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AN ABSTRACT OF THE THESIS OF Ricky Gilmer Atwell for the
Master of Arts in Anthropology presented May 1, 1989.

Title: Subsistence Variability on the Columbia Plateau.

APPROVED BY THE MEMBERS OF THE THESIS COMMITTEE:

Kenneth M. Ames, Chair

Marc R. Feldesman

Sandra L. Snyder

Richard B. Forbes

Long-term human dietary change is a poorly understood aspect of Columbia Plateau prehistory. Faunal assemblages from thirty-four archaeological sites on the Plateau are organized into fifteen aggregate assemblages that are defined spatially and temporally. These assemblages are examined in terms of a focal-diffuse model using ecological measures of diversity, richness and evenness. Variability

and patterning in the prehistoric subsistence record is indicated. Major trends in human diet and shifts in subsistence economies are documented and the relationship between subsistence and some initial semi-sedentary adaptations on the Plateau is clarified.

SUBSISTENCE VARIABILITY ON THE
COLUMBIA PLATEAU

by

RICKY GILMER ATWELL

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

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1989

TO THE OFFICE OF GRADUATE STUDIES:

The members of the Committee approve the thesis of
Ricky Gilmer Atwell presented May 1, 1989.

[REDACTED]
Kenneth M. Ames, Chair

[REDACTED]
Marc R. Feldesman

[REDACTED]
Sandra L. Snyder

[REDACTED]
Richard B. Forbes

APPROVED:

[REDACTED]
Marc R. Feldesman, Chair, Department of Anthropology

[REDACTED]
Bernard Ross, Vice Provost for Graduate Studies

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CHAPTER I

INTRODUCTION

This thesis addresses prehistoric dietary change on the Columbia Plateau by examining the composition of faunal assemblages. Assemblages from thirty-four archaeological sites in three regions are organized into fifteen time periods to document temporal and spatial variability in the Plateau subsistence record. The analysis is accomplished using ecological measures of richness, evenness and diversity. Subsistence trends and patterns are examined in terms of the focal-diffuse model developed by Cleland (1976). The research demonstrates that subsistence adaptations in the region are characterized by patterning and variability. It also provides insights into a historically significant research problem - the nature of the relationship between semi-sedentism and subsistence on the Columbia Plateau.

CHAPTER II

PREVIOUS RESEARCH

Archaeologists have been investigating sites on the Columbia Plateau since the beginning of this century (Schalk and Cleveland 1983). However, it has only been within the past two decades that faunal information has begun to appear regularly in reports. This reflects not only heightened interest in prehistoric subsistence but also the dramatic increase in data collection resulting from the construction of public works projects and land holding development by federal agencies.

A variety of models have been developed to explain subsistence patterns on the Columbia Plateau. Schalk and Cleveland (1983) and others (e.g., Willey 1966) indicate that many early researchers viewed the Plateau as an area infused with traits characteristic of other regions and lacking a discrete cultural identity. Prior to 1950 there was little evidence for extended occupation of the region and no recognition of culture change (Schalk and Cleveland 1983; Swanson 1962).

Ethnographic research identified salmon as a vital and

pervasive subsistence resource in many Plateau economies (Anastasio 1975; Chalfant 1974; Marshall 1977; Spinden 1908; Walker 1967). Not unexpectedly, many archaeologists used these economic patterns as models for prehistoric subsistence. The models have since been referred to as the "ethnographic pattern" (Swanson 1962, cited in Schalk and Cleveland 1983) or "winter village" pattern (Nelson 1972).

Excavations contributed to the premise that reliance on salmon had great antiquity. At Five Mile Rapids where the Columbia River exits the Plateau, large numbers of salmon remains were recovered in deposits of considerable age (Cressman 1960). Findings at this site and along the Fraser River (Borden 1960, cited in Sanger 1967; Sanger 1967) tended to confirm the idea that occupants of the Plateau had long been dependent on the salmon resource. Though other sites of comparable age showed primary reliance on terrestrial fauna or flora (Schalk and Cleveland 1983), many researchers continued to view salmon as critically important in the regions early prehistory.

In later periods, climatic changes inevitably tied to salmon were viewed as major elements of culture change on the Plateau. Daugherty (1962) suggested that dessication associated with the Altithermal reduced hunting efficiency and resulted in population movement to riverine environments where fish and mussels became the economic base. Brauner (1976) postulated a decrease in salmon productivity due to

decreased effective moisture around 3500-4000 BP. He suggested that the attendant settlement shifts and scheduling problems resulted in economic restructuring and culture change.

Tracing the temporal and spatial trajectory of the "ethnographic pattern" was seen as essential in documenting culture process on the Plateau. Nelson (1972) hypothesized that an economic pattern, organized around salmon, emerged on the northwestern margin of the Plateau around 2500 BP. This period corresponded with what were then the earliest dated "winter villages". Nelson maintained there was no evidence of intensification of exploitation of large mammals or roots at these sites, but he pointed to evidence for increased fish exploitation and artifacts that suggested the appearance of innovative fishing technology (1972). Reluctant to view this initial manifestation of the "ethnographic pattern" as an in situ development, Nelson used archaeological and linguistic evidence to suggest it originated in western Washington or British Columbia (1972).

Nelson's (1972) synthesis provided archaeologists with archaeologically visible correlates for semi-sedentary adaptations economically organized around salmon. However, continued investigation suggested a greater temporal depth to the "pattern" and questioned conventional interpretations of the Plateau subsistence record. This research would question the very nature of the relationship between the

intensification of salmon production and semi-sedentary residence.

It became increasingly clear that semi-sedentary occupation as evidenced by house construction had considerably greater antiquity than previously thought (Ames et.al. 1981; Ames 1988; Brauner 1976; Lohse and Sammons-Lohse 1986). The sporadic but widespread distribution of early villages challenged the efficacy of Nelson's (1972) diffusion model.

Ames and Marshall (1980) proposed that villages appeared as one option to factors of population growth and intensification of resource use unrelated to salmon exploitation. Citing the scarcity of fish remains and fishing gear, an abundance of apparent plant processing equipment, presumably low population levels, and labor organization ill-equipped to process and store salmon, the authors concluded that the earliest semi-sedentary residents of the Plateau were intensifying root production (Ames and Marshall 1980). Implicit in this argument was the idea that these social and economic adaptations were incompatible with the familiar "ethnographic pattern".

Schalk and Cleveland (1983) viewed the shift to semi-sedentism as a process involving fundamental reorganization of the settlement and subsistence system made possible through storage. They proposed a shift from residential to logistic mobility accompanied by greater reliance on stored

fish and plant resources to survive the winter season (Schalk and Cleveland 1983).

Recent research has suggested that some early villages may have been optimally positioned on the landscape to exploit a wide range of resources (Lohse and Sammons-Lohse 1986). The authors suggest that villages arose with little impetus from population growth or incentive to intensify; they maintain that intensification and population growth actually postdate semi-sedentary adaptations (Lohse and Sammons-Lohse 1986). These generalizations are based, however, on a single case history. If the conclusions are substantiated, this may be the preeminent example of a tethered foraging strategy (Taylor 1964, cited in Kelly 1983 and in Binford 1980).

To summarize, factors directly and indirectly relating to subsistence have been proposed to account for culture change in the region. Researchers have addressed the origins of semi-sedentism on the Plateau by emphasizing the role of salmon (Nelson 1972), roots (Ames and Marshall 1980), storage (Schalk and Cleveland 1983) and positioning strategies (Lohse and Sammons-Lohse 1986). Recent research suggests that the prehistoric importance of salmonids in Plateau economies has been greatly overstated (Thomison 1987).

In part, the focus on salmon in Plateau prehistory can be attributed to a willingness by archaeologists to push the

"ethnographic pattern" beyond its explanatory limits. Ames (1980, 1982) has stressed the importance of using the ethnographic record as a source for hypotheses rather than a means to explain and describe the past (for a discussion see, Gould and Watson 1982; Wylie 1985).

Investigators benefiting from large scale regional projects have been able to make statements about temporal change in Plateau subsistence behavior (Campbell 1985; Chatters 1986). Data from these projects are incorporated in this research. As yet however, there has been no attempt to describe variation in subsistence. This analysis will be the first to delineate patterns and document temporal and spatial variability in the Plateau subsistence record.

This paper will demonstrate that prehistoric subsistence was extremely variable across the Plateau. Contemporary but radically different subsistence strategies were separated by only hundreds, if not tens, of kilometers. Through examining the patterns of faunal utilization that distinguish these diverse economic systems, we can gain insights into the adaptive patterns of which they are part. This approach will document the evolution of some prehistoric economic systems on the Plateau and illuminate the nature of the relationship between semi-sedentism and subsistence.

CHAPTER III

THEORETICAL PERSPECTIVE

Archaeologists cannot fully comprehend the processes of cultural and social evolution without knowledge of the natural communities of which humans are part (King and Graham 1981). An understanding of the relationships humans maintain with their environment is critical.

Humans, like other organisms, interact with specific habitats rather than the entire environment (Ellen 1982). The habitats are recognized and used because they contain particular resources or "resource clusters" (Ellen 1982:81). Resources include inanimate substances, such as water, or stone for tool manufacture, and the plants and animals that humans rely on for subsistence.

Unlike most other organisms, humans are characterized by considerable variability in the habitats and resources they choose to exploit. In similar or even identical environments, there may be significant differences in the subsistence items used by any two human groups.

In part, the choice of subsistence items is dictated by energy input or calories needed to maintain the population (Earle 1980). Presumably, selecting certain resources over

others can have long-term biological consequences if the choices improve the reproductive fitness of one group over that of another.

However, other differences in resource selection are influenced by cultural differences between groups (Cohen 1977). These differences can relate to a number of variables including available technology, the ability to schedule and organize labor (Earle 1980) and mobility (Kelly 1983). Collectively, these variables can limit and proscribe what resources and habitats are exploited, how they are exploited, and when they are exploited. Variables most commonly identified as affecting subsistence change are population growth, technological change, environmental change and social organization (Clark 1987).

It should be clear from the preceding discussion that subsistence resources can tell us a great deal about human economic strategies if variability in resource use can be measured. The biological sciences provide suitable measures.

Ecologists measure diversity in natural communities. Two components of diversity are richness (the number of different species in a community) and evenness (the relative abundance of species in a community) (Odum 1983). These concepts can likewise be applied to human subsistence.

In most environments, humans have access to a range of potential food items and are selective regarding what they eat (Christenson 1980, c.f. Winterhalder 1981). Richness,

also referred to as resource diversity (Christenson 1980) or diet breadth (Winterhalder 1981) can be defined as the number of different resources or species chosen for consumption. A specialist uses few of the potentially available resources and thus has a narrow diet breadth. A generalist uses many of the potentially available resources and has a wide diet breadth (Schalk 1977).

The proportions in which resources are consumed or "the degree of dependence" on specific resources (Hardesty 1975:75) is a measure of evenness. Together, richness and evenness account for the two aspects of human dietary diversity. Dietary diversity has also been referred to as the food niche (Christenson 1980, Pianka 1983) and subsistence variety (Hardesty 1975).

Theoretical models have been developed to describe human adaptations in terms of resource exploitation. Cleland's (1976) focal-diffuse model proposes economic adaptations ranging between two extremes.

Focal adaptations are characterized by economic dependence on one or several similar resources (Cleland 1976). They are specialized, conservative and stable adaptations that appear when an abundant, reliable and high quality resource can be consistently exploited (Cleland 1976).

Focal or specialized economies require distinctive techniques and technologies to effectively exploit desired

resources (Ames 1981). On the Plains, the bison drive, and associated meat storage and preservation techniques were critical developments if bison were to be the economic focus. Along the Northwest Coast, weirs, nets and storage facilities were required to focus on salmon. Storage and delayed consumption are characteristics of focal economies since they permit specialists to override periods when their principal resource(s) cannot be obtained (Cleland 1976).

Focal adaptations have a specialized economic base revolving around procurement of one or several related resources. The resulting faunal assemblages are uneven (or dominant) indicating that predation probably involved pursuit rather than search strategies (Chatters 1986). Pursuit strategies are those that are explicitly directed toward the exploitation of specific species to the exclusion of others. Conversely, search strategies are opportunistic and non-focused, exploiting fauna as encountered. Pursuit strategies are more commonly employed among collectors while search strategies are more typical of foragers (Binford 1980).

Diffuse adaptations are quite different from focal adaptations and are characterized by multiple, varied resource use (Cleland 1976). They are generalized, versatile adaptations that appear when resources are diverse, dispersed, scarce or unreliable (Cleland 1976). Subsistence pursuits are carefully scheduled to exploit as many resource

options as possible when those resources are most productive (Cleland 1976).

Diffuse adaptations are characterized by a generalized economic base. Resource procurement is more opportunistic. The resulting faunal assemblages are more even (and less dominant) indicating that predation involved search rather than pursuit strategies (Chatters 1986).

Cleland (1976) maintains that focal economies readily develop from diffuse economies. The reverse situation is considerably more difficult because of the rigidity of the focal system. Focal economies can experience drastic reorganization if exposed to environmental perturbations stemming from natural or cultural processes, but otherwise they are resistant to change (Cleland 1976).

Focal and diffuse economies may appear generalized or specialized depending upon which component of dietary diversity is examined. An economic system (A) that exploits 20 species but relies predominantly on one or two is generalized in terms of richness but clearly specialized when evenness is considered. Conversely, an economy (B) that exploits only 5 species but exploits them in equal proportions is specialized in terms of richness but generalized with regard to evenness.

Richness, evenness and dietary diversity are meaningful measures only when used in a comparative context (c.f. Pianka 1983). It cannot be ascertained how much more or

less rich, even or diverse one economy is than another.

Many of the methods and techniques applied to this study have been successfully used elsewhere. In a similar analysis, Clark (1987) documents human dietary change in northern Spain from the Mousterian through the Iron Age. Hardesty (1975) provides theoretical justification for using the measures and presents additional examples derived primarily from ethnographic research.

CHAPTER IV

METHODS

ANALYTIC UNITS

This analysis uses data from site reports representing three study areas on the Columbia Plateau. Each study area contains archaeological sites for which published faunal information exists.

The aggregate faunal assemblage from each study area is subdivided into chronological periods recognized by other investigators. Thus, faunal remains discussed in this analysis are divided into units with spatial and temporal relevance. These faunal data are used here to document interregional and temporal variation in subsistence on the Columbia Plateau.

The Southeastern Plateau encompassing the Lower Snake River region is the first study area (Figure 1). Several site-specific faunal studies exist from this area, but as yet there is no regional synthesis that imposes temporal control on subsistence behavior. For this reason the southeastern study area was the focus of interest in the analysis. The eight sites that were analyzed include three from the Alpowa Locality, in addition to Granite Point,

Hatwai, Lind Coulee, Marmes Rockshelter and Wawawai.

The second and third study areas are both located on the west central Plateau along the Upper Columbia River in north central Washington. Both areas were the focus of intensive regional investigations where archaeologists, using faunal remains, were able to infer temporal changes in subsistence throughout the period of occupation. Wells Reservoir is the second study area and contains eight investigated sites; Chief Joseph Reservoir is the third study area and contains eighteen reported sites (Figure 1).

The chronological units into which fauna from each study area were placed and the justification for placement will be discussed in greater detail in subsequent discussions. For now, a statement identifying the temporal units will suffice.

Faunal remains from the Southeastern Plateau were assigned to eight periods. This is the longest, unbroken sequence of any of the three study areas, encompassing about 10,800 years. The periods used here include recognized phase designations and combined phases derived predominantly from Leonhardy and Rice (1970). The periods are Windust, Windust/Cascade, Cascade, Hatwai Complex, Tucannon, Harder, Late Harder/Piquin and Numipu.

Temporal designations from Wells Reservoir were provided by Chatters (1986: Table 15). Faunal remains can be assigned to four temporal units designated Periods 1, 2,

3 and 4. The time span is about 7800 years.

The faunal inventory from Chief Joseph Reservoir is assigned to three temporal units following Salo (1985). The periods are named phases including Kartar, Hudnut and Coyote Creek, that collectively span about 6000 years.

To summarize, three study areas on the Plateau contain the collective faunal assemblages of the sites within those study areas. These aggregate assemblages are divided into assemblages with temporal significance resulting in fifteen temporally and spatially controlled faunal assemblages. Eight are from the Southeastern study area, four are from Wells Reservoir, and three are from Chief Joseph Reservoir.

MEASURING TAXONOMIC ABUNDANCE

It is difficult to make meaningful statements about prehistoric subsistence using faunal remains from archaeological sites. In order to proceed with this analysis, certain assumptions were necessary.

Subsistence studies require certain accurate and reliable information (Lyman 1982). One must distinguish between culturally and naturally deposited bone (Lyman 1982). This requires that questions of taphonomy be considered. I assumed that all bone (except from certain animals such as microfauna) was a product of cultural processes directly related to subsistence. Taphonomic processes were assumed not to have substantially affected or

altered the composition of the assemblages.

Sampling and recovery biases must be addressed to determine if the sample is representative of the actual subsistence fauna (Lyman 1982). Since archaeologists most often sample for artifacts rather than faunal remains (c.f. Hesse 1982) it is difficult to determine how sampling has affected these assemblages. Recovery biases are somewhat better controlled. Field methods at sites from which samples were drawn generally show similar recovery techniques. I assumed that there were no sampling or recovery biases and that the samples were representative of the animals that were consumed at the sites.

Fossils must be correctly identified and a valid and reliable means of quantification must be devised (Lyman 1982). Since the faunal samples used in this analysis were received from other investigators, I relied upon them for correct identification. The quantification method used in all reports was NISP (Number of Identified Specimens). Inasmuch as NISP was the only unit of analysis common to all reports, it became the operational unit in this analysis.

At this juncture, it is appropriate to discuss the problem of quantifying taxonomic abundance. Two measures of taxonomic abundance have been devised, the Number of Identified Specimens (NISP), which has already been introduced, and the Minimum Number of Individuals (MNI).

The NISP is the number of skeletal elements or

fragments that can be assigned to a taxon (Klein and Cruz-Uribe 1984). It is the most common measure used in quantifying taxonomic abundance and calculating it is a preliminary step in the analysis of any faunal assemblage (Grayson 1984).

Grayson (1979, 1984) offers a number of criticisms of NISP that suggest it is unreliable as a measure of taxonomic abundance. However, he maintains that most criticisms of NISP have been leveled in an attempt to justify the use of MNI (Grayson 1984).

The major problem with NISP is the potential interdependence of tallied skeletal elements (Grayson 1984; Lyman 1982, 1985). The technique does not differentiate between elements belonging to one or more individuals; consequently, it is often impossible to determine whether five skeletal elements from the same species represent one individual, five individuals or some figure in between. Researchers "implicitly" or "explicitly" assume specimen independence (i.e. one specimen equals one individual) when using NISP, but independence or interdependence be "demonstrated" to provide a valid analysis (Grayson 1979: 202).

NISP will vary depending upon how elements or fragments are tallied (Lyman 1985, Table 6.3). Investigators may count individual elements, or group elements of the same species (i.e., count = 1) on the basis of articulation

and/or provenience.

It is important to realize that NISP is an estimate of an actual archaeological population, albeit a maximum estimate (Grayson 1984). Assessments of taxonomic abundance are frequently based upon NISP counts or other measures derived from NISP such as percentages. These statistics must be considered ratio scale data since they are characterized by constant interval size and a real zero point (Zar 1982). According to Grayson (1979), use of such statistics assumes that the distribution of sampled specimens is representative of the actual population and that each specimen is independent of every other. Since it is impossible to know the relationship of the estimate to the actual population or the frequency distribution between the two, researchers maintain that ratio scale analysis is an invalid technique and should not be used to assess taxonomic abundance (Grayson 1984; Lyman 1985).

Grayson (1979) states that NISP can provide only ordinal scale data at best. These are data that are ranked or ordered on the basis of relative rather than quantitative differences (Zar 1984). Applied to NISP, one might be able to rank taxa using differences in magnitude of NISP values and state with some certainty whether species A was relatively more abundant than species B (Grayson 1979). However, even in this situation, the use of ordinal scale data must be demonstrated to be valid (Lyman 1985). In any

event, it cannot be determined quantitatively how much more abundant species A was than species B.

A second measure of taxonomic abundance is the Minimum Number of Individuals (MNI). This statistic was rarely reported in site and project reports. For this reason it was not used in this analysis and I will address it only briefly.

MNI is the least number of individuals of a taxon that can account for the number of identifiable skeletal elements and fragments (Grayson 1984; Lyman 1982; Klein and Cruz-Urbe 1984). MNI is therefore the minimum estimate of an actual population (Grayson 1984). It is calculated by determining which skeletal element or fragment occurs with greatest frequency within a provenience. Right and left elements are calculated separately and the most commonly occurring element is the MNI for that taxon and provenience. The technique largely avoids the issue of interdependence encountered using NISP (Grayson 1984). Unfortunately, MNI does produce other problems.

The MNI value will vary depending on the way faunal materials are aggregated (Lyman 1985). Aggregation is based on provenience designation imposed by the investigator. Larger aggregations produce lower MNI values while smaller aggregations produce higher values (Grayson 1984). Other factors may also cause variation in the MNI value (Lyman 1982).

To summarize, neither NISP nor MNI is a reliable measure of taxonomic abundance. Each method has advantages and disadvantages. Some authorities suggest that NISP and MNI be presented together (Klein and Cruz-Urbe 1984). Grayson (1984) maintains that NISP is the best measure of taxonomic abundance since it provides information without the effects of aggregation and, unlike MNI, it is not a derived measure.

To use NISP operationally in this analysis, I made several assumptions. First, NISP units were considered to be independent; that is, each identified specimen represents one individual. I realize, however, that assuming independence does not "create" independence (Grayson 1979: 202). Second, the distribution of sampled faunal remains for each site and time period were considered representative of the actual distribution of subsistence fauna. The primary motivation behind this tactic was the comparability of spatio-temporal units. If faunal distributions cannot be expressed as ratio scale data (i.e., relative proportions), then units of unequal sample size cannot be compared.

JUSTIFYING THE USE OF NISP

I have discussed reasons why some researchers believe NISP should not be used to generate ratio scale data. Despite these caveats, most researchers continue to use such

data when making interpretations from faunal materials. Unlike most researchers, I have documented the assumptions I made in order to proceed with the analysis. I leave it to the reader to decide whether or not the method is justifiable, but first I wish to provide some additional information.

Grayson (1984) indicates that ratio scale data are suspect, especially when applied to a single site, but provides the following information that suggests regional analyses can produce information unavailable from a site specific context.

When faunas from many sites in the same region are available (and the definition of "region" depends on the problem being addressed), cross-checking sets of taxonomic abundances become available as well. Such sets can provide a powerful means of addressing the validity of any single set, whether the target is human subsistence or past environments. When, for instance, changes in taxonomic abundance through time at a single site are matched by changes through the same period of time at other sites in the same region, it is reasonable to conclude that changing taxonomic abundances are, in fact, being accurately measured (Grayson 1984:111-112).

I am not matching patterns between sites and sets of sites as Grayson (1984) suggests. Rather, I am grouping site assemblages by region and time period regardless of pattern.

It stands to reason from the foregoing discussion that aggregate faunal information from a regional context is probably a more valid and reliable indicator of human

subsistence than any one, site-specific faunal assemblage. After all, the presence and abundance of taxa will vary from site to site depending on the behavior of the occupants, the surrounding micro-environment, seasonal usage and taphonomic factors, to list but a few variables.

Combining site faunal assemblages to produce aggregate assemblages with regional and chronological relevance increases the probability that several sites rather than one will contribute faunal information for each spatial/temporal unit considered. Aggregate assemblages thus operate as an averaging mechanism; intersite differences become less pronounced and patterns of faunal utilization are more likely to emerge. Furthermore, the possibility that data from a single, anomalous site assemblage will affect interpretation is reduced. This methodology provides the information needed to address "normative" subsistence behavior on the Plateau within defined spatial and temporal parameters.

The major source of potential error in the analysis comes from samples that dominate or contribute exclusively to a spatio-temporal unit. If such samples are skewed so they do not reflect actual subsistence fauna (i.e., they primarily reflect factors other than subsistence), then interpretation will likewise be affected. I can address, but not control this situation.

Finally, I anticipate certain criticisms that are

likely to arise from archaeologists and zooarchaeologists. The fundamental controversy in this analysis revolves around whether or not NISP may be used as a measure of taxonomic abundance to make valid statements concerning prehistoric subsistence. There are many who maintain that neither NISP nor MNI is a suitable measure. Furthermore, given current understanding of the problem, it appears we will never be able to accurately assess actual taxonomic abundances within prehistoric contexts.

If NISP cannot be used to make preliminary statements about subsistence, one must question why archaeologists even gather these data. Should we give up this pursuit or try to make sense of the available data? Despite its many problems, analysis using NISP is one of the few ways to access prehistoric subsistence systems. Though the results and conclusions of this study should be cautiously received, it would be rash to relinquish or ignore this information. Hopefully, at some future time, when assumptions can be met, a data set will be available to test results stemming from this study.

USING RECEIVED NISP

The site and project reports used in this analysis were chosen because of consistent treatment of the faunal remains. In all cases, identification of fauna to species was attempted. In addition, all investigators used NISP as

a quantification method. Finally, the faunal specimens were presented so they could be assigned to chronological units.

NISP was used as the sole measure of taxonomic abundance in this analysis. Although MNI appeared in several reports (e.g. Lyman 1976; Ames n.p.), its use is rarely consistent among Plateau faunal analysts.

The effect of articulation and provenience on calculations of NISP (Lyman 1985) could not be determined from the reports; consequently, values in tabular format were used as received. Where skeletal element lists were provided, each element or fragment identified to taxon was counted as "one". For example, one fragmented skull and three left mandible fragments were tallied as 1 and 3, respectively. Judgments were not made with regard to either articulation or provenience.¹

¹ One exception concerns substantially articulated fauna (either natural or cultural burials) that would artificially inflate NISP. These received a value of one (1) NISP rather than the sum of their collective elements. The only example is a dog burial at 450K258 consisting of 110 bone specimens (Livingston 1985:374). This site is from Chief Joseph Reservoir.

There may be additional examples in other reports; however, I was unable to confirm or refute their status using available information. Lyman (1976: 32, 214, Appendix C), for example, documents 18 elements of a Great Horned Owl in a Numipu Phase pit feature (Feature 32b) but elsewhere refers to a "near complete skeleton" of a Great Horned Owl recovered in a cache pit. I could not determine if these descriptions referred to the same find, so I elected to include the 18 elements as NISP since this is substantially less than a "near complete skeleton". Elsewhere in this report, Lyman (1976:47) eliminated dog burials from his analysis, which suggests the owl was also eliminated.

ADAPTING RECEIVED DATA TO A USABLE FORMAT

Species-specific identifications were preferred in this analysis. In reality, this is not always possible and analysts must broaden classification categories. For a review of this process the reader is referred to Lyman (1976). Factors affecting refinement of an analysis include the degree of preservation and fragmentation of the remains, the time and funding allocated to the analysis, access to an adequate comparative collection, and the abilities and experience of the analyst.

In some cases, classifications were unsuitable for use in this analysis. The following examples are not intended to reflect negatively on individual researchers. There are valid reasons why researchers must devise non-species specific categories in a faunal analysis. The reason these examples are included is to illustrate which classification categories could and could not be used and why. The list is not exhaustive, but will give the reader some indication of the problems encountered when using received data for comparative purposes.

Reporting standards varied. In some cases, detailed information could not be used because it was not comparable to the level of reporting in other assemblages. The Wells monograph, for example, includes genus specific identification of avifauna (Chatters 1986: Table 24). This

level of reporting for birds was rarely observed in other reports and was eventually reduced in this analysis to the category "Aves".

There is considerable latitude among researchers in how to handle skeletal elements and fragments not identifiable to species. In most cases genus-level distinctions are used. For example, a researcher unable to distinguish between bones of wolf (C. lupus), coyote (C. latrans) and domestic dog (C. familiaris) may refer to them as Canis sp. (Campbell 1985: Table D:6). On the other hand, broadening the classification to the family designation Canidae (Chatters 1986: Table 24) potentially includes the red fox (genus Vulpes), gray fox (genus Urocyon) and arctic fox (genus Alopex). The level of classification is critically important to interpreting which species may or may not be considered present in an assemblage.

Many investigators use unidentified categories that take into account the relative size of fragmented or poorly preserved skeletal remains. From Wells Reservoir, Chatters (1986: Table 24) uses unidentified large mammal, large-medium mammal, medium mammal and small mammal. Gustafson (1972: Table 5.1, Table 5.2) follows a similar strategy. Such identifications are clearly too general to make statements about the importance of particular species.

Other investigators use a taxon in conjunction with the adjective "size". "Deer-size" might mean specimens from

pronghorn antelope, mountain sheep, mule deer or whitetail deer (Livingston 1985: Table D:6; Lyman 1976: Table 10), while "elk-size" might mean cow, bison, or elk (Lyman 1976: Table 10). Such categories were discarded since it was necessary to specifically identify those species involved.

Using broad categories, even to family level, was not a problem in cases where the member species probably played a minor role in the diet. For instance, mustelids such as the weasel, skunk, fisher, otter and badger were included under the family name Mustelidae. Likewise, felids including the mountain lion, bobcat and lynx were designated Felidae.

In cases where species within a family were likely to be important subsistence items, this methodology usually could not be followed. Cervidae for example, was a category used in the Hatwai faunal analysis (Ames n.p.) to refer to probable deer and elk remains. Despite the fact that Cervidae might also refer to caribou or moose, it was important to keep deer and elk separate in this analysis since both were probably important subsistence items. Thus, specimens identified only as Cervidae were not considered.

There are exceptions to the situation detailed above. For example, the Wells monograph separates rabbits and hares into three categories; Leporidae, Sylvilagus nuttallii and Lepus sp. (Chatters 1986: Table 24) Rather than discard specimens identified only to family (Leporidae) to preserve genus distinctions, specimens from Sylvilagus and Lepus were

placed into the category Leporidae.

Skeletal elements and fragments identified as "modern" were excluded from the analysis while those questionably identified (e.g., a species name followed by a ?) were included since the investigator(s) was confident enough to assign an identification (Irwin and Moody 1978: Appendix E).

CONSTRUCTING FAUNAL CATEGORIES

In most cases, original data sets had to be reworked to make the faunal categories consistent among assemblages for each region. To accomplish this certain faunal categories were eliminated and others were combined. Both the original and modified data sets are included as tables in this analysis. To determine precisely what faunal categories were deleted and/or combined, the two sets of tables can be compared.

This analysis is concerned with vertebrate remains, exclusively mammals, birds and fish. Invertebrates such as molluscs, while present in a number of assemblages, were ignored. This is not to say they were dietarily unimportant, but rather that quantification standards were inconsistent or non-existent in a number of reports. Reptiles and amphibians were excluded from the analysis for similar reasons.

Ungulates were identified to species or genus because they are large mammals ethnographically documented as having

been dietarily important. The categories include elk (Cervus sp.), deer (Odocoileus sp.), mountain sheep (Ovis canadensis), pronghorn antelope (Antilocapra americana) and bison (Bison bison). Domestic sheep (Ovis aries), cattle (Bos taurus) and horses (Equus caballus) appear in some late assemblages. These were included under the category Domestic Stock. When only one variety of domestic ungulate appears in an assemblage, a species name is provided.

Insectivores including moles (Talpidae) and shrews (Soricidae) were excluded from the analysis. Rodents were divided into two groups on the basis of weight using estimates provided by Whitaker (1980).

Rodents with an average live weight less than about 200 grams were excluded from the analysis on the assumption that they would rarely be used as food items. This may or may not be a valid assumption (see Stahl 1982). In most situations however, the costs involved in capture would appear to far outweigh subsistence benefits. Among these groups were pocket gophers (Thomomys), pocket mice (Perognathus), deer mice (Peromyscus), harvest mice (Reithrodontomys) and voles (Microtus and Lagurus).

Rodents weighing over about 200 grams were included in the analysis. Among these are the bushy-tailed woodrat (Neotoma cinerea), ground squirrels (Spermophilus or Citellus), marmots (Marmota), muskrat (Ondatra), beaver (Castor) and porcupine (Erethizon). Spermophilus has

replaced Citellus in current biological nomenclature (Eisenberg 1981). I preserved the term Citellus where it was used by other investigators (i.e., original data sets), however, Spermophilus will be used elsewhere. Hares and rabbits appear under the family designation Leporidae.

Ethnographic accounts of subsistence do not rank most carnivores as important dietary items. Carnivores may become incorporated in archaeological sediments for a variety of reasons. They may represent animals hunted for skins or ornaments. Certain canids may have been valued as hunting animals and/or food sources. Some carnivores such as badgers are burrowers whose appearance in a deposit may have little to do with human occupation. Perhaps more so than any other fauna, the use of carnivores as food items is suspect without more detailed analysis than simple NISP.

It is difficult to suggest that carnivores were not used as food items when many are medium to large size mammals that are potentially significant food sources. Furthermore, it is risky to project the ethnographically reported (and often conflicting) patterns of carnivore food use into Plateau prehistory and assume those patterns remain unchanged. For these reasons, I included all carnivores as potential subsistence items and divided them into several groups to facilitate analysis. The groups include bears (Ursidae), cats (Felidae), canids (Canidae), and mustelids (Mustelidae).

Fish were identified to class, Osteichthyes, unless more detailed information was provided. Where possible, fish were listed as being trout and salmon (Salmonidae), suckers (Catostomidae), minnows and carps (Cyprinidae), or sturgeons (Acipenseridae).

Birds were identified to class designation Aves. Additional information regarding the variety of bird (e.g. waterfowl) is provided when available.

MEASURES OF ABUNDANCE AND DIVERSITY

The following techniques were used to analyze each of fifteen spatially and temporally controlled faunal assemblages. NISP (f_i) was listed for each taxon or composite fauna and the cumulative NISP (n) generated. Raw NISP values were then converted to percentages that sum to 100% for each time period considered. Histograms using the percentage NISP were generated for each spatio-temporal unit. These graphs illustrate relative taxonomic abundance. All subsequent calculations in this analysis, including all indices, are derived from raw NISP values rather than percentage data.

Several methods were used to analyze dietary diversity. Before discussing them it is appropriate to define what is meant by diversity.

I previously noted that there are two aspects to diversity, richness and evenness (Odum 1983). The former is

the number of species in a sample; the latter is the relative abundance of those species in the sample. If all species are equally represented there is maximum evenness. If the proportions of species vary, the sample can be characterized as uneven or exhibiting dominance (Odum 1983).

Shannon Diversity Index

A variety of diversity indices are commonly used among ecologists (Odum 1983: Table 7.5; Whittaker 1975: Table 3.6). The Shannon Index has been used to determine taxonomic diversity in archaeological populations (Grayson 1984) and is one technique used here to measure dietary diversity. The Shannon Index, also known as the Shannon-Weiner or information index (Whittaker 1975: Table 3.6) is derived from information theory (Odum 1983). The formula for calculating the Shannon Index is $-\sum P_i \log P_i$, where P_i is the proportion of individuals of species i in the sample (Grayson 1984; Odum 1983: Table 7.5; Pielou 1977). Since percentage data are not normally distributed, I adapted NISP to the formula following examples provided by Zar (1984).

$$H' = \frac{n \log n - \sum f_i \log f_i}{n}$$

where H' = Shannon Diversity Index
 n = total number of individuals
 f_i = NISP for each species

According to Odum (1983:414), the Shannon Index "gives greater weight to rare species" and is "reasonably independent of sample size" (c.f. Sanders 1983). Since the Shannon Index was calculated from raw NISP values (integers) rather than percentages, the values are normally distributed (c.f. Odum 1983). Other research has confirmed that actual species numbers rather than percentage values are a more valid diversity measurement (Sanders 1983). The values f_i , $\log f_i$ from which the Shannon Index was derived appear for each spatio-temporal unit.

The Shannon Index is a measure of the amount of certainty or uncertainty involved in correctly predicting the species of an individual randomly drawn from the sample (Krebs 1985; Legendre and Legendre 1983). Larger values indicate greater uncertainty (and more diversity) while smaller numbers indicate more certainty (and thus less diversity) (Krebs 1985). The Shannon Index is called a heterogeneity index since it does not separate evenness and richness (Odum 1983; Peet 1974).

Pielou's Evenness Index

Evenness or equitability, the way in which importance is distributed among species (Peet 1974), was calculated using Pielou's Evenness Index. It is simply the Shannon Index divided by the log of the number of species (Odum 1983: Table 7-5; Pielou 1974).

$$E = \frac{H'}{\log S}$$

where E = Pielou's Evenness Index
 H' = Shannon Diversity Index
 S = the number of species

This index is the ratio of observed diversity H' to the maximum value H' could have in a community with the same number of species (Pielou 1974). The maximum value of H' (i.e., $\log S$) represents a maximally even distribution in that all S species occur in the same proportion (Pielou 1974). Pielou's Evenness Index ranges between 1 (maximum evenness/minimum dominance) and 0 (minimum evenness/maximum dominance).

Species Richness Index

Richness is highly dependent upon sample size. Thus, one cannot use any measure of richness that relies entirely upon the number of individual species without regard for the sample from which it was drawn. Larger samples will have more species than smaller samples and vice versa (Peet 1974). Sanders (1983:56) has noted that "as sample size increases, individuals are added at a constant arithmetic rate but species accumulate at a decreasing logarithmic rate".

Richness was calculated using a formula proposed by Margalef (1958). This is referred to as the Species Richness Index (Odum 1983: Table 7-5; see also Peet 1974; Sanders 1983). It is simply a ratio of the number of

species minus 1 to the log of the number of individuals.

$$R = \frac{S - 1}{\log n}$$

where R = Species Richness Index
 S = the number of species
 n = the total number of individuals

There are two assumptions common to all richness indices. First, that "the functional relationship between the expected number of species and the number of individuals in the sample remains constant" among the samples considered, and second, that "the precise functional relationship is known" (Peet 1974:288-289). Peet (1974) maintains that these assumptions are rarely met in ecological contexts. Obviously, neither can be met using the archaeological data at hand. Also, the formula is not completely independent of sample size (c.f. Peet 1974; Sanders 1983).

A simple regression analysis was performed on samples used in this analysis to determine the relationship between the dependent variable, number of species (S) and the independent variable, sample size (n) (Table I). The analysis showed a weak but significant relationship between the two variables ($r = .661$; $p = .007$). Although some of the variability in the Species Richness Index can be attributed to sample size, use of the Index was believed appropriate. Differences in richness values between samples will invariably reflect the numbers of different species

more so than sample size.

Dominance-Diversity Curves

Dominance-diversity curves are a valuable method to visualize species diversity since they graphically illustrate both aspects of diversity, richness and evenness (Odum 1983). They are commonly used by ecologists to study diversity patterns in faunal and floral communities (Whittaker 1975).

The samples analyzed in this study are assumed to be comprised of items gathered by humans from the environment to fulfill subsistence needs. The diversity patterns will therefore reflect human dietary diversity rather than diversity within a "natural" ecological community.

Dominance-diversity curves are plotted so the y-axis represents the relative abundance or importance of species (evenness) and the x-axis represents the number of species (richness) ranked from most to least abundant. Logged abundance values (log NISP) are generally used along the y-axis rather than actual abundances (NISP) (May 1983; Odum 1983; Peet 1974). For each spatio-temporal unit, logged abundance values (log NISP) are provided in addition to faunal rank orders based upon NISP.

Several examples are provided to illustrate how the curves provide information and to show some extremes of distribution. Sample 1 is from a hypothetical sample of 10

equally represented species. The sample therefore exhibits maximum evenness. Log NISP values are plotted as a straight, horizontal line (Figure 2).

Sample 2, also a sample of 10 species, illustrates a minimally even and maximally dominant distribution. One species is represented by many individuals while the remaining nine species are represented by only 1 individual. Log NISP values are plotted as a straight, near vertical line between the first and second ranked species, and between the second and tenth ranked species as a horizontal line (Figure 3). Figures 2 and 3 represent extremes of the possible diversity distribution.

Sample 3 is a geometric distribution where the first ranked species is twice as abundant as the second ranked, the second ranked twice as abundant as the third ranked, and so forth to the tenth ranked species (Odum 1983). Plotting log NISP values produces a straight, diagonal line beginning at the most abundant species and dropping from left to right to the least abundant (Figure 4). Such distributions have been found among subalpine plant communities (May 1983).

According to Odum (1983), most distributions in natural floral and faunal communities can be expressed as sigmoid curves. Sample 4, again using hypothetical data, is a close approximation of a curve that describes the distribution of flora in a deciduous forest (May 1983) (Figure 5). This is referred to as a lognormal distribution (Odum 1983).

To summarize, dominance-diversity curves slope from left (the most abundant taxon) to right (the least abundant taxon). If the slope of the curve approaches zero then overall diversity is high. Steeper curves indicate lower diversity and increased dominance by one or more species (Odum 1983). Longer curves (i.e., those that include more species) indicate greater richness or diet breadth.

Dominance-diversity curves were generated for each spatial and temporal unit considered. For each region, the x-axis (Species Sequence) was standardized at 20 species. The y-axis (Relative Importance-log NISP) was standardized within regions but not between regions. The Southeast Plateau ranges from 0 - 3, Wells Reservoir from 0 - 3.5, and Chief Joseph Reservoir from 0 - 4.

TABLE I

TEST FOR THE SIGNIFICANCE OF THE RELATIONSHIP
BETWEEN NUMBER OF SPECIES AND SAMPLE
SIZE FOR TEMPORAL UNITS

Number of Species	Sample Size	Cultural Phase
13	417	Windust
11	267	Windust/Cascade
9	268	Cascade
12	179	Hatwai Complex
14	889	Tucannon
15	517	Harder
12	397	Late Harder/Piqunin
11	197	Numipu
13	495	Period 1
17	607	Period 2
16	2934	Period 3
10	2542	Period 4
18	3255	Kartar
18	8338	Hudnut
20	4852	Coyote Creek

($r = .661$, $p = 0.007$)

Figure 1. Map showing locations of the three study areas.

Figure 2. Dominance-diversity curve showing a maximally even - minimally dominant distribution. Species 1-10 are each represented by 204 individuals. The log of 204 is 2.30963.

Figure 3. Dominance-diversity curve showing a minimally even - maximally dominant distribution. Species 1 is represented by 2037 individuals (log is 3.308991). Species 2 - 10 are each represented by 1 individual (log is 0).

Figure 4. Dominance-diversity curve showing a geometric distribution. Species numbers and logs are:

Species 1	1024	3.0103
Species 2	512	2.70927
Species 3	256	2.40824
Species 4	128	2.10721
Species 5	64	1.80618
Species 6	32	1.50515
Species 7	16	1.20412
Species 8	8	0.90309
Species 9	4	0.60206
Species 10	2	0.30103

Figure 5. Dominance-diversity curve showing a lognormal distribution. Species numbers and logs are:

Species 1	1166	3.066699
Species 2	350	2.544068
Species 3	180	2.255273
Species 4	125	2.096910
Species 5	85	1.929419
Species 6	65	1.812913
Species 7	44	1.643453
Species 8	23	1.361728
Species 9	7	0.845098
Species 10	1	0.0

CHAPTER V

ARCHAEOLOGICAL SITES

THE SOUTHEASTERN STUDY AREA

Alpowa Locality

The Alpowa Locality consists of several sites investigated by Brauner (1976). Faunal collections from 45AS78, 45AS80 and 45AS82 were utilized in this analysis. The sites are located along the south bank of the Lower Snake River, about 13 kilometers below its confluence with Alpowa Creek, in extreme southeastern Washington.

The present analysis uses the results of Lyman's comprehensive faunal study that details faunal remains by occupation feature (1976: Appendix C). The houses, other features and occupation surfaces at the sites were assigned to four cultural phases following Brauner (1976) and Lyman (1976) (Table II).

Lyman's faunal data are presented in Table III. Table IV displays the data set after aggregation (see Chapter IV).

At Alpowa, excavators employed 20 centimeter levels in 1972; during subsequent field seasons 10 centimeter levels were used. Levels were skim shoveled and artifacts were recorded in situ (Brauner 1976). Excavated material was

waterscreened through 1/4 inch mesh (Ames 1988: personal communication).

Granite Point (45WT41)

The Granite Point site is about 3.2 kilometers upstream of the Wawawai, Washington town site on the north bank of the Snake River (Leonhardy 1970). Leonhardy (1970) defined five components ranging in age from 10,000 BP to 1500 BP. Three assemblages could not be assigned to a component but were dated within the last 1000 years (Leonhardy 1970). Table V presents assemblage designation by component, age and phase at Granite Point.

I combined assemblages C3 and B4 (component 2) and assemblage C2 (provisional component 3) as representing Cascade Phase materials. The major difference among these three assemblages was the presence of Cold Springs projectile points in assemblage C2 (Leonhardy 1970). Assemblages A1, B1a and C1b date from the last 1000 years but contain no Euro-American trade items (Leonhardy 1970). They were therefore designated as mixed Late Harder/Piqunin materials.

Gustafson (1972: Table 5.3) analyzed the Granite Point faunal remains. The received data set appears in Table VI. The modified list is shown in Table VII. Gustafson analyzed assemblages B4, C2, C3 and C4 as a single unit, consequently faunal remains from Windust and Cascade components were

combined. I designated this combined assemblage Windust/Cascade.

Assemblage C1a is a mixed assemblage that (Leonhardy 1970:189) eliminated from his analysis because it contained "a mixture of elements of various ages". Gustafson analyzed an assemblage he designated only as C1 (1972: Table 5.3). I assume that Gustafson's assemblage C1 includes both C1a and C1b. Since C1a was mixed, Gustafson's assemblage C1 was not used in this analysis and does not appear in Table VII.

Assemblages A5, A6, B2 and B3 were analyzed collectively by Gustafson (1972: Table 5.3) and assigned to component 4 (Table V). Assemblages A1, A2, A3 and B1 were also grouped by Gustafson (1972: Table 5.3). I am unsure of Gustafson's (1972: Table 5.3) A2 assemblage since it is not mentioned by Leonhardy (1970). I use assemblages A1, A2, A3 and B1 in this analysis and assign them to component 5 (Table V).

Leonhardy (1970) is not explicit regarding excavation techniques at Granite Point. It appears that excavation proceeded along arbitrary as well as natural and cultural levels (e.g. 1970). Ames (1988: personal communication) indicates that excavated matrix was waterscreened through 1/4 inch mesh hardware cloth. Faunal materials were removed by stratigraphic unit (Gustafson 1972).

Hatwai (10NP143)

The site is situated on the north bank of the Clearwater River at its confluence with Hatwai Creek. The location is about 7 kilometers east of the confluence of the Snake and Clearwater Rivers.

Hatwai was excavated in 1977-1978 by Boise State University in cooperation with the Idaho Department of Transportation. Site excavation was directed by Ames and reported by Ames, Green and Pfoertner (1981).

Hatwai contains material spanning the last 10,800 years (Ames et.al. 1981), however only two components, the Hatwai Complex component and the Tucannon component, contain ample, assignable faunal remains. Houses, other features and surfaces providing faunal remains used in the analysis appear in Table VIII.

Faunal remains as received from Ames (n.p.) appear in Table IX. The modified list appears in Table X.

Excavations at Hatwai proceeded using 10 centimeter levels unless natural or cultural strata were observed. The majority of all artifacts received in situ provenience. Shovel skimming techniques were used until artifact density mandated the use of trowels. All excavated matrix was screened through 1/4 inch mesh hardware cloth, while selected bulk samples were screened through 1/16 inch mesh fiberglass cloth (Ames et.al. 1981).

Lind Coulee (45GR97)

The Lind Coulee site is located about 1.2 kilometers northeast of the town of Warden in south central Washington. The site is located on the east side of a coulee for which it was named. It is the only site in the Southeastern study area located in an upland rather than riverine setting.

Lind Coulee was excavated by numerous investigators between 1951 and 1975 (Irwin and Moody 1978). With radiocarbon dates ranging from 8000 BP to 9000 BP, it is one of the earliest occupation sites on the southeastern Plateau for which abundant faunal information exists (Irwin and Moody 1978).

The faunal remains from all work at Lind Coulee through 1975 are summarized by Irwin and Moody (1978: Appendix E; this study Table XI). The modified data set appears in Table XII. All faunal remains can be attributed to Windust Phase occupations.

In 1975, excavations at Lind Coulee utilized natural stratigraphy and 5 centimeter levels when stratigraphy was not observed. Artifacts and faunal materials received in situ provenience. All matrix was waterscreened through 1 millimeter mesh; artifacts, bones and bone fragments found in the screens were identified to 5 centimeter level and unit quadrant (Irwin and Moody 1978).

Marmes Rockshelter (45FR60)

The site is located on the west bank of the Palouse River about 2.4 kilometers north of its confluence with the Snake River (Rice 1969). Eight stratigraphic units, designated I-VIII, were identified within the shelter (Rice 1969). Deposits range in age from Windust in units I and II, to a historic period manure deposit in unit VIII attributed to domestic livestock.

The chronology of Marmes Rockshelter has been recently reevaluated by Sheppard, et.al.(1987). I correlated Sheppard's, et.al.(1987: Table 2) chronology with that devised by Leonhardy and Rice (1970) (Table XIII). The results indicate that Windust materials comprise units I-II and Cascade materials are in unit III. Unit VI may contain mixed Cascade and Tucannon materials. Tucannon, Harder and possibly Cascade materials are associated with unit V. Harder materials lie within units VI-VII. Unit VIII, the manure stratum, is undated (Table XIII).

I have some reservations about assigning units VI-VIII exclusively to the Harder Phase. The last reliable date on unit VII and the rockshelter is 660 BP (Sheppard et.al. 1987: Table 1). Leonhardy and Rice (1970) place the terminal date of the Harder Phase at 650 BP (Table XIII). Unit VIII, the manure deposit, contained artifacts including a glass bead and a rifle barrel modified to form a scraper (Rice 1969). These artifacts undoubtedly represent an

ethnographic (Numipu Phase) occupation of the shelter.

Faunal remains analyzed and reported by Gustafson (1972: Table 5.1) come from twelve, 10 by 10 foot excavation squares believed to represent relatively undisturbed deposits (1972). He placed faunal remains into four temporal periods by combining units I-II, units IV-V and units VI-VIII. Unit III was analyzed separately (1972: Table 5.1). Gustafson's data appear in Table XIV. The modified data set appears in Table XV.

I discarded units IV-V from my analysis because the temporal span crosscut several periods of interest (Cascade, Hatwai Complex, Tucannon and Harder). Cattle bones encountered in unit VIII were eliminated from the analysis since Marmes was frequented by livestock during the historic period (Rice 1969: Table 1; Gustafson 1972). The potential exists that some of the bones assigned to Harder may be associated with the possible ethnographic occupation mentioned above. I do not know what other faunal specimens were encountered in unit VIII, if any.

At Marmes, samples of fish and bird remains were identified by Taylor and Leffler, respectively (Gustafson 1972). A list of species names was provided but the remains were neither quantified nor assigned to dated periods or phases (Gustafson 1972) so they could not be used in this analysis. Gustafson (1972) indicates that fish occurred in low densities in early deposits but became increasingly

abundant after the Altithermal.

Marmes was excavated using natural stratigraphy; 6 inch levels were used when natural strata exceeded 6 inches in thickness (Gustafson 1972). Faunal remains were assigned provenience on the basis of unit and level; their precise positions were not noted unless some associations were discerned. Excavated matrix was screened through 1/4 inch mesh hardware cloth. A bulk sample unit central to the excavation produced no small mammal remains. This may indicate their absence within the shelter or a "sampling error" (Gustafson 1972:45). The complete absence of small mammals in such a deposit seems unlikely.

Wawawai (45WT39)

This site is located on the north side of the Snake River about 3.2 kilometers south of Lower Granite Dam and 1.6 kilometers north of the former town of Wawawai, Washington (Yent 1976). The site was excavated between 1968 and 1971 by researchers at Washington State University and the University of Idaho (Yent 1976).

Wawawai contains components attributed to Numipu, Late Harder and Tucannon Phases on the basis of stratigraphic association, artifact content and radiocarbon assay. Yent's (1976) analysis revealed no evidence for the Pigunin Phase at Wawawai though assemblages are present that date to that period. Yent proposes that the Pigunin Phase is not a valid

taxonomic distinction and suggests that such assemblages best be characterized as Late Harder (Yent 1976).

The faunal analysis at Wawawai was undertaken by Lyman (Yent 1976: Appendix F; this study Table XVI). Lyman distinguished between remains found in Area A and Area B of the site but did not separate the fauna by assemblage. Area A contained a single Late Harder Phase assemblage (4) (Yent 1976). Area B contained 5 assemblages (1A,1B,2,3,5) that were assigned to three phases including Tucannon, Late Harder and Numipu (Yent 1976).

Because I could not separate the faunal elements in Area B into particular phases, I deleted them from this analysis. This was unfortunate since I think most of these remains could have been assigned to the Numipu Phase. The Numipu Phase faunal sample is rather small and limited to a single locality (Alpowa). Area A remains, designated Late Harder/Piqunin, were modified for use in the analysis (Table XVII).

At Wawawai, artifactual materials and faunal remains associated with occupation surfaces and house floors were mapped and photographed in situ. Excavated matrix was processed through 1/4 inch mesh hardware cloth in Area B (Yent 1976). I assume similar screening techniques were employed in Area A.

Summary

This analysis uses faunal assemblages from eight sites (three are from the Alpowa Locality) in the Southeastern study area. Table XVIII shows the NISP for each temporal unit and the sites from which those samples were drawn. Table XIV presents cumulative faunal data showing faunal categories and NISP by cultural phase.

THE CENTRAL COLUMBIA PLATEAU STUDY AREAS

Wells Reservoir Archaeological Project

Wells Reservoir is located in north central Washington along the Columbia River. The Wells Reservoir Archaeological Project (WRAP) was initiated in 1983 and 1984 when a proposal to raise the reservoir pool threatened to inundate cultural resources. The project was undertaken by archaeologists from Central Washington University and Washington State University (Chatters 1986).

A number of sites were intensively investigated during the project. Faunal remains from dated occupations were recovered at 45OK69, 45OK74, 45OK382, 45OK383, 45OK422, 45OK424, 45D0372 and 45D0387 (Chatters 1986: Table 24). Occupations at these sites are dated to four distinct periods: Period 1 (7800-5500 BP), Period 2 (4350-3800 BP), Period 3 (3300-2200 BP) and Period 4 (<900 BP) (Chatters 1986: Table 15).

Sites were excavated by natural stratigraphy where component and feature boundaries were distinct. Otherwise, 10 or occasionally 20 centimeter levels were used. Non-feature matrix was wet or dry screened through 1/4 inch mesh hardware cloth. Feature matrix was initially screened through 1/16 inch mesh but was later processed through 1/4 inch mesh halfway through the 1983 season (Moura and Chatters 1986).

The total sample of faunal remains appears in Table XX. The modified data set used in this analysis appears in Table XXI.

Chief Joseph Dam Cultural Resources Project

The Chief Joseph Reservoir is located on the Columbia River between Wells Reservoir and Grand Coulee Dam in north central Washington. The University of Washington undertook intensive excavations between 1978 and 1980 at eighteen sites that were to be inundated (Campbell 1985).

Faunal remains recovered at each of the following sites were used in this analysis: 45D0204, 45D0211, 45D0214, 45D0242, 45D0243, 45D0273, 45D0282, 45D0285, 45D0326, 450K2, 450K2A, 450K4, 450K11, 450K18, 450K250, 450K258, 450K287 and 450K288 (Campbell 1985: Table D-6). The Chief Joseph report contains a thorough faunal analysis with contributions by Livingston (1985) and Salo (1985).

Site occupations and faunal collections from the Chief Joseph Project were assigned to three cultural phases on the basis of radiocarbon dates: the Kartar Phase (7000-4000 BP), the Hudnut Phase (4000-2000 BP) and the Coyote Creek Phase (2000-50 BP) (Salo 1985). All excavated sediments were screened through 1/8 inch mesh (Livingston 1985).

The reported faunal remains from Chief Joseph Reservoir are summarized in Table XXII. I deleted fauna attributed to mixed assemblages and those classed into combined phase designations. The faunal data used in this analysis appear in Table XXIII.

I should note that the faunal assemblage used in this analysis was derived exclusively from Table D-6 (Campbell 1985). The summary data I acquired from Table D-6 do not in some cases correspond with summary data appearing elsewhere in the Wells monograph (e.g., Table 12-9). The reason for the discrepancies has not been ascertained.

TABLE II

HOUSES, FEATURES AND SURFACES PROVIDING FAUNAL
REMAINS FROM THE ALPOWA LOCALITY
BY PHASE AND SITE

PHASE	SITE	HOUSE, OTHER FEATURES OR SURFACE
Late Cascade	45AS82	House 5 fz Block 8
Tucannon	45AS82	Block 2,3,4,9,10,12 House 4A fz
Harder	45AS82	House 1 fz House 2 fz 1,2,3 House 4 fz 1, occupation 2
	45AS78	House 1 fz
	45AS80	House 1 fz
Numipu	45AS80	House 2 fz
	45AS82	Area B Plowzone Area B Features Other features in Blocks 2,3,14,21,31

Derived from Lyman (1976: Appendix C)

TABLE III
ORIGINAL FAUNAL DATA FROM THE
ALPOWA LOCALITY

FAUNA	CULTURAL PHASE			
	Hatwai Complex	Tucannon	Harder	Numipu
<u>Odocoileus sp.</u>	7	34	183	66
Deer Size	3	27	238	73
<u>Cervus canadensis</u>	0	10	14	1
Elk Size	0	10	6	0
<u>Antilocapra americana</u>	0	6	6	0
<u>Ovis canadensis</u>	0	4	6	6
<u>Bison bison</u>	1	0	93	9
Bison Size	1	0	119	8
<u>Bos sp.</u>	0	0	0	10
Cow Size	0	0	0	26
<u>Ovis aries</u>	0	0	0	1
<u>Equus caballus</u>	0	0	0	1
<u>Sylvilagus nuttallii</u>	1	3	20	4
<u>Lepus sp.</u>	0	2	1	2
Lagomorpha Indt.	0	4	0	1
<u>Citellus sp.</u>	0	0	0	1
<u>Castor canadensis</u>	0	1	3	0
<u>Erethizon dorsatum</u>	0	1	0	0
<u>Thomomys talpoides</u>	13	30	62	9
<u>Perognathus parvus</u>	1	0	0	2
<u>Microtus sp.</u>	2	4	5	6
<u>Peromyscus maniculatus</u>	0	1	1	0
<u>Lagurus curtatus</u>	0	8	10	2
<u>Canis latrans</u>	0	1	0	0
<u>Canis familiaris</u>	0	0	0	10
<u>Canis sp.</u>	0	0	11	4
<u>Vulpes fulva</u>	1	1	1	0
<u>Lutra canadensis</u>	0	1	0	0
<u>Taxidea taxus</u>	0	0	1	1
<u>Lynx sp.</u>	5	0	0	0
Catostomidae/Cyprinidae	2	18	50	48
Salmonidae	0	7	10	4
<u>Chrysemys picta</u>	0	1	2	0
Viperidae and Colubridae	0	3	3	0
Aves	0	2	6	3
<u>Pediocetes phasianellus</u>	0	1	1	5
<u>Anas platyrhynchos</u>	0	1	0	0
<u>Bubo virginianus</u>	0	0	0	20

Derived from Lyman (1976: Appendix C)

TABLE IV
FAUNAL DATA FROM THE ALPOWA LOCALITY
USED IN THIS ANALYSIS

FAUNA	CULTURAL PHASE			
	Hatwai Complex	Tucannon	Harder	Numipu
<u>Odocoileus sp.</u>	7	34	183	66
<u>Cervus canadensis</u>	0	10	14	1
<u>Antilocapra americana</u>	0	6	6	0
<u>Ovis canadensis</u>	0	4	6	6
<u>Bison bison</u>	1	0	93	9
<u>Bos sp.</u>	0	0	0	10
<u>Ovis aries</u>	0	0	0	1
<u>Equus caballus</u>	0	0	0	1
<u>Leporidae</u>	1	9	21	7
<u>Spermophilus sp.</u>	0	0	0	1
<u>Castor canadensis</u>	0	1	3	0
<u>Erethizon dorsatum</u>	0	1	0	0
<u>Canidae</u>	1	2	12	14
<u>Mustelidae</u>	0	1	1	1
<u>Lynx sp.</u>	5	0	0	0
<u>Catostomidae or Cyprinidae</u>	2	18	50	48
<u>Salmonidae</u>	0	7	10	4
<u>Aves</u>	0	4	7	28
TOTAL	17	97	406	197

Derived from Lyman (1976: Appendix C)

TABLE V
ASSEMBLAGE DESIGNATION BY COMPONENT, AGE AND
PHASE AT GRANITE POINT

ASSEMBLAGE	COMPONENT	AGE (years BP)	PHASE
C4	1	10,000-9000	Windust
C3,B4	2	8000-6700	Cascade (early)
C2	3 provi.	6700-5000	Cascade (late)
A5-6,B3,B2	4	5000-2500	Tucannon
A3a,A3c,B1c	5	2500-1500	Harder
A1,B1a,C1b	Unassigned	<1000	L. Harder/ Piqunin

Derived from Leonhardy (1970: vi,vii,82,113,118,
151,158,159,170,183,189,190)

TABLE VI
ORIGINAL FAUNAL DATA FROM
GRANITE POINT

FAUNA	CULTURAL PHASE			
	Wind/ Casc	Mixed	Tucan	L.Hard/ Piqu
<u>Odocoileus sp.</u>	103	4	82	21
<u>Cervus canadensis</u>	59	0	8	7
<u>Antilocapra americana</u>	2	0	8	1
<u>Ovis canadensis</u>	1	0	0	1
<u>Bison bison</u>	0	0	0	5
<u>Sylvilagus nuttallii</u>	10	1	3	1
<u>Lepus sp.</u>	26	0	0	0
<u>Marmota flaviventris</u>	4	0	1	0
<u>Citellus cf. columbianus</u>	43	4	0	10
<u>Neotoma cinerea</u>	1	0	0	0
<u>Castor canadensis</u>	0	1	0	0
<u>Peromyscus maniculatus</u>	2	0	0	1
<u>Thomomys talpoides</u>	51	28	44	14
<u>Microtus cf. montanus</u>	1	0	5	1
<u>Lagurus curtatus</u>	4	3	0	0
<u>Canis latrans</u>	15	0	7	3
<u>Vulpes fulva</u>	1	0	0	0
<u>Taxidea taxus</u>	1	0	0	0
<u>Lynx rufus</u>	1	0	3	0

Derived from Gustafson (1972: Table 5.3)

TABLE VII
FAUNAL DATA FROM GRANITE POINT
USED IN THIS ANALYSIS

FAUNA	CULTURAL PHASE		
	Wind/ Casc	Tucan	L.Hard/ Piqu
<u>Cervus canadensis</u>	59	8	7
<u>Odocoileus sp.</u>	103	82	21
<u>Antilocapra americana</u>	2	8	1
<u>Ovis canadensis</u>	1	0	1
<u>Bison bison</u>	0	0	5
<u>Leporidae</u>	36	3	1
<u>Marmota flaviventris</u>	4	1	0
<u>Spermophilus cf. columbianus</u>	43	0	10
<u>Neotoma cinerea</u>	1	0	0
<u>Canidae</u>	16	7	3
<u>Taxidea taxus</u>	1	0	0
<u>Lynx rufus</u>	1	3	0
TOTAL	267	112	49

Derived from Gustafson (1972: Table 5.3)

TABLE VIII

HOUSES, OTHER FEATURES AND SURFACES PROVIDING FAUNAL
REMAINS AT HATWAI BY PHASE

PHASE	HOUSE, OTHER FEATURES AND SURFACES *
Hatwai Complex	HP1fz4 HP2fz4 - bottom HP7fz3/4
Tucannon	Upper Zone Trash Feature 4 HP8 - all units HPa - all units HP1 Benches A1-3 HP1fz1 HP2 A1-2 HP2 T1-T2 T3 and A3 HP2fz1 HP2fz2-3 HP7 T units HP7 A units HP7 fz1 and 2 HP1fz3

* HP = House Pit
fz = Floor Zone

Derived from Ames (n.p.)

TABLE IX
ORIGINAL FAUNAL DATA
FROM HATWAI

FAUNA	CULTURAL PHASE	
	Hatwai Complex	Tucannon
Artiodactyl	25	25
Cervidae	17	19
<u>Cervus elaphus</u>	14	23
<u>Odocoileus sp.</u>	126	597
<u>Ovis canadensis</u>	0	3
<u>Antilocapra americana</u>	1	0
<u>Marmota flaviventris</u>	0	1
Leporidae	0	1
<u>Lepus sp.</u>	0	1
<u>Sylvilagus</u>	0	7
<u>Castor canadensis</u>	1	1
Carnivora	0	2
Canid	0	1
<u>Canis sp.</u>	7	7
<u>Vulpes sp.</u>	1	6
<u>Mustela sp.</u>	3	6
<u>Ursus sp.</u>	1	1
Felidae	0	1
<u>Lynx sp.</u>	1	0
<u>Felis concolor</u>	0	2
Aves	4	12
Pisces	3	10

Note: Deletions from information given by Ames include HP1fz2/3 which is mixed, and Yellow C1

Derived from Ames (n.p.)

TABLE X
FAUNAL DATA FROM HATWAI USED
IN THIS ANALYSIS

FAUNA	CULTURAL PHASE	
	Hatwai Complex	Tucannon
<u>Odocoileus sp.</u>	126	597
<u>Cervus elaphus</u>	14	23
<u>Antilocapra americana</u>	1	0
<u>Ovis canadensis</u>	0	3
Leporidae	0	9
<u>Marmota flaviventris</u>	0	1
<u>Castor canadensis</u>	1	1
Canidae	8	14
<u>Mustela sp.</u>	3	6
Felidae	1	3
<u>Ursus sp.</u>	1	1
Aves	4	12
Osteichthyes	3	10
TOTALS	162	680

Derived from Ames (n.p.)

TABLE XI
ORIGINAL FAUNAL DATA FROM
LIND COULEE

FAUNA	CULTURAL PHASE	
	Windust	
<u>Odocoileus sp.</u>	9	
<u>Cervus cf. elaphus</u>	36	
<u>Bison bison</u>	188	
<u>Bison bison/Cervus elaphus</u>	37	
<u>Lepus sp.</u>	1	
<u>Sylvilagus cf. idahoensis</u>	14	
<u>Marmota flaviventris</u>	23	
<u>Citellus sp.</u>	12	
<u>Neotoma cinerea</u>	2	
<u>Castor canadensis</u>	5	
<u>Ondatra zibethicus</u>	6	
<u>Microtus cf. montanus</u>	7	
<u>Peromyscus maniculatus</u>	2	
<u>Thomomys talpoides</u>	11	
<u>Taxidea taxus</u>	17	
<u>Mephitis mephitis</u>	19	
<u>Lutra canadensis</u>	2	
<u>Ardea herodias</u>	2	
<u>Branta sp.</u>	1	
<u>Branta nigricans</u>	1	
<u>Anas platyrhynchos</u>	5	
<u>Anas carolinensis</u>	2	
Aves Indt. Branta Size	2	
Aves Indt. Mallard Size	1	
Aves Indt. Heron Size	3	
Aves Indt. Teal Size	2	
Aves Indt.	5	
Aves Indt. Large	3	
Aves Indt. Small	2	
Aves Eggshell	5	
Lizard	1	
Turtle	1	
Owl pellet	1	
Indt. Herbivore	57	
Large mammal	8	
Medium mammal	1	
Medium rodent	2	
Indt. rodent	4	
Larger than Coyote	1	
Unident ?	1	

Derived from Irwin and Moody (1978: Appendix E)

TABLE XII
FAUNAL DATA FROM LIND COULEE USED
IN THIS ANALYSIS

FAUNA	CULTURAL PHASE
	Windust
<u>Cervus cf. elaphus</u>	36
<u>Odocoileus sp.</u>	9
<u>Bison bison</u>	188
Leporidae	15
<u>Marmota flaviventris</u>	23
<u>Spermophilus sp.</u>	12
<u>Neotoma cinerea</u>	2
<u>Castor canadensis</u>	5
<u>Ondatra zibethicus</u>	6
Mustelidae	38
Aves	29
TOTAL	363

Derived from Irwin and Moody (1978: Appendix E)

TABLE XIII
CORRELATION OF CHRONOLOGY AT
MARMES ROCKSHELTER

Derived from Sheppard et.al.(1987)		Derived from Leonhardy and Rice (1970)	
STRATUM	YEARS BP.	PHASE	YEARS BP.
VII	660 - 1600		
VI	1300 - 1940	Numipu	250 - 50
V	one date (4250)	Piqunin	650 - 250
IV	Mazama tephra (6700)	Harder	2450 - 650
III	6200 - 7870	Tucannon	4950 - 2450
II	8525 - 9540	Cascade	7950 - 4950
I	9820 - 10,810	Windust	9950 - 7950

TABLE XIV
ORIGINAL FAUNAL DATA FROM
MARMES ROCKSHELTER

FAUNA	CULTURAL PHASE			
	Windust	Cascade	Casc/ Tucan	Harder
<u>Odocoileus sp.</u>	22	108	49	26
<u>Cervus canadensis</u>	5	36	8	2
<u>Antilocapra americana</u>	14	79	65	31
<u>Sylvilagus sp.</u>	2	10	12	14
<u>Lepus sp.</u>	3	5	3	2
<u>Marmota flaviventris</u>	1	2	1	5
<u>Citellus cf. washingtoni</u>	0	2	6	22
<u>Neotoma cinerea</u>	3	2	4	4
<u>Ondatra zibethicus</u>	2	4	1	2
<u>Peromyscus maniculatus</u>	1	0	0	0
<u>Thomomys talpoides</u>	3	1	4	3
<u>Canis cf. latrans</u>	2	20	5	3
Indt.Sm.Mam.	10	5	9	16
Indt.Md.Mam.	3	12	14	8
Indt.Lg.Mam.	41	123	70	55
<u>Bos taurus</u>	0	0	0	48

Derived from Gustafson (1972: Table 5.1)

TABLE XV
 FAUNAL DATA FROM MARMES ROCKSHELTER
 USED IN THIS ANALYSIS

FAUNA	CULTURAL PHASE		
	Windust	Cascade	Harder
<u>Cervus canadensis</u>	5	36	2
<u>Odocoileus sp.</u>	22	108	26
<u>Antilocapra americana</u>	14	79	31
<u>Sylvilagus sp.</u>	2	10	14
<u>Lepus sp.</u>	3	5	2
<u>Marmota flaviventris</u>	1	2	5
<u>Spermophilus cf. washingtoni</u>	0	2	22
<u>Neotoma cinerea</u>	3	2	4
<u>Ondatra zibethicus</u>	2	4	2
<u>Canis cf. latrans</u>	2	20	3
TOTAL	54	268	111

Derived from Gustafson (1972: Table 5.1)

TABLE XVI
ORIGINAL FAUNAL DATA
FROM WAWAWAI

FAUNA	CULTURAL PHASE	
	L.Hard/ Piqun	Tucan, L.Hard, Numipu (Mixed)
	AREA A	AREA B
<u>Odocoileus sp.</u>	223	174
<u>Cervus canadensis</u>	28	140
<u>Antilocapra americana</u>	6	6
<u>Ovis canadensis</u>	7	9
<u>Bison bison</u>	3	1
Deer size	127	95
Elk/Bison Size	22	22
<u>Sylvilagus nuttallii</u>	4	5
<u>Citellus sp.</u>	7	5
<u>Neotoma cinerea</u>	8	2
<u>Ondatra zibethicus</u>	0	5
<u>Thomomys talpoides</u>	31	75
<u>Perognathus parvus</u>	0	1
<u>Microtus sp.</u>	11	1
<u>Lagurus curtatus</u>	0	1
<u>Reithrodontomys megalotis</u>	0	1
Carnivora	4	13
<u>Canis sp.</u>	6	35
<u>Canis latrans</u>	0	1
<u>Canis lupus</u>	0	2
<u>Taxidea taxus</u>	0	8
<u>Mustela frenata</u>	2	0
<u>Lynx sp.</u>	0	1
Pisces	42	10
Salmonidae	8	2
Amphibia/Salientia	5	20
Serpentes	1	2
Testudines	1	0
Aves	4	2

Derived from Lyman in Yent (1976: Appendix F)

TABLE XVII
FAUNAL DATA FROM WAWAWAI USED
IN THIS ANALYSIS

FAUNA	CULTURAL PHASE	
	L. Harder/ Piqunin	
	AREA A	
<u>Odocoileus sp.</u>	223	
<u>Cervus canadensis</u>	28	
<u>Antilocapra americana</u>	6	
<u>Ovis canadensis</u>	7	
<u>Bison bison</u>	3	
<u>Sylvilagus nuttallii</u>	4	
<u>Spermophilus sp.</u>	7	
<u>Neotoma cinerea</u>	8	
<u>Ondatra zibethicus</u>	0	
Canidae	6	
Mustelidae	2	
<u>Lynx sp.</u>	0	
Osteichthyes	42	
Salmonidae	8	
Aves	4	
TOTAL	348	

Derived from Lyman in Yent (1976: Appendix F)

TABLE XVIII

SOUTHEASTERN PLATEAU FAUNAL SAMPLE SIZE BY
CULTURAL PHASE AND SITE

CULTURAL PHASE	SITE OR LOCALITY						TOTAL
	Alpo	Gran	Hatw	Lind	Marm	Wawa	
Windust	-	-	-	363	54	-	417
Wind/Cas	-	267	-	-	-	-	267
Cascade	-	-	-	-	268	-	268
HatwCom	17	-	162	-	-	-	179
Tucann	97	112	680	-	-	-	889
Harder	406	-	-	-	111	-	517
L.Har/Piq	-	49	-	-	-	348	397
Numipu	197	-	-	-	-	-	197
<hr/>							
TOTAL	717	428	842	363	433	348	3131

Alpo = Alpowa Locality

Gran = Granite Point

Hatw = Hatwai

Lind = Lind Coulee

Marm = Marmes Rockshelter

Wawa = Wawawai

TABLE XIX
CUMULATIVE FAUNAL DATA BY CULTURAL PHASE
FOR SOUTHEASTERN PLATEAU SITES

FAUNA	CULTURAL PHASE			
	Windust	Wind/ Casc	Cascade	Hatwai Complex
<u>Cervus sp.</u>	41	59	36	14
<u>Odocoileus sp.</u>	31	103	108	133
<u>Antilocapra americana</u>	14	2	79	1
<u>Ovis canadensis</u>	0	0	1	0
<u>Bison bison</u>	188	0	0	1
Domestic Stock	0	0	0	0
Leporidae	20	36	15	1
<u>Marmota flaviventris</u>	24	4	2	0
<u>Spermophilus sp.</u>	12	43	2	0
<u>Neotoma cinerea</u>	5	1	2	0
<u>Castor canadensis</u>	5	0	0	1
<u>Ondatra zibethicus</u>	8	0	4	0
<u>Erethizon dorsatum</u>	0	0	0	0
Canidae	2	16	20	9
Mustelidae	38	1	0	3
Felidae	0	1	0	6
Ursidae	0	0	0	1
Osteichthyes	0	0	0	5
Aves	29	0	0	4
TOTAL	417	267	268	179

TABLE XIX
 CUMULATIVE FAUNAL DATA BY CULTURAL PHASE
 FOR SOUTHEASTERN PLATEAU SITES
 (continued)

FAUNA	CULTURAL PHASE			
	Tucan	Harder	L.Hard/ Piquin	Numipu
<u>Cervus sp.</u>	41	16	35	1
<u>Odocoileus sp.</u>	713	209	244	66
<u>Antilocapra americana</u>	14	37	7	0
<u>Ovis canadensis</u>	7	6	8	6
<u>Bison bison</u>	0	93	8	9
Domestic Stock	0	0	0	12
Leporidae	21	37	5	7
<u>Marmota flaviventris</u>	2	5	0	0
<u>Spermophilus sp.</u>	0	22	17	1
<u>Neotoma cinerea</u>	0	4	8	0
<u>Castor canadensis</u>	2	3	0	0
<u>Ondatra zibethicus</u>	0	2	0	0
<u>Erithizon dorsatum</u>	1	0	0	0
Canidae	23	15	9	14
Mustelidae	7	1	2	1
Felidae	6	0	0	0
Ursidae	1	0	0	0
Osteichthyes	35	60	50	52
Aves	16	7	4	28
TOTAL	889	517	397	197

TABLE XX
ORIGINAL FAUNAL DATA FROM SITES IN
WELLS RESERVOIR

FAUNA	PERIOD			
	1	2	3	4
<u>Cervus canadensis</u>	0	59	4	1
<u>Odocoileus sp.</u>	25	94	25	1
<u>Antilocapra americana</u>	1	80	27	0
<u>Ovis canadensis</u>	1	13	31	0
<u>Bison bison</u>	0	0	1	0
Bovidae	0	1	0	0
Leporidae	114	78	10	3
<u>Sylvilagus nuttallii</u>	0	0	1	0
<u>Lepus sp.</u>	200	19	2	3
Carnivora	2	2	2	0
Canidae	0	1	1	4
<u>Canis latrans/familiaris</u>	45	14	11	0
<u>Canis lupus</u>	0	3	0	0
<u>Ursus sp.</u>	0	11	0	0
Mustelidae	0	2	10	0
<u>Martes</u>	0	0	2	0
<u>Gulo</u>	1	0	0	0
<u>Procyon lotor</u>	0	0	2	0
Rodentia	5	0	0	0
Sciuridae	0	2	8	0
<u>Marmota</u>	6	20	18	1
<u>Citellus</u>	0	1	0	0
<u>Erethizon dorsatum</u>	0	1	1	0
<u>Castor canadensis</u>	1	9	14	2
<u>Ondatra zibethicus</u>	2	1	0	0
Salmonidae	82	55	2591	1546
<u>Oncorhynchus nerka</u>	0	1	0	0
<u>Oncorhynchus tshawytscha</u>	0	5	0	0
<u>Salmo</u>	1	4	2	6
<u>Salvelinus prosopium</u>	0	0	10	23
Cypriformes	1	64	8	216
Cyprinidae	0	1	5	3
<u>Catostomus</u>	1	44	80	720
<u>Acipenser</u>	3	0	0	0
Unident. nonsalmonid	0	33	0	1
Unident. fish	63	96	2116	4720

TABLE XX
ORIGINAL FAUNAL DATA FROM SITES IN
WELLS RESERVOIR
(continued)

FAUNA	PERIOD			
	1	2	3	4
<u>Bucephala</u>	0	0	2	0
<u>Anas</u>	0	2	0	0
<u>Grus</u>	0	0	1	0
Strygidae	0	3	0	0
<u>Aquila</u>	0	1	0	0
<u>Centocercus</u>	0	0	1	0
<u>Lophortyx</u>	0	1	2	0
Unident. bird	12	20	72	13
<u>Chrysemys</u>	89	2	349	96
Unident. mammal	0	0	78	2
Unident. Large mammal	7	142	2536	36
Unident. Large-medium mamm.	303	1759	3843	78
Unident. Medium mamm.	408	2674	1115	3
Unident. Small mamm.	163	319	514	6
Antler Fragment	67	761	75	0

Derived from Chatters (1986: Table 24).

TABLE XXI
FAUNAL DATA FROM WELLS RESERVOIR USED
IN THIS ANALYSIS

FAUNA	PERIOD			
	1	2	3	4
<u>Cervus canadensis</u>	0	59	4	1
<u>Odocoileus sp.</u>	25	94	25	1
<u>Antilocapra americana</u>	1	80	27	0
<u>Ovis canadensis</u>	1	13	31	0
<u>Bison bison</u>	0	0	1	0
Leporidae	314	97	13	6
Canidae	45	18	12	4
<u>Ursus sp.</u>	0	11	0	0
Mustelidae	1	2	12	0
<u>Procyon lotor</u>	0	0	2	0
<u>Marmota</u>	6	20	18	1
<u>Spermophilus</u>	0	1	0	0
<u>Erethizon dorsatum</u>	0	1	1	0
<u>Castor canadensis</u>	1	9	14	2
<u>Ondatra zibethicus</u>	2	1	0	0
Salmonidae	83	65	2603	1575
Cyprinidae	1	65	13	219
Catostomidae	0	44	80	720
Acipenseridae	3	0	0	0
Aves	12	27	78	13
TOTAL	495	607	2934	2542

Derived from Chatters (1986: Table 24)

TABLE XXII
ORIGINAL FAUNAL DATA FROM SITES
IN CHIEF JOSEPH RESERVOIR

FAUNA	CULTURAL PHASE		
	Kartar	Hudnut	Coyote Creek
<u>Cervus elaphus</u>	24	65	17
<u>Odocoileus sp.</u>	1472	4505	3297
<u>Antilocapra americana</u>	59	36	155
<u>Ovis canadensis</u>	345	670	489
<u>Bison bison</u>	10	15	2
Deer sized	1875	6385	4518
Elk sized	19	60	42
<u>Equus caballus</u>	0	0	27
<u>Lepus cf. townsendii</u>	15	14	6
<u>Sylvilagus cf. nuttallii</u>	3	3	13
<u>Marmota flaviventris</u>	275	266	127
<u>Spermophilus sp.</u>	7	76	22
<u>Castor canadensis</u>	9	19	6
<u>Ondatra zibethicus</u>	2	0	1
<u>Erethizon dorsatum</u>	68	6	4
<u>Sorex sp.</u>	0	4	0
<u>Thomomys talpoides</u>	964	1139	256
<u>Perognathus parvus</u>	322	413	221
<u>Peromyscus maniculatus</u>	18	74	25
<u>Neotoma cinerea</u>	2	3	4
<u>Microtus sp.</u>	17	36	27
<u>Lagurus curtatus</u>	17	70	67
<u>Canis latrans</u>	3	2	1
<u>Canis lupus</u>	5	2	0
<u>Canis familiaris</u>	0	118*	3
<u>Canis sp.</u>	24	109	34
<u>Vulpes vulpes</u>	0	6	0
<u>Ursus sp.</u>	4	4	2
<u>Lutra canadensis</u>	0	0	7
<u>Martes americana</u>	2	5	0
<u>Martes pennanti</u>	0	3	4
<u>Mustela frenata</u>	0	5	1
<u>Taxidea taxus</u>	1	3	5
<u>Mephitis mephitis</u>	8	0	0
<u>Lynx rufus</u>	0	8	1

TABLE XXII
 ORIGINAL FAUNAL DATA FROM SITES
 IN CHIEF JOSEPH RESERVOIR
 (continued)

FAUNA	CULTURAL PHASE		
	Kartar	Hudnut	Coyote Creek
Salmonidae	394	2277	552
Cyprinidae	522	211	71
Catostomidae	1	16	1
<u>Chrysemys</u> cf. <u>picta</u>	361	557	311
Viperidae	0	3	1
Colubridae	117	384	107
Ranidae/Bufonidae	72	239	25
Amphibia	0	40	35

* 110 of these specimens are articulated
 (actual count = 9)

Note: This table deletes mixed and combined
 Kartar/Hudnut/Coyote Creek assemblages

Derived from Campbell (1985: Table D-6).

TABLE XXIII

FAUNAL DATA FROM CHIEF JOSEPH RESERVOIR
USED IN THIS ANALYSIS

FAUNA	CULTURAL PHASE		
	Kartar	Hudnut	Coyote Creek
<u>Cervus elaphus</u>	24	65	17
<u>Odocoileus sp.</u>	1472	4505	3297
<u>Antilocapra americana</u>	59	36	155
<u>Ovis canadensis</u>	345	670	489
<u>Bison bison</u>	10	15	2
<u>Equus caballus</u>	0	0	27
Leporidae	18	17	19
<u>Marmota flaviventris</u>	275	266	127
<u>Spermophilus sp.</u>	7	76	22
<u>Neotoma cinerea</u>	2	3	4
<u>Castor canadensis</u>	9	19	6
<u>Ondatra zibethicus</u>	2	0	1
<u>Erethizon dorsatum</u>	68	6	4
Canidae	32	128	38
<u>Ursus sp.</u>	4	4	2
Mustelidae	11	16	17
<u>Lynx rufus</u>	0	8	1
Salmonidae	394	2277	552
Cyprinidae	522	211	71
Catostomidae	1	16	1
TOTAL	3255	8338	4852

Derived from Campbell (1985: Table D:6)

CHAPTER VI

ANALYSIS OF TEMPORAL UNITS

Before proceeding, I reiterate that the Shannon Diversity Index is a combined measure of evenness and richness used in this study to measure dietary diversity. Higher values indicate greater diversity and more diffuse economic strategies. Lower values indicate less dietary diversity and more focal economic strategies.

Pielou's Index is a measure of evenness. Values approaching 1 indicate an even, generalized exploitation pattern typical of diffuse economic systems. Values approaching 0 indicate uneven, specialized exploitation strategies where one or more species dominate the sample. This pattern is typical of focal economic systems.

The Species Richness Index is a measure of richness or diet breadth. High values indicate a wider variety of subsistence items in the diet than do low values.

All values are comparative. One cannot determine exactly how much more or less diverse, even or rich, one economic system is than another.

SOUTHEASTERN PLATEAU

Windust Phase

The earliest documented occupation of the southeast Plateau occurs during the Windust Phase which is dated between 9950 and 7950 BP (Leonhardy and Rice 1970). The assemblage includes 417 specimens distributed among 13 faunal categories (Table XXIV). The sample is drawn from Marmes Rockshelter and Lind Coulee (Table XVIII).

Six categories of fauna each contribute 5% or more to the total faunal assemblage. These categories are bison (45%), elk (10%), mustelids (9%), deer (7%), birds (7%) and marmots (6%) (Table XXIV, Figure 6). Bison appear to have been an important resource during this period. They are rare in most other Plateau assemblages used in this study. Bison dominate the Lind Coulee sample whereas deer and antelope are the most abundant large mammals at Marmes. Fish do not appear in assemblages dating to this Phase.

The diversity index of .83 during the Windust Phase is the highest of any Southeast Plateau period (Table XXIV). This indicates that the Windust Phase subsistence pattern was more diffuse than any on the Southeast Plateau. The evenness value of .75 is the second highest value on the Southeast Plateau which suggests that relatively even proportions of fauna were acquired. The richness index of 4.6, also the second highest, indicates that a variety of

prey items were pursued (Table XXIV).

The dominance-diversity curve (Figure 7) drops steeply from the first (bison) to the second (elk) ranked resource indicating some specialization on bison. However, overall the fit of the curve remains high and flat across most species, indicating a broad based, non-focused economic system.

Windust/Cascade

This is a faunal sample from Granite Point that consists of assemblages C2, C3, C4 and B4. According to Gustafson (1972: Table 5.3), the assemblages can be dated between 8000 and 6700 BP. Using Leonhardy and Rice's (1970) chronology, the Cascade Phase dates between 7950 and 4950 BP, thus the sample probably represents early Cascade occupations. The sample contains 267 specimens distributed among 11 faunal categories (Table XXV).

Five faunal categories each contribute over 5% to the assemblage and are, in order of importance: deer (39%), elk (22%), ground squirrels (16%), leporids (13%) and canids (6%) (Table XXV, Figure 8). Bison and fish do not appear in this assemblage.

All indices are slightly lower than Windust Phase values. The diversity index is .69, the evenness index .67 and the richness index 4.1 (Table XXV). The dominance-diversity curve (Figure 9) for this period remains high and

flat across the first five faunal categories but overall is narrower than that observed during Windust. This suggests that diet breadth (as measured by richness) has contracted somewhat but the proportions of exploited fauna are still reasonably even.

Cascade Phase

The Cascade Phase is dated between 7950 and 4950 BP (Leonhardy and Rice 1970). The faunal sample is from Stratum III at Marmes Rockshelter which dates from 7870-6200 BP (Sheppard et.al. 1987: Table 2). The sample contains 268 specimens distributed among 9 faunal categories (Table XXVI).

Five categories each contribute over 5% to the faunal assemblage. The first three are ungulates and include deer (40%), antelope (29%) and elk (13%). Canids (7%) and leporids (6%) also figure prominently (Table XXVI, Figure 10).

The diversity index is .66, a slight drop from the preceding period. Although diversity values are dropping, the primary reason for this is narrowing dietary breadth. The evenness index actually climbs slightly to .69. The distribution of large ungulates is never more even on the Southeast Plateau than during this period. The richness index is by far the lowest observed on the Southeast Plateau at 3.3 (Table XXVI). This indicates that fewer kinds of

fauna are appearing as subsistence items than during any other period. The shape and height of the dominance-diversity curve (Figure 11) closely approximates the previous period but has constricted substantially from Windust reflecting the narrowed diet breadth.

Hatwai Complex

This period marks the earliest appearance of pithouse villages on the southeastern Plateau. The term Hatwai Complex has been recently introduced by Ames (1989: personal communication) to define and describe this discrete episode of settled occupation. Named after the Hatwai Site, the period dates from 5500 to about 4100 BP (Ames 1989: personal communication). The sample is derived from Hatwai and similarly dated occupations at Alpowa (Table XVIII). Only 179 specimens are in the sample which represents 12 faunal categories (Table XXVII).

This period marks a substantial departure from the preceding periods and a major shift in subsistence economy on the Southeast Plateau. Only three faunal categories each exceed 5% in contributing to the overall faunal assemblage. Remarkably, deer account for 74% of the fauna, followed by elk (8%) and canids (5%). Fish account for about 3% of the assemblage (Table XXVII, Figure 12).

The diversity index plunges to .47 during this period indicating a substantial shift to more focal adaptations

(Table XXVII). Species richness (4.9) has increased substantially over the Cascade Phase indicating that a greater variety of fauna are used as food items. In fact, the Hatwai Complex period has the highest richness index recorded on the Southeast Plateau.

The proportions of exploited fauna vary dramatically resulting in a low evenness index (.44) (Table XXVII). The Hatwai Complex economy is not diversified but dependent upon deer. This is reflected in the dominance-diversity curve (Figure 13) which is extremely steep between the first and second ranked species. The tail of the curve is flat on five faunal categories indicating that these categories contributed to diet breadth but were relatively unimportant in terms of dietary contribution.

Tucannon Phase

The Tucannon Phase is dated from 4950-2450 BP (Leonhardy and Rice 1970:23) and is made up of three faunal samples (Table XVIII). The samples from Alpowa and Hatwai date between 3400 and 2800 BP (Ames 1989: personal communication). The sample from Granite Point is dated around 3200 BP. Collectively, the samples comprise the largest assemblage from the southeastern Plateau with 889 specimens distributed among 14 faunal categories (Table XXVIII).

Only deer (80%) contribute over 5% to the entire assemblage. The remaining 15 categories contribute less than that amount. Ranked beneath deer are elk (5%), fish (4%), canids (3%) and leporids (2%) (Table XXVIII, Figure 14).

The diversity index of .40 is the lowest observed during any period on the Southeast Plateau. This suggests that Tucannon represents the most focal adaptative pattern on the Southeast Plateau. The evenness index of .35 is also the lowest for the region and indicates a very uneven or dominant exploitative pattern. Deer assume focal importance in the economy. The richness index of 4.4 marks a slight drop from the preceding period (Table XXVIII). The dominance-diversity curve (Figure 15) drops abruptly from the first to the second ranked species indicating the extreme importance of deer. The remaining curve is high and broad indicating that a variety of fauna other than deer are taken (compare with Windust, Figure 7).

Harder Phase

The Harder Phase is dated from 2450-650 BP (Leonhardy and Rice 1970). The faunal sample is from Alpowa and Marmes (Table XVIII) and consists of 517 specimens distributed among 15 faunal categories (Table XXIX).

Five faunal categories each contribute over 5% to the assemblage. These categories include deer (40%), bison

(18%), fish (12%), antelope (7%) and leporids (7%) (Table XXIX, Figure 16).

The diversity index of .83 nearly matches that observed during the Windust Phase and more than doubles that of the Tucannon Phase. The return to high dietary diversity values suggests a return to a diffuse economic system. Values for evenness also double to .70. The richness index of 5.2 is the highest recorded for the Southeast region (Table XXIX) marking an expansion of diet breadth. The indices suggest a more diversified, generalized subsistence pattern than that observed during the Tucannon Phase. The dominance-diversity curve for Harder (Figure 17) is high and flat and closely resembles the sigmoid curve characteristic of most natural communities (Figure 5).

Late Harder/Pigunin

This sample contains fauna from Granite Point and Wawawai (Table XVIII). The Granite Point material is from assemblage A1, B1a and C1b and is dated to less than 1000 BP (Leonhardy 1970). Since no artifactual materials in these assemblages indicated an historic period occupation (Leonhardy 1970: Tables 42, 43 and 44) a Numipu Phase occupation was ruled out. Thus the assemblage can be considered to represent Late Harder and/or the Pigunin Phase. Leonhardy and Rice (1970) date the Pigunin Phase between 650-250 BP.

The fauna from Wawawai are from Area A, a portion of the site that contained Assemblage 4, Component II, and is considered to be Late Harder (Yent 1976). Radiocarbon dates the component later than about 950 to 650 BP (Yent 1976: Table 3). No evidence for an historic occupation is present in Area A.

The Late Harder/Pigunin sample includes 397 specimens representing 12 faunal categories. Three faunal categories each contribute over 5% to the faunal inventory; these are deer (61%), fish (13%) and elk (9%) (Table XXX, Figure 18).

The diversity index of .62 is substantially lower than during the Harder Phase suggesting a less diffuse subsistence economy. The evenness value of .58 and the richness index of 4.2 also mark a decline (Table XXX). The dominance-diversity curve appears in Figure 19. The importance of deer is indicated by the steepness of the curve between the first and second ranked species.

Numipu Phase

The Numipu Phase represents the ethnographic period on the southeastern Plateau and dates from about 250-50 BP (Leonhardy and Rice 1970). Archaeological remains identified to this period most likely represent the Nez Perce or Palus.

The Numipu sample is drawn from Alpowa (Table XVIII). It contains 197 specimens distributed among 11 faunal

categories (Table XXXI). Five faunal categories each contribute over 5% to the overall assemblage. The categories include deer (34%), fish (26%), birds (14%), canids (7%) and domestic livestock (6%) (Table XXXI, Figure 20).

The diversity index is .78 during the Numipu Phase suggesting a return to a more diffuse subsistence economy. The evenness index is .75, the highest value observed on the Southeast Plateau. The richness index measures 4.3 (Table XXXI). The dominance-diversity curve for Numipu is high across eight faunal categories confirming the high evenness values for the assemblage (Figure 21).

WELLS RESERVOIR

Period 1 (7800-5500 BP)

The assemblage contains 495 specimens representing 13 faunal categories (Table XXXII). Four faunal categories each contribute over 5% to the faunal inventory and collectively account for 94% of the total assemblage (Table XXXII, Figure 22). Leporids account for 63% of the assemblage followed by salmonids (17%), canids (9%) and deer (5%). The high rank of leporids and canids is an unusual attribute of this assemblage.

The diversity and evenness indices are .53 and .47, respectively. The richness index is 4.5 (Table XXXII). The dominance-diversity curve closely resembles a geometric

distribution where each successive species is twice as abundant as the last (Figure 23, compare Figure 4). The tail of the curve is flat across five faunal categories indicating that they contribute little to the diet while inflating richness values.

Period 2 (4350-3800 BP)

This period represents a substantial departure from the preceding Period 1. The assemblage contains 607 specimens assignable to 17 faunal categories (Table XXXIII).

Seven categories comprising 83% of the faunal assemblage each contribute over 5% to the faunal inventory (Table XXXIII, Figure 24). The categories are leporids (16%), deer (15%), antelope (13%), salmonids (11%), cyprinids (11%), elk (10%) and catostomids (7%). Nearly one third of the sample is fish. Another six categories contribute from 1% to 5% of the faunal inventory while surprisingly few categories contribute under 1%.

Period 2 is the most diffuse exploitative pattern observed at any location on the Plateau. Both components of diversity, richness and evenness, account for this and all indices are the highest observed in this analysis (Table XXXIII). The diversity index of 1.03 is well above that observed during the preceding period. The evenness index of .84 almost doubles that of Period 1. The richness index is 5.7, the highest value recorded for any study area on the

Plateau. The dominance-diversity curve for Period 2 is high and flat indicating that the proportions of exploited fauna are very even with the exception of the last three or four faunal categories which are dietarily insignificant (Figure 25). Period 2 contrast sharply with Hatwai Complex-Tucannon with which it is contemporary.

Period 3 (3300-2200 BP)

Period 3 contains the largest faunal sample from Wells Reservoir. The assemblage has 2934 specimens distributed among 16 faunal categories (Table XXXIV).

One category, the salmonids, comprise 89% of the entire assemblage. No other fauna contribute over 5% to the faunal inventory (Table XXXIV, Figure 26). This distribution is in stark contrast with the subsistence pattern during Period 2 and is clearly an economy focused on salmon exploitation.

The second and third ranked categories include catostomids (2.7%) and birds (2.6%). Large artiodactyls including mountain sheep and antelope are ranked fourth and fifth, respectively. Deer are ranked sixth (Table XXXIV).

The diversity index (.26) and evenness index (.22) are both extremely low, in fact, the lowest scores observed anywhere on the Plateau. They underscore the predominance of salmonids in the assemblage and confirm the focal nature of the subsistence economy. The species richness index measures 4.3 (Table XXXIV) indicating a narrower range of

subsistence items than in Period 2. The dominance-diversity curve graphically shows the overwhelming presence of salmonids as the first ranked resource (Figure 27).

Period 4 (900 BP -)

The faunal assemblage of 2542 specimens represents 10 faunal categories (Table XXXV). Three faunal categories each contribute over 5% to the faunal assemblage while all remaining categories contribute less than 1%. The three dominant categories, all fish, are salmonids (62%), catostomids (28%) and cyprinids (9%) (Table XXXV, Figure 28).

Interestingly, the focal salmonid economy characteristic of Period 3 has broadened to include significant numbers of other fishes. Birds and leporids account for the fourth and fifth ranked faunal categories. Large artiodactyls are nearly absent from the assemblage.

The diversity index of .4 is more diffuse than Period 3 but still extremely focal. Period 4 is an excellent example of a focal economy exploiting closely related species using "similar tools and techniques" (Cleland 1976:61). In terms of an adaptation, it is arguably more focal than Period 3. The evenness index, also .4, is nearly double that of preceding Period 3. The richness index (2.6) is the lowest observed at any location on the Plateau (Table XXXV), an indication that dietary breadth has been substantially

reduced. The dominance-diversity curve for Period 4 is steep and narrow, confirming almost exclusive reliance on the three varieties of fishes and an overall reduction in the variety of exploited fauna (Figure 29).

CHIEF JOSEPH RESERVOIR

Kartar Phase (6000-4000 BP)

The faunal assemblage of 3255 specimens is distributed among 18 faunal categories (Table XXXVI). Five categories each contribute 5% or more to the Kartar assemblage and collectively account for over 92% of the faunal assemblage. Deer appear most frequently (45%), followed by fish, including cyprinids (16%) and salmonids (12%), mountain sheep (11%), and marmots (8%) (Table XXXVI, Figure 30).

The diversity index (.74) is higher during this period than during any phase at Chief Joseph Reservoir; this suggests that the subsistence economy is more diffuse than at any other time. Evenness (.59) values are also higher during this period than during any phase at Chief Joseph Reservoir. The richness index measures 4.8 (Table XXXVI). The dominance-diversity curve presented in Figure 31 closely resembles a geometric distribution (compare Figure 4).

Hudnut Phase (4000-2000 BP)

This is the largest Chief Joseph faunal assemblage containing 8338 specimens distributed among 18 faunal

categories (Table XXXVII). Only three categories contribute more than 5% each to the total faunal assemblage. They collectively make up about 89% of the assemblage. The categories are deer (54%), salmonids (27%) and mountain sheep (8%). Marmots (3%) and cyprinids (3%) have dropped below 5% (Table XXXVII, Figure 32).

The diversity index of .58 marks a slight drop from the Kartar Phase. Evenness (.46) and richness indices (4.3) also decline. The economy is still diffuse but less so than during the Kartar Phase. The dominance-diversity curve for Hudnut also resembles a geometric distribution (Figure 33).

Coyote Creek Phase (2000-50 BP)

This faunal assemblage contains 4852 specimens distributed among 20 faunal categories, two more categories than either the Kartar or Hudnut Phases (Table XXXVIII). Again, deer (68%), salmonids (11%) and mountain sheep (10%) make up about 89% of the assemblage, contributing over 5% each to the faunal inventory. Antelope and marmots rank fourth and fifth (Table XXXVIII, Figure 34).

The diversity index of .52 and evenness index of .4 mark a gradual decrease from Hudnut and are the lowest values recorded at Chief Joseph Reservoir. The richness index of 5.2 is the highest recorded for the region. The high value primarily reflects the addition of two faunal categories over the previous phases. The economy can still

be described as diffuse but is becoming increasingly focal with deer being the primary candidate for intensified exploitation. The dominance-diversity curve for this phase is presented in Figure 35. The steepness between the first and second ranked species illustrates the importance of deer. Again, the curve is geometric, a trait that appears characteristic of Chief Joseph Reservoir.

TABLE XXIV
SOUTHEASTERN PLATEAU, WINDUST PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	41	9.83%	66.12414
<u>Odocoileus sp.</u>	31	7.43%	46.23221
<u>Antilocapra americana</u>	14	3.36%	16.04579
<u>Ovis canadensis</u>		0.00%	0
<u>Bison bison</u>	188	45.08%	427.5417
Domestic Stock		0.00%	0
Leporidae	20	4.80%	26.0206
<u>Marmota flaviventris</u>	24	5.76%	33.12507
<u>Spermophilus sp.</u>	12	2.88%	12.95017
<u>Neotoma cinerea</u>	5	1.20%	3.49485
<u>Castor canadensis</u>	5	1.20%	3.49485
<u>Ondatra zibethicus</u>	8	1.92%	7.22472
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	2	0.48%	0.60206
Mustelidae	38	9.11%	60.03178
Felidae		0.00%	0
Ursidae		0.00%	0
Osteichthyes		0.00%	0
Aves	29	6.95%	42.40954
TOTALS	417	100.00%	745.2975

Number of Categories	13
Log of Number of Categories	1.113943
Pielou's Evenness Index	0.747661
Species Richness Index	4.579915
Shannon Diversity Index	0.832852

Rank	Faunal Category	NISP	log NISP
1	<u>Bison</u>	188	2.274158
2	<u>Cervus</u>	41	1.612784
3	Mustelidae	38	1.579784
4	<u>Odocoileus</u>	31	1.491362
5	Aves	29	1.462398
6	<u>Marmota</u>	24	1.380211
7	Leporidae	20	1.30103
8	<u>Antilocapra</u>	14	1.146128
9	<u>Spermophilus</u>	12	1.079181
10	<u>Ondatra</u>	8	0.90309
11	<u>Castor</u>	5	0.69897
11	<u>Neotoma</u>	5	0.69897
12	Canidae	2	0.30103

TABLE XXV

SOUTHEASTERN PLATEAU, WINDUST/CASCADE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	59	22.10%	104.4803
<u>Odocoileus sp.</u>	103	38.58%	207.3222
<u>Antilocapra americana</u>	2	0.75%	0.60206
<u>Ovis canadensis</u>	1	0.37%	0
<u>Bison bison</u>		0.00%	0
Domestic Stock		0.00%	0
Leporidae	36	13.48%	56.02689
<u>Marmota flaviventris</u>	4	1.50%	2.40824
<u>Spermophilus sp.</u>	43	16.10%	70.23914
<u>Neotoma cinerea</u>	1	0.37%	0
<u>Castor canadensis</u>		0.00%	0
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	16	5.99%	19.26592
Mustelidae	1	0.37%	0
Felidae	1	0.37%	0
Ursidae		0.00%	0
Osteichthyes		0.00%	0
Aves		0.00%	0
TOTALS	267	100.00%	460.3448

Number of Categories	11
Log of Number of Categories	1.041393
Pielou's Evenness Index	0.674456
Species Richness Index	4.121143
Shannon Diversity Index	0.702374

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	103	2.012837
2	<u>Cervus</u>	59	1.770852
3	<u>Spermophilus</u>	43	1.633468
4	Leporidae	36	1.556303
5	Canidae	16	1.20412
6	<u>Marmota</u>	4	0.60206
7	<u>Antilocapra</u>	2	0.30103
8	Felidae	1	0
8	Mustelidae	1	0
8	<u>Neotoma</u>	1	0
8	<u>Ovis</u>	1	0

TABLE XXVI

SOUTHEASTERN PLATEAU, CASCADE PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	36	13.43%	56.02689
<u>Odocoileus sp.</u>	108	40.30%	219.6098
<u>Antilocapra americana</u>	79	29.48%	149.9125
<u>Ovis canadensis</u>		0.00%	0
<u>Bison bison</u>		0.00%	0
Domestic Stock		0.00%	0
Leporidae	15	5.60%	17.64137
<u>Marmota flaviventris</u>	2	0.75%	0.60206
<u>Spermophilus sp.</u>	2	0.75%	0.60206
<u>Neotoma cinerea</u>	2	0.75%	0.60206
<u>Castor canadensis</u>		0.00%	0
<u>Ondatra zibethicus</u>	4	1.49%	2.40824
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	20	7.46%	26.0206
Mustelidae		0.00%	0
Felidae		0.00%	0
Ursidae		0.00%	0
Osteichthyes		0.00%	0
Aves		0.00%	0
TOTALS	268	100.00%	473.4256

Number of Categories	9
Log of Number of Categories	0.954243
Pielou's Evenness Index	0.693347
Species Richness Index	3.29471
Shannon Diversity Index	0.661621

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	108	2.033424
2	<u>Antilocapra</u>	79	1.897627
3	<u>Cervus</u>	36	1.556303
4	Canidae	20	1.30103
5	Leporidae	15	1.176091
6	<u>Ondatra</u>	4	0.60206
7	<u>Neotoma</u>	2	0.30103
7	<u>Marmota</u>	2	0.30103
7	<u>Spermophilus</u>	2	0.30103

TABLE XXVII

SOUTHEASTERN PLATEAU, HATWAI COMPLEX
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	14	7.82%	16.04579
<u>Odocoileus sp.</u>	133	74.30%	282.4723
<u>Antilocapra americana</u>	1	0.56%	0
<u>Ovis canadensis</u>		0.00%	0
<u>Bison bison</u>	1	0.56%	0
Domestic Stock		0.00%	0
Leporidae	1	0.56%	0
<u>Marmota flaviventris</u>		0.00%	0
<u>Spermophilus sp.</u>		0.00%	0
<u>Neotoma cinerea</u>		0.00%	0
<u>Castor canadensis</u>	1	0.56%	0
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	9	5.03%	8.588183
Mustelidae	3	1.68%	1.431364
Felidae	6	3.35%	4.668908
Ursidae	1	0.56%	0
Osteichthyes	5	2.79%	3.49485
Aves	4	2.23%	2.40824
TOTALS	179	100.00%	319.1096

Number of Categories	12
Log of Number of Categories	1.079181
Pielou's Evenness Index	0.435625
Species Richness Index	4.882698
Shannon Diversity Index	0.470118

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	133	2.123852
2	<u>Cervus</u>	14	1.146128
3	Canidae	9	0.954243
4	Felidae	6	0.778151
5	Osteichthyes	5	0.69897
6	Aves	4	0.60206
7	Mustelidae	3	0.477121
8	<u>Castor</u>	1	0
8	<u>Antilocapra</u>	1	0
8	Leporidae	1	0
8	Ursidae	1	0
8	<u>Bison</u>	1	0

TABLE XXVIII

SOUTHEASTERN PLATEAU, TUCANNON PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	41	4.61%	66.12414
<u>Odocoileus sp.</u>	713	80.20%	2034.253
<u>Antilocapra americana</u>	14	1.57%	16.04579
<u>Ovis canadensis</u>	7	0.79%	5.915686
<u>Bison bison</u>		0.00%	0
Domestic Stock		0.00%	0
Leporidae	21	2.36%	27.76661
<u>Marmota flaviventris</u>	2	0.22%	0.60206
<u>Spermophilus sp.</u>		0.00%	0
<u>Neotoma cinerea</u>		0.00%	0
<u>Castor canadensis</u>	2	0.22%	0.60206
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>	1	0.11%	0
Canidae	23	2.59%	31.31974
Mustelidae	7	0.79%	5.915686
Felidae	6	0.67%	4.668908
Ursidae	1	0.11%	0
Osteichthyes	35	3.94%	54.04238
Aves	16	1.80%	19.26592
TOTALS	889	100.00%	2266.522
Number of Categories			14
Log of Number of Categories			1.146128
Pielou's Evenness Index			0.348463
Species Richness Index			4.408421
Shannon Diversity Index			0.399383

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	713	2.85309
2	<u>Cervus</u>	41	1.612784
3	Osteichthyes	35	1.544068
4	Canidae	23	1.361728
5	Leporidae	21	1.322219
6	Aves	16	1.20412
7	<u>Antilocapra</u>	14	1.146128
8	Mustelidae	7	0.845098
8	<u>Ovis</u>	7	0.845098
9	Felidae	6	0.778151
10	<u>Marmota</u>	2	0.30103
10	<u>Castor</u>	2	0.30103
11	<u>Erethizon</u>	1	0
11	Ursidae	1	0

TABLE XXIX

SOUTHEASTERN PLATEAU, HARDER PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	16	3.09%	19.26592
<u>Odocoileus sp.</u>	209	40.43%	484.9106
<u>Antilocapra americana</u>	37	7.16%	58.02346
<u>Ovis canadensis</u>	6	1.16%	4.668908
<u>Bison bison</u>	93	17.99%	183.0689
Domestic Stock		0.00%	0
Leporidae	37	7.16%	58.02346
<u>Marmota flaviventris</u>	5	0.97%	3.49485
<u>Spermophilus sp.</u>	22	4.26%	29.5333
<u>Neotoma cinerea</u>	4	0.77%	2.40824
<u>Castor canadensis</u>	3	0.58%	1.431364
<u>Ondatra zibethicus</u>	2	0.39%	0.60206
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	15	2.90%	17.64137
Mustelidae	1	0.19%	0
Felidae		0.00%	0
Ursidae		0.00%	0
Osteichthyes	60	11.61%	106.6891
Aves	7	1.35%	5.915686
TOTALS	517	100.00%	975.6772
Number of Categories			15
Log of Number of Categories			1.176091
Pielou's Evenness Index			0.702582
Species Richness Index			5.159406
Shannon Diversity Index			0.826301

TABLE XXIX
SOUTHEASTERN PLATEAU, HARDER PHASE
SUMMARY FAUNAL DATA
(continued)

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	209	2.320146
2	<u>Bison</u>	93	1.968483
3	<u>Osteichthyes</u>	60	1.778151
4	<u>Leporidae</u>	37	1.568202
4	<u>Antilocapra</u>	37	1.568202
5	<u>Spermophilus</u>	22	1.342423
6	<u>Cervus</u>	16	1.20412
7	<u>Canidae</u>	15	1.176091
8	<u>Aves</u>	7	0.845098
9	<u>Ovis</u>	6	0.778151
10	<u>Marmota</u>	5	0.69897
11	<u>Neotoma</u>	4	0.60206
12	<u>Castor</u>	3	0.477121
13	<u>Ondatra</u>	2	0.30103
14	<u>Mustelidae</u>	1	0

TABLE XXX

SOUTHEASTERN PLATEAU, LATE HARDER/PIQUININ
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	35	8.82%	54.04238
<u>Odocoileus sp.</u>	244	61.46%	582.5231
<u>Antilocapra americana</u>	7	1.76%	5.915686
<u>Ovis canadensis</u>	8	2.02%	7.22472
<u>Bison bison</u>	8	2.02%	7.22472
Domestic Stock		0.00%	0
Leporidae	5	1.26%	3.49485
<u>Marmota flaviventris</u>		0.00%	0
<u>Spermophilus sp.</u>	17	4.28%	20.91763
<u>Neotoma cinerea</u>	8	2.02%	7.22472
<u>Castor canadensis</u>		0.00%	0
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	9	2.27%	8.588183
Mustelidae	2	0.50%	0.60206
Felidae		0.00%	0
Ursidae		0.00%	0
Osteichthyes	50	12.59%	84.9485
Aves	4	1.01%	2.40824
TOTALS	397	100.00%	785.1148

Number of Categories	12
Log of Number of Categories	1.079181
Pielou's Evenness Index	0.575595
Species Richness Index	4.232738
Shannon Diversity Index	0.621171

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	244	2.38739
2	Osteichthyes	50	1.69897
3	<u>Cervus</u>	35	1.544068
4	<u>Spermophilus</u>	17	1.230449
5	Canidae	9	0.954243
6	<u>Neotoma</u>	8	0.90309
6	<u>Bison</u>	8	0.90309
6	<u>Ovis</u>	8	0.90309
7	<u>Antilocapra</u>	7	0.845098
8	Leporidae	5	0.69897
9	Aves	4	0.60206
10	Mustelidae	2	0.30103

TABLE XXXI

SOUTHEASTERN PLATEAU, NUMIPU PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus sp.</u>	1	0.51%	0
<u>Odocoileus sp.</u>	66	33.50%	120.0899
<u>Antilocapra americana</u>		0.00%	0
<u>Ovis canadensis</u>	6	3.05%	4.668908
<u>Bison bison</u>	9	4.57%	8.588183
Domestic Stock	12	6.09%	12.95017
Leporidae	7	3.55%	5.915686
<u>Marmota flaviventris</u>		0.00%	0
<u>Spermophilus sp.</u>	1	0.51%	0
<u>Neotoma cinerea</u>		0.00%	0
<u>Castor canadensis</u>		0.00%	0
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
Canidae	14	7.11%	16.04579
Mustelidae	1	0.51%	0
Felidae		0.00%	0
Ursidae		0.00%	0
Osteichthyes	52	26.40%	89.23217
Aves	28	14.21%	40.52042
TOTALS	197	100.00%	298.0112
Number of Categories			11
Log of Number of Categories			1.041393
Pielou's Evenness Index			0.750647
Species Richness Index			4.358312
Shannon Diversity Index			0.781719

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	66	1.819544
2	Osteichthyes	52	1.716003
3	Aves	28	1.447158
4	Canidae	14	1.146128
5	Domestic Stock	12	1.079181
6	<u>Bison</u>	9	0.954243
7	Leporidae	7	0.845098
8	<u>Ovis</u>	6	0.778151
9	Mustelidae	1	0
9	<u>Cervus</u>	1	0
9	<u>Spermophilus</u>	1	0

TABLE XXXII

WELLS RESERVOIR, PERIOD 1
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus canadensis</u>		0.00%	0
<u>Odocoileus sp.</u>	25	5.05%	34.9485
<u>Antilocapra americana</u>	1	0.20%	0
<u>Ovis canadensis</u>	1	0.20%	0
<u>Bison bison</u>		0.00%	0
Leporidae	314	63.43%	784.0359
<u>Marmota</u>	6	1.21%	4.668908
<u>Spermophilus sp.</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
<u>Castor canadensis</u>	1	0.20%	0
<u>Ondatra zibethicus</u>	2	0.40%	0.60206
Canidae	45	9.09%	74.39456
<u>Ursus sp.</u>		0.00%	0
Mustelidae	1	0.20%	0
<u>Procyon lotor</u>		0.00%	0
Salmonidae	83	16.77%	159.2835
Cyprinidae	1	0.20%	0
Catostomidae		0.00%	0
Acipenseridae	3	0.61%	1.431364
Aves	12	2.42%	12.95017
TOTAL	495	100.00%	1072.315

Number of Categories	13
Log of Number of Categories	1.113943
Pielou's Evenness Index	0.474272
Species Richness Index	4.453343
Shannon Diversity Index	0.528312

Rank	Faunal Category	NISP	log NISP
1	Leporidae	314	2.49693
2	Salmonidae	83	1.919078
3	Canidae	45	1.653213
4	<u>Odocoileus</u>	25	1.39794
5	Aves	12	1.079181
6	<u>Marmota</u>	6	0.778151
7	Acipenseridae	3	0.477121
8	<u>Ondatra</u>	2	0.30103
9	Cyprinidae	1	0
9	Mustelidae	1	0
9	<u>Antilocapra</u>	1	0
9	<u>Ovis</u>	1	0
9	<u>Castor</u>	1	0

TABLE XXXIII

WELLS RESERVOIR, PERIOD 2
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus canadensis</u>	59	9.72%	104.4803
<u>Odocoileus sp.</u>	94	15.49%	185.474
<u>Antilocapra americana</u>	80	13.18%	152.2472
<u>Ovis canadensis</u>	13	2.14%	14.48126
<u>Bison bison</u>		0.00%	0
<u>Leporidae</u>	97	15.98%	192.7169
<u>Marmota</u>	20	3.29%	26.0206
<u>Spermophilus sp.</u>	1	0.16%	0
<u>Erethizon dorsatum</u>	1	0.16%	0
<u>Castor canadensis</u>	9	1.48%	8.588183
<u>Ondatra zibethicus</u>	1	0.16%	0
<u>Canidae</u>	18	2.97%	22.59491
<u>Ursus sp.</u>	11	1.81%	11.45532
<u>Mustelidae</u>	2	0.33%	0.60206
<u>Procyon lotor</u>		0.00%	0
<u>Salmonidae</u>	65	10.71%	117.8394
<u>Cyprinidae</u>	65	10.71%	117.8394
<u>Catostomidae</u>	44	7.25%	72.31192
<u>Acipenseridae</u>		0.00%	0
<u>Aves</u>	27	4.45%	38.64682
TOTAL	607	100.00%	1065.298
Number of Categories			17
Log of Number of Categories			1.230449
Pielou's Evenness Index			0.835603
Species Richness Index			5.748802
Shannon Diversity Index			1.028167

TABLE XXXIII
 WELLS RESERVOIR, PERIOD 2
 SUMMARY FAUNAL DATA
 (continued)

Rank	Faunal Category	NISP	log NISP
1	Leporidae	97	1.986772
2	<u>Odocoileus</u>	94	1.973128
3	<u>Antilocapra</u>	80	1.90309
4	Cyprinidae	65	1.812913
4	Salmonidae	65	1.812913
5	<u>Cervus</u>	59	1.770852
6	Catostomidae	44	1.643453
7	Aves	27	1.431364
8	<u>Marmota</u>	20	1.30103
9	Canidae	18	1.255273
10	<u>Ovis</u>	13	1.113943
11	<u>Ursus</u>	11	1.041393
12	<u>Castor</u>	9	0.954243
13	Mustelidae	2	0.30103
14	<u>Erethizon</u>	1	0
14	<u>Spermophilus</u>	1	0
14	<u>Ondatra</u>	1	0

TABLE XXXIV
WELLS RESERVOIR, PERIOD 3
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus canadensis</u>	4	0.14%	2.40824
<u>Odocoileus sp.</u>	25	0.85%	34.9485
<u>Antilocapra americana</u>	27	0.92%	38.64682
<u>Ovis canadensis</u>	31	1.06%	46.23221
<u>Bison bison</u>	1	0.03%	0
<u>Leporidae</u>	13	0.44%	14.48126
<u>Marmota</u>	18	0.61%	22.59491
<u>Spermophilus sp.</u>		0.00%	0
<u>Erethizon dorsatum</u>	1	0.03%	0
<u>Castor canadensis</u>	14	0.48%	16.04579
<u>Ondatra zibethicus</u>		0.00%	0
<u>Canidae</u>	12	0.41%	12.95017
<u>Ursus sp.</u>		0.00%	0
<u>Mustelidae</u>	12	0.41%	12.95017
<u>Procyon lotor</u>	2	0.07%	0.60206
<u>Salmonidae</u>	2603	88.72%	8890.479
<u>Cyprinidae</u>	13	0.44%	14.48126
<u>Catostomidae</u>	80	2.73%	152.2472
<u>Acipenseridae</u>		0.00%	0
<u>Aves</u>	78	2.66%	147.5834
TOTAL	2934	100.00%	9406.651
Number of Categories			16
Log of Number of Categories			1.20412
Pielou's Evenness Index			0.217068
Species Richness Index			4.325933
Shannon Diversity Index			0.261376

TABLE XXXIV
WELLS RESERVOIR, PERIOD 3
SUMMARY FAUNAL DATA
(continued)

Rank	Faunal Category	NISP	log NISP
1	Salmonidae	2603	3.415474
2	Catostomidae	80	1.90309
3	Aves	78	1.892095
4	<u>Ovis</u>	31	1.491362
5	<u>Antilocapra</u>	27	1.431364
6	<u>Odocoileus</u>	25	1.39794
7	<u>Marmota</u>	18	1.255273
8	<u>Castor</u>	14	1.146128
9	Leporidae	13	1.113943
9	Cyprinidae	13	1.113943
10	Mustelidae	12	1.079181
10	Canidae	12	1.079181
11	<u>Cervus</u>	4	0.60206
12	<u>Procyon</u>	2	0.30103
13	<u>Erethizon</u>	1	0
13	<u>Bison</u>	1	0

TABLE XXXV

WELLS RESERVOIR, PERIOD 4
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus canadensis</u>	1	0.04%	0
<u>Odocoileus sp.</u>	1	0.04%	0
<u>Antilocapra americana</u>		0.00%	0
<u>Ovis canadensis</u>		0.00%	0
<u>Bison bison</u>		0.00%	0
Leporidae	6	0.24%	4.668908
<u>Marmota</u>	1	0.04%	0
<u>Spermophilus sp.</u>		0.00%	0
<u>Erethizon dorsatum</u>		0.00%	0
<u>Castor canadensis</u>	2	0.08%	0.60206
<u>Ondatra zibethicus</u>		0.00%	0
Canidae	4	0.16%	2.40824
<u>Ursus sp.</u>		0.00%	0
Mustelidae		0.00%	0
<u>Procyon lotor</u>		0.00%	0
Salmonidae	1575	61.96%	5035.717
Cyprinidae	219	8.62%	512.5573
Catostomidae	720	28.32%	2057.279
Acipenseridae		0.00%	0
Aves	13	0.51%	14.48126
TOTAL	2542	100.00%	7627.714
Number of Categories			10
Log of Number of Categories			1
Pielou's Evenness Index			0.404501
Species Richness Index			2.643036
Shannon Diversity Index			0.404501

Rank	Faunal Category	NISP	log NISP
1	Salmonidae	1575	3.197281
2	Catostomidae	720	2.857332
3	Cyprinidae	219	2.340444
4	Aves	13	1.113943
5	Leporidae	6	0.778151
6	Canidae	4	0.60206
7	<u>Castor</u>	2	0.30103
8	<u>Marmota</u>	1	0
8	<u>Odocoileus</u>	1	0
8	<u>Cervus</u>	1	0

TABLE XXXVI

CHIEF JOSEPH RESERVOIR, KARTAR PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus elaphus</u>	24	0.74%	33.12507
<u>Odocoileus sp.</u>	1472	45.22%	4663.16
<u>Antilocapra americana</u>	59	1.81%	104.4803
<u>Ovis canadensis</u>	345	10.60%	875.5476
<u>Bison bison</u>	10	0.31%	10
<u>Equus caballus</u>		0.00%	0
<u>Leporidae</u>	18	0.55%	22.59491
<u>Marmota flaviventris</u>	275	8.45%	670.8165
<u>Spermophilus sp.</u>	7	0.22%	5.915686
<u>Neotoma cinerea</u>	2	0.06%	0.60206
<u>Castor canadensis</u>	9	0.28%	8.588183
<u>Ondatra zibethicus</u>	2	0.06%	0.60206
<u>Erethizon dorsatum</u>	68	2.09%	124.6106
<u>Canidae</u>	32	0.98%	48.1648
<u>Ursus sp.</u>	4	0.12%	2.40824
<u>Mustelidae</u>	11	0.34%	11.45532
<u>Lynx rufus</u>		0.00%	0
<u>Salmonidae</u>	394	12.10%	1022.626
<u>Cyprinidae</u>	522	16.04%	1418.624
<u>Catostomidae</u>	1	0.03%	0
TOTAL	3255	100.00%	9023.321
Number of Categories			18
Log of Number of Categories			1.255273
Pielou's Evenness Index			0.58984
Species Richness Index			4.839787
Shannon Diversity Index			0.740409

TABLE XXXVI
CHIEF JOSEPH RESERVOIR, KARTAR PHASE
SUMMARY FAUNAL DATA
(continued)

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	1472	3.167908
2	<u>Cyprinidae</u>	522	2.717671
3	<u>Salmonidae</u>	394	2.595496
4	<u>Ovis</u>	345	2.537819
5	<u>Marmota</u>	275	2.439333
6	<u>Erethizon</u>	68	1.832509
7	<u>Antilocapra</u>	59	1.770852
8	<u>Canidae</u>	32	1.50515
9	<u>Cervus</u>	24	1.380211
10	<u>Leporidae</u>	18	1.255273
11	<u>Mustelidae</u>	11	1.041393
12	<u>Bison</u>	10	1
13	<u>Castor</u>	9	0.954243
14	<u>Spermophilus</u>	7	0.845098
15	<u>Ursus</u>	4	0.60206
16	<u>Neotoma</u>	2	0.30103
16	<u>Ondatra</u>	2	0.30103
17	<u>Catostomidae</u>	1	0

TABLE XXXVII

CHIEF JOSEPH RESERVOIR, HUDNUT PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus elaphus</u>	65	0.78%	117.8394
<u>Odocoileus sp.</u>	4505	54.03%	16459.9
<u>Antilocapra americana</u>	36	0.43%	56.02689
<u>Ovis canadensis</u>	670	8.04%	1893.47
<u>Bison bison</u>	15	0.18%	17.64137
<u>Equus caballus</u>		0.00%	0
<u>Leporidae</u>	17	0.20%	20.91763
<u>Marmota flaviventris</u>	266	3.19%	645.0185
<u>Spermophilus sp.</u>	76	0.91%	142.9418
<u>Neotoma cinerea</u>	3	0.04%	1.431364
<u>Castor canadensis</u>	19	0.23%	24.29632
<u>Ondatra zibethicus</u>		0.00%	0
<u>Erethizon dorsatum</u>	6	0.07%	4.668908
<u>Canidae</u>	128	1.54%	269.7229
<u>Ursus sp.</u>	4	0.05%	2.40824
<u>Mustelidae</u>	16	0.19%	19.26592
<u>Lynx rufus</u>	8	0.10%	7.22472
<u>Salmonidae</u>	2277	27.31%	7644.716
<u>Cyprinidae</u>	211	2.53%	490.4236
<u>Catostomidae</u>	16	0.19%	19.26592
TOTAL	8338	100.00%	27837.17
Number of Categories			18
Log of Number of Categories			1.255273
Pielou's Evenness Index			0.464019
Species Richness Index			4.33556
Shannon Diversity Index			0.582471

TABLE XXXVII

CHIEF JOSEPH RESERVOIR, HUDNUT PHASE
SUMMARY FAUNAL DATA
(continued)

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	4505	3.653695
2	Salmonidae	2277	3.357363
3	<u>Ovis</u>	670	2.826075
4	<u>Marmota</u>	266	2.424882
5	Cyprinidae	211	2.324282
6	Canidae	128	2.10721
7	<u>Spermophilus</u>	76	1.880814
8	<u>Cervus</u>	65	1.812913
9	<u>Antilocapra</u>	36	1.556303
10	<u>Castor</u>	19	1.278754
11	Leporidae	17	1.230449
12	Mustelidae	16	1.20412
12	Catostomidae	16	1.20412
13	<u>Bison</u>	15	1.176091
14	<u>Lynx</u>	8	0.90309
15	<u>Erethizon</u>	6	0.778151
16	<u>Ursus</u>	4	0.60206
17	<u>Neotoma</u>	3	0.477121

TABLE XXXVIII

CHIEF JOSEPH RESERVOIR, COYOTE CREEK PHASE
SUMMARY FAUNAL DATA

FAUNAL CATEGORY	NISP	%	NISP* log NISP
<u>Cervus elaphus</u>	17	0.35%	20.91763
<u>Odocoileus sp.</u>	3297	67.95%	11599.24
<u>Antilocapra americana</u>	155	3.19%	339.5014
<u>Ovis canadensis</u>	489	10.08%	1315.072
<u>Bison bison</u>	2	0.04%	0.60206
<u>Equus caballus</u>	27	0.56%	38.64682
<u>Leporidae</u>	19	0.39%	24.29632
<u>Marmota flaviventris</u>	127	2.62%	267.1831
<u>Spermophilus sp.</u>	22	0.45%	29.5333
<u>Neotoma cinerea</u>	4	0.08%	2.40824
<u>Castor canadensis</u>	6	0.12%	4.668908
<u>Ondatra zibethicus</u>	1	0.02%	0
<u>Erethizon dorsatum</u>	4	0.08%	2.40824
<u>Canidae</u>	38	0.78%	60.03178
<u>Ursus sp.</u>	2	0.04%	0.60206
<u>Mustelidae</u>	17	0.35%	20.91763
<u>Lynx rufus</u>	1	0.02%	0
<u>Salmonidae</u>	552	11.38%	1513.55
<u>Cyprinidae</u>	71	1.46%	131.4393
<u>Catostomidae</u>	1	0.02%	0
TOTAL	4852	100.00%	15371.02
Number of Categories			20
Log of Number of Categories			1.30103
Pielou's Evenness Index			0.398104
Species Richness Index			5.15475
Shannon Diversity Index			0.517945

TABLE XXXVIII

CHIEF JOSEPH RESERVOIR, COYOTE CREEK PHASE
SUMMARY FAUNAL DATA
(continued)

Rank	Faunal Category	NISP	log NISP
1	<u>Odocoileus</u>	3297	3.518119
2	Salmonidae	552	2.741939
3	<u>Ovis</u>	489	2.689309
4	<u>Antilocapra</u>	155	2.190332
5	<u>Marmota</u>	127	2.103804
6	Cyprinidae	71	1.851258
7	Canidae	38	1.579784
8	<u>Equus</u>	27	1.431364
9	<u>Spermophilus</u>	22	1.342423
10	Leporidae	19	1.278754
11	Mustelidae	17	1.230449
11	<u>Cervus</u>	17	1.230449
12	<u>Castor</u>	6	0.778151
13	<u>Neotoma</u>	4	0.60206
13	<u>Erethizon</u>	4	0.60206
14	<u>Bison</u>	2	0.30103
14	<u>Ursus</u>	2	0.30103
15	Catostomidae	1	0
15	<u>Ondatra</u>	1	0
15	<u>Lynx</u>	1	0

Figure 6. Histogram showing the relative frequency (%) of faunal categories during the Windust Phase.

Figure 7. Windust Phase dominance-diversity curve.

Figure 8. Histogram showing the relative frequency (%) of faunal categories during the Windust/Cascade period.

Figure 9. Windust/Cascade dominance-diversity curve.

Figure 10. Histogram showing the relative frequency (%) of faunal categories during the Cascade Phase.

Figure 11. Cascade Phase dominance-diversity curve.

Figure 12. Histogram showing the relative frequency (%) of faunal categories during the Hatwai Complex period.

Figure 13. Hatwai Complex dominance-diversity curve.

Figure 14. Histogram showing the relative frequency (%) of faunal categories during the Tucannon Phase.

Figure 15. Tucannon Phase dominance-diversity curve.

Figure 16. Histogram showing the relative frequency (%) of faunal categories during the Harder Phase.

Figure 17. Harder Phase dominance-diversity curve.

Figure 18. Histogram showing the relative frequency (%) of faunal categories during the Late Harder/Piqunin period.

Figure 19. Late Harder/Piqunin dominance-diversity curve.

Figure 20. Histogram showing the relative frequency (%) of faunal categories during the Numipu Phase.

Figure 21. Numipu Phase dominance-diversity curve.

Figure 22. Histogram showing the relative frequency (%) of faunal categories during Period 1.

Figure 23. Period 1 dominance-diversity curve.

Figure 24. Histogram showing the relative frequency (%) of faunal categories during Period 2.

Figure 25. Period 2 dominance-diversity curve.

Figure 26. Histogram showing the relative frequency (%) of faunal categories during Period 3.

Figure 27. Period 3 dominance-diversity curve.

Figure 28. Histogram showing the relative frequency (%) of faunal categories during Period 4.

Figure 29. Period 4 dominance-diversity curve.

Figure 30. Histogram showing the relative frequency (%) of faunal categories during the Kartar Phase.

Figure 31. Karter Phase dominance-diversity curve.

Figure 32. Histogram showing the relative frequency (%) of faunal categories during the Hudnut Phase.

Figure 33. Hudnut Phase dominance-diversity curve.

Figure 34. Histogram showing relative frequency (%) of faunal categories during the Coyote Creek Phase.

Figure 35. Coyote Creek Phase dominance-diversity curve.

CHAPTER VII

SUMMARY ANALYSIS OF TEMPORAL UNITS

This section will discuss subsistence trends within each study area and compare them with one another to document subsistence variability. Table XXXIX presents the summary indices by study area and cultural phase. Three figures are provided that plot index values along a time line (Figure 36 - Shannon Diversity Index, Figure 37 - Pielou's Evenness Index, Figure 38 - Species Richness Index).

The positioning of phases and periods along the time line is approximate. The midpoint of the phase or period was assigned to the closest 500 year increment. The Hudnut Phase for example, falls between 4000 and 2000 BP. The mean date is 3000 BP which happens to fall on a 500 year increment.

In addition, tables and histograms have been constructed that show summary faunal data for each study area. Faunal categories were combined to form six major faunal groups. These groups include 1) all ungulates other than deer, 2) deer, 3) rodents and leporids, 4) carnivores, 5) fishes, and 6) birds.

SOUTHEASTERN PLATEAU

A number of subsistence trends are apparent on the Southeast Plateau. Dietary diversity is high during the Windust Phase (.83) but drops steadily to a low point during the Tucannon Phase (.40) (Table XXXIX, Figure 36). Both Hatwai Complex and Tucannon mark significant departures from preceeding or succeeding subsistence economies in terms of low diversity and low evenness. Diversity values rise during Harder (.826) and nearly match that of Windust. During the period represented by Late Harder/Pigunin diversity values drop slightly (.62) but rebound with the ethnographic occupation (.78) (Figure 36).

The evenness indices closely mirror the pattern displayed by the diversity indices (Table XXXIX, Figure 37). Hatwai Complex and Tucannon are clearly focal economies specializing on deer while Windust, Harder and Numipu show much more diffuse faunal exploitation patterns.

Species richness values decrease from Windust (4.6) and reach a lowpoint in Cascade (3.3). Richness values then rise with little variation beyond Hatwai Complex (Table XXXIX, Figure 38). The limited range of subsistence fauna during Cascade seems unusual. If Altithermal conditions made subsistence pursuits more difficult, higher richness values might be expected since more "marginal" fauna would be pursued and utilized for food (c.f. Pianka 1983).

Periods such as Hatwai Complex and Harder with very dissimilar evenness indices are comparable in terms of richness.

The Windust Phase fauna reflect a diffuse, diversified economy typical of broad spectrum foragers. High evenness values suggests a predation strategy involving search rather than pursuit.

This period has the heaviest reliance on ungulates other than deer (58%) including bison, elk and antelope (Table XL, Figure 39). Some specialization on bison is apparent. On the Southeast Plateau, deer (7%) are least important during this phase (Figure 39) even though they are the primary subsistence fauna at Marmes (Table XV). Deer remains appear with increasing frequency in each period up to Tucannon where they become the dominant remains.

Rodents and leporids (18%) are important subsistence items during Windust times (Table XL, Figure 39). Marmots are the most important rodent, but a variety of others such as ground squirrels, muskrats, beavers and woodrats suggest that hunting was opportunistic and based on an encounter strategy (Table XXIV).

Carnivores (10%) are primarily mustelids, specifically badgers and skunks (Table XL, Figure 39). Neither species is likely to have been a valued furbearer. Mustelids figure prominently only at Lind Coulee and their presence may be unrelated to human occupation at the site (Table XI).

Canids, identified as coyotes, are the only carnivore at Marmes (Table XIV). Canids are not as common in Windust as in later periods. This might suggest that the mutualistic relationship between humans and canids was in an early stage of development. Incidentally, the earliest dated evidence of Canis familiaris in North America is 10,400 BP at nearby Jaguar Cave, Idaho (Reed 1971).

Birds (7%), especially ducks and geese (Table XL), are well represented during this period but again are only from Lind Coulee (Table XI, Figure 39). Fish remains are notably absent in the Windust sample.

The Windust/Cascade faunal assemblage is from Granite Point. In some respects it resembles neither phase, which suggests some of the following conclusions are suspect.

Ungulates other than deer decline to well under half (23%) their former representation in Windust and are exceeded by deer (39%) as the most important faunal resource (Table XL, Figure 39). Elk become a significant subsistence item while bison are conspicuously absent (Table XXV). If Windust/Cascade is not considered in the analysis, there is a long term trend from Windust through Tucannon for deer to increase in importance while ungulates other than deer become less important (Figure 39). This suggests a significant narrowing of dietary breadth through time and the possibility that opportunistic hunting strategies are being supplanted by planned encounters where prey choice is

predetermined. Evenness values from Windust through Tucannon support this assertion; their decline indicates that search strategies are being replaced by pursuit strategies.

The heaviest reliance on leporids and rodents (31%) occurs during Windust/Cascade (Table XL, Figure 39). Ground squirrels are the major rodent but leporids are also very important (Table XXV). When Windust/Cascade is deleted from the analysis, there is a general decline in these mammals (i.e., leporids and rodents) from Windust through Hatwai Complex or Tucannon. Again, a trend toward less opportunistic hunting strategies is suggested.

Carnivores (7%) are almost exclusively coyotes (Table XL, Table VI, Figure 39). Neither bird nor fish remains are present.

The Cascade Phase assemblage is from Marmes Rockshelter. Richness is substantially lower than during Windust but the exploitation pattern is still reasonably even.

As in the Windust Phase, ungulates other than deer (43%) continue to exceed deer (40%) in importance (Table XL, Figure 39). After the Cascade Phase this pattern reverses itself permanently and deer appear in greater frequencies than all other ungulates. Bison are conspicuously absent from the Cascade assemblage. Antelope however, appear in greater frequencies than during any other period (Table

XXVI). This phenomenon may be peculiar to Marmes Rockshelter from which the sample was drawn. Alternatively, the abundance of antelope may reflect environmental degradation associated with the Altithermal. Elk also play an important role in subsistence (Table XXVI).

Rodents and leporids (9%) become less important. However, the variety of rodents characteristic of Windust (muskrats, ground squirrels, wood rats and marmots) is still present (Table XXVI). The relative importance and variety of rodents will decrease in Hatwai Complex and Tucannon.

Carnivores (7%) appear with about the same frequency as Windust and Windust/Cascade (Table XL, Figure 39) but the sample is made up exclusively of coyotes (Table XIV). Neither fish nor bird remains appear in the Cascade assemblage.

The Hatwai Complex faunal materials from Hatwai and Alpowa signal a radical departure from preceding subsistence strategies on the Southeastern Plateau. The appearance of settled villages suggests that logistically organized collectors began to replace foragers in many areas on the Plateau. During Hatwai Complex times and the succeeding Tucannon Phase, focal economies arise that appear to have specialized on deer. Evenness values are dramatically lower than in previous periods suggesting a shift in predation strategies from search to pursuit.

The relative frequency of deer (74%) is nearly double

that of the preceding period (Table XL, Figure 39). Ungulates other than deer drop by a factor of five to only 9% of assemblage content and are represented almost exclusively by elk (Table XXVII). This is significantly different from Cascade where deer and ungulates other than deer are nearly equally represented (Figure 39).

Utilization of rodents and leporids (1%) reaches its lowest point in any of the southeastern samples (Table XL, Figure 39). Beavers are the only rodent in the assemblage (Table XXVII).

On the other hand, carnivores (11%) achieve their greatest representation in any Southeast Plateau faunal assemblage (Table XL). By order of rank they are canids, felids, mustelids and ursids (Table XXVII). Interestingly, both Hatwai Complex and Tucannon display a greater variety of carnivore families than any other period. This might be expected given the sample size of Tucannon but not Hatwai Complex.

Fish (3%) first appear in this sample in this period and become increasingly important in each succeeding period. Birds account for about 2% of the Hatwai Complex fauna (Table XL).

The Tucannon Phase continues and accentuates trends that first appeared during the Hatwai Complex period. The faunal sample from Alpowa, Granite Point, and Hatwai is characterized by low diversity, uneven exploitation patterns

and increased richness.

Deer (80%) assume focal importance in the economy while contributions from ungulates other than deer (7%) drop to their lowest point (Table XL, Figure 39). By rank the other ungulates include elk, antelope and mountain sheep (Table XXVIII).

Rodents and leporids (3%) continue to show low frequency distributions characteristic of Hatwai Complex (Table XL, Figure 39). Leporids dominate this category and the only rodents in the assemblage are marmots, beaver and porcupine (Table XXVIII).

Carnivores (4%) are predominantly canids but there are still a variety of families represented as there was during the Hatwai Complex period. Mustelids, felids and ursids are all present.

Fish (4%) increase slightly in importance marking the trend begun during Hatwai Complex. The relative frequency of birds (2%) remains about the same (Table XL, Figure 24).

The distribution of ungulates during Tucannon and Hatwai Complex is quite different from any period on the Southeastern Plateau. Ames and Marshall (1980) have hypothesized that intensification of roots and tubers occurred during this period; a reasonable conclusion in view of the abundance of plant processing artifacts that appear during Hatwai Complex and Tucannon. If so, we might expect a concomittant shift to decreased reliance on hunting.

Certain fauna, including some ungulates, would probably be dropped as resources because of scheduling conflicts. Deer are prolific, adaptable to a variety of environments and habituate to long-term human predation pressure. These may have been factors that encouraged economic specialization.

Decreased reliance on hunting may have taken the form of untended hunting facilities. These are not as selective in prey choice as weapon based technologies (Oswalt 1970; Wagner 1960). Facilities would include such items as traps, snares and deadfalls (Oswalt 1976). This technology might account for the high diversity but low frequencies of carnivores in the assemblages.

The Harder Phase is significantly different than either Hatwai Complex or Tucannon. Since it is probable that Harder peoples were also logistically organized, it is difficult to account for these differences unless the adaptation involved a more efficient means of managing task groups and scheduling resources. Evenness values suggest a search predation strategy; a situation that would seem at odds with logistically organized groups. The Harder Phase faunal remains are from Alpowa and Marmes. The Phase signals a return to a wider subsistence base and exhibits more even proportions of exploitable fauna than either previous period.

Deer (40%) drop to one half of their former importance (Table XL, Figure 39). Ungulates other than deer (29%) are

well represented. By rank they include bison, elk, antelope and mountain sheep (Table XXIX). Bison (18%) reappear in substantial frequencies for the first time since the Windust Phase.

Rodents and leporids (14%) appear more frequently than before. Leporids are abundant while rodents are represented mainly by ground squirrels (Table XXIX). In fact, the percentage of rodents and leporids utilized during the Harder Phase is exceeded only during Windust and Windust/Cascade (Figure 39).

Carnivores (3%) are almost exclusively canids (Table XXIX). There is no longer the variety of carnivores characteristic of Hatwai Complex or Tucannon.

Fish (12%) remains increase by a factor of four over Tucannon (Table XL). This jump documents an increased focus on aquatic resources and is the first time that fish appear to play a significant role in subsistence. The sample from Alpowa suggests that about 80% are cyprinid and catostomid and 20% are salmonid (Table III). Birds account for 1% of the total assemblage.

The period encompassing Late Harder and the Piquin Phase is characterized by a drop in diversity. The period exhibits similarities and differences with the preceding Harder Phase. The faunal sample is from Granite Point and Wawawai.

Evidence indicates increased reliance on deer (61%)

(Table XL, Figure 39). In fact, deer are about one-third more abundant than during the Harder Phase. Ungulates other than deer (15%) appear half as frequently. They include mostly elk but also bison, mountain sheep and antelope (Table XXX).

Rodents and leporids (8%) decrease to about half their former frequency (Table XL, Figure 39). Leporids are poorly represented while rodents are mainly ground squirrels with lesser percentages of woodrats (Table XXX). Overall, rodent diversity appears substantially less than during Harder. Carnivore representation (3%) remains largely unchanged from Harder and most are canids.

Fish comprise about 13%, and birds about 1% of the faunal inventory (Table XL, Figure 39). Both categories remain essentially unchanged from Harder.

The Numipu Phase represents the ethnographic period. The faunal sample is from Alpowa. During this time large mammals appear less frequently and fish more frequently than during any preceeding period.

The relative abundance of deer (34%) is lower than at any time other than Windust (Table XL, Figure 39). For the first time, deer and other ungulates amount to less than half the faunal inventory. Ungulates other than deer (14%) by rank include domestic stock in addition to bison, mountain sheep and elk (Table XXXI). Domestic stock (6%), are mostly cattle but also sheep and horse.

Rodents and leporids (4%) are represented predominantly by leporids. Carnivores (8%) are almost exclusively canids. For the first time, most canids are identified as Canis familiaris (Table III).

Fish (26%) achieve their highest rank having increased steadily in importance from the Hatwai Complex period (Table XL, Figure 39). Over 90% of the fish are cyprinids and catostomids and only 10% are salmonids (Table III). Birds (14%) occur in greater frequencies than during any other period. However, the high percentage results from 18 elements of a Great Horned Owl previously discussed.

WELLS RESERVOIR

The faunal record at Wells Reservoir is unusual in many respects and extreme in terms of some calculated indices. The patterns are more variable than either the Southeastern study area or Chief Joseph Reservoir. Overall, there is a long term trend toward increased reliance on aquatic resources.

The diversity index climbs from .53 in Period 1 to a high of 1.03 during Period 2 (Table XXXIX, Figure 36). Period 2 marks the most diffuse exploitation pattern observed anywhere on the Plateau. Chatters (1986:151) indicates that Period 2 "may prove to be a classic example of optimal foraging". In Period 3, the index drops to .26, signaling a substantial drop in diversity as the subsistence

economy becomes focused on salmonids. This is the most focal economy observed on the Plateau. By Period 4, the index rises to .4 though 99% of the subsistence inventory comprises three families of fishes.

Evenness scores mirror the pattern seen in the Shannon Indices (Table XXXIX, Figure 37). Richness indices of 4.5 in Period 1 rise to 5.7 in Period 2. From this highpoint richness values decline steadily in Period 3 (4.3) and Period 4 (2.6) (Table XXXIX, Figure 38).

Deer, subsistence mainstays in other parts of the Plateau, are not heavily utilized at Wells Reservoir (Table XLI, Figure 40). They appear in substantial numbers only in Periods 1 (5%) and 2 (15%) and amount to less than 1% of the assemblage in succeeding periods.

Ungulates other than deer appear most frequently in Period 2 (25%) (Figure 40) and by rank, include antelope, elk and mountain sheep (Table XXXIII). Period 3 ungulates amount to only 3% of the fauna, however mountain sheep rank higher than antelope and deer (Table XXXIV).

Leporids and rodents account for fully 65% of the fauna during Period 1 (Table XLI, Figure 25). All but a fraction are identified as leporids. The heavy emphasis on leporids during the early period at Wells Reservoir is a surprising aspect of the analysis. The relative frequency of leporids and rodents drops to 21% in Period 2 and thereafter amounts to less than two percent.

Carnivores figure prominently in the Period 1 assemblage accounting for 9% of the faunal inventory (Table XLI, Figure 40). Almost all elements are identified as dogs or coyotes (Table XX). During Period 2 carnivores decrease to 5% of assemblage content and thereafter account for no more than 1% of the assemblages.

Birds are best represented in the Period 2 assemblage (4%) and least represented in the Period 4 assemblage (.51%). Periods 1 and 3 have roughly equal proportions at about 2.5% of assemblage content (Table XLI).

Fish resources become increasingly important throughout the prehistoric period at Wells Reservoir (Table XLI, Figure 40). About 18% of the Period 1 assemblage is fish remains; almost all are salmonids (Table XXXII). By Period 2, fish are 29% of the fauna; salmonids and cyprinids are equally important while catostomids appear less frequently (Table XXXIII). During Period 3, fish amount to 92% of the faunal assemblage; almost all are salmonids (Table XXXIV). In Period 4 fish increase to a record 99% of the total assemblage but the proportions of fish families represented is more even than that observed during Period 3. Salmonids (62%) account for the majority followed by catostomids (28%) and cyprinids (9%) (Table XXXV).

CHIEF JOSEPH RESERVOIR

The archaeological record at Chief Joseph Reservoir

reveals a number of subsistence trends. The subsistence record is less variable than either the Southeastern Plateau or Wells Reservoir.

The diversity index declines throughout the observed period, from a high of .74 in Kartar, to .58 in Hudnut, to a low of .52 in Coyote Creek (Table XXXIX, Figure 36). Evenness also declines, from .59 to .46 to .40 (Figure 37). Richness indices fall from Kartar (4.8) to Hudnut (4.3) but then rise during Coyote Creek (5.2) (Figure 38).

Utilization of deer increases through time from a low of 45% in Kartar, to 54% in Hudnut, to 68% in Coyote Creek (Table XLII, Figure 41). Mountain sheep account for 8-10% of each assemblage and are the most common ungulate in the assemblages after deer (Tables XXXVI, XXXVII, XXXVIII).

The frequencies of rodents and leporids decline noticeably from Kartar (12%) to Hudnut (5%), but thereafter stabilize (Table XLII, Figure 41). Overall, leporids appear to be less important at Chief Joseph Reservoir than any other study area. Marmots are by far the most important rodent in each assemblage (Tables XXXVI, XXXVII, XXXVIII). Carnivore representation in each assemblage is a constant 1 to 2 percent; most are canids (Table XXIII).

Fish resources are nearly equally represented in Kartar (28%) and Hudnut (30%) assemblages but decline significantly in Coyote Creek (13%) assemblages (Table XLII, Figure 41). This decline in fish resources is contrary to the pattern

that emerged in the Southeastern region and in Wells Reservoir. The ranking of specific fish categories is of considerable interest. During the Kartar Phase, cyprinids and salmonids are ranked second and third, respectively (Table XXXVI). Hudnut and Coyote Creek find salmonids ranked second but cyprinids have dropped to fifth in the former assemblage and sixth in the latter (Tables XXXVII, XXXVIII). This suggests that while fish generally are decreasing in importance, salmonids are becoming increasingly economically valuable.

TABLE XXXIX
SUMMARY INDICES BY STUDY AREA
AND CULTURAL PHASE

STUDY AREA	PHASE	INDICES		
		Shannon Divers.	Pielou's Even.	Species Rich.
Southeastern Plateau				
	Windust	0.832	0.747	4.579
	Windust/Cascade	0.702	0.674	4.121
	Cascade	0.661	0.693	3.294
	Hatwai Complex	0.470	0.435	4.882
	Tucannon	0.399	0.348	4.408
	Harder	0.826	0.702	5.159
	L.Harder/Piquin	0.621	0.575	4.232
	Numipu	0.781	0.750	4.358
Wells Reservoir				
	Period 1	0.528	0.474	4.453
	Period 2	1.028	0.835	5.748
	Period 3	0.261	0.217	4.325
	Period 4	0.404	0.404	2.643
Chief Joseph Reservoir				
	Kartar	0.740	0.589	4.839
	Hudnut	0.582	0.464	4.335
	Coyote Creek	0.517	0.398	5.154

TABLE XL
PROPORTIONS OF FAUNAL CATEGORIES BY
CULTURAL PHASE ON THE
SOUTHEASTERN PLATEAU

PHASE	FAUNAL CATEGORY (%)					
	Ungul*	Deer	Rodnt Lepor	Carnv	Fish	Bird
Windust	58.27	7.43	17.76	9.59	0	6.95
Wind/Casc	23.22	38.58	31.45	6.73	0	0
Cascade	42.91	40.3	9.34	7.46	0	0
Hatwai	8.94	74.3	1.12	10.62	2.79	2.23
Tucannon	6.97	80.2	2.91	4.16	3.94	1.8
Harder	29.4	40.43	14.13	3.09	11.61	1.35
L.Hard/Piqu	14.62	61.46	7.56	2.77	12.59	1.01
Numipu	14.22	33.5	4.06	7.62	26.4	14.21

* Ungulate other than deer

TABLE XLI
PROPORTIONS OF FAUNAL CATEGORIES BY
PERIODS AT WELLS RESERVOIR

PERIOD	FAUNAL CATEGORY (%)					
	Ungul*	Deer	Rodnt Lepor	Carnv	Fish	Bird
Period 1	0.04	5.05	65.24	9.29	17.58	2.42
Period 2	24.96	15.44	21.51	5.1	28.56	4.43
Period 3	2.14	0.85	1.83	0.89	91.64	2.65
Period 4	0.04	0.04	0.36	0.16	98.9	0.51

* Ungulate other than deer

TABLE XLII
 PROPORTIONS OF FAUNAL CATEGORIES BY
 CULTURAL PHASE AT CHIEF
 JOSEPH RESERVOIR

PHASE	FAUNAL CATEGORY (%)				
	Ungul*	Deer	Rodnt Lepor	Carnv	Fish
Kartar	13.46	45.22	11.71	1.44	28.17
Hudnut	9.43	54.03	4.64	1.88	30.03
Coyote Cr	14.22	67.95	3.76	1.19	12.86

* Ungulate other than deer

Figure 36. Summary diversity indices.

Figure 37. Summary evenness indices.

Figure 38. Summary richness indices.

Figure 39. Summary histogram showing relative frequency (%) of faunal categories - Southeastern Plateau. * Ungulate other than deer.

Figure 40. Summary histogram showing relative frequency (%) of faunal categories - Wells Reservoir. * Ungulate other than deer.

Figure 41. Summary histogram showing relative frequency (%) of faunal categories - Chief Joseph Reservoir. * Ungulate other than deer.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

I chose to interpret the distribution of faunal remains as direct evidence of human subsistence. Analysis of these data support the following interpretations.

Prior to about 5500 BP, the Southeastern Plateau was occupied by mobile bands of hunters and gatherers. Economic strategies were diffuse, and revolved primarily around the exploitation of a variety of ungulates. Hunting appears to have been opportunistic and based upon search predation strategies. Bison may have been locally important during the Windust Phase but were later supplanted by elk, antelope and deer. From the Windust Phase through Tucannon, deer become more important, and other ungulates less important in aboriginal subsistence economies. During the early periods, leporids and a variety of rodents, most importantly marmots, were utilized. Leporids and rodents decline in importance to become almost insignificant by Hatwai Complex times. Dietary breadth declines through the Cascade Phase.

The Hatwai Complex period and subsequent Tucannon Phase mark the emergence of sedentism on the Southeastern Plateau. Collecting presumably replaced foraging as a means of provisioning consumers in many areas. Economic strategies

were focal and centered on the exploitation of deer almost to the exclusion of other large herbivores. Predation strategies were oriented toward pursuit rather than search. During these periods, previously important fauna were overlooked as subsistence items, probably because of scheduling conflicts with other subsistence resources. Carnivores appear in greater variety than ever suggesting greater use of facilities rather than implement based hunting techniques.

There is little if any indication that intensifying the production of salmon played a role in the initial emergence of sedentism on the Southeastern Plateau. Fish remains first appear during Hatwai Complex times and increase in abundance from this period forward. However, fish do not appear in substantial numbers until the Harder Phase and even then are nowhere as abundant as during the ethnographic period. In this respect, Hatwai Complex and Tucannon economies clearly do not fit the "ethnographic pattern". If there is intensification, it is directed toward deer or non-preservable aspects of the subsistence record such as roots. Hatwai Complex and Tucannon are substantially different from the "ethnographic pattern" in terms of indices, basic subsistence resources and presumably the economic infrastructure associated with labor organization. The two adaptive patterns have similar archaeological signatures but each arose in response to specific (as yet

undetermined) needs and were maintained by very different resource, energy and organizational inputs.

The Harder Phase marks a return to a diffuse economic system and contrast sharply with the Hatwai Complex and Tucannon periods. A high evenness index suggests a search predation strategy. The distribution of subsistence fauna seems typical of those left by broad spectrum foragers. In fact, comparable dietary diversity is found only during the Windust Phase. How this can be reconciled in a system that is presumably logistically organized is a question that remains to be addressed. The diversity may relate to nuances in settlement, mobility, resource scheduling or organization of tasks groups. Deer are not focal resources in Harder economies but appear with a variety of other ungulates and rodents. Fish become important for the first time on the Southeastern Plateau.

It is important to determine what event(s) precipitated the dramatic shift from the focal Tucannon economy to the diffuse Harder economy. Cleland (1976:66-67) maintains that such shifts are "born of extraordinary conditions" and require significant economic, social, political and ideological adjustments.

Late Harder/Piquin and Nimipu Phase economies are diffuse rather than focal. Indices suggest a diverse exploitative pattern with little indication of the importance ascribed to fish. Fish resources become

increasingly important until they account for over one-quarter of the faunal remains during the Numipu Phase. There is decreased dependence on deer and other ungulates until they amount to less than half the assemblage.

Ethnographers suggest that Plateau peoples living the "ethnographic pattern" acquired from one-third to one-half of their subsistence needs from the salmon resource. If the Late Harder/Piqunin and Numipu Phase assemblages represent the emerging "ethnographic pattern" and contain from 13% to 26% fish remains, it should be abundantly clear that Hatwai Complex and Tucannon represent entirely different adaptations. Not only do these assemblages contain less than 4% fish remains but faunal procurement is geared toward the focal exploitation of deer.

Subsistence economies at Wells Reservoir are extremely variable and include the most diffuse (Period 2) and most focal (Period 3) economy observed in this analysis. Long term trends at Wells Reservoir include decreased reliance on leporids and increased dependence on fish resources. Ungulates do not play as significant a role in the subsistence economy in this area as either the Southeastern region or Chief Joseph Reservoir.

Period 1 is characterized by unusually heavy reliance on leporids. They decline in frequency to become a negligible subsistence resource by Period 3. Deer and other ungulates are best represented during Period 2 but are

otherwise uncommon. Fish are important resources in Periods 1 and 2 but become the overwhelming economic focus in Periods 3 and 4. Salmon are almost singularly exploited in Period 3. In Period 4 fish are even more important but the variety of fishes is greater than during Period 3. If Period 4 represents the emerging "ethnographic pattern" at Wells Reservoir, it represents a variation oriented more toward fish exploitation than any other.

Chief Joseph Reservoir is not as variable as the other two study areas. Overall, there is a trend for deer to become increasingly important. Rodents, particularly marmots, are important during the Kartar Phase but appear less frequently during later periods. The pattern of rodent and/or leporid exploitation being important during early periods seems consistent in all three study areas. Unlike the other study areas, there is a decline in fish resources during the late period at Chief Joseph Reservoir. If the Coyote Creek Phase is yet another variation on the "ethnographic pattern", it too is unique.

The earliest semi-sedentary residence in pit houses on the Plateau occurs during Hatwai Complex/Tucannon times on the Southeastern Plateau (Ames n.p.), during Period 2 at Wells Reservoir (Chatters 1986), and during the Kartar Phase at Chief Joseph Reservoir (Campbell 1985). Economic analysis of the periods suggests that these adaptations were fundamentally different. Hatwai Complex/Tucannon are two of

the more focal systems, Period 2 is the most diffuse, and Kartar lies somewhere between. These results seem to indicate that the patterns for the regional emergence of sedentism are complex and not easily given over to single factor explanations (see Chapter II). It does seem abundantly clear that salmonids are not as instrumental in the initial appearance of sedentism as previously thought. The roles of storage and intensifying root production cannot be evaluated using the data at hand. The role of positioning strategies could presumably be investigated by examining, at the site level, the relationship between subsistence systems (i.e., whether focal or diffuse) and faunal productivity within the site catchment or resource area. Is there a predictable relationship between the nature of subsistence systems and the environmental and community structure within a catchment area? This question is intriguing but well beyond the scope of this research.

This analysis has shown that prehistoric subsistence on the Columbia Plateau was characterized by diversity and variability. Environmental differences across time and space surely account for some of the variability in faunal utilization. However, I chose not to address this extremely complex issue. Environmental reconstruction is difficult at best without extrapolating on the nature and distribution of prehistoric faunal communities from samples already biased by human selection.

I previously stated that I chose to interpret the faunal remains as direct evidence of human subsistence. I will not deny that taphonomic and cultural factors, sampling biases and other considerations have influenced the faunal distributions. There are many questions that can be raised and eventually tested regarding these interpretations. For example, how might behavioral differences in the processing of deer bone affect the interpretation of Hatwai Complex and Tucannon as focal economies? If bone is more fragmented during processing, NISP values will be higher (up to a point where the fragments become unidentifiable). Another pertinent question concerns the effect of seasonality on assemblage composition. Ideally, this is a variable that should be tightly controlled since resource utilization is closely tied to seasonal rhythms. Other factors needing to be addressed are the type and duration of occupation(s) since these too influence faunal distributions. Unfortunately, there was neither the time nor an adequate data set to address many of these considerations.

Despite these deficiencies, this analysis has documented patterning in the Plateau subsistence record. I suspect that most of the patterns reflect actual human subsistence adaptations on the Plateau. I am sure that other patterns are probably unrelated to human subsistence. The high rank of mustelids in Windust Phase assemblages is an example. What is important is that the patterning and

trends observed in this analysis be critically examined and restated as testable hypotheses with data more amenable to rigorous testing. Interpretations regarding the Southeastern Plateau would be strengthened if the samples were larger but this will be possible only when archaeologists provide usable faunal data with adequate taphonomic and temporal control.

There appear to have been several critical transitions in human subsistence on the Plateau. The diffuse-focal shift from the Cascade Phase to Hatwai Complex/Tucannon is one; the focal-diffuse shift from Tucannon to Harder is another. The most dramatic transition is surely between Periods 2 and 3 at Wells Reservoir. Another relevant problem is the apparent lack of significant subsistence change at Chief Joseph Reservoir when compared to the other study areas.

This research suggests that the Plateau was not an area of static, unchanging subsistence patterns but rather the stage for dynamic adaptations accomodating changing environments, shifting resource structure, technological innovation, and social and cultural reorganization. Examined individually, the subsistence economies are unique and distinctive. As a group, they are distributed across the entire continuum from diffuse to focal. Critical periods of economic reorganization have been recognized. For archaeologists to fully understand culture process on

the Plateau, environmental and cultural factors responsible for these economic changes must be identified.

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