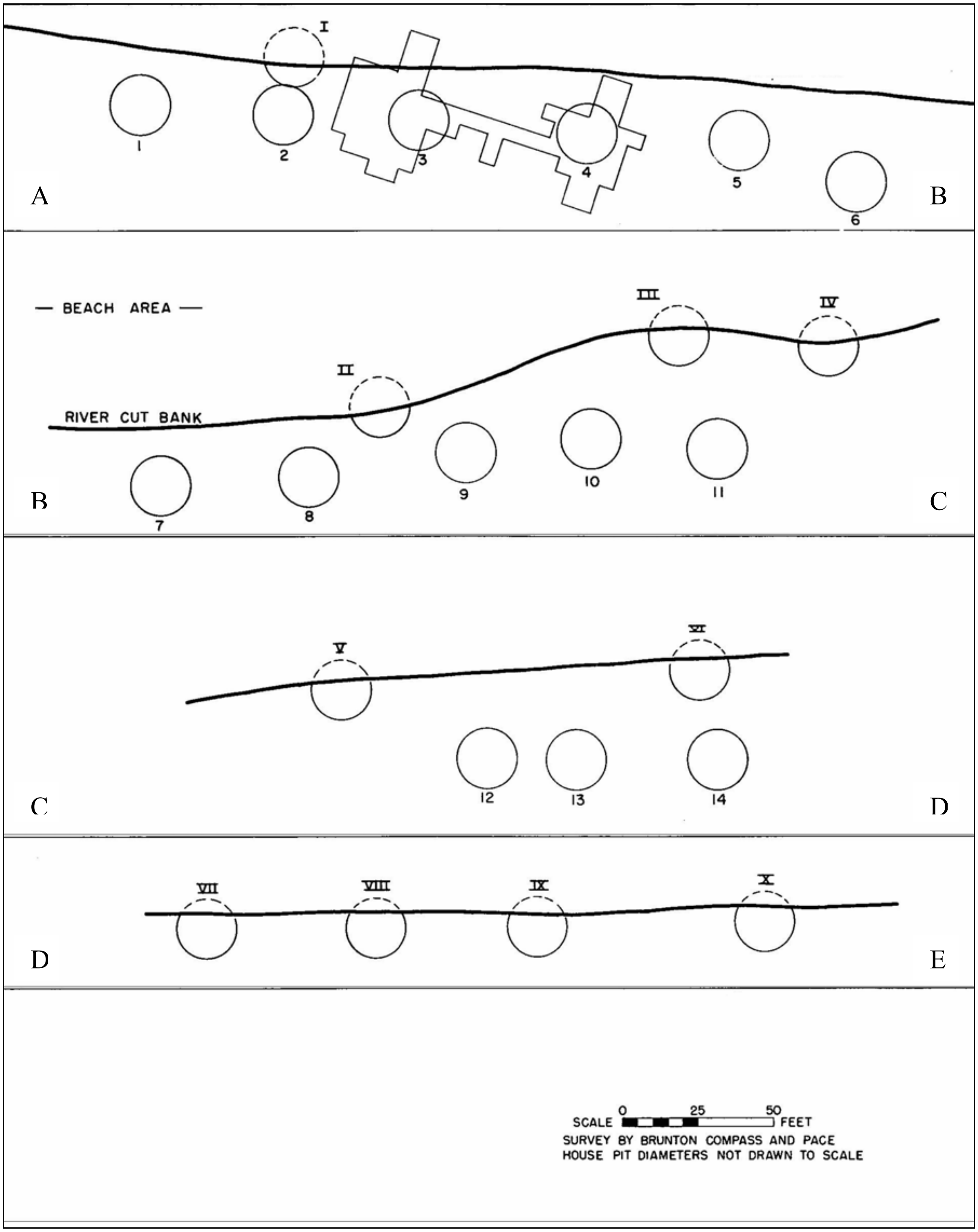

Figure 4.2 Housepit depressions at the Harder site (from Kenaston 1966).

were clustered with the depressions furthest from the river (see Figure 4.2 and Kenaston 1966:13-14).

Test Pit 2 was excavated into the river's cutbank where a firepit and shell midden were identified which appeared to predate the housepit occupations. However, the bulk of the excavation occurred at housepits 3 and 4 from which the vast majority of the vertebrate faunal assemblage was recovered. The excavators worked in units measuring 5 feet square that were laid out over the two housepits (Figure 4.3). While working in the housepits, the excavators made every effort to "excavate according to cultural strata" (Kenaston 1966:8), and the provenience of each artifact was carefully recorded and plotted (see Figure 4.4). Meticulous recordation of the provenience of each artifact and the presence of small mammal bones and fish vertebrae in the assemblage attest to the careful attention to detail of the excavators. Unfortunately however, the deposits were not screened.

In the area of housepits 3 and 4 there were three strata which were distinguished on the basis of color. The uppermost stratum was lighter in color and contained mostly square iron nails and other Euro-American artifacts. The middle darker stratum and lower light colored stratum contained most of the stone and virtually all of the bone artifacts. The darker colored stratum corresponded to the fill and floors of the housepits (Kenaston 1966:17). Kenaston was able to identify distinct occupational surfaces in both housepits and within a trench (see Figure 4.5) excavated between the two. These were based on artifact distribution. The layers were labeled "a" through "e" in housepit 3, "1" through "5" in housepit 4, and "III" through "VII" for the corresponding occupational layers identified within the trench (Kenaston 1966:18-23)(see figures 4.3, 4.4 and 4.5). The only date for the Harder site is a ^{14}C date taken on charcoal from a small fire pit which was located on the lowest occupational layer (layer 1) of housepit 4. The

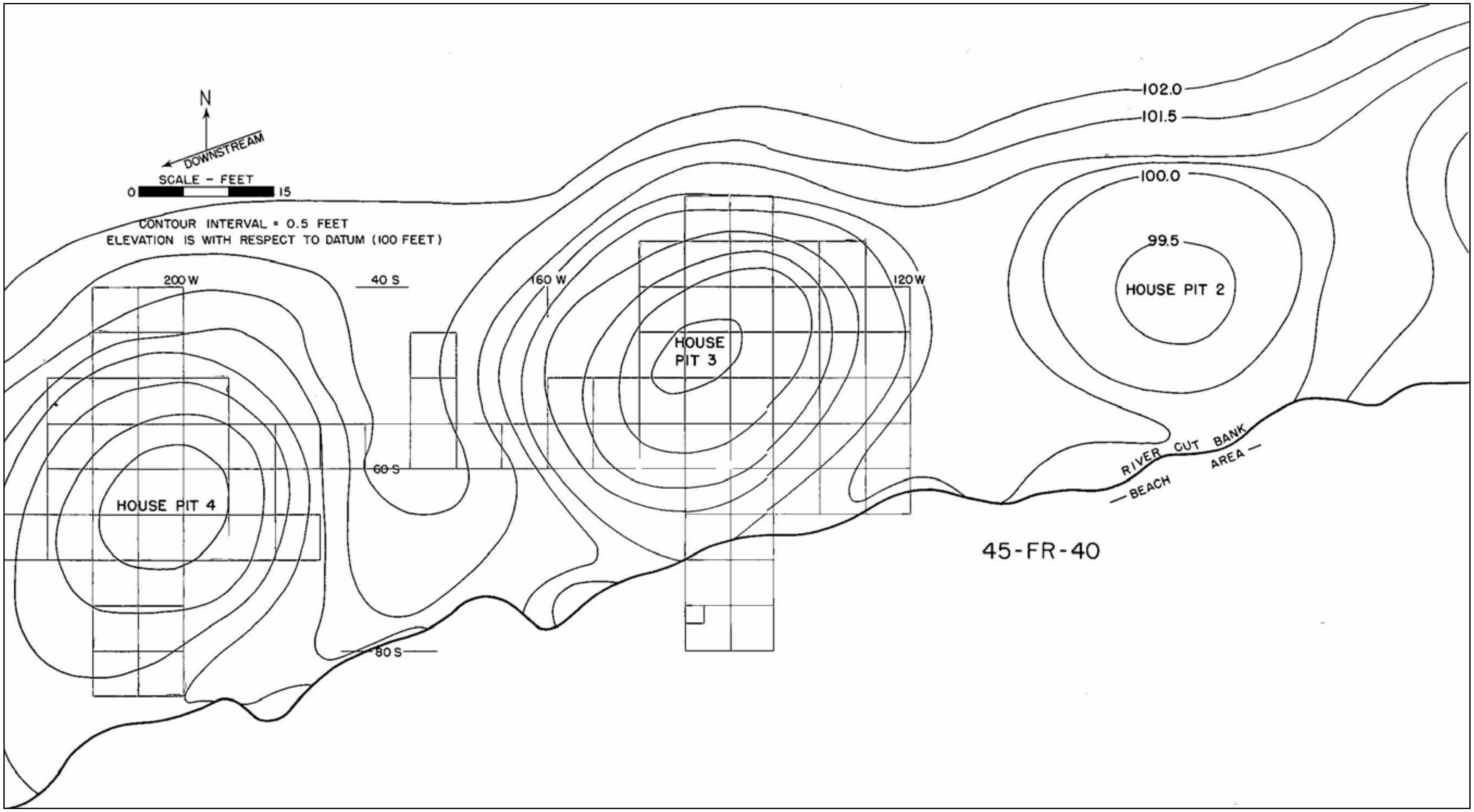

Figure 4.3 Pre-excavation topography and excavation units of housepits 3 and 4. The coordinates (200W, 40S etc.) were calculated with respect to datum, and correspond to the vertical profiles presented in Figures 4.4 and 4.5 (from Kenaston 1966).

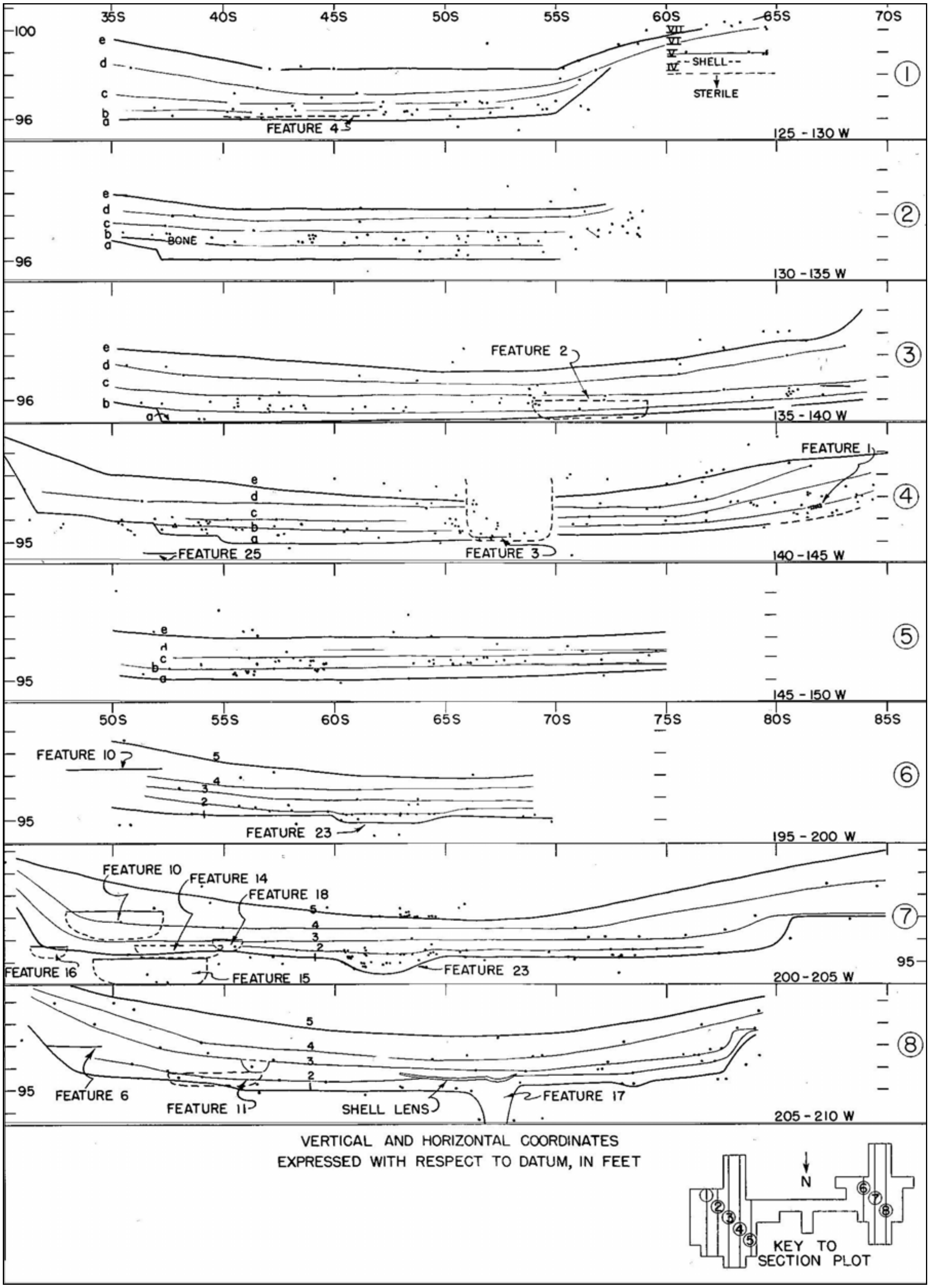

Figure 4.4 Vertical and horizontal coordinates for occupation levels identified by Kenaston in housepits 3 and 4. The marks on the vertical scale for each profile represent one foot. Each mark on the horizontal scale represents 5 feet (from Kenaston 1966).

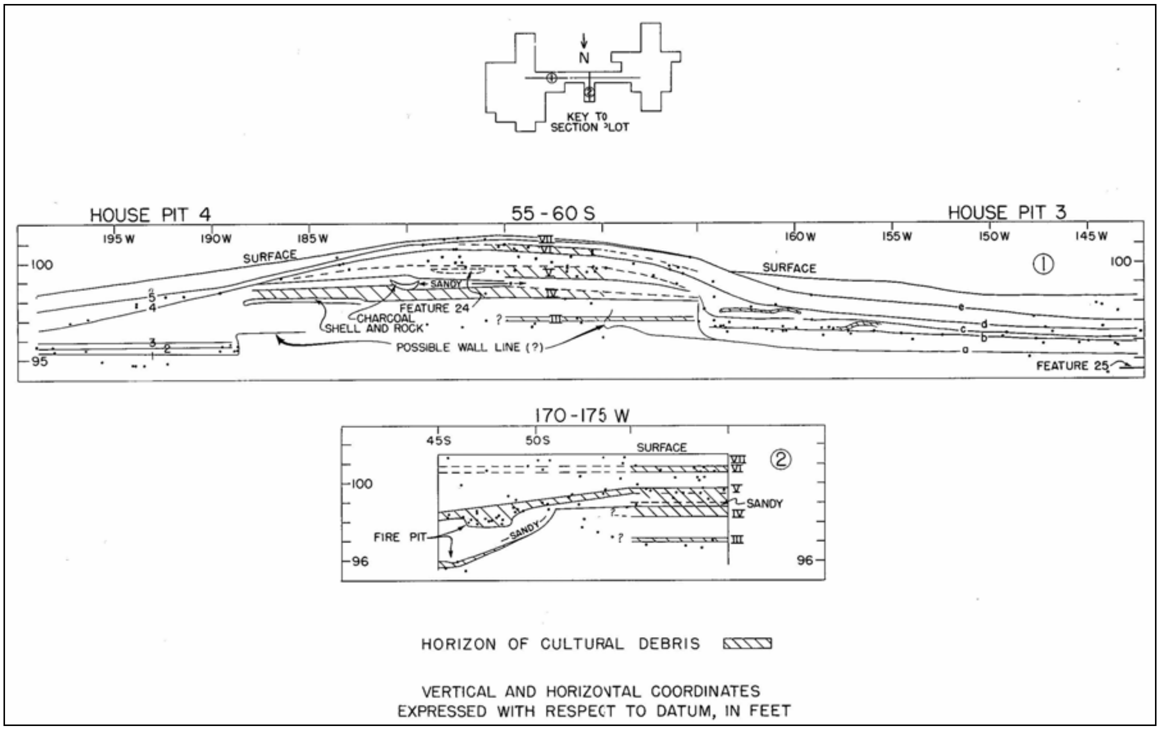

Figure 4.5 Vertical and horizontal artifact distribution and occupation levels in trench (scale same as Figure 4.4)(from Kenaston 1966).

charcoal yielded a date of 1,525±125 B.P. (Kenaston 1966:82). Kenaston concluded that the two lowest occupational layers (a and b in housepit 3, 1 and 2 in housepit 4, and III and IV in the trench) (see Figures 4.4 and 4.5) represented a separate, early occupation of the structures. This conclusion was based on the presence of sterile layers of soil between occupational layers V and VI of the trench, and 2 and 3 in housepit 4. The occupation represented by layers c, d, and e of housepit 3 was not separated from layers a and b by a sterile layer of soil. Nevertheless, it appeared to represent a housepit that had been excavated into the earlier occupation (layers a and b) by the occupants of layers c through e. A perforated thimble and the nails found in layer 5 of housepit 4 also indicate a later, at least protohistoric date for the later occupation. Therefore, the ^{14}C date from the charcoal can only be applied with any confidence to the lower two occupational layers from the two housepits and the trench (Kenaston 1966:22).

The Faunal Assemblage

The archaeological assemblage from the Harder site is currently housed at the Washington State University Museum of Anthropology. The assemblage is separated according to provenience and material type. Inventory that was labeled bone was separated out and included in the faunal analysis. The vertebrate faunal assemblage was examined for purposes of identification only, and not for evidence of taphonomic processes, human or otherwise. The comparative collection of the zooarchaeology lab at the Washington State University Department of Anthropology was used in conjunction with various texts and papers (Brown and Gustafson 1990; Cannon 1987; Gilbert 1990; Lawrence 1951; Olsen 1996) to identify the bones from the assemblage. Unfortunately many bones could not be identified to taxa. I assigned these bones to a size-class based on Thomas' (1969) designations, and added a sixth size-class to accommodate very large animals such as bison and elk. Based on body-size they would be expected to have significantly higher prey rankings than either of the two species from this assemblages that represent Class V (i.e. deer and pronghorn). These size classes are defined as follows:

Class I: mammals weighing less than 100 grams (e.g. meadow mouse or pocket gopher)

Class II: mammals weighing between 100 and 700 grams (e.g. squirrel or chipmunk)

Class III: mammals weighing between 700 grams and 5 kilograms (e.g. cottontail rabbit or marmot)

Class IV: mammals weighing between 5 and 25 kilograms (e.g. coyote or bobcat)

Class V: mammals weighing between 25 and 150 kilograms (e.g. antelope or deer)

Class VI: mammals weighing more than 150 kilograms (e.g. elk or bison)

Table 4.1 NISP by body part for specimens identified to the class, genus, or species level. The bones tabulated here represent all of the bones from the Harder site, and are not separated by provenience. Also, some of the bones tabulated in this chart were fragmentary. For a record of each bone, whether it was whole or fragmented, and what fragment is represented, and its provenience within the site, see Appendix A.

	art VI*	art V*	rod III*	rod II*	Cervus	Bison	Odoc	Antl	Canis	Sylv	Sprm	Tam	Thom	fish	Salm	Aves
cranial frag									1		1		3			
Maxillae	3				6						2		2			
Mandible	9				15					1	2		4			
tooth frag	17	3	2	3	8		1				1					
Vertebrae	16	2			1									3	7	1
Rib	31	1														
Scapulae	2				3	2			1							
Humeri	1				3	1			1							
Ulnae					2	3				2						
Radii	2	1			6	2										
Carpals					8	5		2								
Ilium					1											
Ischia	1					1										
Femora	3				2	2				1		1	1			
Patellae	1				1	2										
Tibiae	1				5	1							1			
Fibula						1										
Tarsals		1			5	3		1								
Tarsometatarsus																1
Metatarsal					1			1								
Mts/mtc*	11	8														
radial sesmoid	3															
phalanx 1	2	1			7	3		2								
phalanx 2		1			9	3										
phalanx 3					1	1	2	1								
Total	103	18	2	3	84	30	3	7	3	4	6	1	11	3	7	2

* These columns represent specimens that were identifiable only to the taxonomic level of artiodactyls, rodents. The Roman numeral represents the size class (see page 30) of the specimens.

The vertebrate faunal assemblage contained a total of 7,424 specimens, which comprised all bones and bone fragments recovered from the Harder site excavation. It was extremely fragmented as attested to by the fact that 5,879 specimens (79.2% of the assemblage) could not even be assigned to a size class with any degree of certainty. This may have been due to intensive processing for marrow and fat extraction, post-depositional taphonomic processes, or in part to the fact that the specimens have dried and begun to splinter having been in storage for almost 50 years. Of the bones in the assemblage, 1,065 (14.3% of the assemblage) were assignable to size classes. While class I mammals were found within the assemblage (i.e., *Thomymus sp*.), no unidentifiable specimens were assigned to that size class. Thirty-three of the 1,065 were assigned to class II, 30 were assigned to class III, 133 were assigned to class IV, 312 were assigned to class V, and 557 were assigned to class VI. The determination of size class was sometimes admittedly subjective, but was based on overall size, and especially cortical thickness of the bone. Nine pieces of tooth enamel were too fragmentary to assign to any taxonomic category or size class, and 184 fragments were determined to be from artiodactyls. There were 121 bones or bone fragments which could not be identified to species but are known to have come from artiodactyls. One-hundred and three were identified as Class VI artiodactyls, and 18 were identified as Class V artiodactyls. The fragments included acetabula, distal metatarsals and metacarpals, thoracic vertebrae, and other fragments that were identifiable to the Order Artiodactyla, but too fragmentary to be assigned to any genus or species (see Table 4.1 and Appendix A).

Taxonomic Descriptions. Phylum: Chordata
Class: Aves

Material: 1 sacrum, 1 tarsometatarsus

Comments: These fragments were not identifiable to species, but it is not surprising that they were recovered from the Harder site. Birds are represented in the faunal assemblages from nine of the thirteen components at other sites in the region (see Table 5.1). Birds might have been a supplemental part of people's diet on the Plateau.

Class: Osteichthyes

Material: 3 vertebral fragments

Comments: These three fragments were not identifiable beyond the classification of boney fish. Although salmon are widely recognized as having been an important staple in the diet, other species of fish were also taken when available including whitefish (*Coregonus sp.*), suckers (*Catostomus sp.*), and northern squawfish (*Ptychocheilus oregonensis*) (Hewes 1998).

Order: Salmoniformes
Family: Salmonidae

Material: 7 vertebrae

Comments: Salmon were an extremely important part of the aboriginal diet of Plateau people during protohistoric times (Hewes 1998). It is somewhat surprising that there were not more fish bones found in this assemblage, given the site location. But the fact that the deposits were not screened likely contributed to the poor recovery of fish bones from this site.

Class: Mammalia
Order: Artiodactyla
Family: Cervidae
Cervus Elaphus
Common name: Elk

Material: 4 left and 2 right maxillae, 7 left and 8 right mandibles, 1 left lower 2nd premolar, 3 right lower 2nd premolars, 1 right lower 3rd premolar, 1 right lower 1st molar, 2 left lower 3rd molars, 1 axis, 1 left and 2 right scapulae, 2 left and 1 right humeri, 1 left and 1 right ulnae, 1 left and 5 right radii, 1 left pisiform, 1 left and 3 right scaphoids, 1 left and 2 right cuneiforms, 1 left ilium, 2 right femora, 1 left patella, 2 left and 3 right tibiae, 2 right calcanei, 2 right astragali, 1 right naviculocuboid, 1 right metatarsal, 7 1st phalanges, 9 2nd phalanges, 1 third phalanx

Comments: Gustafson (1972) suggested that elk and pronghorn were likely to be represented in zooarchaeological assemblages in an east-west gradient in the Southern Plateau, with pronghorn being more abundant in the more arid western region, and elk being more common in the mountainous eastern region. When examining sites such as the Alpowa locality (Lyman 1976) and Hatiuhpuh (Brauner et al. 1991) where there are proportionately more elk and pronghorn respectively, Gustafson's conclusions appear to be correct. However, other sites like Kooskia and Spalding that are located in the far eastern part of the study area have more pronghorn than elk. Elk are also by far the most commonly represented identifiable vertebrate species in the Harder assemblage. The large number of elk in the Harder site faunal assemblage also challenge Gustafson's assertion as it is located in the western portion of the Southeastern Plateau.

Odocoileus sp.
Common name: Deer

Material: 1 right lower 3rd molar, 2 3rd phalanges

Comments: Both mule deer (*O. hemionus*) and white-tailed deer (*O. virginianus*) are present in Eastern Washington, and they are virtually impossible to distinguish based only on post-cranial skeletal elements. Finding only three specimens of deer bone in this assemblage was unexpected because deer are by far the most commonly represented species in other assemblages from this part of the Plateau (Ames et al. 1998), and were likely a very important part of the aboriginal diet.

Family: Bovidae
Bison bison
Common name: Bison or American Buffalo

Material: 2 left scapulae, 1 right humerus, 3 right ulnae, 1 left and 1 right radii, 1 right cuneiform, 1 right scaphoid, 2 right lunars, 1 right pisiform, 1 left ischium, 2 right femora, 2 left patellae, 1 left tibia, 1 right distal fibula, 1 left and 1 right astragali, 1 left naviculocuboid, 3 1st phalanges, 3 2nd phalanges, 1 3rd phalanx.

Comments: Osborne (1953) was the first to recognize that a significant amount of bison remains could be found in prehistoric zooarchaeological assemblages from the Plateau. Twenty years later, Schroedl (1973) compiled a list of all of the sites from the Southern Plateau known to contain bison remains. He recognized that there was a significant increase in the occurrence of bison remains in assemblages which dated to the time period between 2,500 and 1,000 years ago. The increase in bison in archaeological assemblages relative to other taxa has been examined and discussed by other researchers as well (Schalk 1983, Ames et al. 1998). Chatters (2004) uses increasing proportions of bison in archaeological assemblages dating to that time period to support a hypothesis that the human population on the Southern Plateau was decreasing (but see Kimball 2004 for a discussion of this and other related hypotheses).

Family: Antilocapridae
Antilocapra Americana
Common name: Pronghorn Antelope

Material: 1 right cuneiform, 1 right trapezoid magnum, 1 left astragalus, 1 metatarsal, 2 1st phalanges, 1 3rd phalanx

Comments: Although not as important as the similarly sized deer, pronghorn antelope was an economically important species in this region. It has been identified in many assemblages from the Southeastern Plateau (see Table 5.1), and the paucity of remains here is surprising.

Order: Carnivora
Family: Canidae
Canis sp.

Material: 1 auditory bulla, 1 right scapula, 1 left humerus

Comments: Although not identifiable as to species, based on size these specimens probably represent either coyote (*C. latrans*) or dog (*C. familiarus*). Dogs were important in Plateau culture during protohistoric times and they have been found in secondary burial contexts both alone and accompanying human burials. Dogs may have played an important role in the ritual of some Plateau communities, and may have been closely associated with elite status (Hayden and Schulting 1997). The specimens of *Canis sp.* found at the Harder site however do not appear to have been deposited in a burial or ritual context and could just as easily represent *C. latrans* as *C. familiaris*.

Order: Lagomorpha
Family: Leporidae
Sylvilagus sp.
Common name: Cottontail rabbit

Material: 1 left mandible, 2 left ulnae, 1 left femur

Comments: Three species of cottontail rabbit occur in the Southeastern Columbia Plateau (Chatters 1998). They are common in zooarchaeological assemblages from sites of this region. However, they do not appear to have been as important economically in the eastern part of this region and are more common further west, especially in the late prehistoric component at Strawberry Island (see Table 5.1).

Order: Rodentia
Family: Sciuridae
Tamias sp.
Common name: Chipmunk

Material: 1 left femur

Comments: This specimen was from a small sciurid, and probably represents one of several chipmunk species (*Tamias sp.*) in the region. Given that the Least Chipmunk (*T. minimus*) is the most common at this elevation (Ingles 1965) it is probably from an individual of this species.

Spermophilus sp.
Common name: Ground Squirrel

Material: 1 frontal, 1 left and 1 right maxillae, 1 right and 1 left mandibles, 1 right upper P4.

Comments: All of these specimens were found in the same unit and probably come from the same individual. It is also interesting to note that they were found approximately 2.5 meters below datum. *Spermophilus sp.* burrows excavated to a depth of 6 feet or greater are common (Zeveloff 1988) lending credence to the conclusion that this was a burrow death. It is likely one of several species of ground squirrel that currently inhabit the region including the Washington Ground Squirrel (*S. Washingtoni*), Columbia Ground Squirrel (*S. Columbianus*), Golden Mantled Ground Squirrel (*S. lateralis*), or Townsend's Ground Squirrel (*S. Townsendii*) (Ingles 1965).

Family: Geomyidae
Thomymus sp.
Common name: Pocket gopher

Material: 1 skull, 1 left and 1 right auditory bullae, 1 maxillae, 2 left and 2 right mandibles, 1 left femur, 1 left tibia

Comments: All of these specimens except for one left mandible, were found in the same unit. Furthermore, the Norther Pocket gopher (*T. talpoides*), the most commonly encountered species of this genus in the Plateau today (Ingles 1965), can excavate burrows to a depth of 1.5 to 3 feet (Zeveloff 1988), approximately the depth at which these specimens were found. These two observations tend to support the conclusion that these specimens represent a burrow death.

MNI and NISP for the assemblage. The number of identifiable specimens (NISP) refers to the total number of specimens from the assemblage that could be identified to a given taxonomic category (see Table 4.1). The minimum number of individuals (MNI) is defined as the minimum number of animals from a particular species that is represented in that assemblage (i.e. the minimum number of elk necessary to have been deposited as part of the assemblage).

The values for NISP are based on the total number of identifiable fragments. For example, there were 8 right elk mandibles or fragments of right mandibles in the assemblage therefore each was tallied as part of the total elk NISP of 83. Because many of the identifiable specimens were only fragments of a single bone, MNI for each species in the assemblage was determined based on whole bones represented. For example, based on this method, the MNI for elk was calculated as 4 because only 4 of the original 8 mandibles contained either a lower right 3rd molar, or the socket for that tooth. A minimum of 4 individual elk are represented because the other mandibular fragments could have come from the same 4 mandibles. The identifiable specimens are recorded in Appendix A which indicates the body part and when applicable, the fragment of bone, represented by each specimen. The MNI and NISP values for the whole assemblage are presented in Table 4.2.

Table 4.2 MNI and NISP for taxa identified from the entire Harder site faunal assemblage

	Cervus	Bison	Odoc.	Antlcpr.	Canis	Sylvlgs	Sprmphls	Thmyms	Boney fish	Aves
NISP	83	30	3	7	3	4	6	11	10	2
MNI	4	2	1	1	1	2	1	2	1	1

Separation of the Early Housepit Occupation at the Harder site. I analyzed the entire Harder site vertebrate faunal assemblage as one unit. However, as explained earlier the only ^{14}C date for the site came from the lowest layer in housepit 4, and Kenaston (1966) concluded that the lower two layers represented an earlier occupation separate from the occupation represented by the upper three layers. Based on the fact that at least part of the later assemblage was deposited as much as 1,500 years after the use of the dated fire pit in housepit 4, I partitioned the assemblage into two distinct subassemblages, each representing a different temporal occupation. In separating the two assemblages, I encountered two problems.

First, although some effort was made to excavate according to “cultural strata” (Kenaston 1966:8) the four distinct occupational layers in the housepits and trench were not recognized in the field, but were only identified later by Kenaston during his analysis (1966:20-21). This created a problem because the provenience information listed on the curation bags didn’t report what cultural stratum the material had been recovered from, only its depth with respect to datum. This information had to be correlated with the excavation schematics in Kenaston’s thesis (Figures 4.4 and 4.5). I used the scale in Kenaston’s thesis and a straight edge ruler to determine the layer or layers from which each bag of faunal remains had been recovered (see Appendix A for occupational layer provenience information). As a result of these complications, the contents of many of the bags consisted of material that appeared to span two and sometimes three of the different occupational layers originally identified by Kenaston. Therefore, I developed a criteria whereby only bags that came predominantly from the lower two occupational layers were included as part of the 1,500 B.P. housepit assemblage. If two levels were represented, one of the two had to be from the lower occupation for the bag to be included. If the contents of a bag appeared to have been recovered from three different levels, then two of the three had to be the lower two occupational levels. If on the other hand three levels were represented, but only one was from the lower occupation, the contents of that bag were not included as part of the 1,500 B.P. occupation. For example, if a bag appeared to have been recovered from occupational layers b and c at housepit 3 it was included. If, on the other hand, it was derived from layers b, c, and d, it was not.

Second, some of the bags in the assemblage did not contain any provenience information. This made it impossible to determine from which occupational layers the material of unmarked bags had been recovered. Because this could not be controlled for, the NISP values for the 1,500 B.P occupation were calculated based only on material from marked bags. Rows for the bags that were determined to have been recovered at least partially from the lower occupation are set in bold type in appendix A. Table 4.3 shows the NISP values for the 1,500 BP occupation determined in this manner.

Table 4.3 NISP values for the faunal material associated with 1500 BP occupation.

Cervus	Bison	Antl	Odoc	Canis	Fish
27	14	2	2	1	9

These NISP values for the 1,500 B.P. occupation of the Harder site are used in the following chapter to augment other regional data in an analysis of Southeastern Plateau prey utilization strategies over the past 4,000 years.

Chapter 5

Analysis of Lower Snake and Clearwater Faunal Assemblages

In this chapter faunal data from nine sites from the region of the lower Snake and Clearwater rivers are compiled and analyzed in conjunction with the data from the Harder site faunal assemblage in order to evaluate prehistoric prey use strategies on the Southeastern Plateau in particular. Relative abundance and diversity indices have been used effectively to measure prehistoric subsistence variability and change in other parts of North America. As a means of exploring possible changes in subsistence through time in the Southeastern Columbia Plateau, I calculated relative abundance and diversity indices for a sample of sites located on the lower Snake and Clearwater rivers. Statistically significant spatial and temporal patterns evident in these data are discussed and used to evaluate the models for the appearance of the ethnographic winter village pattern discussed in Chapter 2.

While faunal assemblages from Hatiupuh and Spalding (see Table 5.1) suggest that salmon fishing was important at particular sites and particular times, the overall number of sites in the Southeastern Plateau with significant amounts of fish remains is surprisingly low given what we know about the importance of the salmonid fishery during ethnohistoric times (Hewes 1998). In fact, there are surprisingly few fish bones found in archaeological sites from the Southern or Columbia Plateau in general (Campbell 1985; Johnston 1987). Nevertheless, the spatial and temporal patterns evident in these data suggest a possibility that can be tested; that some substantial differences in subsistence related to prey utilization existed at certain times and places within the Southeastern Plateau.

I begin this analysis by identifying significant patterns in the spatial distributions of artiodactyls and fish in archaeological sites across the Southeastern Columbia Plateau that date between approximately 500 and 4,000 years ago. My analysis indicates that the proportions of artiodactyls and fish covary through time. Furthermore, fluctuations between the proportional representation of these two taxa are roughly correlated with alluvial cycles on the Snake and Clearwater rivers. These results suggest that prehistoric aggrading floodplains may have had deleterious effects on the salmon population as suggested by other researchers (Chatters 1998).

Study Sample of Sites

I selected my sample of sites by reviewing literature for sites excavated along the Lower Snake and Clearwater Rivers over the past 40 years and examined site reports for a total of 26 sites. The selection of sites to be included in the study was based on three criteria: 1) completeness of faunal identifications, 2) presence of at least one pithouse so that the analysis would be a comparison of habitation sites that would presumably have had a comparable function, 3) presence of reliable ^{14}C dates for reliable chronological context. Unfortunately, many of the reports reviewed indicated that taxonomic identifications of faunal assemblages had either been only partially completed, or never undertaken. Also, the chronology of one important site in particular (45WT2) was determined without the aid of ^{14}C dates (Nance 1966) and was based solely on artifact cross-dating. Consequently I identified twelve sites, three of which were from the Alpowa locality (Brauner 1976), that met these criteria (Figure 5.1).

There are well known statistical problems associated with the use of diversity measures on assemblages with small samples (Grayson 1984). For this reason only

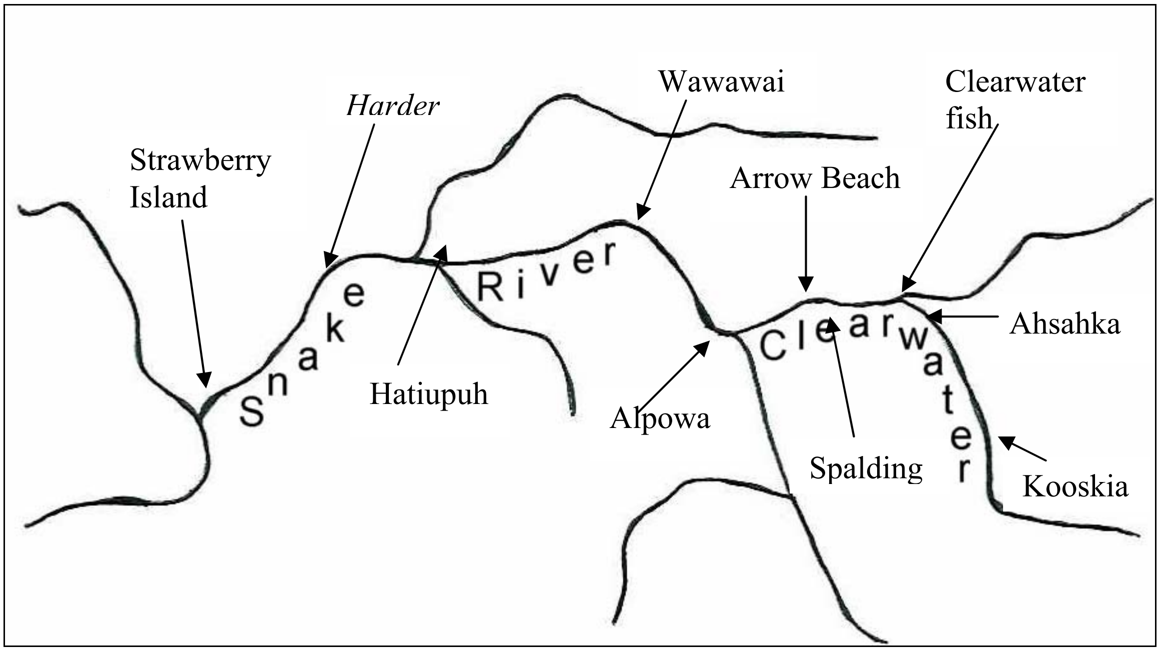

Figure 5.1 Sites along the Lower Snake and Clearwater Rivers which met the criteria outlined on page 42.

components with an NISP of at least fifty were included in the analysis of relative abundances and measures of diversity. Lyons Ferry and 45AS78 from the Alpowa locality were not included in the analysis because of the smallness of the samples from those two sites.

Following the identification of sites for analysis, I created a chronological ordering of the assemblages from each site using 2 criteria. First, to calculate measures of taxonomic abundance and diversity, I used only those portions of the faunal assemblages from each site that were either directly associated with, or determined to be stratgraphically associated with floors or other C^{14} dated features. Second, the confidence intervals of the ^{14}C dates for each feature were examined. If there was overlap in the confidence intervals of two seperate pithouses located at the same site (as was the case for 45AS82 housepits 2 and 4, and Hatiupuh housepits 2 and 3), the assemblages from those pithouses were combined. If the dates of separate houses from the same site did not overlap (as was the case for 45AS82 housepits 1 and 5), the assemblages were kept separate (see Figure 5.2). In no case were the assemblages of housepits from different sites combined.

There were two important exceptions to these criteria. First, the late Cascade/early Tucannon assemblage taken from a deposit of calcareous sand at 45AS82 was not dated using ^{14}C, but was believed to be roughly contemporaneous with the assemblage from house pit 5, which dated to approximately 4,000 BP (Brauner 1976; Lyman 1976). These two assemblages were combined to increase the sample size for that component of 45AS82. The combination of these two assemblages is based on the fact that they are roughly contemporaneous and have a similar faunal composition. Second, the data for Hatiupuh house 3 is derived from all the Block C material of the 1989 excavations, except a separate upper 1,400 BP occupation (Brauner et al. 1991). This is somewhat problematic because there was an undated storage feature which contained a lot of fish remains that may or may not date to the same time period as the rest of the early housepit 3 occupation. Again, it was included to improve the size of the sample, but the results should be considered tentative given the uncertainty of the date for the remains from the storage feature.

After having segregated the sites into temporally distinct occupations, it was determined that the 3,000 B.P. component at Arrow Beach had a sample too small for meaningful analysis (<50 NISP). For this reason it was also excluded from the analysis.

Temporal Segregation of the Sample. The purpose of the temporal segregation of the components at each site was to introduce as much temporal control as possible given that one of the goals of the study is to observe variability in prey-use strategies through time. Lyman (2003) recently demonstrated that analytical lumping (both spatial and temporal) when using taxonomic measures of abundance and diversity in this fashion has a tendency to inflate the significance of the results, and should be avoided whenever possible.

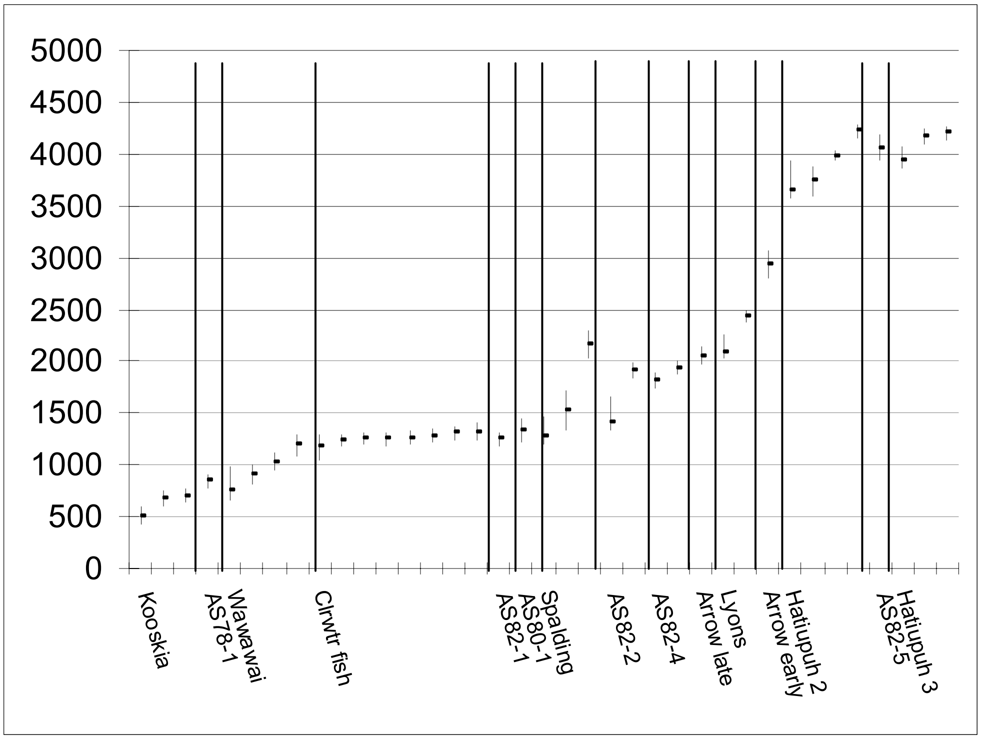

Figure 5.2 Distribution of radiocarbon dates for sites and their respective components used in the analysis. The site names beginning with AS are those from the Alpowa locality. The number following the dash is the housepit number from that site. For example, AS82-2 indicates C^{14} dates from housepit 2 at site 45AS82 of the Alpowa locality.

I restricted my analysis to faunal assemblages associated directly or stratigraphically with housepits or other dated features to avoid the lumping effect as described by Lyman (2003). But my solution is not without its potential problems. The importance of differentiation between primary and secondary refuse from archaeological sites has been discussed thoroughly in the archaeological literature (Schiffer 1972) and demonstrated in ethnoarchaeological contexts (Binford 1978; O’Connell 1987). Larger refuse tends to be removed from living or other activity areas (O'Connell 1987) which may create problems for my analysis. Because a large part of the sample is derived from the floors of pithouses, a bias against larger, identifiable faunal material would be expected. Nevertheless, including all of the assemblages from a given pithouse could potentially result in the inclusion of faunal material that was deposited later as refuse, thus causing a "temporal lumping" effect as discussed by Lyman (2003). I assume that using only material associated in some way with housepit floors or other dated features is in this case the "lesser of two evils."

Screen Size. It has been demonstrated that screen mesh size used in excavation can bias vertebrate faunal assemblages due to differential recovery of material from large vs. small species (Shaffer 1992). Smaller taxa tend not to be recovered when larger mesh sizes, and/or no screens are used, and a discussion of the different screen sizes used in excavating each site is therefore in order. Screen mesh size used at each site is shown in Table 5.2 and was not consistent across the sample. Some of the sites in the sample were excavated with 1/4 inch mesh, some with 1/8 inch mesh, and others such as the Alpowa locality were not screened at all. Since screen mesh size influences the proportion of small to large bones that are recovered, it can also influence relative abundance indices and measures of taxonomic diversity. But as shown in Table 5.2, some sites and time periods appear to have relatively higher proportions of fish than others, and these differences do not appear to be correlated to mesh size or the use of screens during excavation.

Site Seasonality. Given the seasonal patterning of resource use evident in the winter village pattern, site seasonality could have an impact on relative abundance indices. Even though my sample includes only sites where at least one housepit was identified (i.e., presumably representing a similar stage in the winter village pattern “cycle”), it is nevertheless possible that some of the variability in this sample is due to seasonal sites with different subsistence roles. Most of the site reports used for my study do not have detailed discussions of season of site use. Presumably all represent “winter villages,” but the actual seasonal span of the sites may not be uniform. Some sites may have been used in early winter, while others were used in early spring/late winter. Since there is no published data to make these determinations, I assume the season of occupation among the sample is uniform, or has no appreciable effect.

Relative Abundance Indices

Relative abundance indices are easy to calculate and can be used to quantify subsistence variability through time (Broughton 1994; Butler 2000; Janetski 1997) or between different sites or regions of the same time period. In most cases they are used to measure changes in foraging efficiency. When used in that context, the method is based on assumptions about prey rank and body size, and the expected results are inferred from the implications of the prey choice model (Ugan and Bright 2001). It normally involves computing the ratio of large bodied animals to the sum of large and small bodied animals (Large/(Large+Small)) and the result is a number between 0 and 1. This simple calculation, although generally used for large-bodied animals, can be used to quantify the relative abundance of any species or group of species by isolating the desired taxa.

Relative abundance indices and measures of taxonomic diversity were calculated for the assemblages from this sample based on the NISP of the subsistence related taxa from each assemblage. Very small rodents and snakes were presumed for the most part to have been introduced naturally and were not included in the calculation of these values. For example gophers (*Thomomys sp.*) were not included in the calculation of these values but muskrat (*Ondatra sp.*) and woodrat (*Neotoma sp.*) were included. Number of Identified Specimens (NISP) for mammalian taxa is based on those bones that were identifiable to the level of genus or species. All of the fish, including those not identifiable beyond the level of osteichthyes (boney fishes), were added together and included as one taxa for the calculation of NISP. Separation of the fish at the family and/or genus level would of course have been preferable. However faunal analyses done on the Southeastern Columbia Plateau over the past 30 years were not equally meticulous. In some cases only a very small number of positively identified salmonid bones are reported from a given assemblage, while numerous unidentified fish bones are present. Although indigenous freshwater fishes were exploited ethnographically (Hewes 1998), there are more identified salmonid bones than the remains from other families of fish in each of the assemblages discussed here. For this reason, all of the fish bones are summed in these calculations in an effort to include all the possible data related to the abundance of salmon. The relative abundance of fish in general in these assemblages is considered a gross representation of the relative importance of the salmon fishery. The NISP values from each temporally distinct component at each site are presented in Table 5.1.

Calculation of Relative Abundance Indices. Relative abundance indices were calculated for these sites based on three categories of vertebrates known to have been important in the diet of Southeastern Plateau groups; artiodactyls (including deer pronghorn, bison and elk), fish, and lagomorphs (including jackrabbits and cottontails).

Table 5.1 NISP values for various taxonomic categories used to calculate richness, evenness, and the artiodactyl index. Data taken from site reports and other papers (Branuer 1976[6], Brauner et al. 1990[7], Chance and Chance 1985[4], Chatters 1995[7], Lyman 1976[6], Sappington 1994[5], Sappington and Carley 1987[3], Sappington et al. 1988[2], Sappington et al. 1987[1], Schalk 1983b[9], Toups 1969[5], Yent 1976[8]). The sites beginning with AS are those from the Alpowa locality; 82-4/2 is the assemblage from site 82 housepits 4 and 2, tuc/82-5 is the combined assemblage from housepit 5 and the early Tucannon component. Straw (1400) and Straw (600) represent Strawberry Island occupations dating to those two approximate time periods.

	Ahsahka[1]	Clrwtrfish[2]	Kooskia[3]	Spalding[4]	Arrow (2000)[5]	AS80-1[6]	AS82-1[6]	AS82-4/2[6]	AS tuc/82-5[6]	Hatiupuh[7]	Wawawai[8]	Straw (1400)[9]	Straw (600)[9]
Odoc.	49	49	126	39	98	27	41	113	23	60	397	26	11
Cervus	7	1	2	4	26	3	1	10	10	4	168	0	0
Bison	23	0	0	0	21	90	0	1	1	0	4	0	0
Ovis	3	0	1	13	6	1	0	4	3	0	16	0	0
Antilocapra	0	0	171	12	3	0	0	8	1	49	12	7	318
Ursus sp.	1	0	16	0	1	0	0	0	0	0	0	0	0
Canid	2	0	1	0	5	1	2	8	1	8	44	0	6
Procyon	0	0	0	2	0	0	0	0	0	1	0	0	0
Vulpes sp.	0	0	0	4	0	0	0	0	2	0	0	0	0
Lynx	0	0	0	0	1	0	0	0	0	1	1	0	0
Lutra	0	0	0	0	1	0	0	0	1	1	0	0	0
Taxidea	0	0	0	0	0	0	0	1	0	5	8	0	0
Mustela	0	0	0	0	0	0	0	0	0	0	2	0	0
Erethizon	0	0	0	0	0	0	0	1	0	0	0	0	0
Castor	0	1	0	4	1	0	0	3	1	0	0	0	0
Lepus sp.	0	0	0	0	1	0	0	2	5	7	0	14	680
Sylv. sp.	0	0	0	5	2	1	2	17	3	15	9	4	32
Ondatra	0	0	0	0	0	0	0	0	0	0	5	0	0
Neotoma	0	0	0	0	0	0	0	0	0	0	10	0	0
Fish	0	0	5	63	8	2	7	56	21	103	62	293	1157
Aves	5	0	0	3	3	0	1	7	2	0	6	10	75
Turtle	0	0	0	11	0	0	0	2	0	8	0	0	0
Total	90	51	322	160	177	125	54	233	74	262	744	354	2279

In this case I used a version of the artiodactyl index in which the value for each assemblage was calculated as

∑artiodactyls)/ (∑artiodactyls + ∑all other subsistence related taxa).

The fish index was calculated as

∑fish)/ (∑fish + ∑all other subsistence related taxa).

And the lagomorph index was calculated as

∑lagomorphs)/ (∑lagomorphs + ∑all other subsistence related taxa).

Essentially, the values for these three indices are the proportion of the subsistence related taxa based on NISP, that each taxonomic grouping represents (i.e. the artiodactyl index is the proportion of subsistence related taxa that are artiodactyls based on NISP). The artiodactyl index, the fish index, and the lagomorph index calculated for each site are displayed in Table 5.2.

Spatial Patterns in Relative Abundance indices

Artiodactyl Index. To examine potential spatial differences of prey abundances within my sample, I plotted the Universal Transmercador (UTM) easting coordinates for each of the sites from the sample against the artiodactyl index (see table 5.2 for UTM easting coordinates to each site). The UTMs were obtained by referring to maps in the site reports and pinpointing each site's location on the applicable USGS 7.5" series quadrangle. The coordinates were then calculated to the nearest 500 meters. As shown in Figure 5.3, sites located farther east tended to have higher values for the artiodactyl index than those in the west.

In order to test the significance of this observation I calculated a linear regression model with the artiodactyl index of each site as the dependent variable, and easting as the

Table 5.2 Values for UTM easting, relative abundance indices, and screen size for the sites from the sample.

Site	Easting	art ind	fish ind	lag ind	Screen size
Harder	381000	0.82	0.16	0	None
Ahsahka	552500	0.91	0	0	1/8
Clrwtr fish	552000	0.98	0	0	1/8
Kooskia	579000	0.93	0.02	0	1/8
Spalding	515500	0.43	0.39	0.03	1/8
Arrow(2000)	518000	0.87	0.05	0.02	None
AS80-1	484000	0.97	0.02	0.01	None
AS82-1	484000	0.78	0.13	0.04	None
AS82-4/2	484000	0.58	0.24	0.08	None
AS tuc/82-5	484000	0.51	0.28	0.11	None
Hatiupuh	410000	0.43	0.39	0.08	1/8
Wawawai	471000	0.8	0.08	0.01	¼
Straw(1400)	346500	0.09	0.83	0.05	¼
Straw(600)	346500	0.14	0.51	0.31	¼

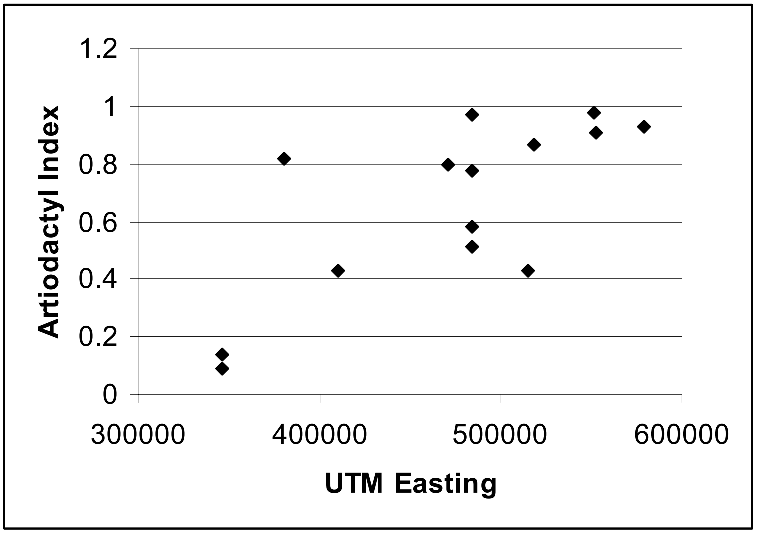

Figure 5.3 Scattergraph of UTM easting and the artiodactyl index

independent variable. The results indicated a moderately strong, significant, positive linear relationship ($r^2=0.72$, $p<0.01$), and conform somewhat to what we might expect given the regional resource variation discussed in Chapter 3.

Fish Index. As mentioned, anadramous fish are emphasized in many models dealing with prehistoric subsistence on the Plateau, and are known to have played an important role in subsistence during the ethnographic period. For this reason I also examined the relationship between UTM easting and the fish index. In this case however, the fish index was found to be not normally distributed using the Shapiro-Wilk test (p=0.03). For this reason, the fish index was transformed using a square root transformation (p=0.68). The linear regression of the transformed fish index and UTM easting also reveals a moderately strong, statistically significant, but inverse relationship (r^2=0.69, p<0.01) (see Figure 5.4) indicating a greater use of fish to the west than in the east. This might be expected given the ethnographic and archaeological evidence that suggests artiodactyls were more emphasized in the eastern region of the Plateau (Ames et al. 1998; Marshall 1977).

Given what is known both about the physiography and ethnohistory of this region, the results of the regression models are not necessarily surprising. They do however have important implications for the potential usefulness of taxonomic abundance and diversity measures in research on prehistoric subsistence in the Southeastern Columbia Plateau.

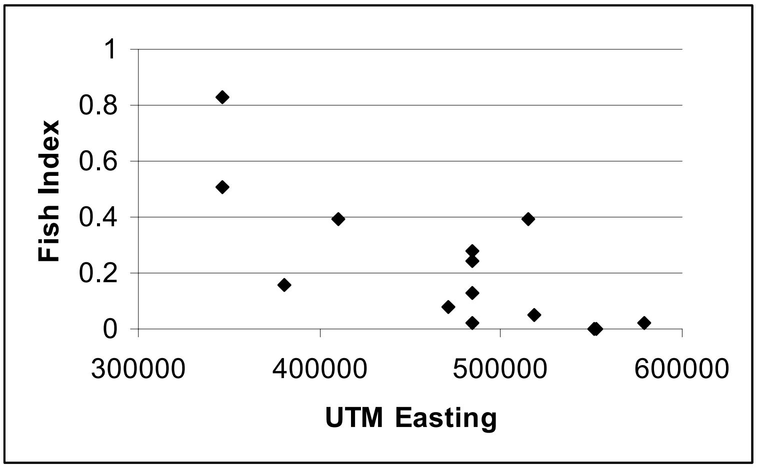

Figure 5.4 Scattergraph of UTM easting and the fish index

Various researchers have noted the difficulty of assessing salmon exploitation in the Plateau using archaeofaunal assemblages because of a variety of commonly observed ethnographic practices (Johnston 1987; Nelson 1973; Campbell 1985). These practices included ritual destruction of salmon bones, butchery practices that involved removing the head and filleting the meat from the skeleton, and the discard of entrails and boney fish remains on beaches where they would eventually wash away (Nelson 1973:381). It is obvious how these processes would make it difficult, if not impossible, to rely on faunal assemblages for an accurate representation of the overall dietary importance of salmon. Nevertheless it is encouraging that in my sample, proportions of certain taxa occur in an east to west cline that conforms to what might be expected from geographic features and ethnographic information. It is likely that the aforementioned taphonomic processes prevented large quantities of fish remains from being deposited in the archaeological record. However, if taphonomic processes influenced fish abundances, I would not expect an east to west pattern as seen here. Instead I would expect no apparent patterning. Consequently, it is more probable that the differential representation of fish remains at these sites represents geographic variation in utilization as a resource. This is still true even if we are ultimately incapable of assessing the overall dietary contribution of fish.

Lagomorph Index. A third resource that was at least marginally important economically as evidenced by the lagomorph index at sites such as Hatiupuh, and the later component at Strawberry island, were jackrabbits (*Leporidae sp.*) and cottontails (*Sylvilagus sp.*). The lagomorph index was also found to be not normally distributed ($p<.01$) and so was transformed, again using a square root transformation ($p=.24$). A linear regression of the transformed lagomorph index and UTM easting also reveals a moderately strong, statistically significant, inverse linear relationship ($r^2=0.60$, $p<0.01$). These results concur with the artiodactyl index and easting results. If artiodactyls (high-ranked prey) were less abundant further west, more lagomorphs (low-ranked prey) would be expected to have been taken. Given the link between prey body-size and rank, I expect lagomorphs to be increasingly abundant in archaeofaunas further west where high-ranked artiodactyls were probably less abundant.

The results of the regression models have important implications for the application of prey exploitation models to this region. They support the idea that there are significant differences in subsistence the farther upstream in the Snake River drainage a site is located. Hence, changes in the environment that may have affected anadramous fisheries as a whole (for example see Chatters 1998 and Chatters et al. 1992) would likely have had less of an impact on the subsistence of people living in the Southeastern Plateau than on populations living further west towards the central part of the basin. These data underscore the necessity of recognizing that, at least during certain time periods, salmon and smaller mammals were more important resources to the west, and artiodactyls were more important resources to the east. Differences in geography should be particularly considered in arguments based on how observed changes in the anadramous fishery are related to social change, a possibility that has been explored in some parts of the Northern or Canadian Plateau (Hayden 1994). The effects of changes in the anadramous fishery on human subsistence may have been less profound and less discernible archaeologically in this part of the Plateau because of the focus on artiodactyls as an abundant and high-ranked resource.

Although these results appear to be strong, there are some noteworthy problems with the regression models. The most obvious is the fact that the Strawberry Island data have an inordinate amount of influence on all of the least squares regression lines. In fact, if the sites at Strawberry Island are removed, all of the relationships are no longer statistically significant. Because the independent variable for these models is UTM easting, the problem may be related to a lack of sites for which faunal identifications have been completed. There are no sites between the mouth of the Palouse River and Strawberry Island for which taxonomic identifications of the faunal assemblage have been completed. If the trend is indeed linear and significant, taxonomic identifications for sites located on that stretch of the river should conform to this pattern. This is one reason why the Harder site faunal assemblage (see Chapter 4) was chosen for analysis.

The inclusion of the Harder site data actually reduces the strength of the regression models for easting and the artiodactyl index ($r^2=0.54$, $p<0.01$), and easting and the fish index ($r^2=0.61$, $p<0.01$). This tends to suggest that perhaps these relationships are not linear as previously suggested. I will return to this question later in this chapter.

Relationship Between the Artiodactyl Index and the Fish Index

Having analyzed the spatial relationships between these variables, there is another relationship which is important to consider. A linear regression of the artiodactyl index and the transformed fish index reveals a statistically significant inverse linear relationship ($r^2=0.93$, $p<0.01$), which is much stronger than the relationship between any of the three indices and the variable UTM easting. That means the abundance of artiodactyls and fish covary in a potentially significant way; when one is abundant, the other is not. It is tempting to dismiss this as a closed array effect in which the two variables are proportions taken from the same sample, but there is another possible explanation.

The strength of the relationship indicates that the proportion of the identifiable subsistence related taxa that is made up by artiodactyls is nearly the inverse of the proportion made up by fish. In essence this means that artiodactyls and fish together constituted the vast majority of the vertebrate portion of the diet. Lagomorphs appear to have been significant only at sites further west such as Strawberry Island. In fact, a multiple linear regression with artiodactyl index as the dependent variable and UTM Easting, the transformed fish index and the transformed lagomorph index as independent variables (Table 5.3) indicates that the fish index is the only statistically significant variable of the three in predicting the artiodactyl index, when the relationships between the artiodactyl index and each of the other two variables are held constant (adjusted $r^2=0.93$, $p=<0.01$). This relationship between the artiodactyl index and the fish index becomes even more significant when their temporal distributions are examined.

Table 5.3 t statistic and significance values for multiple linear regression.

	T Stat	*P-value*
Intercept	3.82	<0.01
Easting	-0.30	0.77
Fish ind	-5.22	**<0.01**
Lag ind	-1.82	0.10

Temporal Variation in Resource Use

A great deal of research on Holocene environmental change on the Plateau has been linked to resource variation through time (Chatters 1995; Chatters 1998; Chatters and Hoover 1992; Chatters et al. 1995; Mehringer 1985). To explore this possibility I organized the artiodactyl and fish indices from the assemblages into Table 5.4 in descending order according to mid-date of occupation based on ^{14}C dates in order to detect any temporal patterns. As shown in Table 5.1, artiodactyls are more abundant throughout the sample, except at Strawberry Island, where fish and lagomorphs appear to have been more important. This might be expected considering the earlier results. If fewer artiodactyls were available that far west, the Strawberry Island components wouldn't be expected to follow the same pattern as sites located further east. With the two components from Strawberry Island removed from the sample it becomes apparent that artiodactyl and fish abundances covary through time.

The earliest sites from the sample, the late Cascade/early Tucannon component at Alpowa and the combined assemblage of housepits 2 and 3 from Hatiupuh, date to between 4,000 and 3,800 years ago. The proportions of the assemblages that consist of fish appear to be higher during this time period relative to the majority of the rest of the sites. The component at the Alpowa locality represented by Housepits 2 and 4 at 45AS82 and Spalding have dates that center around 1,500 years ago and also appear to demonstrate an elevated emphasis on fish and decreased emphasis on artiodactyls. The single assemblage that represents the intervening period from the late Arrow Beach component and those that are younger than approximately 1,500 to 1,400 years ago, appear to demonstrate an elevated emphasis on artiodactyls.

The fish index for the Harder site is 0.16. While this certainly isn't as high as for AS82 houses 2 and 4, and Spalding (the time period to which it dates), it is nonetheless higher than any of the assemblages that come later. Furthermore, all of the fish bones recovered from the Harder site are from the early occupation which dates to 1,500 B.P. None were recovered from the later occupation dating to the proto-historic period. This

Table 5.4 Artiodactyl index and fish index organized according to mid-date of occupation. The five sites that have higher proportions of fish and lower proportions of artiodactyls are in bold type. Ahsahka was excluded from this table because the dates range from 700 to 2,400 BP, and the reported NISP is a palimpsest of almost 2,000 years of occupation.

Site	Mid-date(BP)	art index	fish index
AS tuc/82-5	**4000**	**0.51**	**0.28**
Hatiupuh	**3925**	**0.43**	**0.39**
Arrow(2000)	2050	0.87	0.05
AS82-2/4	**1665**	**0.58**	**0.24**
Harder	**1525**	**0.82**	**0.16**
Spalding	**1460**	**0.43**	**0.39**
AS80-1	1330	0.97	0.02
AS82-1	1250	0.78	0.13
Clrwtr fish	1225	0.98	0
Wawawai	980	0.8	0.08
Kooskia	600	0.93	0.02

tends to support the hypothesis that the time period from 1,800 to 1,400 B.P. was indeed marked by increased use of fish along the lower Snake and Clearwater Rivers. This conclusion should be considered tentative for the fact that there were so few fish bones found at the site overall, and the vast majority of the unidentifiable assemblage is almost certainly mammal. Unfortunately the true importance of fish in the diet of the prehistoric occupants of this site will never be known because the deposits were not screened.

The Harder Site Assemblage Compared With Regional Data

As explained in Chapter 3, diversity measures are also used in zooarchaeologial assemblages to quantify changes in prey use strategies through time. In order to gain a better understanding of how all of these variables (both temporal, spatial, and faunal abundance and diversity) were interacting, I performed a Principle Components Analysis (PCA) in which I included the variables of easting, artiodactyl index, the transformed fish index, and two measures of taxonomic diversity; richness and evenness.

Taxonomic Diversity. Diversity has two critical components; richness and evenness (Pielou 1975**,** Schmitt and Lupo 1994). Richness is described simply as the total number of taxa represented (Σ taxa). Evenness quantifies the degree to which different classes within an assemblage are equally represented (Jones 2004; Schmitt and Lupo 1995). These measures have been widely used in zooarchaeological analyses to demonstrate changing encounter rates with prey (Grayson and Delpech 1998; Nagaoka 2001). The diet breadth model asserts that high-ranked prey is always taken when encountered and low-ranked prey is taken only according to the availability of high-ranked prey (Kelly 1995:78-90). Therefore, assemblages with a greater degree of evenness are considered to represent a broader diet-breadth because progressively increasing use of low-ranked prey will bring their representation in the assemblage closer to that of the high-ranked prey (Jones 2004). Assemblages with a lower degree of evenness are often interpreted as representing a more narrow diet breadth and presumably higher foraging efficiency.

Richness and evenness were calculated for the Harder site assemblage as well as the other zooarchaeological assemblages from this region. Richness was calculated simply as the number of taxa represented in each assemblage. Following Grayson (1984), and Schmitt and Lupo (1995), evenness values for the assemblages of this study were calculated as the reciprocal of Simpson's index,

$$1/\sum p_i^2$$

where p_i represents the proportion of identifiable specimens in the total assemblage that fall into a particular taxonomic grouping (genus for mammals, and order for osteichthyes). The higher the value obtained based on this index, the higher the evenness of the assemblage. The values for richness and evenness are presented in table 5.5.

Table 5.5 Evenness and richness values for the 1,500 BP Harder site occupation, and the other sites from the regional sample.

	Evenness	Richness
Harder	2.98	6
Ahsahka	2.68	7
Clrwtr fish	1.08	3
Kooskia	2.28	7
Spalding	4.26	13
Arrow(2000)	2.88	14
AS80-1	1.77	7
AS82-1	1.68	6
AS82-4/2	3.37	14
AS tuc/82-5	5.27	14
Hatiupuh	4.02	12
Wawawai	2.88	7
Straw(1400)	1.44	6
Straw (600)	2.72	7

Principle Components Analysis. The PCA yields some potentially important results that illustrate some of the spatial and temporal dynamics of prehistoric subsistence on the Southeastern Plateau, but before discussing them there is a significant caveat that should be mentioned. Normally, a PCA should have no less than 5 times the number of observations as number of variables being tested (Shennan 1997). For example, in order to follow these guidelines with this sample, there should have been at least 25 assemblages for which each of the five variables had been calculated. It should be recognized that this procedure was performed in an exploratory fashion and the results can and should be updated when more zooarchaeological assemblages are available to include in the analysis. Nevertheless, the results of the PCA do appear to yield some significant information and important perspectives on Southeastern Plateau subsistence.

The principle components of a PCA are generally evaluated for their utility in explaining variation in the sample by looking at their eigenvalues. An eigenvalue of >1 is taken to indicate that the component explains a significant degree of variation. As illustrated in table 5.6, Principle Components 1 and 2 were the only components with eigenvalues > 1 and so were the only two graphed in figure 5.5, and subsequently discussed in this analysis. The relationship of each of the variables to the components is then determined by examining the eigenvectors for each component and the respective variables. The higher the eigenvector is, whether in the negative or positive direction, the more influential the variable is for that component. As can be seen in table 5.6, the three most influential variables in Principle Component 1 are the artiodactyl index, the fish index and easting, while the three most influential for Principle Component 2 are easting, richness, and evenness. Assemblages that scored high on Principle Component 1 tended to have fewer artiodactyls, more fish, and were located further west, while assemblages that scored high on Principle Component 2 tended to have high richness and evenness values. The scores for Components 1 and 2 of each assemblage are plotted in figure 5.5.

Three distinct clusters appear in the graph. Hatiupuh and the early 45AS82 assemblages, as well as the assemblages from Spalding and the 45AS82 housepits 2 and 4, cluster in the top right hand corner of the graph. These assemblages are the four that

Table 5.6 Eigenvalues and Eigenvectors for PCA of lower Snake and Clearwater river sites.

Eigenvalues		Eigenvectors	Prin 1	Prin 2
1	**2.88**	Easting	**-0.44**	**0.42**
2	**1.67**	Evenness	0.32	**0.60**
3	0.26	Richness	0.28	**0.64**
4	0.16	art ind	**-0.55**	0.18
5	0.04	Fish ind	**0.57**	-0.15

date to time periods in which there are higher proportions of fish. Having scored high on Components 1 and 2 indicates that these sites not only have elevated proportions of fish and less artiodactyls but that their values for richness and evenness tend also to be higher. Elevated values for richness and evenness in zooarchaeological assemblages are commonly interpreted to represent increasing diet breadth and broader based subsistence (Jones 2004). For example, Chatters (1995) used the richness of multiple Plateau sites to demonstrate that subsistence strategies differed between Pithouse I and Pithouse II. He concluded that the Pithouse I subsistence strategy was a broader based forager strategy, while Pithouse II which focused on deer and/or mountain sheep and salmon, was a collector strategy. These results seem to support that conclusion as the early Alpowa and Hatiupuh assemblages date to Chatter's Pithouse I phase.

The period from approximately 1,800 to 1,400 BP is represented by the assemblages from Spalding, Alpowa site 45AS82 housepits 2 and 4, and now also the Harder site. If that time period was similar to the period represented by the early Alpowa and Hatiupuh assemblages as has been hypothesized, I would have expected all three assemblages to score positively for both components and cluster in the graph with the two earlier sites. While Spalding and 45AS82 housepits 2 and 4 seem to also demonstrate a broader based subsistence strategy, the Harder site is clearly more similar to the sites that tend to have lower diversity and higher proportions of artiodactyls in their assemblages. This may be due to two possible reasons. First, as mentioned earlier, the Harder site was not excavated using screens. The presence of very small fragments of bone including fish vertebrae and rodent bone attest to the fact that the excavators were actively collecting smaller specimens, but the potential for missing smaller bones when no screen

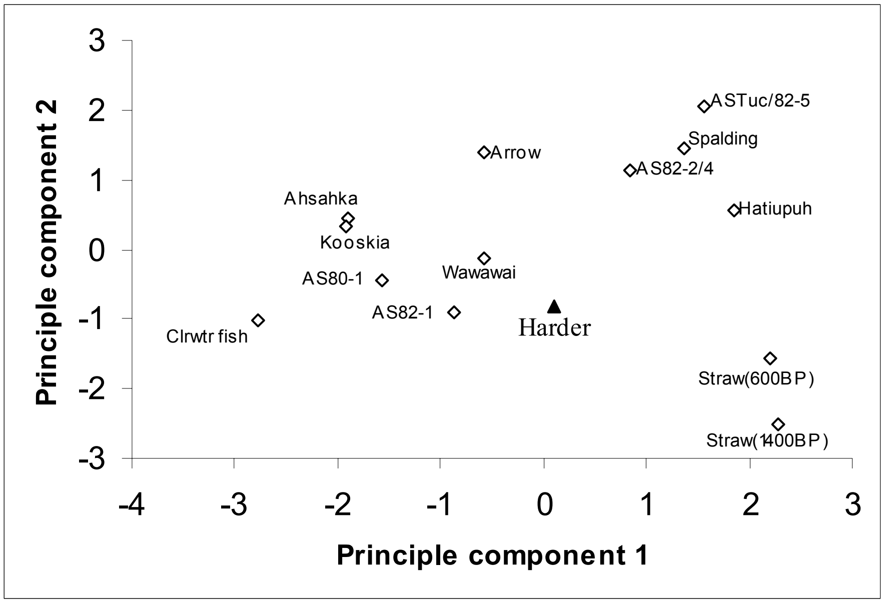

Figure 5.5 Results of Principle Components analysis for sites from the Lower Snake and Clearwater rivers.

is used is obviously increased. All of the other sites from the sample were excavated with at least ¼ inch mesh screen except for the sites at the Alpowa locality which were not screened either. Nevertheless, Alpowa was meticulously excavated and both high and low values for the respective indices are represented by the various Alpowa assemblages. Second, although the fact that the site wasn't screened could have skewed the values for taxonomic diversity and relative abundance indices, it is also possible that the apparent increase in proportions of fish at sites dating between 1,800 and 1,400 BP was simply the product of a small sample of sites and that the results for the Harder site illustrate this. Analyses of more carefully excavated assemblages dating to this time period will be needed in order to support the hypothesis that the time period from 1,800 to 1,400 BP was marked by a broader based subsistence strategy that was more similar to that represented by the early component at 45AS82 and Hatiupuh.

The hypothesis that proportions of fish decrease in a west to east linear cline is also challenged by the results of the PCA. Interestingly the two Strawberry Island components cluster together in the lower right-hand corner of the graph, having scored positively with respect to Principle Component 1 and negatively with respect to Principle Component 2. These results are exactly what we would expect given the emphasis on salmon in the more arid central basin (Spier and Sapir 1930) where artiodactyls were likely less available. Mass capture technologies are known to improve the return rates of smaller prey (Madsen and Schmitt 1998) and late prehistoric salmon fisheries on the Plateau certainly may have fit into this category. Therefore, it is not surprising to find that Strawberry Island has low values for richness and evenness. Being located in the more arid central basin, subsistence was probably focused on the fishery which probably yielded high overall caloric returns thereby eliminating the need to broaden the diet. As this is represented in this sample by only one site these conclusions should of course be considered tentative. Either way, the proportions of fish at the sites in this sample do not appear, as was hypothesized earlier, to decrease in a linear cline from west to east. Rather, it seems more likely that the lower Snake River from the region of the lower Monumental Dam to the east was characterized by a distinct subsistence strategy. Rather than a gradual linear cline in relative abundances, there seem to be distinct regions with different habitats and distinct subsistence strategies. Strawberry Island appears to be more similar to sites located further west on the Columbia River such as the Umatilla site which contains substantial numbers of salmonid remains (Schalk 1980).

Environmental Factors and Salmon Productivity

Various environmental factors are recognized to have significant impacts on the abundance of salmon and artiodactyls in the Columbia Plateau. Some research indicates that aggrading flood plains can be detrimental to the salmon population because of the lack of availability of suitable spawning beds (Chatters 1998). Higher temperatures have also been predicted to have deleterious effects on the abundance of salmon. Chatters et al. (1992) argued that a 2° increase in temperature between 6,000-7,000 years ago resulted in a 30-60% decline in salmon stocks relative to modern conditions. The abundance of salmon is negatively affected by warmer temperatures because warm water increases the risk of infection in adults. Furthermore, a short warm winter makes spawned eggs more susceptible to fungal attacks (Chatters 1998). Conversely, warm temperatures if not accompanied by decreasing moisture, have the effect of increasing ungulate populations as habitat suitable for winter grazing expands (Chatters 1998). Some of the patterned fluctuations in relative abundance of the taxonomic categories, artiodactyls and fish, in the current sample of sites from the lower Snake and Clearwater Rivers may be related to these types of environmental conditions.

Impact of Alluvial Cycles on Salmon. An alluvial cycle begins with the aggrading of the floodplain and margins of a stream. Over time, the amount of deposition along these margins diminishes, and the floodplain is no longer significantly built up by overbank flow. The stream may then downcut, or the flow regime may diminish. At this point the floodplain becomes a stable surface where continued aeolian deposition or soil formation may occur.

Aggrading streams tend to result in sediment-laden water and finer textured beds for the Columbia, the major stream in this region (Chatters and Hoover 1992). Research indicates that when streams are aggrading, a specific species of bivalve, *Margaritifera falcata,* which prefers clear gravel-to-sand bedded streams becomes less abundant as compared to another bivalve, *Gonidea angulata,* which tolerates more sediment-laden water (Vannote and Minshall 1982). Salmonids reproduce more successfully when eggs are spawned in gravelly beds and clear flowing streams, and perform poorly when eggs are spawned in finer textured beds (McNeil and Ahnell 1964; Phillips et al. 1975). Therefore, aggrading streams in this region may result in poor performance of the salmon fishery.

Alluvial Cycles on the Clearwater. Cochran (1988) studied the alluvial stratigraphy of three streams in the interior Pacific Northwest. He wanted to see if there were any correlations in the alluvial cycles of these streams that may have been expressions of regional environmental and climatic conditions. His work on the lower Clearwater showed evidence of four Holocene alluvial cycles, beginning at approximately 11,000 BP. The end of the first alluvial cycle and beginning of the second date to approximately the time of the eruption of Mt. Mazama at 6,700 BP. The associated period of aggradation lasted for approximately 2,400 years, with an ending point of 4,300 BP (Cochran 1988:106). This was followed by a period of erosion on the lower Clearwater that lasted until approximately 3,500 BP. The cessation of aggrading floodplains between 4,300 and 3,000 BP could have had a positive impact on salmon populations, and by extension the observed frequencies of fish at some of the sites in my sample (Table 5.7).

Table 5.7 Episodes within alluvial cycles of the Clearwater River, and their possible impact on zooarchaeological assemblages.

Time	Cochran 1988	Sites	Fish or Artiodactyls
6,700-4,300 BP	Aggradation		
4,300-3,500 BP	Erosion	Early 45AS82 and Hatiupuh	Elevated fish
3,500-2,300 BP	stable flood plain		
2,300 BP	Aggradation	Arrow Beach (2000 BP)	elevated artiodactyls

For example, the Hatiupuh assemblage, and the assemblage from the late Cascade/early Tucannon component at 45AS82 correspond to a period of erosion which may have been characterized by coarser textured stream beds and a lower sediment load in the water and by extension higher abundance of salmon. For the assemblage from the Arrow Beach 2,000 BP occupation, there is a return to higher proportions of artiodactyls and lower proportions of fish, which seems to correspond to the beginning of another alluvial cycle as identified by Cochran (1988) for the Clearwater at 2,300 BP. Finally, there is another short episode represented by 45AS82 houses 2 and 4, and Spalding in which proportions of fish are again higher (Table 5.4). It is difficult to determine whether or not the increase in relative abundance of fish at these sites may have been related to a cessation in aggradation because Cochran (1988) was not able to adequately date the last alluvial cycle he identified for the Clearwater. However, the relative proportions of fish and artiodactyls and the results of the PCA, indicate that they are similar in composition to assemblages from the earlier time period of elevated proportions of fish.

While it is difficult to correlate the observed fluctuations in the relative abundance of fish and artiodactyl remains with alluvial cycles in both these instances, it does appear to be potentially significant that the sites dating to 4,000-3,800 BP contain elevated proportions of fish and the site that contains elevated proportions of artiodactyls at approximately 2,300-2,000 BP, correspond to periods of erosion and deposition respectively on a major tributary to the Snake River.

It is also difficult to assert that aggrading floodplains on the Clearwater alone would result in a decrease in the salmon fishery significant enough to produce these patterns in the archaeological record. Some researchers suggest that asynchronous alluviation is possible not only in the same region, but even within different parts of the same stream (Chatters and Hoover 1992). If this was true during the periods of alluviation identified by Cochran, then fish returning to presumably good spawning beds in other parts of the Snake River or its tributaries would probably compensate for bad spawning beds in the lower Clearwater. Nevertheless, Cochran (1988) concluded that there were indeed regional conditions that resulted in some degree of synchronicity of alluvial cycles between the three streams he studied in the Interior Northwest. Small as my sample of sites may be, the patterns apparent within these data might warrant further research into alluvial cycles of other streams in the region with particular emphasis on the potential for synchronicity of cycles between them and the impact of aggrading flood plains on the salmon population.

Implications for Understanding the Establishment of the Winter Village Pattern

Although certainly not conclusive, the results of these analyses have implications for some aspects of the models discussed in chapter 2 and their applicability to the Southeastern Plateau in particular. The earliest sites that have been hypothesized to have had some continuity with the establishment of this pattern date to between 5,000 and 4,500 years ago. These are not however believed to be related to the pattern based on comprehensive evidence that demonstrates the presence of all, or even multiple characteristics of the ethnographic pattern. Rather they are believed to have some continuity with the pattern based primarily on the presence of pithouses (Ames and Marshall 1980; Lohse and Sammons-Lohse 1986). The presence of pithouses is hypothesized in these models to have been the first characteristic of the ethnographic pattern to have appeared, while the other characteristics such as reliance on salmon and storage technology developed later. Ames (1991) and Chatters (1995) have demonstrated the possibility, however, that the intensity of pithouse construction was episodic, and that during certain time periods between the occupation of the earliest pithouse sites and the establishment of the winter village pattern, pithouses were not in use on the Southern Plateau. The presence of pithouses alone may therefore not be adequate evidence to assume the beginning of the establishment of the winter village pattern (Chatters 1989).

A recent debate over the continuity between cultural chronological periods on the Northern or Canadian Plateau as defined by Stryd and Rousseau (1996) may have interesting parallels to the Southeastern Columbia Plateau. In their cultural chronology of the Mid Fraser-Thompson rivers area, Stryd and Rousseau suggest that the Lochnore phase (~4,500-3,500 BP) was contiguous with the Shuswap Horizon (~3,500-2,500 BP). They assert that a collector system facilitated by storage technology developed *in situ* on the Northern Plateau during the Lochnore phase which continued uninterrupted into the Shuswap Horizon. In contrast, Prentiss and Kuijt (2004) argue that there was no storage technology during the Lochnore phase. They hypothesize that the Lochnore phase population was displaced by people migrating from the coast who brought with them storage technology and an already well developed collector system, represented in the Shuswap Horizon. The crux of the argument centers around storage pits found at the Baker site. Stryd and Rousseau (1996) maintain that the site represents a Late Lochnore Phase/Early Shuswap Horizon site, but Prentiss and Kuijt (2004) demonstrate that the lithic technology found at the Baker site is more similar to that of some of the coastal traditions than to technology from any other sites in the interior. They assert that the

Baker site is an early incursion into the Northern Plateau by coastal groups and is not related to the Lochnore Phase.

Chatters (1995) has suggested a dynamic model for late Holocence subsistence in the Columbia Plateau which corresponds roughly to environmental fluctuations. He has recently asserted that the differences in subsistence between Pithouse I and Pithouse II are probably related to a phenomenon similar to that described by Prentiss and Kuijt for the Northern Plateau (Chatters 2004). He also points out that this hypothesis is similar to what Nelson (1973) originally suggested; displacement of the Southern Plateau population by immigrants from the coast who brought with them a collector system (fishing and storage technology) that was already well developed. Chatters (1995) and Prentiss and Chatters (2003) hypothesize that part of what facilitated the spread of that system was its adaptability in a markedly seasonal environment.

The results of my analyses of faunal assemblages from the Southeastern Plateau tend to support a dynamic model of subsistence throughout the late Holocene for this region. They are certainly not conclusive in their support of the Nelson (1973) and Chatters (1995) models for the establishment of the winter village pattern. Nevertheless my analyses suggest fluctuations in prey resource use through time which might be expected if the hypotheses of these two models concerning the displacement of foraging populations by collector populations are correct.

Conversely, these results do not appear to support the application of other models which suggest that the earliest pithouses represent the beginnings of the ethnographic pattern, and that storage and salmon intensification developed gradually in response to increasing population pressure (Lohse and Sammons-Lohse; Schalk and Cleveland 1983).

If this kind of gradualist model were accurate, we would expect at some point to see a gradually increasing abundance in fish remains in these sites rather than the punctuated, episodic fluctuations observed in this sample.

My conclusions are somewhat suspect given the smallness of the sample of sites from which they are derived. There is only one site (Arrow 2000) in my model to represent the period at ~2,000 BP, which could obviously be very easily biased. Further complicating the issue is the fact that the undated storage feature from Hatiupuh house 3 contained much of the fish remains for the assemblage (Brauner et al. 1991). If the feature did not date to ~4,000 BP, the pattern of increased fish during that time period is also suspect. Nevertheless, the broad patterns are significant enough to warrant further investigation.

Chapter 6

Implications for Understanding Southeastern Plateau Subsistence

The results of these analyses have many implications for our understanding of prey exploitation within the Southeastern Plateau over the past 4,000 years. They also have implications for understanding the establishment of the winter village pattern. Most researchers, both ethnographic and archaeological, have recognized that subsistence, especially prey exploitation patterns, varied among separate regions within the Plateau (Ames et al. 1998; Marshall 1977; Speir and Sapir 1930). However my analysis is the first to examine regional variation based on faunal data that focuses on this subregion of the Plateau. My data suggest some explanations for the patterning seen within this sample of assemblages, but perhaps more importantly, they also suggest questions that may guide future research.

The spatial patterns tend to support the assertion that seperate regions within the Plateau were significantly different in terms of their prehistoric prey exploitation strategies. The temporal patterns suggest the possibility that there were also periods of time wherein fish were a more important resource than in other periods of time. This patterning could be related to alluvial cycles, but much more research would be required to really substantiate that claim. The late Arrow Beach component is the only assemblage that represents the interim period between increases in abundance of fish. It is possible that the decreased abundance of fish is simply an artifact of a small sample (1 site), and does not reflect overall temporal trends. Clearly, more data from sites that date between 2,000 and 3,000 years ago are needed in order to definitively test these hypotheses.

The fact that all of the fish bones from the Harder assemblage were recovered from the lower occupation that dates to approximately 1,500 BP tends to support the hypothesis that the period from 2,000 to 1,400 BP, represented by 45AS82 housepits 2 and 4, was characterized by increased use of fish as a resource. However, the paucity of fish remains from the site overall tend to challenge this conclusion, and the fact that the deposits weren't screened make any conclusions in this regard very tenuous.

These data are valuable in helping us to determine which models of the establishment of the winter village pattern apply to this region of the Plateau. The periodic fluctuations in resource abundance through time would tend to lend more credence to the Chatters (1995) model for the establishment of the winter village pattern. Unlike Ames and Marshall (1980) and Lohse and Salmons-Lohse (1986) he asserts that the pithouses at early sites such as 45OK11, Alpowa and Hatwai do not represent the beginnings of the establishment of the winter village pattern. Instead, he believes that the winter village pattern appeared as a "full blown collector strategy" (Chatters 2004) and was selected for because of its adaptability to a seasonal climate (Chatters 1995; Prentiss and Chatters 2003). Although much more data is needed to work out the specifics of this dynamic model, the fluctuations in relative abundance of fish and artiodactyls tend to support his assertion that subsistence and mobility patterns existed in flux for some time before the winter village pattern appeared or was introduced, and became entrenched on the Plateau. Even though the data suggest that the overall subsistence pattern of the Southeastern Plateau was distinct from other regions of the Plateau, they still support a dynamic model that posits continued fluctuations in subsistence that were closely tied to the environment (Chatters 1995), versus gradualist models that suggest steadily increasing dependence on fish (Lohse and Sammons-Lohse 1986; Schalk 1977; Schalk and Cleveland 1983) or vegetable (Ames and Marshall 1980) resources, linked to increasing population pressure.

Finally, as we continue to research the establishment of the winter village pattern, archaeologists need to take into account the variation in availability of resources within different parts of the Plateau. We know from historic and ethnographic records that reliance on salmon and storage technology was widespread in the region by the time of European contact. Nevertheless, much of the archaeological data suggests that there were significant differences in prey-use strategies prehistorically, from region to region. Most explanations for the establishment of the winter village pattern are tied to increasing reliance on specific resources. However, regional resource variation would probably have a considerable impact on how quickly a collector strategy would have spread. This is true whether or not we believe that it developed *in situ* on the Plateau, or was introduced from other areas. Future research efforts to develop, test, and refine models explaining the establishment of the winter village pattern should take into account the potential impact of this regional variation, especially given the reliance upon intensification of specific resources as important variables in these models.

References Cited

Ames, Kenneth M.

1991 Sedentism: A Temporal Shift or a Transitional Change in Hunter-Gatherer mobility Patterns? In *Between Bands and States*, S. A. Gregg, editor, pp. 108-134. Center for Archaeological Investigation, Occasional Paper no. 9. Southern Illinois University.

Ames, Kenneth M. , Don E. Dumond, Jerry R. Galm, and Rick Minor

1998 Prehistory of the Southern Plateau. In *Plateau,* edited by D.E. Walker, pp. 103-119. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Ames, Kenneth M., James P. Green, and Margaret Pfoertner

1981 Hatwai (10NP143): Interim Report. *Boise State University, Anthropological Reports,* no. 9. Boise.

Ames, Kenneth M., and Alan G. Marshall

1980 Villages, Demography, and Subsistence Intensification on the Southern Columbia Plateau. *North American Archaeologist* 2:25-52.

Binford, Lewis R.

1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. *American Antiquity* 43:330-361.

1980 Willow Smoke and Dogs Tails: Hunter-gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4-20.

Brauner, David R.

1976 Alpowai: The Culture History of the Alpowa Locality. Unpublished PhD dissertation, Department of Anthropology, Washington State University, Pullman.

Brauner, David, Timothy Satler, and Francine Havercroft

1991 Archaeological Data Recovery at Hatiupuh, 45WT134, Whitman County, Washington. Department of Anthropology, Oregon State University, Corvallis.

Broughton, Jack

1994 Late Holocene Resource Intensification in the Sacramento Valley, California: The Vertebrate Evidence. *Journal of Archaeological Science* 21:501-514.

Broughton, Jack, and James O'Connell

1998 On Evolutionary Ecology, Selectionist Archaeology, and Behavioral Archaeology. *American Antiquity* 64(1):153-165.

Brown, Christopher L., and Carl E. Gustafson

1990 A Key to Postcranial Skeletal Remains of Cattle/Bison, Elk, and Horse. *Washington State University Laboratory of Anthropology Reports of Investigations* No. 57. Pullman.

Butler, Virginia B.

2000 Resource Depression on the Northwest Coast of North America. *Antiquity* 74:649-661.

Campbell, Sarah K., editor

1985 *Summary of Results, Chief Joseph Dam Cultural Resources Project*. Washington Office of Public Archaeology, Institute for Environmental Studies. University of Washington, Seattle.

Cannon, Debbi Yee

1987 *Marine Fish Osteology: A Manual for Archaeologists.* Simon Fraser University Archaeology Press, Burnaby B.C.

Chance, David H. and Jennifer V. Chance

1985 Archaeology at Spalding 1978-1979. *University of Idaho Anthropological Research Manuscript Series,* No. 85. Moscow.

Chatters, James C.

1989 Resource Intensification and Sedentism on the Southern Plateau. *Archaeology in Washington* 1:3-19.

1995 Population Growth, Climatic Cooling, and the Development of Collector Strategies on the Southern Plateau, Western North America. *Journal of World Prehistory* 9:341-400.

1998 Environment. In *Plateau,* edited by D.E. Walker, pp. 29-48. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

2004 Safety in Numbers: Conflict and Village Settlement on the Plateau. In *Complex Hunter-Gatherers: Evolution and Organization of Prehistoric Communities on the Plateau of Northwestern North America,* edited by W.C. Prentiss and I. Kuijt, pp. 67-83. University of Utah Press, Salt Lake City.

Chatters, James C., and Karin Hoover

1992 Response of the Columbia River Fluvial System to Holocene Climatic Change. *Quaternary Research* 37:42-59.

Chatters, James C., and David L. Pokotylo
1998 Prehistory: Introduction. In *Plateau,* edited by D.E. Walker, pp. 73-80. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Chatters, James C., Virginia L. Butler, Michael J. Scott, David M. Anderson, and Duane A. Neitze.
1995 A Paleoscience Approach to Estimating the Effects of Climatic Warming on Salmonid Fisheries of the Columbia River Basin. In *Climate change and northern fish populations,* R.F. Beamish, editor, pp. 489-496. Can. Spec. Publ. Fish. Aquat. Sci. 121.

Cochran, Bruce
1988 Significance of Holocene Alluvial Cycles in the Pacific Northwest Interior. PhD dissertation, University of Idaho, Moscow.

Gilbert, B. Miles
1990 *Mammalian Osteology.* Missouri Archaeological Society. Columbia.

Gustafson, Carl E.
1972 Faunal Remains from the Marmes Rock shelter and Related Archaeological Sites in the Columbia Basin. Unpublished PhD Dissertation, Department of Anthropology, Washington State University, Pullman.

Grayson, Donald
1984 *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas.* Academic Press. Orlando.

Grayson, Donald K., and Francois Delpech
1998 Changing Diet Breadth in the Early Upper Palaeolithic of Southewestern France. *Journal of Archaeological Science* 25:1119-1129.

Harkins, Stanley
1980 The Prehistoric Occurrence and Aboriginal Utilization of Bison sp. in the Central Columbia Basin, Washington. Unpublished Masters Thesis, Department of Anthropology, Washington State University, Pullman.

Hayden, Brian
1994 Competition, Labor, and Complex Hunter-gatherers. In, *Key Issues in Hunter-gatherer Research,* eds. E.S. Burch, Jr. and L>J> Ellanna, pp. 223-239. Berg Press, Oxford.

Hayden, Brian, and Rick Schulting
1997 The Plateau Interaction Sphere and Late Prehistoric Cultural Complexity. *American Antiquity* 62:51-85.

Hewes, Gordon W.
1998 Fishing. In *Plateau,* edited by D.E. Walker, pp. 620-640. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Hunn, Eugene S, Nancy J. Turner, and David H. French
1998 Ethnobiology and Subsistence. In *Plateau,* edited by D.E. Walker, pp. 525-545. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Ingles, Lloyd G.
1965 *Mammals of the Pacific States.* Stanford university Press, Stanford, CA.

Janetski, Joel C.
1997 Fremont Hunting and Resource Intensification in the Eastern Great Basin. *Journal of Archaeological Science* 24:1075-1088.

Johnston, Robbin T.
1987 Archaeological Evidence of fishing in the Southern Plateau, a Cultural Area of the Columbia Plateau. Unpublished Masters Thesis, Department of Anthropology, University of Idaho, Moscow.

Jones, Emily
2004 Dietary Evenness, Prey Choice, and Human-Environment Interactions. *Journal of Archaeological Science* 31:307-317.

Kelly, Robert
1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways.* Smithsonian Institution Press, Washington DC.

Kenaston, Monte R.
1966 The Archaeology of the Harder Site, Franklin County, Washington. *Washington State University, Laboratory of Anthropology, Reports of Investigations,* No. 35. Pullman.

Kimball, Vaughn R.
2004 The Effects of Multiple High-rank Prey Species on the Use of Evenness as a Proxy Measure for Diet Breadth: an Example from the Southeastern Columbia Plateau. *Journal of Northwest Anthropology,* 38(2):195-210.

Kroeber, Alfred L.
1939 *Cultural and Natural Areas of North America.* University of California Press, Berkeley.

Lawrence, Barbara

1951 Postcranial Skeletal Characteristics of Deer, Pronghorn, Sheep and Goat, with notes on Bos and Bison. *Papers of the Peabody Museum of American Archaeology and Ethnology,* 35(3). Cambridge Massachusetts.

Lohse, Ernest S., and D. Sammons-Lohse

1986 Sedentism on the Columbia Plateau: A Matter of Degree Related to the Easy Efficient Procurement of Resources. *Northwest Anthropological Research Notes* 20:115-136.

Lyman, R. Lee

1976 A Cultural Analysis of Faunal Remains from the Alpowa Locality. Unpublished Masters Thesis, Department of Anthropology, Washington State University, Pullman.

1983 The Paleozoology of the Avey's Orchard Site. In *Avey's Orchard: Archaeological Investigation of a Late Prehistoric Columbia River Community,* edited by J. Galm, and R.A. Masten, pp. 243-319. Eastern Washington University. Archaeological and Historic Services. Reports in Archaeology and History, Cheney.

Lyman, R.Lee., and Stephanie Livingston

1983 Late Quaternary Mammalian Zoogeography of Eastern Washington. *Quaternary Research* 20(3):360-373.

Madsen, David B., and Dave N. Schmitt

1998 Mass Collecting and the Diet Breadth Model: a Great Basin Example. *Journal of Archaeological Science,* 25:445-455.

Marshall, Alan G.

1977 Nez Perce Social Groups: An Ecological Interpretation. Unpublished Ph.D. Dissertation, Department of Anthropology, Washington State University, Pullman.

McNeil, W.J., and W.H. Ahnell

1964 Success of Pink Salmon Spawning Relative to Size of Spawning Bed Materials. *U.S. Fish and Wildlife Services Special Scientific Report- Fisheries* 469.

Mehringer, Jr., Peter

1985 Quaternary Pollen Records from the Interior Pacific Northwest and Northern Great Basin of the United States. In: *Pollen Records of Late-Quaternary North American sediments,* edited by V.M. Bryant, Jr. and R.G. Holoway, pp. 167-189. The American Association of Strategraphic Palynologists Association, Dallas, Texas.

Morgan, Vera
1993 *Cultural Resource Investigations at 45AD104, an Upland bison Site, Adams County, Washington.* Reports in Archaeology and History 100-81, Eastern Washington University, Cheney.

Nance, Charles R.
1966 45 WT 2: An Archaeological Site on the Lower Snake River. Unpublished Masters Thesis, Department of Anthropology, Washington State University, Pullman.

Nagaoka, Lisa
2001 Using Diversity Indices to Measure Changes in Prey Choice at the Sag River Mouth Site, Southern New Zealand. *International Journal of Osteoarchaeology* 11:101-111.

Nelson, Charles M.
1969 The Sunset Creek Site, *Washington State University Laboratory of Anthroplogy Report of Investigations,* no. 47. Pullman.

1973 Prehistoric culture change in the Intermontane Plateau of Western North America. In *The Explanation of Culture Change: Models in Prehistory,* C. Renfrew, editor, pp. 371-390. Pittsburgh: University of Pittsburgh Press.

O'Connell, James F.
1987 Alyawara site Structure and its Archaeological Implications. *American Antiquity* 52(1):74-108.

Olsen, Stanley J.
1996 Mammal Remains from Archaeological Sites part 1: Southeastern and Southwestern United States. *Papers of the Peabody Museum of Archaeology and Ethnology*, 56(1). Cambridge Massachusetts.

Osborne, D.
1953 The Archaeological Occurrences of Pronghorn Antelope, Bison, and Horse in the Columbia Plateau. *Scientific Monthly,* 77(5):260-269.

Petersen, James H., and James F. Kitchell
2001 Climate Regimes and Water Temperature Changes in the Columbia River: Bioenergetic Implications for Predators of Juvenile Salmon. *Canadian Journal of Fisheries and Aquatic Sciences,* 58(9):1831-1841.

Phillips, R.W., R.L. Lantz, E.W. Claire, and J.R. Moring.
1975 Some Effects of Gravel Mixtures on Emergence of Coho Salmon and Steelhead Trout Fry. *Transactions of the American Fisheries Society,* 104:461-466.

Pielou, E. C.
1975 *Ecological Diversity.* John Wiley and Sons, New York City.

Prentiss, William C., and James C. Chatters
2003 Cultural Diversification and Decimation in the Prehistoric Record. *Current Anthropology* 44(1):33-58.

Prentiss, William C., and Ian Kuijt
2004 The Evolution of Collector Systems on the Canadian Plateau. In *Complex Hunter-Gatherers: Evolution and Organization of Prehistoric Communities on the Plateau of Northwestern North America,* edited by W.C. Prentiss and I. Kuijt, pp. 49-63. University of Utah Press, Salt Lake City.

Reid, Kenneth C, and James C. Gallison
1996 Lower Snake River Basin. In *An Overview of Cultural Resources in the Snake River Basin: Prehistory and Paleoenvironments*, edited by K.C. Reid, pp. 15-104. Northwest Anthropological Research Notes, Vol. 30, R. Sprague and D.E. Walker, general editors, NARN Inc., Moscow, Idaho.

Sappington, Robert Lee
1994 The Prehistory of the Clearwater River Region, North Central Idaho. *University of Idaho Anthropological Reports,* no. 95. Moscow.

Sappington, Robert Lee, and Caroline Carley
1987 Archaeological Excavation at the Kooskia Bridge Site (10-IH-1395), Middle Fork, Clearwater River, North Central Idaho. *University of Idaho Anthropological Reports,* no. 87. Moscow.

Sappington, Robert Lee, Bruce Cochran, and Terry L. Ozbun
1988 Archaeological Test Excavation and Evaluation of the Proposed Clearwater Fish hatchery Site (10-CW-4), on the North Fork of the Clearwater River, North Central Idaho. *University of Idaho Anthropological Reports,* no. 88. Moscow.

Sappington, Robert Lee, Bruce Cochran, and Roderick Sprague
1987 Results of Archaeological Test Excavations at the Parking Area of the Planned Ahsahka Sportsmen's Access Site (10-CW-5) at Ahsahka, Idaho. Laboratory of Anthropology, University of Idaho, *Letter Report,* no. 87-8. Moscow.

Schalk, Randall F.
1977 The Structure of an Anadramous Fish Resource. In *For Theory Building in Archaeology,* L. R. Binford, editor, pp. 207-249. New York: Academic Press.

1981 Land Use and Organizational Complexity Among Foragers of Northwestern North America. In, *Affluent Foragers,* S. Koyama and D. H. Thomas, editors, pp. 53-76. Osaka: Senri Ethnological Studies, National Museum of Ethnology.

Schalk, Randall F. (editor)
1980 *Cultural Resource Investigations for the Second Powerhouse Project at McNary Dam Near Umatilla, Oregon.* Laboratory of Archaeology and History, project report no. 1. Washington State University, Pullman.

1983a Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, Near Lyons Ferry, Washington. *Washington State University Laboratory of Archaeology and History, Project Report* no. 8. Pullman.

1983b The 1978 and 1979 Excavations at Stawberry Island in the McNary Reservoir. *Laboratory of Archaeology and History, Project Report,* no. 19, Washington State University, Pullman.

Schiffer, Michael B.
1972 Archaeological Context and Systemic Contex. *American Antiquity* 37:156-165.

Schmitt, Dave, and Karen Lupo
1995 On Mammalian Taphonomy, Taxonomic Diversity, and Measuring Subsistence Data in Zooarchaeology. *American Antiquity* 60(3):496-514.

Schroedl, Gerald
1971 The Archaeology of Site 45GA17, Little Goose Dam reservoir, Southeastern Washginton. MS on file, Laboratory of Anthropology, Washington State University, Pullman.

1973 *The Archaeological Occurrence of Bison in the Southern Plateau.* Reports of Investigations no. 51, Laboratory of Anthropology, Washington State University, Pullman.

Shaffer, Brian S.
1992 Quarter-inch Screening: Understanding Biases in Recovery of Vertebrate Faunal Remains. *American Antiquity* 57(1):129-136.

Shennan, Stephen
1997 *Quantifying Archaeology.* Edinburgh University Press, Edinburgh.

Simms, Steve
1987 *Behavioral ecology and hunter-gatherer foraging: An example from the Great Basin.* BAR International Series, no. 381, British Archaeological Reports, Oxford.

Spier, L., and E. Sapir
1930 Wishram Ethnography. *University of Washington Publications in Anthropology* no. 3. Seattle.

Sprague, Roderick

1998 Palouse. In *Plateau,* edited by D.E. Walker, pp. 352-359. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Stephen, D.W., and J.R. Krebs

1986 *Foraging Theory.* Princeton University Press, Princeton.

Stern, Theodore

1998 Cayuse, Umatilla and Walla Walla. In *Plateau,* edited by D.E. Walker, pp. 395-419. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Stryd, Arnoud R. and Michael K. Rousseau

1996 Early Prehistory of the Mid-Fraser-Thompson River Area. In *Early Human Occupation in British Columbia,* edited by R. Carlsonand R. Dela Bona, pp. 177-204. University of British Columbia Press, Vancouver.

Thomison, Patrick

1987 When Celilo was Celilo: An analysis of Salmon Use during the past 11,000 years in the Columbia Plateau. Unpublished Masters Thesis, Department of Anthropology, Oregon State University, Corvallis.

Toups, Polly A.

1969 The Early Prehistory of the Cleawater Valley, North-central Idaho. Unpublished Ph.D. Dissertation, Department of Anthropology, Tulane University, New Orleans.

Ugan, Andrew, and Jason Bright

2001 Measuring Foraging Efficiency with Archaeological Faunas: The Relationship Between Relative Abundance Indices and Foraging Returns. *Journal of Archaeological Science,* 28:1309-1321.

Vannote, R.L., and G.W. Minshall

1982 Fluvial Processes and Local Lithology Controlling Abundance, Structure, and Composition of Mussel Beds. *Proceedings of the National Academy of Science* 79:4103-4107

Walker, Deward E.

1967 *Mutual Cross-Utilization of Economic Resources in the Plateau: An Example from aboriginal Nez Perce Fishing Practices.* Washington State University Laboratory of Anthropology Reports of Investigations no. 41. Pullman.

1998a Introduction. In *Plateau,* edited by D.E. Walker, pp. 1-7. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

1998b Nez Perce. In *Plateau,* edited by D.E. Walker, pp. 420-438. Handbook of North American Indians, Vol. 12, W.C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Yent, Martha E.
1976 The Cultural Sequence at Wawawai (45WT39) Lower Snake River Region, Southeastern Washington. Unpublished Masters Thesis, Department of Anthropology, Washington State University, Pullman.

Zeveloff, Samuel I.
1988 *Mammals of the Intermountain West.* University of Utah Press, Salt Lake City.

Appendix A

Key to Tables:

Bones:
audb -- auditory bulla
max -- maxilla
mand -- mandible
P, M -- premolar, molar
inc -- incisor
enml-- enamel fragment
vert -- vertebra
    thr – thoracic
    crv – cervical
    cdl – caudal
sacr – sacrum
scap – scapula
hum – humerus
rad – radius
cun – cuneiform
scph – scaphoid

Species:
class – size class
mam – mammal
art -- artiodactyl
rod -- rodentia
bisn -- bison
cerv -- cervus
odoc – odocoileus
antl – antilocapra
cans – canis
sprm – spermophilus
thom – thomymus
fish – unknown boney fish
salm -- salmonidae

psfm – pisiform
trmg – trapezoid magnum
phlx – phalanx
isch – ischium
ilim – ilium
fem – femur
pat – patella
tib – tibia
fib – fibula
calc – calcaneus
astg – astragalus
nvcb – naviculocuboid
mttr – metatarsal
mtt/c – metacarpal or metatarsal (unknown)
tsmt – tarsometatarsus (as in aves)

Table A.1 Results of taxonomic identifications for the Harder site faunal assemblage. This table consists of those bags which lacked either horizontal or vertical provenience information. The inventory number represents the number assigned by the Washington State Museum of Anthropology to each level and unit bag in the assemblage, and can be correlated with their records. The Roman numerals represent size classes.

Inventory #	Unit	Occ. Level	VI	V	VI	III	II	indet.size	Bone	Fragment	species	comments
272	S65.5/W216.6											
495	S70-75/W190-195							7				
598	HOUSEPIT3		8	5	3			77				
									enml	3 fragments	Art	
1099			5									
1125			3					16				
									mand	fragment	Art (VI)	
									mand	fragment	Art (VI)	
									rgt low P3		cerv	
									rgt low P2		cerv	
									lft mand	P3,4 M1	cerv	
									rgt mand	P4	cerv	
									lft low P2		cerv	
									rgt low M1		cerv	
									scap	blade	class VI	
									lft rad	proximal	Art (VI)	
									enml	9 fragments	Art	
1135			5					10				
									Fem	head	Art (VI)	
									enml	1 fragment	Art	
1147	S130/W50								rgt scap	distal	cerv	
1155			24	9			1	452				
									enml	1 fragment	Art	
									thr vert	centrum	Art (V)	
									molar	fragment	Art (VI)	

									Phlx, 3		odoc	
									rgt calc		cerv	
1168									lft mand	fragment	art (VI)	
1169									rgt astg		cerv	
									rgt nvcb		cerv	
									rgt mttr	proximal	cerv	
1171									thr vert		art (VI)	
1172									Rib	head	art (VI)	
1173									mtt/c	distal	art (VI)	
1174									skull		thom	
1175									Rib	head	art (VI)	
									rib cart		art (VI)	
									rib cart		art (VI)	
									rib cart		art (VI)	
									rib cart		art (VI)	
1176									thr vert		art (VI)	
1177			1									
1178									rib cart		art (VI)	
									rib cart		art (VI)	
1179									rgt radius	distal	cerv	
1180									rgt scap		class VI	
1181									rib cart		art (VI)	
1182									rib cart		art (VI)	
1183									rib cart		art (VI)	
1184									rib cart		art (VI)	
1185			1									
1186			10									
									Rib	head	art (VI)	
									rgt mand	medial, buccal	art (VI)	
									mtt/c	distal	art (VI)	
									lft mand	P2,3,4, M,1	cerv	
									Rib	head	art (VI)	

									enml	6 fragments	art	
									rad ses		art (VI)	
									lft mand	M2,3	art (VI)	
									Phlx, 2		cerv	
									Phlx, 2		cerv	
									Phlx, 2		cerv	
									Phlx, 2		cerv	
									Phlx, 3		cerv	
									Phlx, 1		cerv	
									Phlx, 1		cerv	
									lft scph		cerv	
									lft cun		cerv	juven
1187									rgt mand	diastema & P1	art (VI)	
									molar		art (VI)	
1188									rib cart		art (VI)	
1189				1								
1190									rib cart		art (VI)	
1192									rgt hum		cerv	
1195									Phlx, 1		antl	
1196									lft mand		sylv	
1197									mtt/c	distal	art (V)	
1198									lft astg	distal, palmar	antl	
1199									lft ulna		sylv	
1200									rib cart		art (VI)	
1205									Rib	head	art (VI)	
1206									thr vert	centrum	art (VI)	
1207									thr vert		art (VI)	
1208									audb		cans	
1209									rib	head	art (VI)	
1210									rib	head	art (VI)	
1211									cdl vert		class VI	
1212									vert		salm	

1213								7				
									sacr	fragment	aves	
1214									rib	head	art (VI)	prob juv
1215									phlx, 1	no proximal articulation	cerv	
1217									inc		art (V)	
									inc		art (VI)	
1219								1				
1221									phlx,1		cerv	
1222									tsmt		aves	
1223									rib	head	art (VI)	tooth punc
1224									lft fem	no condyles	sylv	
1225									rib	head	art (VI)	
1226									crv vert	spinous	class V	
1232								19				
1239						1						
1250									rib	head	art (VI)	
1251									rib cart		art (VI)	
1252			1									
1253								1				
1254									rib	head	art (VI)	
1255									mtt/c	distal	art (VI)	
1256									phlx, 1	distal	cerv	
1257									phlx, 2	distal	cerv	
1258									phlx, 1	distal	antl	
1259									cdl vert		class VI	
1260									rgt scap	distal	cans	
1265									rgt ulna	proximal	bisn	
1267									thr vert		art (VI)	
1269									lft scap	distal	cerv	
1270									thr vert		art (VI)	
1271									thr vert		art (VI)	

1272									thr vert		art (VI)	
1275									thr vert		art (VI)	
1280									thr vert		art (VI)	
1281									rgt rad	proximal	cerv	
1282									scap	proximal	art (VI)	
1283									rgt tib	distal	cerv	
1284									rgt tib		bisn	
1285			1									
1286									lft hum	distal	cerv	
1287									lft mand	P2,3,4 M,1	cerv	
1288			1									
1289									lft rad	proximal, medial	cerv	
									rgt tib	distal	cerv	
1290									axis	anterior articulation	cerv	
1291			3									
									lft ulna	lunar notch	cerv	
			1									
1292									rgt max	P2,3,4 M,1	cerv	
1293									Inc		art (VI)	
1294									rgt low P2		cerv	
1295									molar		art (VI)	
1296				1								
1297									lft ischium	acetabulum	bisn	
1298									rgt scap	distal	cerv	
1299									rgt mand	M3	cerv	
1300									inc		art (VI)	
1301									rgt isch	acetabulum	art (VI)	
									lmb vert	centrum	art (VI)	
									rgt pat		art (VI)	jvn epi unf
1302									lft tib	distal	cerv	
1303									rgt rad	proximal medial	art (V)	
1304									rgt max	M1,2,3	art (VI)	

1305									inc		art (VI)	
1306									rgt max	M3	art (VI)	
1307									lmb vert		cerv	
1308									rgt mand	condyle	art (VI)	
1309									inc		art (V)	
1310									mtt/c	distal	art (VI)	
1311									thr vert	ventral	art (VI)	
1312									inc		art (V)	
1313									rgt rad	medial	art (VI)	
1314									axis	anterior articulation	art (VI)	
1315									lft ilim	acetabulum	cerv	
1316				1								
1317								1				
1318									rgt rad	proximal medial	bisn	jvn epi unf
1319									lft hum	distal volar	cerv	
									rgt tib	distal	cerv	
1321			2		1			14				
									rgt mand	M2,3	cerv	
1322					1							
1329	N69.7/W30.4							1				
1344	S55-60/W240-245		4					3				
1817			1									
1822			1									
									rgt fem	trochanter	bisn	prox epi unf
									phlx, 2		bisn	
									phlx, 3		bisn	
									lft rad		bisn	
1830	S50-55/?								rib	head	art (VI)	
									rgt scph		cerv	
1843									scap		art (VI)	unf epi

									phlx, 1	proximal	bisn	
									rgt rad	proximal	cervus	
Totals			72	17	5	1	1	609				

Table A.2 Results of the taxonomic identifications for the Harder site faunal assemblages. This table consists of those inventory bags which were determined to have been recovered from House Pit 3.

Inventory #	Unit	Occ. Level	VI	V	IV	III	II	indet.size	bone	fragment	species	comments
8	S56.07/W129.45	d							enml	1 fragment	art	
499	S60-65/W130-135	e	1	2				19				
									enml	1 fragment	art	
528	S60-65/W140-145	c,d	14	13	5			198				
									enml	4 fragments	art	
									rib	medial	class VI	
540	S50-55/W130-135	b,c,d						10				
572	S55-60/W140-145	e	13	13	5	2		308				
									phlx, 2		bisn	
									rgt hum	distal condyle	bisn	vry wthrd
577	**S60-65/W145-150**	**a,b,c**							**vert**		**fish**	
579	**S60-65/W145-150**	**a,b,c**	**21**	**5**				**378**				
									enml	**3 fragments**	**art**	
637	**S55-60/W145-150**	**a,b**	**14**	**3**	**2**			**254**				
									mtt/c	**distal**	**art (VI)**	
651	**S55-60/W145-150**	**a**		**1**				**16**				
670	S55-60/W145-150	e	6					106				
									rib	head	art (VI)	
									enml	17 fragments	art	
									mtt/c	distal	art (VI)	
691	S55-60/W145-150	b,c,d	3		2	3		121				

									enml	1 fragment	art	
680	**S50-55/W150-155**	**a**		**1**	**2**			**12**				
701	**S50-55/W150-155**	**a**	**64**	**38**	**6**			**84**				
									enml	**7 fragments**	**art**	
									rib	**head**	**art (VI)**	
706	**S50-55/W150-155**	**a,b,c**	**5**	**9**	**18**	**4**		**43**				
									enml	**1 fragment**	**art**	
713	S50-55/W150-155	e	5	5	1							
721	S50-55/W150-155	d,e	1		5							
									enml	1 fragment	art	
729	**S55-60/W150-155**	**a**	**1**									
732	**S55-60/W150-155**	**b,c**	**14**	**10**	**6**			**23**				
									rgt mand		**thom**	
									enml	**5 fragments**	**art**	
744	S55-60/W150-155	d,e	2		2	1	10					
									enml	1 fragment	art	
748	S55-60/W150-155	e	2					3				
765	S50-55/W145-150	d,e	8	26	9							
779	**S55-60/W145-150**	**b,c**	**18**	**12**	**10**	**0**	**1**	**298**				
									enml	**5 fragments**	**art**	
									rgt cun		**antl**	
									rib	**medial**	**class VI**	
									rib	**medial**	**class VI**	
									lft fem		**scrd**	

795	S40-45/W145-150	d	5	5	4	1		23				
781	S55-60/W150-155	b,c,d	7	5				36	enml	2 fragments	art	
									phlx, 3		antl	
804	S50-55/W145-150	e	2		2	1		6				
									rib	medial	class V	
									ulna	proximal	sylv	
813	S55-60/W145-150	d,e	2	2								
									enml	1 fragment	art	
823	**S55-60/W150-155**	**b,c**	**24**	**18**	**11**		**1**	**69**				
									phlx, 2	**volar proximla**	**bisn**	
									rib	**medial**	**class VI**	
833	**S55-60/W150-155**	**b,c**							**vert**		**fish**	
834	**S55-60/W150-155**	**b,c**	**31**	**19**	**4**	**3**		**231**				
									mtt/c	**distal**	**art (VI)**	
									enml	**5 fragments**	**art**	
									phlx, 1	**proximal**	**bisn**	
845	S50-55/W145-150	e	15	7	1			219				
									enml	28 fragments	art	
855	S50-55/W145-150	c,d	13	15	1	1		99				
									lft mand		thom	
									inc	1 fragment	art (VI)	
858	**S40-45/W140-145**	**a**	**4**	**4**	**9**	**1**		**14**				
									lft mand		**sprm**	
877	**S50-55/W145-150**	**a,b**	**1**	**7**	**2**	**1**		**149**				

891	S45-50/W150-155	d,e						1				
906	**S40-45/W145-150**	**b,c**	**6**	**7**	**2**			**184**				
									lft max		**sprm**	
908	S40-45/W145-150	c		1				59				
928	**S40-45/W145-150**	**a,b**	**29**	**20**				**272**				
									enml	**1 fragment**	**art**	
									rib	**medial**	**class VI**	
									lft tib	**posterior, distal, lateral**	**bisn**	
929	S40-45/W145-150	d,e						3				
938	S40-45/W145-150	d,e	1	1				14				
									inc		art (VI)	
952	S35-40/W145-150	c,d	1	2	1			115				
									enml	31 fragments	art	
996	S35-40/W145-150	e						49				
									enml	2 fragments	art	
1002	**S40-45/W145-150**	**a,b**					**1**	**49**				
									enml	**1 fragment**	**mam**	
1011	**S35-40/W145-150**	**a**	**1**					**13**				
									scap	**3 fragments**	**class VI**	
									phlx,2		**cerv**	
1025	S45-50/W145-150	e	9	1			1	71				
									enml	1 fragment	art	
									inc		rod (II)	

1036	**S35-40/W145-150**	**b,c**	**18**	**6**	**6**	**3**		**136**				
									rad ses		**art (VI)**	
									thr vert	**dorsal fragment**	**class VI**	
									enml	**21 fragments**	**art**	
1045	S35-40/W145-150	d,e			2			69				
									mtt/c	distal	art (V)	
									enml	1 fragment	art	
1054	S35-40/W145-150	e						5				
									enml	1 fragment	mam	
1061	S45-50/W145-150	d		1			1	53				
1072	S35-40/W145-150	c,d	48	6	2		1	286				wthrd
									rgt cun		cerv	
									rib	head	art (V)	
									vert	fragment	class VI	
1082	**S45-50/W145-150**	**a,b**	**15**	**2**				**221**				
									rgt scph		**cerv**	
									mtt/c	**distal**	**art (V)**	
									enml	**1 fragment**	**art**	
1083	**S55-60/W140-145**	**a**							**molar**	**fragment**	**art (VI)**	
									phlx, 3		**odoc**	
									rgt calc		**cerv**	
1118	S45-50/W145-150	c,d		1				34				
1167	S50-55/W135-140	c		1	2		5	151				
									rgt tib		thom	
									lft fem		thom	

									lft scap	blade broken	thom	
									maxillae		thom	
									rgt mand		thom	
									lft mand		thom	
									rgt audb		thom	
									lft audb		thom	
									enml	4 fragments	mam	
1238	S60-65/W135-140	c,d	1									hist., cleaved
1248	S45-50/W145-150	e		1				5				
									enml	1 fragment	art	
1273	**S50-55/W130-135**	**a**							**rgt fem**	**distal**	**bisn**	
1277	S60-65/W135-140	c						16				
									lft scap		bisn	
									mtt/c		art (VI)	
									thr vert		art (V)	
									rgt astg		bisn	
									rgt fem	proximal	art (VI)	
									rgt hum	proximal	art (VI)	
1279	**S40-45/W140-145**	**a**	**2**	**1**				**14**				
									rgt fem	**proximal**	**art (VI)**	
									rgt fem	**distal**	**cerv**	**w/o ephys**
									rgt fem	**trochlear epiphysis**	**cerv**	
									rgt ulna	**distal**	**bisn**	**w/o ephys**
									rgt ulna	**distal epiphysis**	**bisn**	
									rgt lunar		**bisn**	
									rgt lunar		**bisn**	
									rgt scph		**bisn**	
									rgt cun		**bisn**	

									rgt psfm		**bisn**	
									rgt fib	**distal**	**bisn**	
1342	**S30-35/W140-145**	**b,c**							**rib**	**fragment**	**class V**	
1413	**S54.5/W131**	**a**						**1**				
1756	S55-60/W140-145	e							lft low M3		cerv	
1820	S60-65/W140-145	c,d,e							mtt/c	distal	art (V)	
									rgt mand	M3	cerv	
									enml	1 fragment	art	refit
1821	**S65-70/W140-145**	**b**							**rgt mand**	**anterior**	**cerv**	**refit**
									lft mand	**anterior**	**cerv**	
									lft max	**M1,2,3**	**cerv**	
									lft max	**P2,3,4**	**cerv**	
									lft max	**P2,3,4**	**cerv**	
									rgt max	**M3**	**cerv**	
1823	**S35-40/W140-145**	**a,b**				**2**						
									lft tib	**distal, medial epiphysis**	**cerv**	
									rgt ulna	**lunar notch**	**cerv**	
									rgt rad	**proximal**	**cerv**	
									lft max	**P2**	**cerv**	
									lft mand	**P3,4**	**cerv**	
									lft mand	**anterior, w/ incisors**	**cerv**	
									lft max	**fragment**	**art (VI)**	
									phlx, 1		**cerv**	
									lft mand	**M1,2**	**cerv**	
1824	S65-70/W135-140	c							molar		art (VI)	
									molar		art (VI)	
1825	**S60-65/W140-**	**b,c**							**inc**		**art (VI)**	

	145											
									inc		**art (VI)**	
1826	**S45-50/W140-145**	**a,b**							**molar**		**art (VI)**	
									rgt low M3		**odoc**	
1827	S55-60/W140-145	d		1								
									enml	1 fragment	art	
									incisor		art (VI)	
									thr vert	ventral fragment	art (VI)	
1828	S65-70/W140-145	c							rgt low P2		cerv	
1829	**S60-65/W140-145**	**a,b**							**mtt/c**	**distal**	**art (V)**	
1831	S65-70/W140-145	e							crv vert	centrum	art (VI)	
									rgt cun		cerv	
									mtt/c	distal	art (VI)	
1832	**S30-35/W135-140**	**a,b**							**rib**	**head**	**art (VI)**	
									rib	**head**	**art (VI)**	
									thr vert	**ventral fragment**	**art (VI)**	
									mtt/c	**distal**	**art (V)**	
									phlx, 1	**proximal, volar**	**art (V)**	
1833	S60-65/W135-140	e							rgt scph		cerv	
1835	**S40-45/W140-145**	**a,b**							**lft low M3**		**cerv**	
									mtt/c	**distal**	**art (VI)**	
									rgt astg		**cerv**	
									rad ses		**art (VI)**	
1836	S60-65/W140-145	c,d							rgt mand	P,4 M1,2,3	cerv	

1838	S65-70/W135-140	d							mtt/c	distal	art (V)	
									mtt/c	distal	art (V)	
1840	S55-60/W140-145	e							lft pat		cerv	
1841	S60-65/W135-140	d		1					phlx, 1		bisn	
									rgt trmg		antl	
									rgt mand	P2,3,4 M1,2	cerv	
1842	**S55-60/W140-145**	**a**							**lft psfm**		**cerv**	
									lft tib		**art (VI)**	**fetal?**
									rgt mand	**where art w/ skull**	**cerv**	
1844	S60-65/W140-145	d,c							phlx, 2		cerv	
1845	S35-40/W140-145	c							phlx, 1	proximal	art (VI)	
									phlx, 1	distal	art (VI)	
									rgt mand	ramus	art (VI)	
									rgt M3, P34		art (VI)	old indiv
									lft pat		bisn	
1846	**S35-40/W140-145**	**a**							**phlx, 2**	**palmar**	**cerv**	
									cdl vert		**art (VI)**	
									enml	**1 fragment**	**art**	
1881	S35-40 W140-145	d						40				
Totals			427	273	122	23	21	4580				

Table A.3 Results of taxonomic identifications for the Harder site faunal assemblages. This table consists of those inventory bags that were determined to have been recovered from Housepit 4.

Inventory #	Unit	Occ. Level	VI	V	IV	III	II	indet.size	bone	Fragment	species	comments
101	**S55-60/W200-205**	**1,2**										
161	**S70-75/W200-205**	**1,**										
346	**S77.15/W206.6**	**1,**										
347	**S77.15/W206.6**	**1,**										
508	**S60-65/W200-205**	**1,**	**1**	**2**				**30**				
									enml	**1 fragment**	**mam**	
587	**S65-70/W200-205**	**1,**				**1**						
615	S65-70/W195-200	4,5						17				
661	**S60-65/W200-205**	**1,**	**8**	**5**	**1**	**1**	**9**	**217**				
									enml	**2 fragments**	**art**	
									upp rgt P4		**sprm**	
									rgt mand		**sprm**	
									rgt max		**sprm**	
									frontal		**sprm**	
									lft hum		**sprm**	
1089	S50-55/W205-210	4,5	1					38				
									enml	2 fragments	mam	
1093	**S50-55/W210-215**	**1,**						**1**				
		1,							**phlx, 2**		**art (V)**	
1106	**S65-70/W195-200**	**1,**						**36**				
									rib	**Medial**	**class VI**	

									inc	2 fragments	rod (II)	
									inc	2 fragments	rod (III)	
									lft pat		bisn	
1145	**S55-60/W205-210**	**2,**	**11**	**1**	**3**		**1**	**30**				
									enml	**5 fragments**	**art**	
									phlx, 1		**cerv**	
1170	**S55-60/W205-210**	**1,2**							**rgt rad**	**Distal**	**cerv**	
1216	**S60-65/W210-215**	**2,**							**lft scap**		**bisn**	
									lft hum	**Distal**	**cans**	
									rgt mttr	**proximal, medial**	**antl**	
1220	**S48.1/W200**	**1,2**							**phlx, 2**		**cerv**	
1768	**S75-80/W205-210**	**1,**						**1**				
1794	**S55-60/W205-210**	**1,2**	**1**									
1795	**S75-80/W205-210**	**1,**						**1**				
Totals			22	8	4	2	10	371				

Table A.4 Results of taxonomic identifications for the Harder site faunal assemblage. This table consists of those inventory bags that were determined to have been recovered from the trench.

Inventory #	Unit	Occ. Level	VI	V	IV	III	II	indet.size	bone	fragment	species	comments
519	**S55-60/W180-185**	**IV**	**1**					**13**				
544	S55-60/W170-175	V,VI	12	3	2	2		248				
									enml	10 fragments	art	
									lft astg	proximal, lateral	art (V)	
620	S59.59/W170.48	V	2									
1127	**S55-60/W165-170**	**III**				**1**						
1201	**S45-50/W170-175**	**IV,V**						**2**				
1202	**S45-50/W170-175**	**IV**							**vert**	**6 vert**	**salm**	
									vert	**1 vert**	**fish**	
1218	**S45-50/W170-175**	**III**		**2**								
1236	**S45-50/W170-175**	**IV**					**1**	**1**				
1498	**S48.26/W171.1**	**IV**						**1**				
1501	**S47/W173.5**	**IV**		**1**								
Totals			15	6	2	3	1	265				

Table A.5 Results of taxonomic identifications for the Harder site faunal assemblage. This table consists of those level bags that were determined to have been recovered from the beach area. Vertical provenience information was not available for the beach area and so these data were not included in analysis of the 1,500 B.P. assemblage.

Inventory #	Unit	Occ. Level	VI	V	VI	III	II	indet.size	bone	fragment	species	comments
954	S75-80/W135-140		1					10				
									rib	Medial	class V	
961	S70-75/W135-140							2				
963	S70-75/W135-140							2				
969	S70-75/W135-140		1					18				
975	S70-75/W135-140			1				5				
981	S75-80/W135-140			1				3				
985	S75-80/W135-140		2	2				1				
1016	S70-75/W135-140		1			1		5				
									enml	2 fragments	art	
1122	S75-80/W140-145		1					8				
1406	S71.6/W143.7								molar		art (VI)	
1837	S70-75/W140-145								lft nvcb		bisn	
1839	S70-75/W140-145								lft astg		bisn	
Totals			6	4	0	1	0	54				