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The presence and significance of salmon for prehistoric and aboriginal people of the Columbia Plateau is a matter of considerable debate among anthropologists, archaeologists and historians. Data from over 100 archaeological sites are scrutinized in the light of an example salmon fishery developed from ethnographic and archaeological information on aboriginal salmon dependencies and exploitation in the locale of The Dalles on the central Columbia. The research incorporates a cultural ecology orientation.

Data from prehistoric sites of the Columbia Plateau do not conform precisely to The Dalles fishery example and strongly suggest both a temporal and spatial variation in salmon use and cultural patterning and therefore call to question the presumption of the primary relevancy of salmon to cultural patterning throughout the Plateau. Other resources, including especially botanical species, appear to have an importance too often overlooked.

Other riverine and terrestrial mammal food resources are presumed to have a lesser prehistoric importance, though the archaeological record actually supports the importance of resources other than salmon as having pervasive affects on cultural patterning in the Columbia Plateau. Data show that it was not until recent times that salmon occurrence had the effect on cultural systems that has been observed in historic times.

WHEN CELILO WAS CELILO: AN ANALYSIS OF SALMON USE DURING THE PAST 11,000 YEARS IN THE COLUMBIA PLATEAU

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CHAPTER I

Introduction

This paper investigates the relative importance salmon played in aboriginal Columbia Plateau subsistence patterns. A general consensus, by northwest anthropologists, suggests that salmon were a significant resource during the late prehistoric and contact periods. The occurrence of salmon faunal remains, fishing gear, and ethnographic documentation support this contention. A diversity of opinions exist over the importance of salmon resources for periods dating from approximately 11,000 B.P. up through 2,000-4,000 years ago.

The Columbia Plateau is a geographic area that includes sections of Oregon, Washington, and British Columbia. The Plateau extends in the west to the Cascade Mountains and on the east to the Rocky Mountains. The southern extension of the Plateau includes the headwaters of the John Day and Deschutes Rivers. In the north, the Plateau includes all of the upper Columbia River drainage (see Figure 1.)

This investigation will focus first on documenting the occurrence of salmon faunal remains and fishing implements as they appear in specific archaeological sites.

It is possible that for the greater period of Plateau occupation, salmon resources have been over-emphasized in reconstructions of past lifeways. Documenting salmon faunal remains and fishing equipment, in conjunction with an ethnographically documented Wishram/Wasco fishing villages, should allow a comparative assessment of the relative importance of this resource during the prehistory of the Plateau. This information, in turn, could aid in developing more specificity regarding the general Plateau subsistence patterns over time.

The second focus of my research deals with the larger problem of the relation between environment and culture. A theoretical discussion of this relationship will integrate the anthropological, sociological, and archaeological perspectives that underly this study. In the Columbia Plateau, significant climatic changes have been proposed for the prehistoric period (Antevs 1948). However, to what degree these climatic changes affected local resources and cultures finds considerable disagreement among anthropologists. Therefore, this research will focus on this question by drawing on climatic, resource, and technological data in order to see if correlations can be drawn between the proposed climatic sequences and the occurrence and changes in faunal and technological assemblages during the prehistory period.

The structure of the research is as follows: First, an integrative theoretical discussion incorporates the three social science disciplines noted above. The theoretical section lays the foundation and provides the focus of the study.

Second, an ethnographic overview of the Wishram/Wasco locale will synthesize the perspectives presented in the initial theoretical discussion. That is, the pervasive effects specific resource utilization and its associated technological system have on other cultural systems. The Chinook ethnographic information should aid in assessing the relative importance of salmon resources for other locales of the Plateau during prehistory and also will test the viability of applying ethnographic analogies from The Dalles locale to other locales of the Plateau.

The third phase of this research will document the occurrence of salmon faunal remains and fishing tackle as they occur in specific sites over time. Information will be documented until redundancy outweighs unique singular occurrences of data that do not coincide with the general faunal and implement pattern.

The Importance of the Salmon Resource

The Columbia River and its tributaries have been the spawning grounds for four species of anadromous salmon for many thousands of years. Included in these "runs" are the chinook (Oncorhynchus tschawytscha), coho

(O. kisutch), chums (O. keta), and sockeye (O. nerka). How long and in what numbers the salmon have ascended the Columbia's 1,214 miles are important questions when attempting to reconstruct the lifeways of past inhabitants of the Columbia Plateau.

The salmon, as recorded in ethnographic documents (Spier 1938; Spier and Sapir 1930), and archaeological records (Nelson 1969; Cressman 1960), were an important and often times principal resource for specific populations of the Plateau. The importance of this resource has been shown to affect many aspects of Plateau cultural systems, such as yearly migration routes, settlement patterns, and technological and economic systems (Walker 1967; Sanger 1967), during the ethnographic period. However, archaeologists have shown that many changes have occurred in the Plateau's environmental systems and specific cultural systems during the past 12,000 years.

The importance of salmon resources in the Plateau, during specific climate sequences, has been the subject of much discussion by Plateau archaeologists and anthropologists (Cressman 1960; Butler 1961; Daugherty 1962; Sanger 1967). In general, most archaeologists' climate sequences have followed, if not literally, then in some abridged fashion, Antevs' (1948) neothermal climate sequence. Specific features of this climate scheme (anathermal, altithermal, medithermal) have been used to explain the occurrence, or lack of salmon faunal remains,

TABLE 1. ENVIRONMENTAL AND CULTURAL PHASES

ANTEVS (1948)	LEONHARDY AND RICE (1970)	NELSON (1969)	AMES AND MARSHALL (1980)
Anathermal 7,000 B.C.	8,000-7,000 B.C. Windust	11,000-8,000 B.P. Lind Coulee	11,000-8,500 B.P. Windust
to 5,000 B.C.	6,000-3,000 B.C. Cascade	8,000-6,500 Indian Well	8,500-4,500 Cascade
Altithermal 5,000 B.C. to 2,500 B.C.	3,000-500 B.C. Tucannon	6,500-4,000 Cold Springs 4,000-2,000	4,500-2,500 Tucannon
Medithermal 2,500 B.C.	500-1,300 A.D. Harder	1,600-2,000 Frenchman Springs	2,500-1,720 Harder
to present	1,300-1,700 A.D. Piqu'nin	800 B.C.-0 A.D. Quilomene Bar	1,720-present Numipu
	1,700-1,900 A.D. Numipu	100 B.C.-600 A.D. Cayuse	

during the past 11,000 years.

The fact that salmon bones are not present in all archaeological sites, over time, has created a diversity of opinions over the "mystery of the missing bones" (Cressman 1960:69). Some archaeologists have utilized environmental explanations in accounting for the lack of faunal and/or technological remains that would indicate salmon fishing (Sanger 1967; Kew 1976). Sanger suggests "the combined aridity during the hypsithermal and normal downcutting, served to create a formidable obstacle to salmon between 6,000 and 1,000 years ago" (Sanger 1966: 19).

Ames and Marshall suggest a different approach, "fishing tackle and fish remains, though generally rare in sites, are present throughout the regional sequence", and "there is yet no independent data showing any major fluctuation in salmon productivity during the past 11,000 years" (Ames and Marshall 1980:41).

Other theorists have utilized biological explanations to explain salmon resource fluctuations, "it is a natural condition of salmon races to experience disastrous failures" (Kew 1976:2). Casteel (1972), and Shirazi (1979), support Kew's contentions with more specificity by showing that turbidity, temperature, and siltation are specific factors influencing resource mortality and seasonal fluctuations. Variations in all of these factors have been noted or can be inferred from climatic data on the Columbia Plateau.

A further example of diversity of opinion over salmon resource utilization will clarify the potential importance of this research. Daugherty suggests salmon fishing occurred early in the Plateau, at 9,000 B.P. at The Dalles (Daugherty 1962). Sanger suggests that salmon fishing occurred at the 10,000 year old levels at The Dalles (Sanger 1966:17). Though a disparity exists between the temporal position of these two inferences, the strata from which salmon bones are first noted at The Dalles is dated 7675±100 (y-341).

This confusion is compounded by David Rice's observations (1972), in which the Windust Phase (10,000-8,000 B.P.) in the Lower Snake Region is discussed. Rice suggests that the Initial Early assemblage, at the Five Mile Rapids Site, is the counterpart of the Windust Phase in the Lower Snake River Region (Rice 1972:167). The Initial Early assemblage at The Dalles is dated 9785±220 (y-340), a period that several theorists, as noted, have suggested salmon fishing was occurring at The Dalles. Rice notes, for the Windust Phase "the fish bones identified to date include chub and sucker, but no salmonids" (Rice 1972:160). The economic resources of the Windust Phase were dominated by large mammal resources with distinctly minor resources of fish, but no salmonids (Rice 1972:160).

Thus, we are left with much disparity between interpretations of the salmon resource utilization during the early prehistoric Plateau. The remainder of the prehistoric period finds similar interpretive disparity. Thus, a systematic documentation of the occurrence of fishing tackle and salmon remains as they occur in specific sites, over time, should prove valuable in assessing the relative importance of salmon. This information will allow more specificity in interpretations of prior lifeways in the Plateau.

Research Strategy

A central goal of this research, as noted, is to gain an understanding of the general subsistence patterns of prehistoric plateau peoples and, specifically, the role that salmon played in those subsistence systems. The procedure becomes one of, first, establishing the underlying pattern of specific data occurrences as they have been recorded by various researchers; and second, drawing inferences about prehistoric subsistence systems from the underlying pattern established by the large sample of the field research that has been conducted. This research incorporates data from over one hundred archaeological sites that have been either fully excavated, sample tested, surface collected, or surface investigated during field reconnaissance. The large sample size was felt necessary in order to provide a more comprehensive

TABLE 2. ARCHAEOLOGICAL SITES INVESTIGATED

45FR40	45OK127	45AS4	45ST72
45FR39	45OK147	45AS81b	45ST95
45WT39	45OK102	45AS87x	45FE16
45ST41	45OK101	45KT28	45FE34
WS-4	45OK141	45AD2	45FE43
WS-1	45OK145	45GR162	45L16
45FR50	45OK143	45GR144	45L123
45GR97	45OK144	45GR145	45L125
45FR46	45OK29	Mesa 30	Wenas
45FR5	DiQw2	45WW25	Wakemap Mound, and approx. 30 sites
Hell's Canyon Creek Rockshelter	EbQu12	45CH204	
	EbQr1	45CH64	Fort Colville
35UM5	EbQr2	45DO172	45ST119
35UM3	EcQt2	45AS41	45ST65
35UM7	10IH483	45GA61	45ST201
35UM17	45AS82	45FR267	45ST203
45BN53	45AS82b	45DO174	45ST94
45WW6	45AS80	45ST1	45FE16a
Nahas Cave	45AS78	45ST21	EbQu9-16
45OK146	45AS79	45ST44	

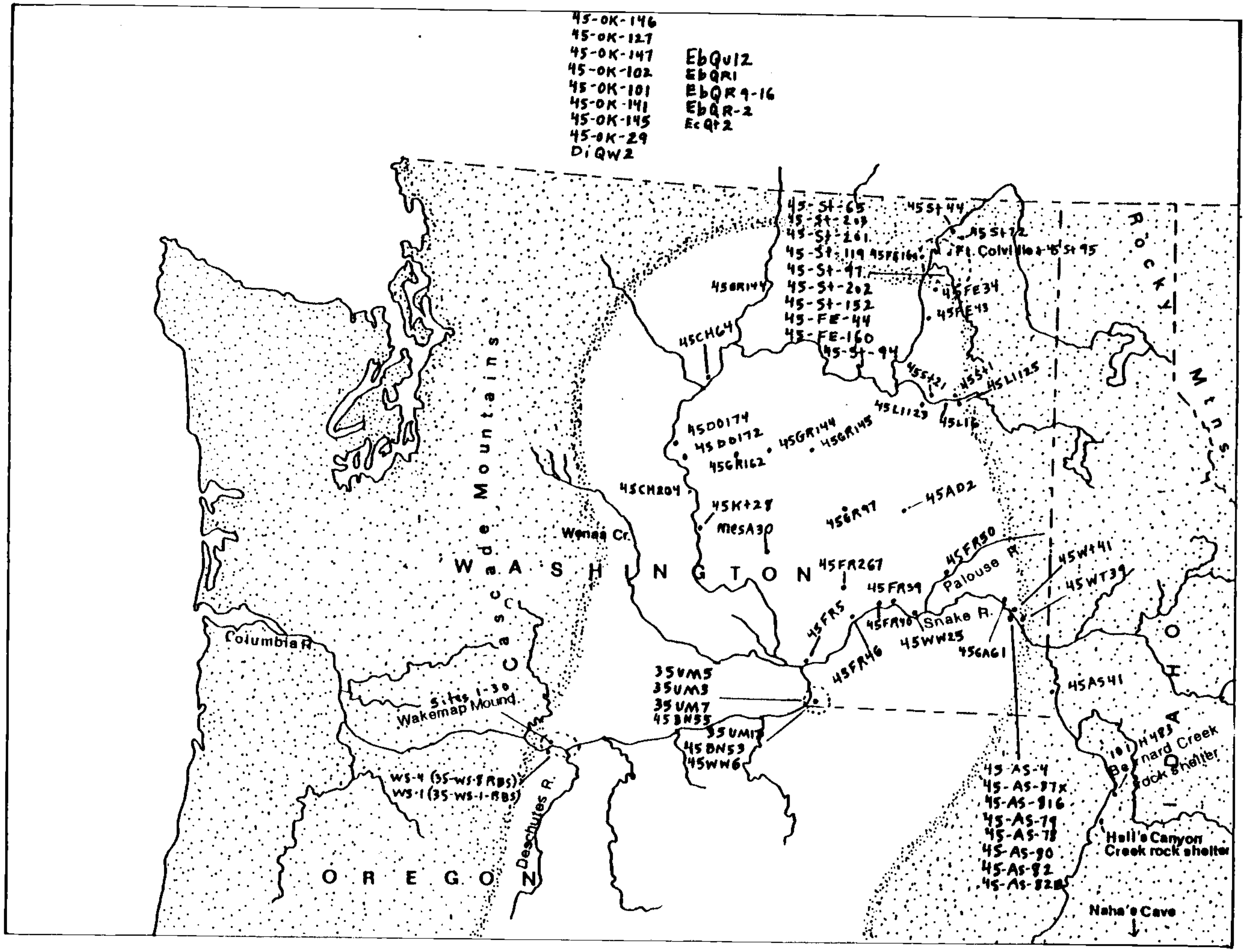


FIGURE 1. COLUMBIA PLATEAU AND ADJACENT SITE LOCATIONS. Non-stippled area sagebrush, juniper, and bunchgrass steppe; stippled area forested (after Daubenmire 1943; Warren 1968).

inventory of the Plateau.

The data base for this research includes archaeological site reports, ethnographic reports, and personal interviews and discussions where possible. The principal data base is the archaeological site reports. The remaining sources listed either influenced, informed, or encouraged this research project. The archaeological data has been recorded with as strict adherence to the original sources as time, clarity, and methodology would allow.

The use of the term selected sample appearing in chapters IV through VII, refers to the specific sites and site components. The term selected sample does not refer to a statistical population. Sites were selected according to their quality. Criteria are listed in the following pages.

Chapters IV through VII are broken down into time periods. The sites and components used for analysis are representative of the cultural phases in each period. All sites do not contain all cultural phases, thus, some chapters have larger numbers of sites and components than other chapters. This is based primarily on the fact that some cultural phases are better represented in the archaeological record.

The sites selected for this study were based on several criteria. First, a representative example of the Plateau and immediately adjacent localities was deemed essential. Hopefully, this has been accomplished.

Second, where information was too vague to allow even the most general quantification, the site was removed from consideration. The report does include some site reports that are questionable in their treatment of data, but their inclusion was felt necessary in order for a comprehensive sample to be accomplished. The reader can draw his own conclusions about these reports, however, it was not the intention of this researcher to conduct a critique of specific site reports.

Third, the large sample size was evaluated in order that the total sample might more accurately reflect the various types of sites encountered in the Plateau and adjacent localities. Specifically, an attempt was made to include not only riverine sites, but also non-riverine sites as it was felt this would be more representative of the varied cultural activities of the area.

It was also a goal of this research to provide a comprehensive synthesis of the archaeological record relative to salmon fishing, fishing implements, and fishing in general. As the project continued, mussel shell and general faunal occurrences were added to the documentation so comparisons might be drawn between various resources.

Fourth, information was recorded until redundancy outweighed unique singular occurrences of data that did not coincide with the general faunal and implement pattern.

Five specific variables are recorded from specific anthropological records. A brief discussion of each variable is necessary in order to clarify the specific recording methods employed and to define the category each variable was placed in.

Salmon bones are listed by number when this is possible. When the data is specific as to species, this also has been recorded. It should be noted that this is a rare occurrence. More commonly, salmon faunal remains are discussed simply as salmon, salmonid, or salmonoid. The salient issue here is that a general pattern is being sought. Individual differences in recording methods are assumed to be minimized with a large sample in which "general patterns" rather than unique occurrences is the goal.

The family of Salmonidae includes the genus Oncorhynchus, of which seven species of salmon are members. Four species have occurred in the Columbia River system: O. kisutch, coho or silver; O. tschawytscha, chinook, king, or tyee; O. nerka, sockeye or blueback; and O. keta, chum or dog. A fifth species, O. gorbuscha, or pink, is considered negligible in both occurrence and economic value for the Columbia River. Salmo gairdneri, or steelhead, are noted when specified in particular reports. In this study, steelhead are considered as significant as Oncorhynchus when their presence is noted in archaeological reports. This is based on their anadromous qualities and potential "run" sizes which could be as influential as salmon in affecting culture systems such as settlement and seasonal migration.

All other fish that are noted by researchers have been classified under the term Pisces. Count and species are listed when possible, but in most cases, data occurs under a general description. It is possible that some of the material recorded under Pisces could be salmon remains. However, only when salmon are noted specifically were they recorded under the category of salmon. All general terms such as "fish bones" were placed under the category of Pisces.

A third category includes shell and bone of all other species. Again, numbers are given when they appear in the records. The primary consideration in establishing this category was to include information that would allow comparisons to be made between salmon, shell, and mammal bone occurrences. An example comparison would be between salmon faunal occurrence and mollusk occurrence. Bense (1972:41) suggests that the occurrence of Margaritifera indicates Salmonidae were also available. Randolph and Dahlstrom (1977) suggest a correlation between fish use and mussel occurrence at the Hell's Canyon Creek Rockshelter. This research should allow more specificity regarding whether a correlation exists between fish and mussel occurrence.

A fourth category separates bone and antler artifacts, fishing implements and total artifacts into three separate groups. Shell artifacts also are separated when noted in specific texts. The considerations here were to provide first, a comparative sample within each site regarding fishing implements and total artifacts; and second, to record bone, antler, and shell artifacts in a manner that would allow inferences to be made about faunal implement preservation. This is an important consideration when dealing with potential fish implements. Fishing implements are recorded as they are noted by prior researchers. Where information is questionable or identifications dubious, I have followed the recorded statements appearing in the literature. "Total artifacts" is a classification that is general in the broadest sense and should include all artifacts. The salient issue was to allow a comparative base between total fishing implements, potential fishing implements, bone and antler implements, and the total assemblage.

A final aspect of the method involved in classifying the information involves direct quotes. I have tried to record any relevant statements regarding salmon fishing or fishing in general as they appeared in archaeological site reports, specific to the sites or stratigraphy utilized in this research. It should be noted that often a simple statement about salmon or fish bone occurrence is the only indicator of their presence in a particular site or stratigraphy.

At the end of chapters IV through VII, a selected sample of the total data base is presented in order to show the specific temporal components that were used in the specific chapter's analysis. Each chapter's data base is representative of how each site listed was dealt with (Table 2).

The time periods used in chapters IV through VII are sequences that combine an acknowledgment of the cultural phases proposed for the Columbia Plateau and specific climatic changes as designated by Antevs (1948) and other researchers. Since there are variations between most researchers' cultural phases and environmental sequences, I separated the temporal periods of the Plateau into four major periods that reflect the general pattern of cultural and environmental changes that have been proposed for the Plateau.

CHAPTER II

Relations Between Culture and Environment: Theoretical Context

The importance of the salmon resource in the Columbia Plateau for aboriginal residents has been discussed by anthropologists and archaeologists who have worked in or written about the Plateau area (i.e. Cressman 1977, Sapir 1909, Borden 1979, and others). Generally, considerable emphasis has been placed on the salmon resource, and the role this resource has played in the development of the social and economic institutions of the indigenous groups of this area.

> The Plateau was dominated by an orientation to salmon fishing, which concentrated populations along the Columbia River. Villages of five to ten earth lodges were situated on the flood plains of major streams, where salmon could be taken during the summer spawning runs and stored for winter consumption (Aikens 1978:164).

Most studies show a wealth of supportive documentation, which leads to the stress that has been placed upon the salmon resource and its effects on aboriginal populations. The importance of this resource is clear especially when dealing with the late prehistoric and contact periods. However, when the period of time extends back as much as 12,000 years, the difficulties of reconstructing past lifeways becomes more problematic. The use of ethnographic analogies for the early prehistoric periods, based on studies from the historic period, become more difficult the further one proceeds back in time. Thus, the importance of accurate archaeological, geological, and climatic studies become essential.

A central focus of this work emphasizes the potential effects that environmental changes had on the anadromous fish populations and the specific cultures utilizing these resources in the Columbia Plateau. A discussion relating to this emphasis follows; first, to alleviate any questions that may arise as to whether this study "promotes" environmental determinism; second, to show the wide disparity which has existed between the different theoretical positions, which have dealt with the relation between environment and culture; and third, to address the theoretical position of this research.

Two diverse theories have addressed this issue as exemplified by the environmental determinists and cultural determinists. The position this study takes involves a position midway between these two positions, or what has been called "cultural ecology". I take the position that both the environment and culture are dynamic systems. The effect of one system upon the other is viewed as varying in deterministic attributes over time. That is, the environment, for example, will be considered as placing stronger challenges upon specific adaptive systems at different periods of time. Cultures in turn are seen as having more effective adaptive systems at different periods of time.

The role that environment has played in the shaping of human cultures has been discussed, theorized about, and fought over for milleniums. Aristotle, though undoubtedly not the first, was an early proponent of what is now referred to as the "environmental determinist" school of thought. In 384-322 A.D., he stated that the behavioral manifestations, which differed between various regions of the world, were a result of three environmental zones. The cold, temperate, and tropical schemes in Aristotle's theory correlated specific behaviors with specific climates. "Those who live in a cold climate and Europe are full of spirit, but wanting in intelligence" (Aristotle reprint 1943:393). Though Aristotle's concepts were presented many years ago, it is amazing that many theorists still presented similar environmental deterministic perspectives, resembling Aristotle's writings, as late as the mid-nineteen hundreds. Aristotle equated the Mediterranean environment, (his middle zone), with the development of Greek civilization, which was, in his judgement, considered the best cultural area derived of the three climate zones.

In 1931, Ellen Semple, a geographer, stated "the intercontinental location of the Mediterranean Sea afforded the fundamental geographic condition for a cosmopolitan culture" (Semple 1931:9); and "the Mediterranean Basin thus stimulated the development of a cosmopolitan civilization" (Semple 1931:10). Ellsworth Huntington also focused on the role of environment as a deterministic factor in influencing the course of history (Huntington 1945). The environmental determinists thus "regarded the physical environment as the moving cause and neglected interaction or feedback systems" (Harvey 1969:115). In the field of geography, the role of environment in affecting human societies has held a dominant position throughout the development of the discipline. "The theme of man-environment relations has never been far from the heart of geographic research, and for many it has functioned as the overriding theme" (Harvey 1969:115). This position in geography has now given way to a view that the "human ecosystem" should be the overriding consideration.

Geographers have not been the only professionals to utilize the environmental deterministic perspectives. The use of "ecotone" concepts and "transition zones" in explanations of particular adaptive strategies of cultures leans towards the deterministic explanations of earlier geographers. Robert Rhoades (1978:608-614) reminds archaeologists of the hazards of using these approaches, especially since many environmental scientists consider the basis of these approaches to be outdated, and that serious debate still exists as to the accuracy of the definitions of these zones.

Sociologists also have used the environmental determinist perspectives, but much less than geographers.

This may be due in part to the early influence of Emile Durkheim (1858-1917), who recognized the importance of "social phenomena" as opposed to individualistic, environmental, or psychological explanations of society. "We must seek the explanation of social life in the nature of society itself" (Durkheim 1938:102).

A number of sociologists and historians have expressed a central concern for environmental perspective. Arnold Toynbee's (1947) principal hypothesis dealt with environmental factors as determinants in the growth of civilizations.

> It is clear that if the geneses of civilizations are not the result of biological factors or of geographical environments acting separately, they must be the result of some kind of interaction between them (Toynbee 1947:60).

This statement is strongly reflective of Aristotle's earlier writings. Toynbee added the element of biological or genetic determinants to his postulation, in which societal changes are seen as the result of either biological, environmental, or combined determinants. "Civilizations arise out of response to challenges: The causal mechanism is not an entity but a relation, and that relation may be one of man-nature or man-man" (Toynbee 1978:36). Toynbee's writings thus reflect a movement away from a strict environmental determinist position insofar as he adds a biological determinant and establishes the notion of "relations" to his theory of how civilizations grow.

Amos Hawley (1975) suggests a more contemporary sociological view of the relation between humans and the environment. He also reflects a synthesis of ideas and issues that now pervade the social sciences, so far as the problem of environment and culture is concerned. Hawley's focus is on technology, the basis of the cultural structure that Leslie White constructed in The Science of Culture (1949). In this structure, (White 1949:363-393), culture is organized and integrated into three subdivisions, which would resemble a pyramid structure. At the basal core is technology which includes subsistence tools and activities utilized in the procurement of energy. Above and derivative of technology is the sociological system, including patterned behaviors. Atop the sociological system rests the ideological system. Each system reacts and interacts with the other, but according to White, the primary role as a cultural determinant is dominated by the technological system. The central relation is that between technology as an energy procurement system, and the environment as an energy supplier. Cultures change and grow as the amount of energy per capita, per year, increases through better utilization and technological developments.

Amos Hawley notes this latter relationship and states "technology is a concept that is commonly used in much too narrow a sense" (Hawley 1975:10). Hawley desires a much broader view of the importance of technology in affecting the total cultural system. Hawley would have us show how the technological system relates, not only to the environment, but also to the "organized group" that uses the specific technology. Hawley also utilizes the concept of adaptation which plays a key role in anthropological studies. Now, rather than viewing the environment as a determinant, Hawley states that "the relation of the organism to the environment is necessarily an adaptive one" (Hawley 1975:10). This reflects a change in focus from environmental determinants to an emphasis on humans and their adaptive mechanisms, and the effects these have on the remainder of the cultural system. This is now a dominant research area in the social sciences.

Sociologist James Quinn (1950) discussed this problem in an important publication, Human Ecology, in which he recognizes that both culture and is adaptive mechanisms, and the environment interact upon one another. Therefore, we must recognize and research both areas in order to gain a clearer understanding of human culture systems.

> Man cannot live apart from the environment. The latter continually sets conditions to which man must adjust; it supplies food and drink and air to satisfy his biological needs, and it acts both directly and indirectly to influence his behavior. At the same time, man as a living organism continually modifies his environment. Adjustment occurs between the two (Quinn 1950:18).

It is this statement which best sums up the approach which exemplifies the perspectives underlying this research. Quinn has noted the importance of both environment and culture and the interaction between the two systems which is a principal determinant in the development of a specific cultural system.

Anthropology has long dealt with the relation between culture and the environment, and in doing so, is able to add many specifics which are of importance in understanding any cultural system. What has developed, in the theoretical realm, is that each theorist adds a new dimension to an evergrowing system of relationships. Each new focus leads to important information about the entire cultural system. To focus on only one perspective creates, I feel, too narrow of a perspective. It also is very difficult for one researcher to handle the wealth of information accumulated from the various perspectives. It is therefore important to acknowledge differing perspectives in order to show the extreme complexity of materials that are now evolving in the anthropological field.

With the development of the historical school of thought in anthropology, under the direction of Franz Boas, emphasis was placed primarily on cultures, and the unique historical features of each culture. Boas noted the influence of environment on cultures, but refuted any sort of deterministic explanations (Boas 1940:265-266).

Durkheim influenced sociology to focus on "social phenomena," while Boas influenced anthropologists to research cultural histories and the unique particularities of each culture. Thus, both disciplines were drawn away from the environmental determinist camp. Boas did take into consideration the effects of environment in his earlier studies (Boas 1888:417), but he abandoned environmental explanations for the remainder of his career. The effects of environment on culture were viewed as "influences" but not determinants (Boas 1940:266).

Ruth Bunzel added a new dimension to the environmental/cultural relationship. Bunzel focused on economics, as have other social theorists, and states that economics equals "the total organization of behavior with reference to the problem of physical survival" (Bunzel 1938:327). Bunzel took the problem one step further and discussed her perspective in relation to how the economic system functions in connection to both culture and the environment. "Fundamentally the function of any economic system is to maintain some kind of equilibrium between material needs and the potentials of the environment" (Bunzel 1938:327). Thus Bunzel, though an adherent of the Historical School, adds the dimension of a "functionalist" explanation to her theory.

Leslie White extended the importance of culture as the primary determinant over any explanations that sought psychological, environmental, or biological explanations about culture (White 1949). White was a strict cultural determinist, and in a sense reflects the antithesis of the previously discussed environmental determinist position. White's position was that the technological system and energy procurement were the principal factors to be considered when viewing culture change and development. The biological organism was considered to be insignificant in the development of culture over the past 50,000 years. James Quinn supports this proposition. "Biological factors ordinarily do not change from generation to generation except as they become culturally redefined. Therefore, they are generally to be counted as constants" (Quinn 1950:21). Leslie White considered the environment as a "conditioner" of culture, not a determinant (White 1949:xix). For White, any significant understanding of culture must come from cultural explanations, no psychological, biological, or environmental. White also discussed Durkheim's concepts involving "social phenomena," and felt that:

> there is not a single sociologist that we know of (Durkheim excepted) who has a clear conception of what a science of culture would be and who has devoted himself to the advancement of such a science (White 1949:86).

White felt that Durkheim's <u>The Rules of Sociological Method</u> (1938), was in fact laying the groundwork for a true science of culture. However, White also felt that Durkheim fell short, through the use of the term "sociology" rather than "science of culture" or "culturology." The essential point here is that White's position represents the extreme opposite of what has developed as a dialectic between strict environmental determinists and culturologists.

From the two extreme perspectives of strict environmental and deterministic cultural explanations, there has gradually evolved numerous foci which appear directly related to one or the other theoretical positions, and at the same time, often reflect both approaches in a synthesized manner.

As an example of this development, Wendell Oswalt states: "Salmon are well recognized as a primary source of food along the northwest coast, and salmon were pivotal in establishing the character of Northwest Coast Indian economic life" (Oswalt N.D.:2). This would appear to reflect a direct offshoot of the environmental determinist position; one might say it reflects Aristotle's earlier statement. However, Oswalt's primary focus is technology. We must focus on technology because, "it unquestionably has been instrumental in the development and maintenance of cultural systems" (Oswalt N.D.:1). Here, Oswalt has taken technology, a central factor of Leslie White's theory discussed above, and given it added emphasis. At the same time, Oswalt stresses the resource, in this case salmon, as a primary determinant in the establishment of the unique characteristics of Northwest

Coast Indian cultures (see Suttles 1968).

M. A. Baumhoff has duplicated this position in discussing California Athabaskan fishers: "California Athabaskans are a fishing people so we may expect the quantity of fish resource to affect in some way their population" (Baumhoff 1958B:34). Again, the specific resource utilized by a group now becomes a determinant of other aspects of their social and cultural system.

Deward Walker (1967) attributes yearly migration patterns of Plateau dwellers to their reliance on a resource with anadromous characteristics. "The ancient pattern of wide travel was typical of most people of the Plateau and stemmed primarily from reliance on anadromous type of fish" (Walker 1967:1).

It is clear that theorists are still using the environment as a deterministic factor in explaining the development of cultural systems. In fact, the environmental factors, though now used in association with technological explanations, have become more specific as particular resources are now used in deterministic explanations.

As an outgrowth of information developed in the natural sciences, "ecological" interpretations of culture have developed, an example: "Any species survives by virtue of its niche - the opportunity afforded it by the environment" (Sears 1956:472). Here, the terminology developed in the natural sciences is applied to explanations of human cultures, the realization being that humans are part of the ecosphere, regardless of popular "Western" thought that often projects the image of humans having somehow, through scientific technology, reached the point where they can "control" their environment. Sears explains this point further:

> Man is dependent upon other organisms both for the immediate means of survival and for maintaining habitat conditions under which survival is possible (Sears 1956:471).

The salient point in this type of analysis is that a biological interpretation is offered to explain the interrelatedness of all organisms and the tremendous repercussions which can affect all participants of the ecosphere whenever a change is encountered in the environment (Commoner 1970:2-16). Regardless of the potentials exhibited by human culture systems to alter the environment. There are specific environmental limits which are impossible to surpass without affecting the existence of the species itself. Humans are "organisms" regardless of their "cultural illusions," and as organisms they too have a biological niche. This habitat can only withstand so many alterations prior to failure. The hypothesis demands that humans recognize the interrelatedness of all aspects of the ecosphere. Domination by one organism (humans) becomes a delusion as the environment has a limited resource potential upon which each species must either adapt or cease to exist.

This theoretical position has lead to the questioning, by many anthropologists, of many traditional concepts employed in the social sciences regarding the comparison of primitive and contemporary cultures. Richard Lee and Marshall Sahlins have questioned the very nature of concepts such as "development" and "evolution" and the criteria used to explain these phenomena. Richard Lee, in his field work with the !Kung Bushmen, discusses the relation of the !Kung subsistence system and their environment, in terms of energy input-output analysis. Lee's findings suggest that hunting and gathering populations were better adapted to their ecosystem than succeeding systems utilizing agricultural techniques. "Throughout his long history as a hunter and gatherer, man was intimate with the natural world. He was part of the ecosystem in which he existed" (Lee 1972:52). Of course, it would be absurd to consider any group as not part of the ecosystem, but Lee emphasizes that there is a qualitative difference in how a particular group views its position in relation to their environment. Coupled with the technological systems employed by hunters and gatherers, this total system is seen to be more efficiently adapted to the environment than the succeeding agricultural systems. Lee also refutes prior concepts that had placed hunters and gatherers in a position where they were viewed as "at the limits of technological simplicity and of environmental harshness" (Lee 1979:432). Lee focused on population carrying capacities of the environment, technology, nutrition, and adaptation. The longevity of the hunting and gathering systems are equated with the security these adaptive systems fostered.

Marshall Sahlins has expanded upon this position in reference to "primitive" cultures, and states that we might consider viewing hunters and gatherers as "the original affluent society" (Sahlins 1968:85). Sahlins' arguments directly refute certain premises that evolve from the use of concepts such as those developed by Leslie White, i.e. "energy harvest per capita per year" (White 1949:368), which are used as measuring devices of cultural "development." Sahlins argues that hunting and gathering cultures have "less energy harnassed per capita per year than any other mode of production" (Sahlins 1968:85), and: "By common understanding an affluent society is one in which all the people's wants are easily satisfied" (Sahlins 1968:85). According to Sahlins, "wants" are "easily satisfied either by producing much or desiring little" (Sahlins 1968:85).

Therefore, based on the concepts developed in the natural and social sciences, Sahlins and Lee have focused their attention principally on the human organism and its relation to the ecosystem. After utilizing ecological, adaptive, carrying capacity, and demographic modes of analysis, and drawing comparisons to industrial societies, primitive hunters and gatherers are viewed as surpassing their industrial counterparts in many important ecological categories. Hunting and gathering systems gain a significant ecological advantage over succeeding systems in relation to the amount of energy input relative to energy output. White's position failed to note the important aspect of "energy output" and only focused on increasing amounts of energy procurement as measurements of culture growth. In relation to the basic question of organism survival, as linked to efficient adaptive mechanisms, these studies bring to question the direction of many social science studies which focus on "development" and culture change while ignoring the basic biological question of how these developments affect the survival capabilities of the species itself. The longevity of the hunting and gathering system of adaptation, coupled with the versatile nature of the system (i.e. worldwide adaptability), argue in favor of this system's efficiency (Lee 1979:432-461).

These ecological studies show that the relationship of humans and the environment can be viewed utilizing specific measurable techniques employable with the energy input-output analysis, population demographies, and nutritional studies. At the same time, specific cultural factors, such as the economic attitudes of the group under study, also must be taken into account. This implies there are a host of factors existing in any cultural/ecological situation that must be carefully analyzed in order to understand the full relationship between the two specifics, environment and culture. We move from a strict environmentalist or culturologically determinist position to realize that both dimensions must be incorporated as part of an interacting system in which the factors influence still other components. These must be explored if any reasonable understanding of the whole system of relations is to occur. Jesse Jennings sums up this point:

> The first factor to be recognized is that for man there are literally two environments. One is the natural setting itself, the combination of land, species and climate as they exist. The second is that insulating fabric or blanket of material objects, beliefs, and behaviors called culture that man interposes between himself and the world of nature (Jennings 1968:47).

The relationship of environment and culture, in which both aspects are considered now "essentials," in formulating theories and conducting field studies, has spawned varying theoretical schemes under the terminology of "cultural ecology." These perspectives lean toward either one or the other, culture or the environment, in discussions of cultural systems. The major point is that theorists now refuse to ignore the importance of each aspect when focusing on their particular interest area. The common meeting ground of cultural ecologists centers on the adaptive strategies and the technological and economic systems of the groups being studied. "This adaptive process, which is a continuous pattern of adjustment to continuously changing circumstances, we call the process of cultural ecology" (Bennett 1969:viii). The adaptive mechanisms are seen as reflecting influences from both cultural and environmental systems.

> Adaption embraces both the relations to nature and, except for completely isolated societies, to other cultural systems. Adaption to nature will shape a cultures' technology, and derivatively its social and ideological components (Sahlins 1960:48).

The analysis of the interaction between the environment and the adaptive strategies of the particular group in question now has become a principal focus in the analysis of any cultural system.

Julian Steward has dealt with the importance of subsistence for many years and is one of the strongest proponents of this important area of study. For Steward, the subsistence system of any group is the principal group of relations from which other patterns of culture, such as the social organization, are shaped. Steward's emphasis was on the development of primitive hunting and gathering cultures and he hypothesized that:

> subsistence patterns have been extraordinarily potent in shaping the social organization of a number of primitive hunting and gathering peoples in different parts of the world (Steward 1973:206).

Steward ruled out environmental determinism and coined the phrase "human ecology" (Steward 1938). Human ecology was a research focus that emphasized the adaptive strategies employed by a particular group and from which societal institutions were "conditioned" (Steward 1938:1).

Subsistence and the technological and economic systems have long been a principal focus in the research strategies employed in archaeology. Cultural reconstructions, typologies, and classifications have been largely constructed with this focus in mind. By nature of the study of prehistory, archaeologists often are left with scant remnants of past cultures, from which inferences are drawn. This material, as reflective of past adaptations and specific technological systems, exists in the form of bone and stone implements. This is especially true of the Pacific Northwest where preservation can be a problem. The remaining cultural material has led archaeologists to the emphasis placed on technology and adaptation as specific research area foci of this discipline. Social organization and ideological systems have been inferred from the technological and environmental factors viewed in specific excavations. The "cultural ecology" approach has been used, with special emphasis on technological and economic systems, by many leading authorities in Northwest archaeology (i.e. Cressman 1977, Leonhardy and Rice 1970, Daugherty 1962). In each of these studies the adaptive technological and economic systems have been employed to explain specific culture systems and culture change over time. At the same time, specific climatic and topographic factors are brought into play in order to explain specific adaptive strategies and culture changes that have occurred during the prehistory of the Northwest (Daugherty 1962). It might be considered that subsistence patterns are now viewed as deterministic factors in the development of cultural systems (Steward 1973:205-212). Of course, prehistorians have shown that environment affects the subsistence system, so the question becomes moot as to which systems affect the others most. Where a major environmental or climatic change takes place, this would appear as a major factor in influencing a specific adaptive response. The cultural response is also affected by the cultural systems involved (a difficult measurement in archaeology). This latter interaction is explained in an interesting statement:

> existing social and cultural forms influence our ability to identify and take innovative advantage of environmental resources. Moreover, organizational and technological responses to the environment sometimes become institutionalized to a point of critical inflexibility (Demerath and Marwell 1976:586).

A statement by June Helm sums up the major focus of the cultural ecology approach utilized by anthropologists in viewing the relationship between culture and the environment.

> The anthropological view of ecology stresses the adaptive and exploitive relations, through the agency of tech-

> nology, of the human group to its habitat, and the demographic and sociocultural consequences of those relations (Helm 1962:630).

We now focus on "environments", social and environmental, and the affects each system has in shaping a particular culture. The adaptive technological and economic systems become a primary focus from which other aspects of culture are specifically affected. However, it is a wholistic approach in which each aspect of the cultural environment and natural environment interact. With the exception of major cultural or environmental catastrophies, it is I feel, impossible to label any one aspect as completely deterministic in nature.

My perspective incorporates not only the cultural ecologists' approach, but also the biological and materialistic emphases as exemplified by Leslie White. In this approach, the relation of environment and culture is viewed as interacting systems, both of which exert specific effects on the other, and both of which are also part of a larger integrated system of interacting components. The technological and economic systems become not determinants, but reflections of the relationships within a specific cultural system and the relation between that system and it immediate ecosphere.

Where an environmental change occurs, of significant magnitude and duration, a cultural response would be dependent not only on the environmental factors, but also the response mechanisms of a given cultural system. These mechanisms would in turn be dependent upon the relations existing within the given culture confronted by the environmental stress. That a significant culture change will follow an environmental change affecting a culture's resource base is assumed by the nature of a culture's position in relation with the environment as a "symbiotic component" (McHale 1970:1).

The cultural ecology perspective employed in this work focuses on documenting first, the occurrence of the salmon resource; second, on the technological and economic means of procurement, that is, fishing implements; third, the environmental factors that may have influenced the occurrence of the salmon resource; and fourth, to what extent salmon, as a resource, are relevant over time.

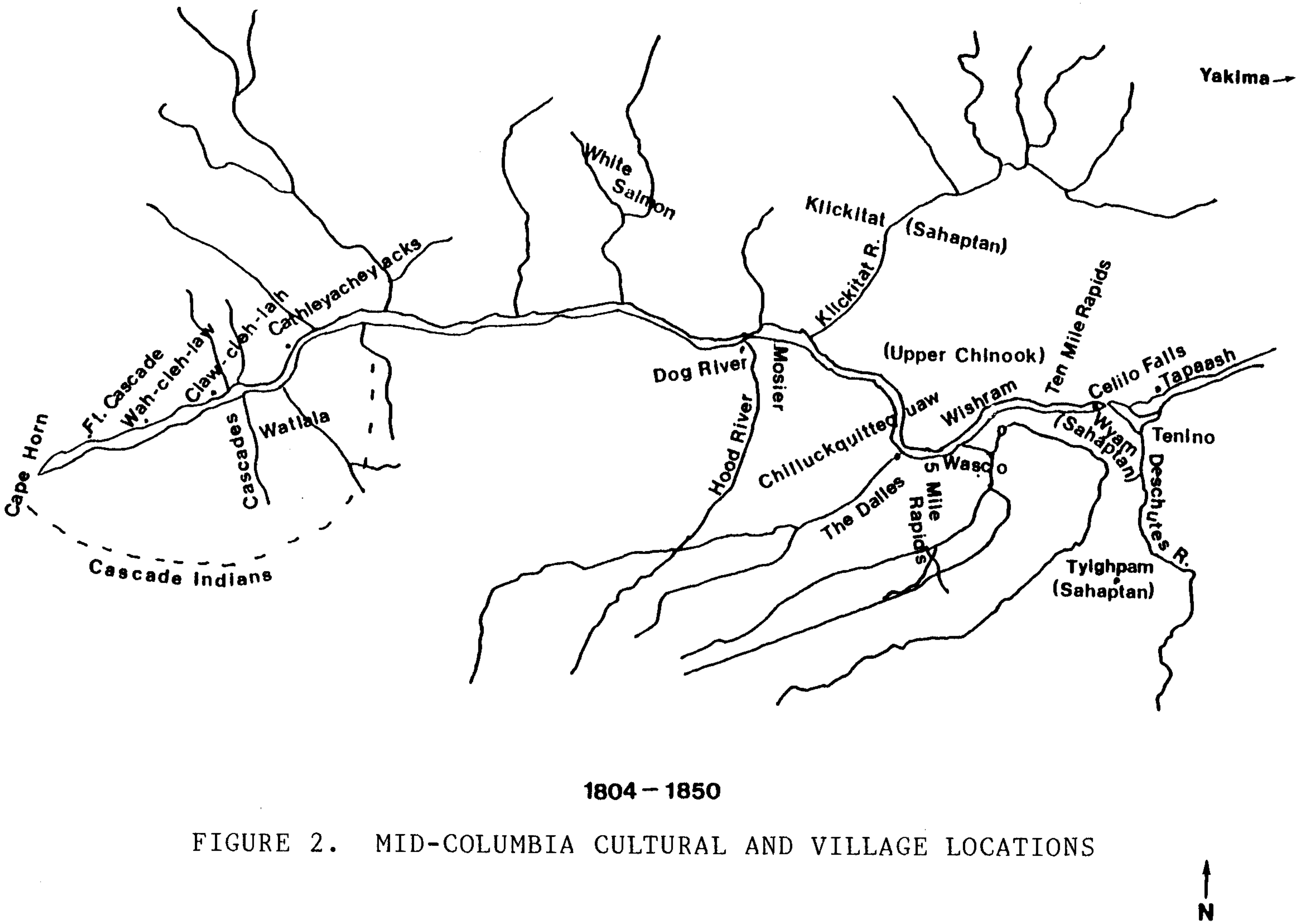
CHAPTER III

The Dalles: A Mid-Columbia Salmon Fishery

This chapter's emphasis is on the Upper Chinook Indians of the Columbia Plateau, the principal groups are the Wishram and Wasco. Information is drawn from ethnographic data gathered during and after Euro-Indian contact and archaeological information from the last 35 years. The extensive utilization of the salmon resource is exhibited in both the ethnographic and archaeological records pertaining to the Chinook and associated mid-Columbia localities.

The salmon resource will be shown to have had a pervasive influence throughout the social and cultural systems of the Chinook. This analysis of a Columbia River fishing locale should allow a comparative analysis to be drawn between a specific locale, where fishing was of primary importance, and other temporal periods and geographic locales in the Columbia Plateau.

Several difficulties are inherent in the use of historic documents relating to traditional Upper Chinook culture. First, there is difficulty in trying to identify prehistoric groups who once lived along the banks of the Columbia River due to the series of epidemics in the early 1800's. Secondly, other factors such as seasonal movement, "and an imperfect knowledge of their political organization" (Mason 1979:1), makes it difficult to iden-



1804 — 1850

FIGURE 2. MID-COLUMBIA CULTURAL AND VILLAGE LOCATIONS

tify with certainty the boundaries between specific groups. When the first traders and explorers were traveling the Columbia:

> they found a range of names existing along this rather short stretch of river, each of these names specific to the people of a particular village or group of villages. Besides, then, whatever cultural affiliations these people had with more general groupings within the Upper Chinook, this profusion of group specific names in a limited geographic area suggest very discrete and specific cultural divisions (Mason 1979:1).

Ethnographic materials have focused on specific groups with generalizations then being applied to other groups who lived, or are inferred to have existed, in the same geographic area. However, these generalizations are often myopic, ignoring important aspects of prehistoric cultures, village locations, and migration patterns.

Environment

The Upper Chinook lived in an area immediately adjacent to the Columbia River, from several miles east of The Dalles to the Cascade Mountains. At the Cascades, annual rainfall is over 70 inches and average temperature ranges from 75° (July) to 35° (January). At The Dalles, rainfall averages 16 inches and temperature averages range from 35° (January) to over 75° (July). Elevation varies between The Dalles (200 feet A. S.) and the Cascades (1,700 feet A. S.) (Cressman 1960:13). As exhibited by these figures, the environment offers tremendous variation within the Upper Chinook occupation area. At the Cascades, coniferous forests in a narrow steep canyon of Columbia basalts dominate the landscape. At The Dalles, the environment changes to the steppe environment prevalent throughout the middle Plateau area. Rainfall is minimal and vegetation is dominated by the bunchgrass steppe vegetation zone (see Figure 1).

The geographic area in which the Upper Chinook lived consists roughly of an area immediately bordering the Columbia River from several miles east of The Dalles, and west to the Cascade Mountains. Boas (1940) has included the Kathlamet, who occupied an area below the Cascades, in the Upper Chinook dialect system. However, Sapir and Spier felt that more dialectic differences occurred at the Cascades, from present day Cascade Locks to approximately Cape Horn, and considered this region to be a transition between lower river dialects (Clackamas) and upper river dialects (Spier and Sapir 1930:159).

The environment of this region offers tremendous variation considering the short distance between the Cascades and The Dalles. Within approximately fifty miles, annual rainfall can vary by over 75 inches. Steppe vegetation of Eastern Washington consists of agropyron Festuca grassland, bounded on the west by dryer and warmer Artemisia tridenta-Festuca idahoensis. To the north, cooler Artemisia tripartita-Festuca idahoensis, and to the east, cooler and moister, Festuca symphoricarpos and

Festuca rosa (Blinman, Mehringer, Sheppard 1979:409). The Upper Chinook area consisted of a transition environment which offered its inhabitants a riverine, coniferous, and plateau (steppe) environment from which to draw upon for resources.

The Dalles Locale

Approximately five miles east of The Dalles, there was a series of rapids where the river narrows significantly. Big Eddy, Five Mile Rapids, Ten Mile Rapids, and the once magnificent Celilo Falls, were landmarks of The Dalles locale, flooded by construction of The Dalles Dam in 1957. It was here that aboriginal settlers established permanent villages based on the then plentiful salmon runs. It was here also that early white settlers were drawn, eventually pushing out the aboriginal inhabitants of the region (Cressman 1960:40).

At the Cascades, to the west of The Dalles, a similar occupation is evident. Here also, a long rapids flowed before the 1930's Bonneville Dam construction. Many settlements also were evident from both archaeological and ethnographic information (Campbell 1976; Spier and Sapir 1930). Cressman proposes an explanation for the settlements and larger population aggregates that occur at The Dalles and Cascade rapids:

> The important point is that some places were more favorable than others as fishing stations and long stretches of the river offered no

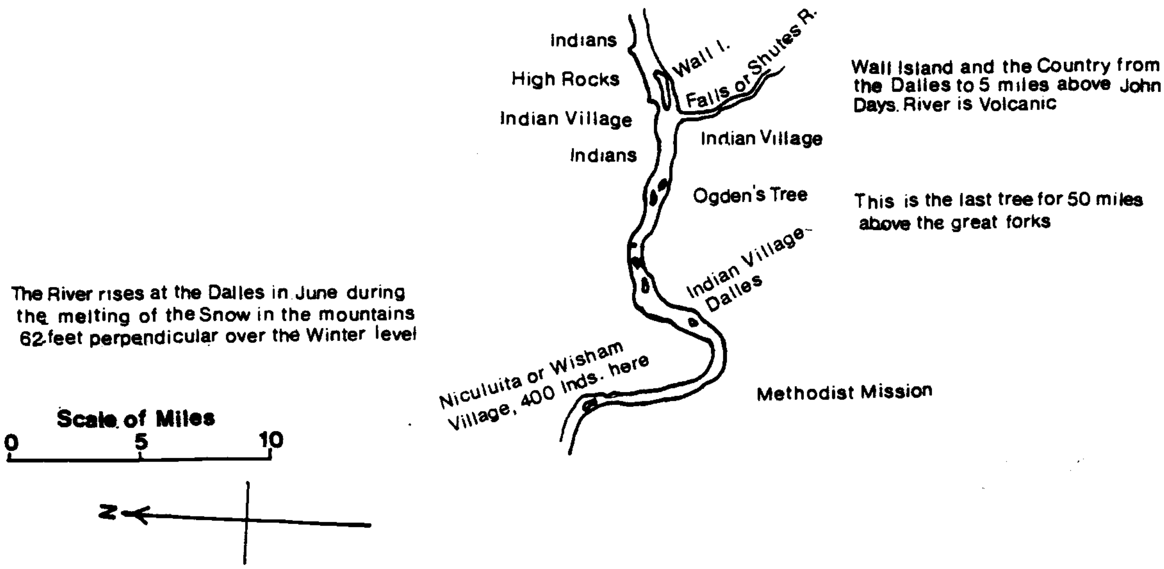


FIGURE 3. MAP OF THE COLUMBIA, 1841 (after Biddle 1926)

> suitable sites for use of aboriginal fishing gear. The location of a rapids or waterfalls determined the best fishing sites (Cressman 1972:2).

Migration and Settlement

The principal settlements of the Upper Chinook were located in the immediate area of The Dalles. West of The Dalles, there were other Upper Chinookan groups located at the mouth of the White Salmon River, at present day Hood River (Dog), and the Watlala at the Cascades. At The Dalles, on the south side of the river, the Wasco were located at the head of Five Mild Rapids (Biddle 1926:118). The term "The Dalles", or La Dalle, was indicative of the major resource of the area, meaning slab or fillet of fish. The Wishram were located directly across the Columbia from the Wasco on the Washington shore (Spier and Sapir 1930:160; Strong 1959; Cressman 1960). The Wishram main village appears to have been located "directly northeast of Spedis, Washington" (Biddle 1926: 118), near or at the excavated site of Wakemap. From Ten Mile Rapids west to Mosier, there is indicated to have been at least 18 villages, including the Sahaptan Klickitats. Due to the proliferation of settlements in the Rapids area above The Dalles, there have been disputes over exact locations of the main villages. However, the general view that now prevails, based on archaeological data and ethnographic materials, places "wa'sp!o, the primary village located five miles east of The Dalles op-

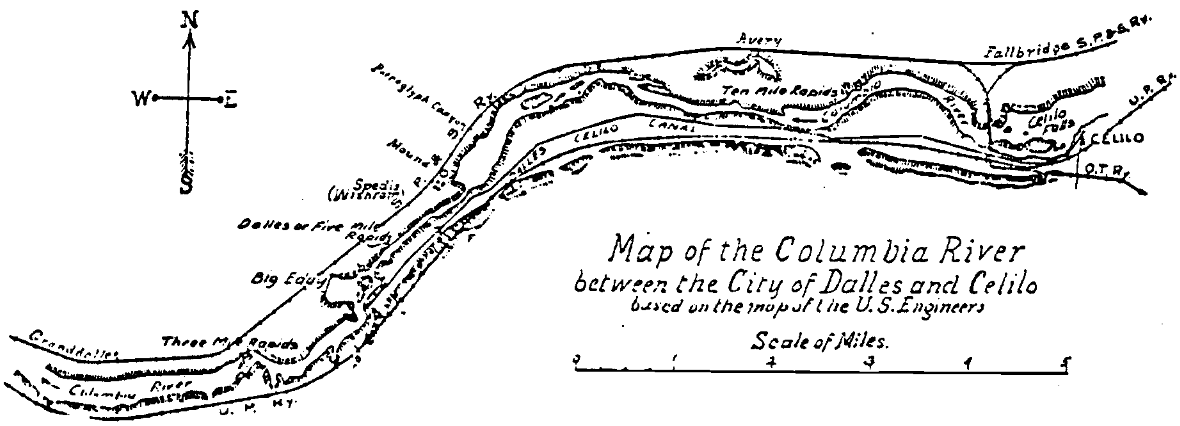


FIGURE 4. MAP OF THE COLUMBIA RIVER
BETWEEN THE DALLES AND CELILO FALLS
(after Biddle 1926)

posite the Chief Wishram village Nixlu'idix" (Altseimer-Tilson 1976:14), at the Five Mile Rapids and Wakemap sites respectively.

It appears now that earliest settlement at The Dalles occurred soon after the Pleistocene about 11,000 years ago (Cressman 1960:66). Cressman's site, WS-4, at Five Mile Rapids, has a basal C14 date of 9,785±200 B.P. Cressman viewed this site as, potentially, the location of the latter main Wasco village site.

Several migration theories have been presented in recent years that deal with interpretations of how early migrations occurred in the Plateau and Columbia Gorge (Borden 1979:963-970; Cressman 1960; Butler 1961). Butler's hypothesis regarding early settlement in the Pacific Northwest is one which has received much comment and debate in archaeological circles. Regarding the Northwest, it was Butler's contention that there existed an early cultural tradition that ranged the length of the Western Cordilleran in the Western United States. Its arrival in the Northwest is speculated to have been around 12,000 B.P. This was ascribed as a hunting-gathering and fishing economy. After reaching major inland river systems, by way of the Cordilleran, Butler assumes this early culture then migrated westward from the inland regions. Butler then speculated as to later influences upon this early culture as coming from the desert cultures of the Northern Great Basin and eventually dominating the old Cordilleran culture. This possibly occurred in the range of 6,000 to 8,000 B.P. A major factor in Butler's concept is that the Old Cordilleran culture is speculated as originating in the more inland regions and then spreading out to more coastal regions along the Northwest Coast. Cressman's report on excavations at Five Mile Rapids, near The Dalles, also speculates as to early inland adaptation to the riverine environment about 7,875 B.P. (Cressman 1960:67), with later migration downriver to coastal areas.

Borden's theory (Borden 1979:963-971) deals with a somewhat different approach. However, it is based also on more recent archaeological information. His theory has the early migration of humans into the Northwest as coming from west of The Rockies. Borden proposes several western routes running both south and north in the Plateau and coastal areas. He uses archaeological sites in this area to support his contentions.

Regarding migration patterns that are specific to The Dalles region, and Chinook in particular, much of the speculation has dealt with which direction the initial migrations occurred on the river. As yet, no conclusive information exists to substantiate which direction initial migrations occurred on the Columbia (see Rigsby 1965).

Several more recent migrations have been dealt with in the ethnographic literature. It is very difficult to document these migrations; however, they are mentioned in several sources (Teit 1928:96-100; Spier and Sapir 1930: 160). In these references, the Salish are said to have formerly occupied areas near The Dalles. It has been hypothesized that the "Thompson Indians of British Columbia are descendants of the part of the tribe that went North" (Teit 1928:96). The general view, held by early ethnographers, is that the Sahaptan groups who occupied this region at the time of contact may have arrived fairly recently from the Upper Deschutes country or from areas southeast of the Columbia. With their arrival it is speculated that early residents of The Dalles region, specifically the Salish, either were pushed out, or an inner tribal dispute led to their leaving the area. Again, these migrations have yet to be substantiated. Rigsby (1965) found no evidence for Salish speakers having occupied an area near The Dalles.

Suttles and Elmendorf (1963) have discussed Salish movements during prehistory utilizing linguistic data. Their findings do not substantiate Teit's suggestion that the Thompson of British Columbia were ancestors of a group once living near The Dalles. However, prehistoric migration patterns are still speculative to a large degree when dealing with inferences drawn from ethnographic period linguistic groups. Suttles and Elmendorf offer several migration possibilities, but all within the ethnographic Coastal Salish and interior Salish boundaries.

Linguistic relations between interior Salish groups is suggested to run from the northwest to the southeast with western linguistic branches more closely related than southeastern groups. Western groups include the Thompson Indians. One would not expect them to have close linguistic ties if they were more recent arrivals in the area as proposed by Teit. Sanger also suggests an interior Salish movement southward as early as 2,000 B.C. (Sanger 1967:192).

As for the Penutian speakers (i.e. Chinook and Sahaptan), Cressman suggests a migration from the northern Great Basin into the Plateau, perhaps during the hypsithermal period (Cressman 1960:74; Suttles and Elmendorf 1963). Penutian speakers are considered to have dominated the Southern Plateau for an extensive period, with the Salish spreading from the Northern Plateau much later (Aikens 1978:164). The term "Chinook" is stated to be a Salish term of the Chehalis dialect (Ray 1938).

Cultural Continuum

The culture that was in existence during the initial contact period was also apparently one of considerable longevity. Pettigrew focuses on the archaeological investigations that have taken place on the lower and middle Columbia River. Pettigrew finds during the past 2,600 years, up to the contact period, that "there is no evidence of cultural replacement, migration, or any basic changes in the way of life of the people" (Pettigrew

1977:369).

This may turn out to be a conservative estimate. On the lower Snake River at Alpowa, Brauner (1976) found a cultural continuum of 6,000 years. Since the lower Columbia sites that have been investigated occur primarily along lower river terraces, a longer cultural continuum may be established with future research into older terraces existing further away from the river.

It should be noted that the often limited material culture inventory exposed at archaeology sites may be misleading as to whether or not it reflects a continuous occupation by the final occupation group. This is especially problematic in the mid-Columbia where linguistic and cultural differences are noted from the ethnographic sources.

The Upper Chinook

Although cultural and linguistic diversity existed in the middle Columbia region, the area from The Dalles west to the coast has been labeled part of the "Coast Salish-Chinook Province" (Drucker 1965:113). The area incorporates features which link it to the larger Northwest Coast culture and unique linguistic and cultural features which make it a subdivision of the larger cultural area. The steppe environment of The Dalles and locations eastward, plus affiliations with a range of Plateau groups, create a cultural situation unique from coastal Chinook groups and other northwest coastal groups. The use of cedar plank houses, potlatches, a class-ranked social system,and heavy emphasis on salmon fishing and trade contribute to the Upper Chinook's designation as part of the "Coast Salish-Chinook Province."

Within the mid-Columbia region, there existed linguistic and cultural variation. Adjacent to the Chinook settlement areas, Sahaptan groups included the Tenino, Umatilla, Yakima, Wyam, Tyighpam, and Klickitat (Figure 2).

As noted, Salish groups have been mentioned as having possibly once lived in the mid-Columbia region. The Thompson (British Columbia) and Columbia (Central Washington), along with the Sanpoil, Spokane, Okanagan, are Salish groups that once occupied territory north of the Chinook locales. However, Rigsby (1965) found no evidence of Salish speakers having lived in the mid-Columbia areas.

The Chinook's location on the Columbia River placed them in an extremely rich resource area. The nature of resources along the Northwest Coast, and the middle and lower Columbia River regions, has been offered as an explanation for the richness of material culture in that region. Ray suggests that the Columbia has produced more salmon than any river in the world (Ray 1938:46).

Due to the abundant resources of this region, anthropologist Ruth Bunzel has correlated this wealth of resources as the major factor in the elaborate social and material cultures that existed in the Northwest:

> It is not the source of supply, but the existence of surplus, that is more significant for social forms. Hunting and fishing peoples with reliable and abundant food supplies, such as the people of the Northwest Coast of America, have developed the elaborate social and religious institutions which are usually associated with agricultural economics (Bunzel 1938:330).

Suttles (1968) sums up the traditional view of Northwest Coast cultures as having permanent villages with large populations, a ranked society, elaborate ceremonies and art styles, all attributable to the "richness of the habitat of the area and the efficiency of the subsistence techniques of the people" (Suttles 1968:56). However, Suttles also suggests that elaborate systems exemplified by Northwest Coast cultures, (one might include the Chinook), were attributable not to the "richness" of resources in the area, but more to a reliance on resources that were subject to seasonal variations and year-to-year fluctuations. This applies specifically to the anadromous resources such as smelt, cut-throat trout, steelhead, and salmon. The adaption to this resource base is exemplified by the potlatch system (Mitchell 1971:27) which allowed a dispersal of wealth between varying biotic communities with prestige acting as a support mechanism for the adaptive system. Suttles therefore focuses on the "extreme periods" of resource fluctuations as being essential in the formation of particular adaptive strategies in the Northwest Coast area. A further elaboration of this problem follows in a discussion on Plateau marriage systems.

As a cultural sub-area of the greater Northwest Cultural area, the Chinook has unique cultural qualities. What has probably received the most attention about Chinookan people was their role as middlemen in the trade that flourished among Northwest Coast, Plateau, and Northern Great Basin Cultural areas (Ray 1938:107; Spier and Sapir 1930:224-227). It was The Dalles that groups from each of the areas traveled to and procured goods either first-hand or through elaborate trade networks. The Chinookan Jargon (Ruby and Brown 1976:100, 150) was used as a trade language not only along the Columbia, but was also used by other groups coming into the area. After contact, Euro-American words were incorporated into the jargon, as it continually expanded and evolved, taking words from a variety of sources. Nootkan, Spanish, and English are all examples of the variety of group languages incorporated into the system. The key, however, is that it allowed groups to communicate over wide areas in the Northwest.

Social Organization

The social organization of the Wishram and Wasco reflected the class structure that dominated the Northwest

Coast (Spier and Sapir 1930:210-212). In addition to a class of slaves, there existed three other classes. A ruling class of band leaders directed the autonomous village in maintaining order. Often, there might be several leaders of one village, including a War Chief, whose powers were derived from a powerful guardian spirit. Leadership was patrilineal and hereditary with leaders marrying within the same rank. Besides the ruling class, there also existed a middle class and a poorer class. Due to the fact that leadership was hereditary, it was not always the case that a leader was also the wealthiest, as the possibility of attaining wealth was relatively open to most members of the group (Spier and Sapir 1930: 211).

Marriage was governed through an exogamous, patrilineal system. The ceremony gained sanction of the participating families by an exchange of gifts. Often women were sought from outside the territory, from the Cascades, Klickitats, and at the mouth of the Columbia (Spier and Sapir 1930:220).

The exogamous marriage form might be explained as being facilitated by the desire to form alliances with other groups in order to assure access to resources throughout the Plateau and Coastal regions. Walker suggests that due to the nature of the anadromous fish runs, wide travel was typical throughout the region. "The ethnic groups of the region were unified by common exploitation of aquatic foods concentrated in a single, major river system" (Walker 1967:39). An exogamous marriage system would aid in cementing ties and preventing friction between groups vying for the same resources. Where groups existed in areas of a differing biotic nature, intergroup marriage could aid in securing access to groups outside the particular biotic province. Hence, the exogamous marriage system may have been one of several "specific cultural patterns facilitating movement and exchange throughout the region" (Walker 1967:39).

Trade

The tremendous trade activity that centered around The Dalles has been well documented in the ethnographic literature (Ruby and Brown 1972; Spier and Sapir 1930; Ruby and Brown 1976).

> It was further upstream at The Dalles in late summer and early fall that tribes from as far as Canada to the north, California to the south and the Great Plains to the east gathered in the homeland of the Upper Chinookan Wishrams and Wascos to trade, wager - in the largest mart in the Pacific Northwest (Ruby and Brown 1976:21).

After Euro-American contact, the enormous influx of white trade goods were carried up the Columbia and traded to scores of groups trading at The Dalles. "The bulk of the western trade in these as in native goods was probably conducted in the vicinity of The Dalles" (Ruby and Brown 1972:21).

In all of this trade, the Wishram and Wasco were located in the middle, occupying the central territory for what appears to be an unbelievably vast network of trade between groups covering enormously large territories. "Products of the lower Columbia, the coast and southern Oregon, were traded for inland goods" (Spier and Sapir 1930:224). Shells, especially Dentalia which were used for adornment and currency, were brought by coastal groups. Dentalia reached the Columbia by way of Nootka Sound, along with the famous Nootka canoes, which were in use along the Columbia when Lewis and Clark first journeyed down the river in 1805.

> Products from as far south as the Modoc, Rogue, and Shasta reached The Dalles and products from Puget Sound, the Plateaus of the interior to the north and east, the Plains, the interior of Oregon and Northern California, reached The Dalles (Spier and Sapir 1930:224).

Major trade items included skins, fish, oil, pemmican, feathers, robes, wappato, camas, tobacco, and slaves. The name Nixlu'idix (Spedis, Washington) is representative of the activities that took place on the Wishram side of the Columbia at The Dalles. Sapir explains this as meaning "the trading place" (Spier and Sapir 1930:223).

The key item which the Wishram and Wasco traded was salmon. Dried, cured, and pounded salmon cakes were sought by tribes throughout the Plateau Region. The pounded salmon cakes were even sought by Coastal Chinook;

> from Chinookan peoples of The Dalles they secured the great product of that place - salmon pounded fine and packed in ninety-nine pound pieces in two-foot high rush and salmon skin baskets protected by cord-laced fish skins (Ruby and Brown 1976:21; Spier and Sapir 1930).

It is inferred that the preparation and packaging of salmon in this manner was either not understood or at least not practiced by the Lower Chinook people.

An explanation, or at least a partial explanation, for this vast trade network has been discussed in the section on exogamous marriage. Several anthropologists have dealt with this problem in some detail (Cressman 1977; Anastasio 1977; Walker 1967). Due to the nature of salmon runs, their unpredictability in some years, and the factor of deterioration that occurs in the upper rivers, some areas of the Columbia offer better procurement and healthier fish. Celilo Falls, The Dalles, and the Cascades offered just such areas. It has also been noted that salmon fishing stations were held by particular families, especially the higher classes (Walker 1967:17; Cressman 1977:126). "Since the distribution of favorable sites was quite uneven along the River, some form of socially approved access to fishing spots by outsiders had to develop to prevent conflict" (Cressman 1977:126). Hence, village exogamy and intergroup trade partners became devices which, in the Plateau at least, "provided a series of friendly associations throughout the Columbia

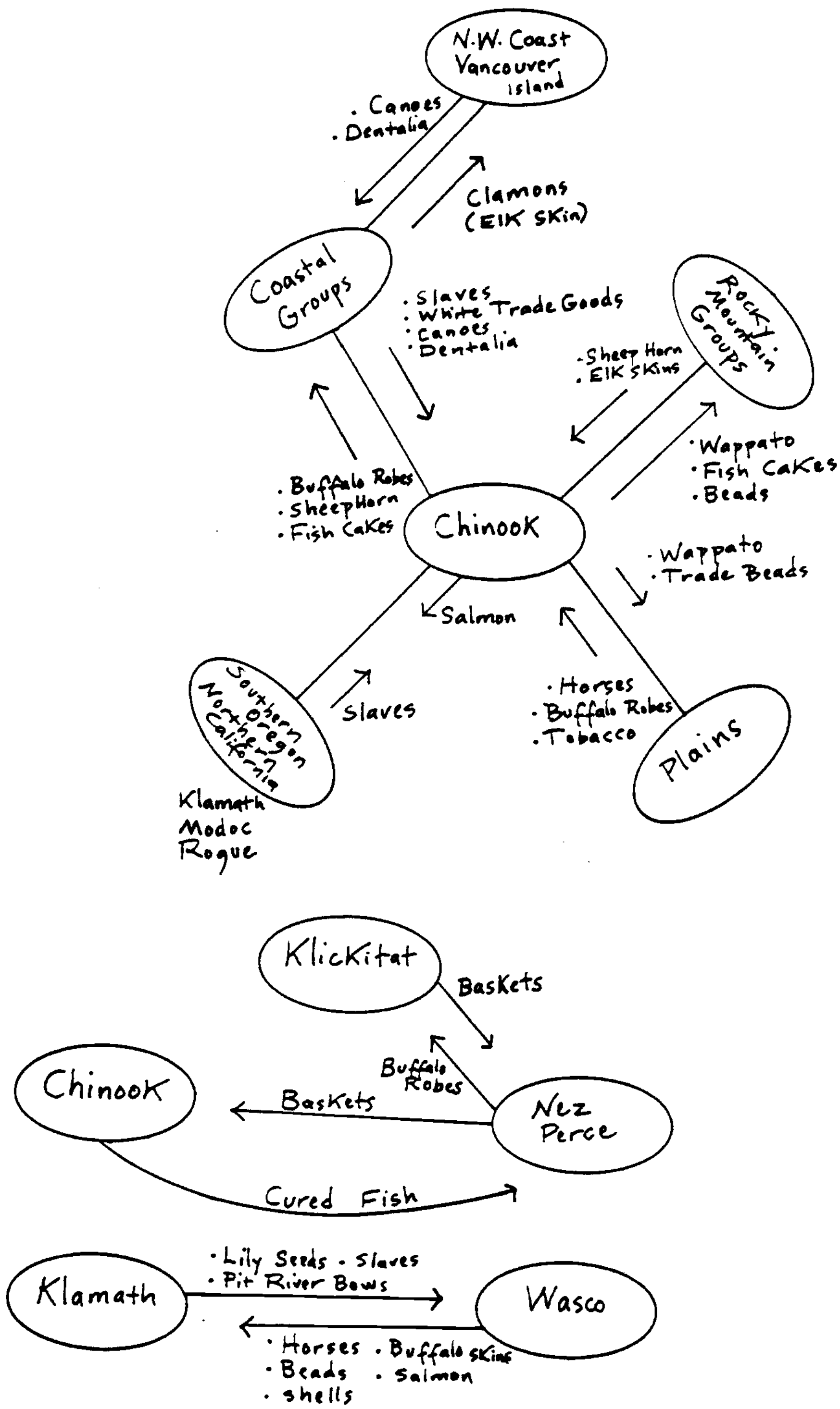


FIGURE 5. POSSIBLE TRADE ROUTES: COLUMBIA PLATEAU
(after Sapir 1930; Ruby and Brown 1972, 1976; and others)

Plateau" (Cressman 1977:126).

Walker felt it was essential that these alliances be formed due to the environmental nature of the Plateau. Groups existed in varying biotic regions with resources which outside groups may deem necessary. With alliances formed, differing groups were allowed wide travel throughout the area in order to secure needed resources. Outside this immediate area, it is difficult to hypothesize what, if any, alliances or trading partners existed between the groups of The Dalles and those from great distances, such as Southern Oregon.

Other items used as trade goods at The Dalles included wild onions, wild potatoes, harvested in May and June; wild carrots, hazel nuts and acorns, harvested in November; cranberries, harvested in the fall on the slopes of Mt. Adams and Mt. Hood, and blueberries.

The initial trade at The Dalles often times signaled only the beginning of an ever expanding trade network. One group, such as the Cayuse, might pick up trade goods such as fish cakes or beads and then travel back to their territory and trade them to groups in their areas. An item might change hands several times and move through varying groups before it reached its final destination. James Teit offers another example of this extended network in reference to the Salish:

> Many articles obtained by the Columbia Salish at The Dalles, were carried across country and sold to the

Sanpoil and others (Teit 1928:121).

Material Culture

> . . . . it is probable that the Wishram depended primarily on fishing for subsistence, secondarily on root and seed gathering, with hunting in a distinctly subordinate place (Spier and Sapir 1930:174).

It is clear that salmon played a dominant role in the material as well as social life of the Upper Chinook. Four species of salmon - chinook, sockeye, silver, and chum - were available in the Columbia River. Also present were trout, steelhead, smelt, sturgeon and suckers. Ray explains that "the fish (salmon) was of a primary importance but sturgeon, trout, and smelt, played an important economic role" (Ray 1938:46). In the lower river, early February saw the first major fish run of the year, "these are candlefish, (Eulachon) the fish which are commonly known in Oregon as Columbia River Smelt" (Holman 1926:265). These were caught in the Columbia using small mesh nets, and possibly "fish rakes," that were common to Coastal Salish groups (Jones 1972:60). In the spring, chubs and suckers were also plentiful in the river. Late summer and winter found good sturgeon and lamprey eel catches. In order to catch sturgeon, a long pole with detachable barbs and secured with a twined rope enabled landing of these massive fish (Kane 1971:30). With the larger fish, and when storage was a problem, fish could be tethered in water for line storage (Jones 1972:59).

In order to catch salmon or smaller fish in streams, a variety of methods and equipment were used. The fishing stations, common even today on the Columbia and Deschutes, were "highly prized and passed by inheritance" (Spier and Sapir 1930:175). These platforms consist of a series of split planks supported over a favorable fishing spot. Usually a narrows or pool area where salmon congregate before continuing upstream was seen as favorable for fishing. Due to the nature of the runs involved, there were separate fishing stations, one for summer when dip nets were used, and one for fall when spears were used. All of the fish caught belonged to the fisherman, but elders were allowed to take enough for their meals (Spier and Sapir 1930:174-175). There were several varieties of dip nets in use. For salmon and large fish, a net was attached to a two foot diameter ring with a long handle. Often the net was attached loosely with a slip knot so as to close when the salmon weight pulled on the net. A much smaller net was used for eel and smelt.

Seine nets were also in use throughout the Columbia and net size was dependent on the fishing spot. Nets were made from fibers with a mesh of three to four inches (Spier and Sapir 1930:177). Floats were attached to the top of the net to keep it afloat and perforated, banded or notched stone net sinkers held the net in place on the river bottom (Stewart 1977:79; Ray 1938:110-111).

Along with nets and basket traps, weirs and dams were also in use for smaller streams. Basket traps were cylindrical and tapered to a closed end. Larger traps of a similar design were also used for salmon. These traps were made from willow and hazel wood and fastened together using open twine construction (Spier and Sapir 1930:177; Jones 1972:58; Stewart 1977:102-118). The weirs were used to guide fish into the basket traps. Where larger streams were fished, weirs might be used to trap fish, which were then gaffed. The Upper Chinook also used assorted clubs to kill fish that were trapped.

Spears were a common form of catching fish in the Columbia and the many surrounding streams (Jones 1972:58; Walker 1967:38). "Fish spears were usually of the two-pronged variety common to the Northwest Coast" (Spier and Sapir 1930:172). At least two types of these spears were in use on the Columbia River. One spear has diverging prongs with detachable points attached which, in turn, were attached to a rope (Curtis reprint 1970:101-photo). Another two-pronged spear is the common Leister Barb, and Walker shows several of these in use in Nez Perce territory. Leister barbs are also reported in use with the Wappato Indians near Sauvie Island (Jones 1972:111). The use of this type spear has been documented throughout the Northwest and Alaska.

In the lower Columbia, Franklin Jones reports that hooks baited with live bait, attached to lines, were in use (Jones 1972:58). I did not find any indication of this activity as being common in The Dalles area.

The preparation of fish took several forms. Fish drying on salmon rocks was common with the Upper Chinook as well as other areas of the Northwest. Salmon were also smoked, steamed, and boiled. Salmon drying and processing was the central method of salmon preparation at The Dalles. "Salmon were dried, pulverized, and preserved in baskets" (Spier and Sapir 1930:178). The baskets were line with salmon skin, which had been dried and stretched. After this procedure, the salmon were ready for storage as winter food or as a trade item. If the fish were to be stored for winter food, this was usually done in pits below ground which were then covered with skins.

Steaming salmon occurred in pits lined with preheated rocks, then a layer of grass, then the layer of fish, and then another layer of grass. After this was complete, water was added and the pit was sealed to allow the steaming process to occur. There are several variations to this method of steaming, but the process works in a similar manner.

Hunting methods and equipment showed considerable variability, based on type of game available and the decisions of the head man as to which method or equipment was to be used (Spier and Sapir 1930:179-180). Before a hunt, the head man took sweats, prayed, and decided how the hunt would take place. This was an important decision, as his future status depended on how well the hunt went.

A variety of game was hunted either in the vicinity of The Dalles, or on the slopes of Mt. Hood and Mt. Adams. Bear, cougar, deer, elk, fox, and wolves are noted as being hunted using three different methods. Some animals were driven into pits, and others were dispatched using a bow and arrow. Another method used was to drive animals towards waiting hunters. Bows were of two types, the "self" and the "sinew backed" bows (Spier and Sapir 1930: 199).

Sapir also states that meat was divided equally among hunters, but the hide and horns went to the one who killed the animal. The antler and hides were valuable materials. As an example, the hide could be used as an apparel and the antler might be used as a "soft hammer" in the manufacture of stone tools. After a kill, the meat would be processed and smoked, roasted or sundried.

Within the Upper Chinook, a division of labor existed between men and women. However, there is little material that deals with the women's role. Spier and Sapir do mention that women gathered roots, berries, and nuts, which were either stored for winter use or traded outside the group. The primary tools involved here would be a digging stick and baskets. Most plant items listed in the section discussing trade were apparently gathered by women. The principal method of preparing these foods was either to roast or boil the food in pits as previously explained.

The Columbia River offered the primary route of travel up and down its lengthy course. From the mouth of the Columbia, at present day Astoria, east to Hood River existed a richly forested region. With the exception of the two major areas of rapids at The Dalles and the Cascades, the river ran wide and relatively smoothly. The river provided a quick and, if traveling downstream, an effortless journey. The Chinook made use of three types of canoes in their trade, fishing, and social excursions. The first canoe was shovel-nosed with a rounded stern and prow. This canoe was "constructed from a single fifteen-foot log, it was manned by one or two people working notched paddles" (Ruby and Brown 1976:17). Lewis and Clark noted the use of the shovel-nosed canoes at Celilo Falls in 1805. They burned and gouged out the center of the log to construct these canoes. There were two sizes of this canoe. Some ranged up to 20 feet in length and others were considerably smaller (Spier and Sapir 1930: 186-188). A larger canoe was also in use, at least by the Lower Chinook. It ranged up to 35 feet in length, with a width of six feet (Ruby and Brown 1976:18). It is believed that this canoe was obtained in trade from the Nootka at Vancouver Island (Drucker 1965:172). A third canoe used by the Chinook was the "cutwater" (Ruby and Brown 1976:18). This canoe was also in the 30-plus foot range. An explanation given for the trade north for these canoes is that a primary resource utilized in their construction was the white cedar.

The Upper Chinook tool kit contained a large number of implements. Woodworking tools consisted of adzes, chisels, wedges, knives, and awls. Bone, antler, and stone were the raw materials used in the production of these tools. With these tools, they accomplished a variety of tasks, such as the construction of dwelling structures, or precision work on canoes.

Stone implements consisted of projectile points, drills, mortars, pestles, netsinkers, pipes, mauls, and scrapers (Cressman 1960; Campbell 1977; Strong 1959). An interesting factor involving the tool technology of the Upper Chinook was the "pecking" technique used in working basalt and quartzite cobbles. These rocks, which were worked into large mortars and mauls, involved a combination of pecking, grinding and incising which, when complete, formed elaborately shaped and incised implements. These implements are very artistic and quite beautiful. The Upper Chinook also carved bone and antler into a variety of designs (Strong 1959:34). Bone, wood, and antler also were shaped into bowls, spoons and ladles.

Teit (1928:111-112) noted that the people of the

Columbia were "superior in stone-work." this appears to be accurate when one views the variety of implements found in the assemblages of The Dalles region. However, it is difficult to say exactly who made all of the tools found, due to the amount of trade which occurred in the area.

A variety of implements were constructed out of various fibers found in the area and gained through trade. Tulee mats were in use for house coverings, fish drying, and floor coverings (McKeown 1959:14; Spier and Sapir 1930:190-192). Baskets were also in use with two specific technologies (twined and coiled) utilized. Many baskets are assumed to have come through trade with the Klickitats who were renowned basket makers in the immediate area. Conical basket hats were in use and made from white mountain grass. Willow, bark, and perhaps cedar, were used in basket construction. Fibers, also, were used for netting material in fishing practices.

There appears to be some confusion as to the type of house structures in use at The Dalles. Lewis and Clark mention seeing wooden houses sunk partially underground in The Dalles area (Thwaites 1905). Biddle repeats this information in 1926, however, no clarification is given as to what kind of wooden houses were present. James Teit (1928:114) is more specific in his description. He refers to a semi-subterranean earth covered house in use by the Middle Columbia Salish. He also explains this to be a winter house. In the summer, an above ground tulee mat lodge was in use. This information would appear to correlate with the findings of Spier and Sapir in their Wishram Ethnography of 1930. Two houses are inferred to have been in use during the pre-contact period. A large, semi-subterranean earth lodge was used as a winter dwelling, a real necessity in the Columbia Gorge where winters are frigid with high winds able to destroy any but the sturdiest above ground structures. In the summer, camp was moved back down to a closer proximity with the river and smaller tulee mat lodges were used. The earth lodge was dug up to six feet in depth, with the roof supported by timbers, and then covered with mats, grass, and dirt. Floors and walls inside the structure were lined with mats, and sleeping platforms were elevated slightly to allow for storage space underneath. The large, semi-subterranean structures were oval in shape, but the above ground tulee mat lodges were of two types, round and rectangular (Spier and Sapir 1930:202). Sapir also notes a third type structure, but debate exists as to whether it was a late development in The Dalles area; this is a rectangular plank-house, also semi-subterranean. This type structure, with a gabled roof, is common along the Northwest Coast area. With the Upper Chinook, however, archaeological information and ethnographic information appears too sketchy to state whether this structure was in regular use or not. The University of Washington is noted to have discovered a cedar plank house at Wakemap (Strong 1959:15).

Clothing also offers significant problems in defining exactly what was worn during the pre-contact and earlier period (Teit 1928:113-118; Altseimer-Tilson 1976; Spier and Sapir 1930:204-210). Most ethnographic sources note a significant influence on Upper Chinook clothing, coming from the Plains prior to Euro-American contact. Hence, the use of leather as wearing apparel dominates the discussions on cloting worn at The Dalles. This appears distinctive from the clothing worn by the Lower Chinook at the mouth of the Columbia.

> The continuous moisture of their country, unlike the plateau and plains, prevented the use of leather, an exception being clamons, elkskin cuirasses purchased by Chinooks from their Clatsop neighbors across the river and from other peoples upstream (Ruby and Brown 1976:15).

It has already been noted that the Upper and Lower Chinook occupied distinctively differing biotic regions, which could account for the variance in clothing and the raw materials used in construction. This has to be taken into account when speculating as to clothing worn during prehistoric times at The Dalles. Sapir notes that aboriginal clothing for the Wishram and Wasco was of fibrous materials, an example being the women's fiber apron.

Teit (1928) notes the use of fiber hats worn by the middle Columbia Salish, as has been noted for the Wishram. Hence, the use of fibers (i.e. cedar) has been noted by several sources, regarding aboriginal clothing worn at The Dalles. This would seem likely, owing to the trade and linguistic ties the Upper Chinook had with the Lower Chinook, whose clothing was dominated by the use of fiber. One has also to note trade relations to the east, where leather was in dominant use prior to contact. Leather became the material in dominant use after the contact period, due to the Plains influence on the Upper Chinook.

Men's clothing during the period 1805-1811 consisted of a cap of raccoon, coyote, wolf or mountain goat (Alt-seimer-Tilson 1976). A poncho style Plains shirt of leather covered the upper body and leather breech cloths with leather hide leggings covering the lower body. Leather moccasins were worn, especially in the winter. This is also distinctive from the Lower Chinook, who went barefoot in even the coldest weather. In extremely cold weather, a robe of elk or buffalo was worn, which was very indicative of the Plains influence.

Women's clothing consisted of a twined basket hat; a cape of deer, antelope, or mountain goat; a "wing dress," which fell to mid-calf and was constructed from two hides; and tanned leather leggings. Moccasins were also worn and stuffed with grass in the winter for warmth. Women wore two types of wraps in cold weather. One wrap was of bear, deer, or buffalo. The other wrap was of twined tulee (Altseimer-Tilson 1976:41-47). The wing dress and poncho styled shirt both have been identified with the Plains. Shells, dentalia and beads ornamented both men's and women's clothing.

Salmon and Religion

Salmon was, and still is, an honored entity in ceremonial practices performed by the Upper Chinook. This would include the use of salmon as a prominent ceremonial food, important at a variety of celebrations (Robinson 1977; B.I.A. report 1977).

The Wishram and Wasco mythology incorporated mythological elements from the Plateau and Coastal cultural systems (Cressman 1960:40). Coyote and Salmon appear in roles of creator, trickster, teacher, and local hero of the Wishram (Cressman 1960; Sapir 1909:51). Similar accounts of Salmon and Coyote myths occur in the Kutenai, Thompson, Shuswap, Lillooet, Nez Perce, Sanpoil, Seshelt, and Snohomish, regarding the coming of Salmon. Coyote is credited with liberating Salmon from an enclosure, enabling Salmon to swim freely (Sapir 1909; Gunther 1928: 162).

The First Salmon Ceremony was practiced by the Wishram and Wasco, as was common throughout the Northwest (Jones 1972:62; Gunther 1928:129-173; Spier and Sapir 1930:249). Proper handling and specific rituals accompanied the preparation of the first salmon caught, which was important in order to insure a successful run (Spier 1938:15-18). When caught, the first salmon was handled only by a medicine man. The fish had to be properly cut and processed with prayers offered throughout the ceremony.

Cressman researched an important archaeological consideration involving the Wishram First Salmon Ceremony and the paucity of salmon remains found after the Early Period at The Dalles. Cressman ruled out the ceremonial disposal of bones as having any relation to the lack of faunal remains found after the beginning of the Transition Period. "The Wishram did not throw the bones of the salmon back into the river" (Cressman 1960:68). Ceremonial practices involving the handling of salmon show considerable variation throughout the Plateau and Northwest Coast during the post-contact period. Thus, a lack of salmon bones in archaeological sites cannot generally be attributable to ceremonial practices involving the disposal of bones.

Archaeological Indications of Salmon Fishing at The Dalles and Adjacent Localities

Unfortunately, much of the archaeological data pertaining to The Dalles locale suffers from methodological problems in relation to quantification of data, a lack of specific identification of faunal remains, and vertical/ horizontal controls which allow only speculations of a general nature. The resulting data is difficult to place in a temporal or cultural perspective. However, an assessment of Lower Chinook ethnographic information from localities to the west of The Dalles and site reports from immediately east of The Dalles (Shiner 1961), in association with the ethnographic data presented, allows the assessment that salmon fishing was a dominant activity at The Dalles locale during the late prehistoric period (2,500 B.P.-1,850 A.D.) Fishing was also a significant economic pursuit during the 8,000 to 7,000 year period at The Dalles (Cressman 1960). However, fishing implements do not appear in significant numbers until the late period. In fact, the manner of gathering fish at The Dalles during the "Full Early" period (Cressman 1960) is unknown.

Artifacts identified as potential fishing implements, recovered at The Dalles and adjacent localities, from the late prehistoric components are listed in the following table.

TABLE 3. LATE PREHISTORIC POTENTIAL FISHING IMPLEMENTS FROM THE DALLES AND ADJACENT LOCALITIES (after Cressman 1960; Strong and others 1930; Shiner 1961; Strong 1959)

1. Harpoon prongs.
2. Bone projectile points, barbed.
3. Antler projectile points.
4. Net weights, perforated.
5. Net weights, two notches.
6. Net weights, four notches.
7. Net weights, banded.
8. Composite harpoons.
9. Sturgeon hooks.
10. Fish scaler.
11. Netting shuttle.
12. Bipoints, bone (possible fish gorges).
13. Barbed bone points.
14. Fish hooks.
15. Pointed bone objects.

It is significant that early surveys in The Dalles and McNary locales located net weights in the "hundreds," and four types are noted in the collections. No other Plateau sites have documented such large occurrences of these implements, nor have any other localities documented such a diverse fishing assemblage. The majority of these artifacts are from the "Late Period" of occupation. Cressman (1960) found no netsinkers prior to the "Late Period." Shiner's report (1961) notes large occurrences of fishing implements, and specifically net sinkers, appearing during the late prehistoric (35UM7, 45BN53, 45WW6). Strong and others (1930) also located large numbers of sinkers, presumably from the late prehistoric period, in The Dalles area at Wakemap Mound, at the mouth of the Deschutes River, and at Miller's Island.

Faunal remains from The Dalles locality (i.e. Wakemap) offer little information as to specific identifications or allow quantification. One must infer from ethnographic reports and adjacent localities regarding the use of salmon. Cressman notes large occurrences of salmon bone from his "Early Period" at approximately 7,600 years ago. Soon after this period, the disappearance of salmon bones has created one of the great mysteries involving Plateau prehistory. At Wakemap (Strong and others 1930: 51), fish bones are noted throughout the mound (late prehistoric), but species identification was a rarity during archaeology of this period. We are left to draw our own inferences regarding whether these are salmon bones or other fish types. These bones cannot be presumed to all be salmon, as excavations at Hamilton Island to the west (Campbell 1976;1977) found that a majority of bone was sturgeon, after initial assumptions that the island might have been a salmon fishing station. At 45BN53, Shiner found that "suckers were more common than salmon" (Shiner 1961:200) during the late prehistoric component.

Of Shiner's six sites, four contained salmon bone including the potential Cascade component at 35UM5 (Shiner 1961:175). Several of Shiner's sites, though not specific as to numbers, reports "vast numbers" of salmon and fish bone (45WW6 and 35UM17, Shiner 1961). Further east, at Strawberry Island (45FR17), large numbers of salmon bone have been located in a late prehistoric component (Cleveland and others 1976).

In summary, The Dalles and adjacent localities exhibit a major emphasis on fishing during the late prehistoric and ethnographic periods. An exact quantification and identification of faunal remains is not possible, but salmon bones occur in significant numbers throughout this area during the late period. The ethnographic and archaeological data support the contention that salmon played a significant and possibly dominant role in the social and economic systems of The Dalles locality during the late prehistoric period.

Salmon procurement also was significant at The Dalles during the Early Cascade phase at approximately 7,600 B.P. This is significant as only Bernard Creek Rockshelter (Randolph and Dahlstrom 1977), in western Idaho, has recorded noteworthy numbers of salmon bone from the Early Cascade phase in the middle or southern Plateau. These two sites appear to represent a unique and early reliance on the salmon resource which is not reflective of the general Plateau subsistence pattern during this period.

The technological and faunal inventories present in mid-Columbia components of the late prehistoric period, in conjunction with ethnographic data, reflect the initial theoretical proposition that the technological and economic systems, in association with particular resources, are prominent factors reflected in and influencing both the sociological and ideological systems of the culture. The importance of the salmon resource has been suggested to have been reflected in these specific systems of the Upper Chinook: Settlement, technology, marriage and kin affiliations, trade, hereditary distinctions of occupational localities (fishing locations), religion and mythology.

The faunal assemblage of mid-Columbia salmon fishing locales shows that cultural factors, such as preparation and ceremonial practices, that may have influenced preservation and ocurrence, did not effectively remove all salmon bones from the archaeological record. That is, at a salmon fishing locale in the southwest Plateau of the late prehistoric period, one would expect to find salmon bone and artifacts reflecting a fishing industry. At sites where salmon bones are not present (a hypothesis based on the possibility that faunal identifications in mid-Columbia archaeology sites suffer discrepancies), then the archaeology record of fishing would be reflected in the artifact record (fishing implements) and settlement locale. The important issue here is that fishing implements occur in significant numbers at a variety of locations. During the late prehistoric period in the mid-Columbia, the importance of fishing finds support in the larger number of implements. A significant drop in faunal and artifactual material of a fishing nature in other locales and other time periods would suggest a significant drop in the economic importance of the resource.

A small number of salmon bone or even the lack of faunal remains does not necessarily relegate salmon to a small level of importance in the overall cultural system. Economically (as in food consumption, trade, etc.), this is perhaps so, but socially, the importance of a resource may, in fact, be enhanced by its lack of general availability. The importance of a "lost resource" may elevate it to a more prestigious position, affecting differing aspects of the cultural system. This would be a difficult point to argue for the early and middle prehistoric periods for the Columbia as it has not been shown that salmon occupied a position of importance in the technological or faunal inventories outside two areas (The Dalles, Bernard Creek). However, a contemporary study of Plateau salmon utilization might show a drastic loss in economic importance, relative to the contact period, but the importance of the resource has been transferred to other aspects of specific cultural systems. Salmon resources are now ceremonial food utilized at a variety of contemporary ceremonies in the Plateau (Robinson 1976; B.I.A. report 1977). However, the resource has diminished significantly in numbers in recent years as major fisheries at The Dalles, Bonneville, and McNary have been significantly disrupted by the construction of dams. The salmon resource now may reflect more importance in the area of "cultural revitalization" than in the cultural areas documented during Euro-Indian contact (Harris 1975:555; Pelto and Pelto 1979:531).

The salmon resource's importance is reflected throughout the Upper Chinook cultural systems. The importance of salmon as an economic resource has had considerable longevity with its origin occurring at least 7,600 years ago. Settlement and migration in The Dalles region has specifically been linked to the nature of the salmon resource. Specific areas of the river offer more favorable fishing areas, especially regarding the use of aboriginal fishing equipment. This is also evident in recent history, as it is known that salmon travel specific courses in the river and areas where rapids offer the greatest opportunity to secure salmon. At the Cascades, The Dalles, and the mouths of streams, were areas where the greatest congregation of villages occurred.

The importance of these areas is exemplified by the importance placed on specific fishing stations. These stations were owned and their use was passed from generation to generation in the same family line. With the initial catch of the spring salmon, elaborate ceremonies celebrating the first catch were performed. This ensured a favorable run of salmon, but catching the salmon was assured by the fishing station's location and proper net location.

The characteristics of the anadromous salmon runs also have been linked to other areas of the Upper Chinook social structure. The development of a vast network of trade partners, and possibly the exogamous marriage system, are hypothesized to have been related directly to the nature of the salmon resource and more general resource procurements within the southern Plateau and middle Columbia Basin. As has been noted, only certain areas of the Columbia offered suitable locations to procure this resource. Hence, trade partners and marriage outside one's group might serve to lessen disputes over the much sought resource.

It has also been noted that the primary trade item of the Wasco and Wishram was the pounded salmon cakes, ninety pound blocks, processed in a manner apparently unique to the Upper Chinook in this general region. The importance of this item as a valued trade good has been noted by the vast distances groups traveled to The Dalles in order to secure salmon.

Possibly, the most interesting accounts regarding the importance of salmon in Upper Chinook culture come from the Wasco and Wishram mythologies which dwell on creation, procurement technologies, and use of salmon as a resource. Each detail involving the use and importance of this resource are narrated in a series of stories which tell of origin and subsequent development as a primary resource.

Also of importance in noting the value placed on the salmon resource is the area of technology. A variety of implements and methods were practiced allowing for both efficiency and large numbers of fish to be caught. The Upper Chinook knew the river well and exhibited considerable sophistication in the manufacture of tools best suited for the harvest of salmon. One might note that dip nets and seine nets are still in prevalent use today, which attests to their efficiency.

Hence, the importance of the salmon resource to the Upper Chinook can be summed up by stating that its effects were pervasive throughout Upper Chinookan cultural systems.

CHAPTER IV

Late Pleistocene Environment

Eight thousand to 15,000 years ago, the Northwest still was subjected to the effects of the Pleistocene glaciation (Press and Siever 1974:385). During this period, the last major southward movements of glaciers is documented by the Sumas and Vashon stades. At least three major advances of continental glaciation flowed into northwest Washington from approximately 2,000,000 years ago up through 12,000 years ago (Allen 1981:10; Laport 1968).

Approximately 13,000 years ago, the collapse of an ice dam on the Clark Fork River, Idaho, which had compounded Lake Missoula, caused the scouring and creation of the scablands of eastern Washington (Marshall 1971; Cressman 1960; Allen 1981).

The environment of the mid- and southern Plateau during the 8,000 to 10,000 year period as recorded by archaeologists (Marshall 1971; Cressman 1960; Allen 1981), reflects a cooler and moister climate than today. Stream run-off in the Palouse River is reported as greater than any period durng the last 10,000 years (Rice 1972; Marshall 1971). The Columbia River, as expected, also reflects a turbulent silt-laden stream during this period (Cressman 1960:67). Further pollen and climatic studies (Hansen 1947; Antevs 1948), in conjunction with the lat-

TABLE 4. TEMPORAL ASSOCIATIONS: 11,000-8,000 B.P.

7,000-5,000 B.C.	Anathermal (Antevs 1948:176). Plateau.
11,000-8,500 B.P.	Windust Phase (Ames and Marshall 1980:40). Lower Snake River.
8,000-7,000 B.C.	Windust Phase (Leonhardy and Rice 1970). Lower Snake River.
8,000-3,000 B.C.	Pioneer Period (Leonhardy and Rice 1970). Lower Snake River.
8,000-6,000 B.C.	Windust Phase (Lyman 1976:5; Brauner 1976:2). Lower Snake River.
11,000-8,000 B.P.	Lind Coulee Phase (Nelson 1969:22). S.W. Plateau.
Post-Pleistocene-4,000 B.C.	Okanagan Phase (Grabert 1974:70). S. Okanagan.

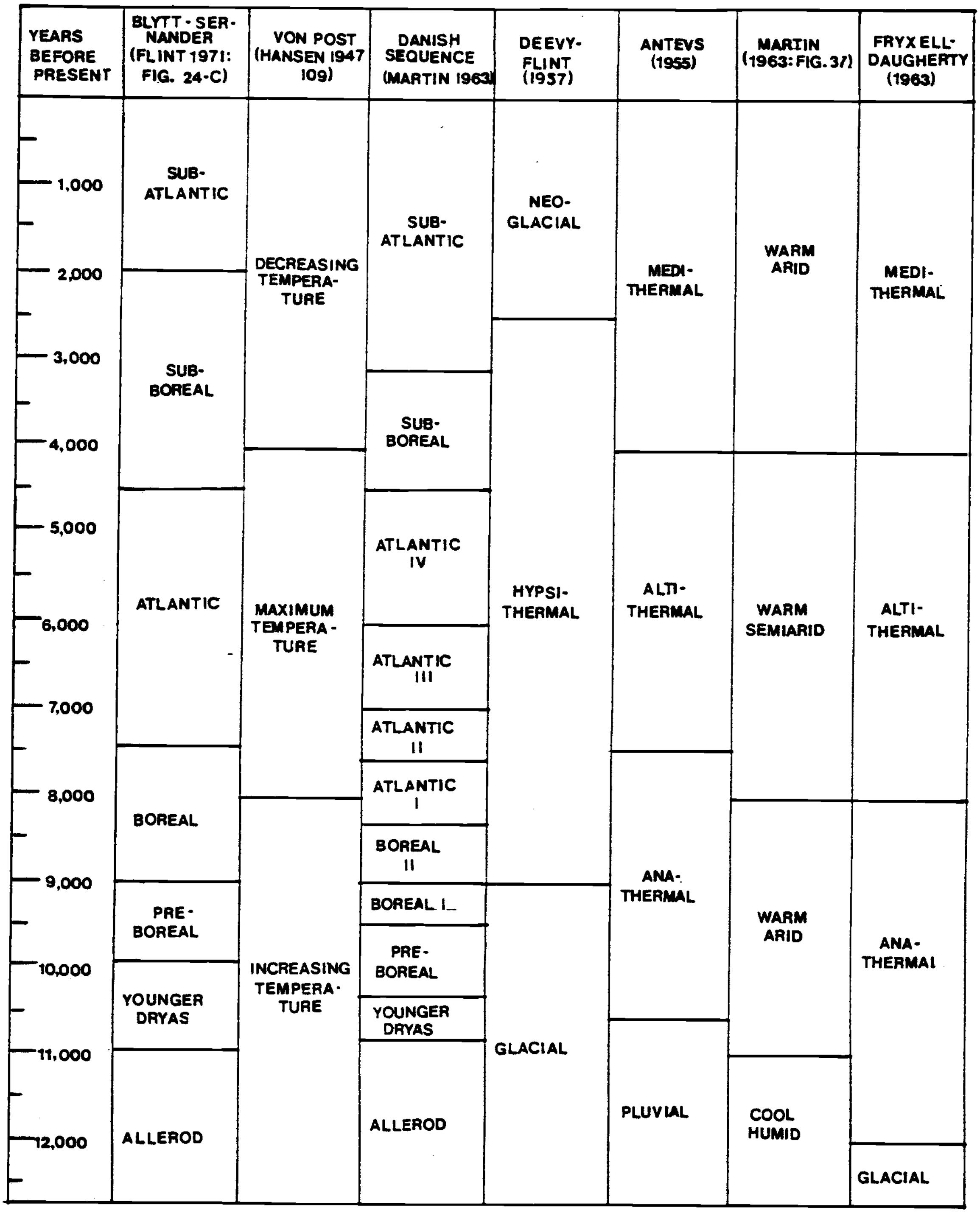


FIGURE 6. CORRELATION OF POST GLACIAL SCHEMES (after Bense 1972)

ter archaeological research, tend to support the general climatic sequence as proposed by Antevs (1948; Gustafson 1972), in which this early period is labeled the Pluvial (10,500-13,000 B.P.) and Anathermal (8,000-10,500 B.P.)

Gustafson (1972) attempted to correlate the climatic sequences of Antevs and those suggested by Hansen with faunal remains from Marms Rockshelter. Gustafson suggests "most are ubiquitous animals which have a broad tolerance to a range of habitats" (Gustafson 1972:84). He does note the occurrence of arctic fox and pine marten from the 8,000 to 10,000 year sediments at Marms Rockshelter, suggesting tundra and forested (coniferous) environments. After the 8,000 to 10,000 year period, Gustafson suggests that the "faunas appear to have remained relatively stable throughout the last 8,000 years" (Gustafson 1972:105). Prior to 10,000 B.P. saw the extinction of the large herbivores (Gustafson 1972). Gustafson suggests that a "cold steppe environment" might best describe the environment in relation to the faunal data during the early 8,000 to 10,000 year period (Gustafson 1972:132).

Thus, climatic, geologic, pollen and faunal evidence tend to support the contentions that the period of early human occupation in the Plateau (8,000 to 12,000 B.P.) correlates with Antevs' Anathermal, cool, moist period; one which saw tremendous stream discharges and floods and a general environment described as "cold steppe." The degree of forestation is questionable as is the degree of

C YEARS BP (APPROX.)	POLLEN DATA FROM BOGS AND LAKES (Hansen 1947)	GLACIAL FLUCTUATIONS (Crandell and Miller 1964; Fryxell et al 1968; Porter 1971)	ROCKFALL FREQUENCY IN CAVES (Fryxell 1965)	RELATIVE TERRACE HEIGHT (Marshall 1971)	INFERRED CLIMATIC CHANGES (Fryxell et al 1968; Hansen 1947)
	YELLOW PINE MAXIMUM	RENEWED ALPINE GLACIAL ADVANCE	MIN. MAX.	MIN. MAX.	PRESENT CONDITIONS
2,000	WHITE PINE	PROLONGED RECESSION			WARMER AND DRIER
4,000		REBIRTH AND ADVANCE OF ALPINE GLACIERS			COOLER AND MOISTER
6,000	GRASSES CHENOPODS COMPOSITES	DISAPPEARANCE OF ALPINE GLACIERS IN CASCADE RANGE			PERIOD OF MAXIMUM WARMTH AND DROUTH
7,000	MOUNT MAZAMA (CRATER LAKE) VOLCANIC ASH MARKER HORIZON				
8,000	WHITE PINE LODGEPOLE PINE YELLOW PINE	OSCILLATING ALPINE GLACIERS IN CASCADE RANGE			BRIEF COLD, ABRUPT WARMING TREND
10,000		DISAPPEARANCE OF CONTINENTAL ICE REMNANTS			FLUCTUATING COOL, MOIST CONDITIONS
12,000					INTERSTADIAL CONDITIONS
	GLACIER PEAK VOLCANIC ASH MARKER HORIZON				
13,000		RETREAT OF CORDILLERAN ICE SHEET			WANE OF INTENSE GLACIAL CLIMATES

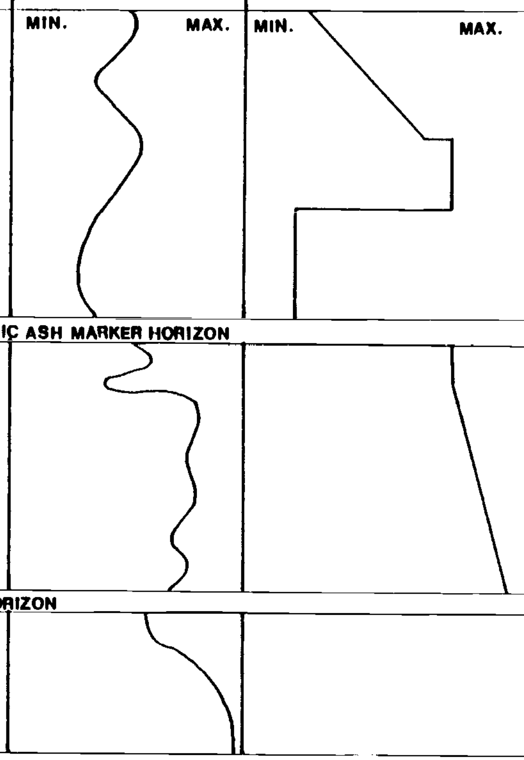


FIGURE 7. SELECTED CLIMATIC DATA FOR POST GLACIAL EVENTS IN EASTERN WASHINGTON (after Gustafson 1972)

faunal correlation with the proposed environment sequence (Gustafson 1972).

Late Pleistocene Glaciation: Potential Effects on Salmonids

The effects of the late Pleistocene glaciation and conjunctive cool, moist environment during the 8,000 to 12,000 B.P. period on salmonid resources needs research. This research found no salmon faunal remains present in the 8,000 to 10,000 year sites sampled. This correlates with Rice's study (1972) of the Windust Phase. The non-occurrence of salmon faunal remains in archaeological sites of this period might be related to environmental pressures on the resource, or cultural factors such as a lack of emphasis on procuring the resource, preparation and consumption, or ceremonial disposal of bones. The first issue to be dealt with involves the relation of the environment, as it has been proposed, and its potential effects on anadromous fish.

The effects of glacial events on the anadromous fish runs of the Plateau must be inferred largely from geologic and oceanic data in association with archaeological data. It might well be that anadromous fish were impacted severely by Pleistocene glaciation. Dott and Batten (1976) suggest that marine species ranging the northern California coast today "ranged only as far north as San Diego during glacial periods" (Dott and Batten

1976:442). Their observation is based on oceanic deep water deposits which reflect glacial and interglacial periods with correlations in microfossil flora and faunal changes (Dott and Batten 1976:443).

Fluctuations in abundance of Globorotalia menardii, a Foraminifera species sensitive to temperature change, has been utilized to infer specific warming and cooling periods during the Pleistocene glaciation (Laporte 1968: 84-91). Besides G. menardii, 20 other planktonic Foraminifera species are utilized in defining Pleistocene stratigraphy and temperature changes in oceanic deposits.

Generally, the abundance of G. menardii and "coiling direction of G. truncatulinoides" (Laporte 1968:87) are utilized to mark water temperature changes during the Pleistocene, in association with variations in oxygen isotopes 0^{18} and 0^{16}, which exhibit fluctuations associated with temperature variations (Laporte 1968).

Through deep sea coring samples in conjunction with C14 samples of core stratigraphies, a general warming trend marks the end of glacial temperature reductions between 11,800±300 B.P. and 18,000±300 (Laporte 1968:88-90). Planktonic Foraminifera assemblages reflect a warming trend at approximately 11,800 B.P. and oxygen isotope ratios reflect a warming trend at approximately 18,300 B.P.

Though oceanic environments are "extremely constant" (Laporte 1968:91), climatic and glacial episodes caused significant temperature variations, thus affecting marine life considerably. As Fladmark has suggested, due to environmental instability, principally as a result of climate and glaciation, salmon may not have reached high productivity in the Northwest until 5,000 years ago (Fladmark 1974).

A basic assumption of this research is that salmon runs fluctuate considerably based on a variety of environmental factors: Temperature, destruction of spawning grounds, river current speed, siltation, light intensity, predators, and fluctuation of zooplankton. There is also considerable variational behavior exhibited within specific species stock (i.e. freshwater residence time varies among stocks of chinook), and considerable variation among different species (i.e. coho rear in freshwater, while chum rear in estuaries) (Eggers 1980:165-170; McNeil and Himsworth 1980). Thus, in the most general sense, fluctuations in salmonid resources are a natural occurrence and one would expect that any significant environmental change would be reflected in the ecology of anadromous resources.

Based on current knowledge of the ecology of salmon (McNeil and Himsworth 1980), it is assumed that environmental changes as proposed for the Plateau (i.e. Antevs 1948; Rice 1965; Hansen 1947) would have impacted the anadromous resources. The ecological paradigm as related to salmon currently suggests "as a consequence of natural selection, organisms possess physiological machinery that translates environmental stimuli into observed behaviors" (Eggers 1980:167).

Temperature

Contemporary studies of salmon show that behavioral aspects of the salmon may be altered by even the slightest environmental fluctuation. Straty and Jaenicke have found that fish perceive and react to temperature gradients as slight as 0.03° centigrade (Straty and Jaenicke 1980:251). Schalk suggests that:

> anadromous fish, like all poikilotherms, are quite sensitive to minor variations in water temperature - cold, stress or freezing may restrict the portions of the year fish can spawn (Schalk 1977:214).

Casteel has noted that temperatures of fish bodies are directly related to riverine temperatures. In fact, fish do not control their own body temperatures (not homeostatic), their habitat maintains this function (Casteel 1972:404-419).

Temperature affects, specifically, a salmon's metabolic rate, which is reflected in feeding, swimming speed, and growth. "A small change in water temperature between four degrees centigrade and ten degrees centigrade may have a significant effect on growth and swimming speed" (Straty and Jaenicke 1980:253).

The effects of temperature changes on fish metabolic rates has led geologists Dott and Batten (1976:410) to discuss the benefits of being a mammal: "the mammals were and are far more successful vertebrates in terms of environment because they are warm-blooded" (Dott and Batten 1976:410). The comparison used is that mammals can sustain body temperature (food energy) and thus sustain activity, whereas fish activity is dependent on air and water temperature (Laporte 1968:36).

The implication is that fish and mammals function under differing biological characteristics. Mammals, due to different metabolic conditions, can move in more varied environments than fish. Thus, environmental factors that adversely affect fish may not register in the mammal population. This is an important consideration regarding the analysis of faunal remains in archaeological sites and inferring climatic and environmental changes from these data. Significant environmental factors may impact fish and thus effect their occurrence as a resource in archaeological sites, that will not be registered in the mammal faunal remains.

A minimal drop in yearly temperature of four to five degrees centigrade is estimated to be significant enough to cause a glacial episode (Broderson, personal communication 1981; Dott and Batten 1976:436). The average differential between normal and glacial climates is considered to be between five and ten degrees centigrade. Since fish body temperture is directly related to air and water temperature, even a four degree centigrade change can be significant (Straty and Jaenicke 1980:253).

Straty points out that Bristol Bay migrating sockeye salmon exist in an environment that varies six degrees centigrade and infers that "migration pattern, distribution, and survival" (Straty and Jaenicke 1980:253) are affected by the temperature fluctuations.

Straty and Jaenicke, in research on sockeye salmon, have also found that fish did not grow at temperatures below four degrees centigrade (1980:253). Dott and Batten suggest deep sea temperatures during the Pleistocene may have ranged as low as between two and five degrees centigrade (1976:437). If this is an accurate assessment, one would expect considerable alteration in the ecology of Northwest salmon.

Current North Pacific water surface temperatures range from seven degrees centigrade (January and February) to ten to 18 degrees centigrade (August) (Fladmark 1974). Temperature during the last glaciation of oceans is considered to have been five to six degrees centigrade lower than today. Fladmark suggests "this is close to the minimum temperature tolerance of all Pacific salmon" (Fladmark 1974:207). The temperature may, in fact, have been below some species' tolerance levels since temperature tolerance levels vary per species.

Thus, as Straty and Jaenicke have suggested, migration and distribution of salmon are affected by temperature range. As noted above, the difference between normal and glacial climates is five to ten degrees centigrade; thus, metabolic, migrational, feeding, and rate of swimming speed, and species distribution, may be inferred to have affected the anadromous fish during the late Pleistocene glacial stades and interglacial periods, a period of approximately 15,000 to 8,000 years ago.

Glacial run-offs present another potential hazard to salmon stocks. Gerking suggested (1950) that flash floods offered considerable stress for fish populations. Longevity is the principal factor to consider, along with magnitude. Short flash floods would only interrupt migration temporarily, whereas seasonal run-off is considered a necessity to spawning beds as they purify the stream of air and water accumulated silt (Shirazi, personal communication 1981). Catastrophic floods, such as the Spokane Flood (13,000 B.P.), and the wasting of glaciers at the end of glacial episodes could be devastating to anadromous fish. The channeled scablands of eastern Washington are a result of the scouring and deposition of immense gravel bars. The melt water which carried great amounts of sediment caused rivers to "become so sediment choked that they formed mosaics of braided channels" (Dott and Batten 1976:429). Fladmark suggests that at approximately 11,000 B.P., "the Fraser River discharged into the ocean, standing at least 150 meters higher than at present" (Fladmark 1974:200).

Siltation is a major factor in salmon embryo mortality. Shirazi (personal communication 1981) has found that size of spawning gravel has a narrow range allowable for high salmon productivity (Shirazi 1979). When gravel size is the size of the egg, survival is minimal. When gravel size is smaller than the egg, survival is low. When gravel size is larger than salmon eggs, survival is high. Fifteen to 25 geometric mean diameter (mm) width gravel offers the highest survival rate for salmon embryo (70% to over 90% survival rate) (Shirazi 1979:4). When gravel size drops to ten millimeters, survival rate drops to 50%. At five millimeters, survival is minimal.

Shirazi's research shows the extremely limited range in which salmon spawning can be successful. A ten geometric mean diameter (mm) range in gravel size may determine whether the spawn has a high or low mortality. The late Pleistocene glacial retreats would appear to have interrupted spawning beds in many Plateau locales with the tremendous amounts of siltation and turbidity that accompanied the melts.

Fladmark (1974) studied Fraser River locales and the effects of glacial and post-glacial discharge on salmon streams. Fladmark suggested that "effects of late glacial and post-glacial drainage instability would have been least marked in those salmon species which spend little time in fresh water" (Fladmark 1974:203). Peterman also has concluded that the "major mortality factors on salmon populations operate in the freshwater environment" (Peterman 1980:1).

Fladmark's conclusions are that post-glacial drainage instability, stream gradient changes, increased siltation, and lower water temperatures significantly affected the salmon population. Fladmark concludes that not until approximately 5,000 B.P. did salmon reach "peak productivity" as a result of environmental stabilization (Fladmark 1974:204).

Based on oceanic, geologic, climatic and pollen data, the late Pleistocene appears as an event that would have severely impacted anadromous resources in the Plateau and Northwest in general. The non-occurrence of salmon remains in Windust Phase components may be directly related to the environmental instability of the region during this period.

Implications of Anadromous Salmon Migration Patterns on Plateau Cultures

The four economically important species of Pacific salmon that have been recorded in the Columbia River system differ markedly in their migration patterns, length of residence in fresh water, and in the type of fresh water habitat utilized. The arrival of each species into the fresh water system is conjunctive with the proper current speed, temperature and oxygen content essential to each particular species (Netboy 1958:4).

Within particular species, variations also exist regarding residence time spent in fresh water environments.

Fall chinook migrate to the ocean in the spring following their hatch. Spring chinook, coho, sockeye, and steelhead may remain in the fresh water environment more than a year (Eggers 1980:168; Netboy 1958:3). Chinook mature in two to six years, whereas sockeye in three to five and coho in three to four years (Netboy 1958:4).

Spawning migrations occur as early as March and may continue through May for spring chinook. The spring chinook will travel throughout the Columbia system into the upper reaches of small tributaries. Summer-run chinook enter the Columbia in June, July and August, and keep to the main river and medium size tributaries. Fall chinook enter the main stem in August and September and spawn throughout the Snake River and Columbia River. Coho and steelhead spawn throughout the Columbia system, while chum usually spawn in closer proximity to the ocean (Netboy 1980:55), thus limiting their accessibility to lower river fishermen. Chum usually spawn within 100 miles of the ocean (Schalk 1977:219). It has been suggested that the Southern Okanagan fished for chum or "dog-salmon" at the mouth of the Okanagan (Spier 1938:11).

The spawning locale of the different salmon species provides a limiting factor for upstream fishermen as less fish enter their locale. For the Southern Okanagan, three of the four anadromous species frequent the Okanagan; chinook, coho, and sockeye. Steelhead trout also migrated to the region and were considered as important as coho and sockeye (Spier 1938:12). The southwest Plateau, specifically The Dalles, in comparison receives more species and greater numbers of fish than the upriver locales.

A second factor of importance in comparing upriver locales with downriver locales such as The Dalles, regards fish preservation. As salmon return to fresh water, they stop feeding and live on stored body fat, literally consuming themselves (Netboy 1958:7). The resulting process leaves upriver fish with smaller average weights and less food value than locales in the lower stretches of the Columbia (Hatley 1976:2-93).

Salmon runs vary between species and between stocks of the same species regarding spawning locale, length of fresh water residence, and in nutritional value between upriver and lower river locales. Upriver locales, such as the upper tributary spawning locales of the Columbia, provide one of the great stress periods for spawning fish seeking these reaches of the river system. Where migration is delayed by such factors as decreased river flow or slides, fish can die prior to completing the spawning cycle. Fish may also arrive at spawning locales in such a battered and deteriorated condition as to render them useless as a food source (Walker 1967:13).

The Archaeological Data: 11,000-8,000 B.P.

The following data represents a selected sample and summary of archaeological data from six components from the 11,000-8,000 period.

Salmon faunal remains:

Of the six components, no salmon remains have been noted in the archaeological reports.

Pisces:

Two of the six components report fish remains. Rice (1972) reports only chub and sucker occur in Windust components.

Shell:

Gastropod, mollusk, and mussel shell are reported for three of the six components. Margaritifera margaritifera, Anodonta grandis, and Gonidea angulata are fresh water mussel common to the Plateau (Mohs 1981:67). Margaritifera adapt to clear shallow streams and rivers. They are "seldom found in muddy waters" (Mohs 1981:67). Margaritifera is very intolerant of drought conditions but tolerant of relatively cold temperatures. Anodonta and Gonidea are more tolerant of silty conditions.

Bense (1972:41) has suggested that the occurrences of Margaritifera in archaeological sites indicates salmonidae were available. Margaritifera attest to the presence of fish not specifically salmon. Fresh water mollusks are obligatory parasites during their early growth stage (Mohs 1981:72). There is a direct relation between the occurrence of fresh-water mussels and the availability of fish in general. No preferential relationship has been established which would specifically link Margaritifera with salmon occurrences. However, the occurrence of Margaritifera may reflect some accessibility of spawning streams since their appearance is limited in muddy, silty, or warm water conditions. This might be an area of importance in evaluating stream accessibility for anadromous fish during climatic periods in which any of the above conditions exist to a significant degree.

Other faunal remains:

Mammal and bird bone dominate the faunal assemblages in the components that have been recorded.

Several factors are important considerations in assessing the occurrence of faunal remains in archaeological sites. The first consideration relates to the procurement/consumption practices of a particular locale in question. Cleveland has suggested that "aboriginal techniques of fish preparation may involve separating bones from meat" (Cleveland and others 1976:58), which may affect the number of bones present in a site.

Complete consumption of all salmon remains after the initial "fist salmon ceremony" was recorded in ethnographic reports of the Southern Okanagan (Gunther 1928: 135). Ceremonial disposal of salmon bones was not a "universal" in the Plateau, as Spinden reports on the Nez

Perce, suggesting "no superstition seems to be attached to the disposal of the bones" (Spinden 1908:206). Cressman (1960) concluded that salmon bones were not disposed of in the river by the Upper Chinook.

The Wishram and Wasco are noted for their pounded salmon cakes (Ruby and Brown 1976:21; Spier and Sapir 1930:226) which would effectively pulverize salmon bone and thus affect bone occurrence in processing sites.

Lyman (1976) has discussed processing techniques that make certain bones of an animal more susceptible to destruction, such as those utilized in the process of marrow extraction and then discarded to scavengers.

Thus, cultural factors involving processing, consumption, and storage (drying for winter food), undoubtedly affect the occurrence of faunal remains in archaeological sites. However, a generalized use pattern that would apply to all Plateau sites in affecting faunal occurrence ratios has not been established. Ceremonial and processing practices are subject to localized variation.

Archaeological sites from the late prehistoric and historic periods, from which ethnographic analogies are drawn in order to explain salmon faunal occurrence or non-occurrence in earlier period sites, show the greatest occurrence of salmon remains, both in number of sites and total bones. Localized variation in ceremonial and processing practices during the ethnographic period did not effectively remove all salmon bone from late period sites.

If salmon were an important resource in early period archaeological sites, based on ethnographic information and late period archaeology sites, one would expect to encounter salmon remains. One might also expect to encounter fishing implements, as fish remains and fishing gear are found in significant numbers in late period sites.

Differential preservation (Irwin and Moody 1978:244) between species also offers an explanation regarding faunal occurrence. However, as Lyman suggests, it would be "difficult to imagine how differing preservation rates might be checked empirically" (Lyman 1976:14). As yet, no test has been constructed which shows specific deterioration ratios between species.

Artifacts:

Bone, antler, or shell artifacts occur in four of the six components. None of the artifacts has been specifically identified as fishing implements, with the exception of a possible harpoon prong at WS-4. However, a serrated bone point and bipoint occur at 45GR97, and cylindrical pointed tool fragment at 45WT41. The remainder of artifacts from the six components reflect a diversified subsistence system making use of large amounts of mammal, with riverine use limited to mussel and occasional fish. The method of fish procurement is left unexplained by the artifact record.

The presence of bone, shell, or antler artifacts at four of the six sites, is conjunction with the faunal assemblage, would appear to rule out the use of faunal deterioration to account for the paucity of fishing tools. Though deterioration, through moisture and soil pH extremes, undoubtedly occurred at specific locales, generally, bone artifacts and mammal remains are found in significant numbers throughout the components. Daugherty (1956) suggested preservation may have played a role at 45GR97, but concluded that preservation was generally good with large amounts of bone artifacts and food bone recovered (Daugherty 1956:252).

The archaeological data from this period reflects a diversified economic system. Mammal bone make up the greatest percentage of faunal remains, with shell, bird, and fish bone occurring in significantly fewer numbers. Salmon bone has yet to be documented for this period. Potential fishing implements occur at several sites, but are not reflective of late period sites in which fishing implements appear in significant numbers in both bone and stone artifact categories. No stone artifacts have been identified as fishing implements from this period.

Relative to the Wishram and Wasco fisheries information presented in Chapter III, the 11,000 to 8,000 B.P. period tool and faunal assemblages do not reflect any emphasis on salmon procurement.

TABLE 5. 11,000-8,000 B.P. - ASSOCIATED SITES

	Salmon	Pisces	Shell	Other	Artifacts
WS-4 (Cressman 1960)	[1]N.M.	Fish bone present	Gastropod	Bird, animal	1 possible harpoon prong, stone and antler artifacts
WS-1 (possible) (Cressman 1960)	N.M.	N.M.	N.M.	N.M.	N.M.
45WT41 (Leonhardy 1968) (see Gustafson 1972:99) Granite Pt. Site	N.M.	N.M.	N.M.	N.M.	1 cylindrical pointed tool fragment, 2 total bone tools, 197 total artifacts
45FR50 (Rice 1969) [3]Marmes Rockshelter (included strat. I&II)	N.M.	Fish vertebrae present	Shell, mussel shell	[2]mammal bone, bird bone, 12 mammal bone (see Gustafson 1972:92)	0 fishing implements, 16 bone/antler artifacts, 17 shell artifacts, 292 total artifacts

1. Referred to W.A. Davis (personal communication 1981), to substantiate lack of salmon bone during the "Initial Early" period.
2. Data supports conclusions of Rice (1972), 45WT35, 45WT36, 45WT2 "have produced a limited number of artifacts from stratified contexts which represent similar components" (Rice 1972:20).
3. Rice notes 69 antler/bone and tooth artifacts from Marmes Rockshelter, of which none appear to represent fishing implements (Rice 1972:120-129).

TABLE 5 (cont'd).

45GR97 (Daugherty 1956; Irwin and Moody 1978)	N.M.	N.M.	4 mollusk species identified		1 serrated bone point, 4 bone artifacts, 186 total artifacts (1956) 1 notched bone point, 1 bipoint, 28 bone tools, 114 total artifacts (1978)
45FR46 (Rice 1965)	N.M.	N.M.	N.M.	large amounts of bone fragments, deer	0 fishing implements, 0 bone artifacts, 129 total artifacts

In a more recent publication, Rice (1972) refers to the Windust Phase and suggests "the fish bones identified to date indicate chub and sucker, but no salmonids" (Rice 1972:159). "Fresh water molluscs were of some economic importance, particularly Margaritifera falcata and Goneida angulata" (Rice 1972:159). Rice investigated 45FR46, 45FR50, 45WT41 (Lower Snake); 45WT2, 45WT35, and 45WT36. Surface finds of diagnostic Windust type artifacts have been located at 45WT41, 45CO1, and 45WT2. Rice focused specifically on Windust Caves (45FR46), Marmes Rockshelter (45FR50), and Granite Point (45WT41):

Windust Caves: 480 artifacts (Rice 1972:20-35).

Marmes Rockshelter: 440 artifacts (Rice 1972:33).

Granite Point: 408 artifacts. (1,328 total artifacts, 0 fishing implements) (Rice 1972:35-130).

TABLE 6. ANTLER, BONE, AND TOOTH ARTIFACTS FROM 45FR46, 45FR50, AND 45WT41 (from Rice 1972:120-129)

Windust Caves (45FR46)	Marmes Rockshelter (45FR50)	Granite Point (45FR41)
0	7 awls	1 awl
0	1 needle	0
0	1 flat needle	0
0	33 polished/striated bone fragments	4
0	1 atlatl spur	2
0	1 wedge	0
0	1 chipping tine	0
0	1 beaver tooth	0
0	12 olivella shell brads	0
0	5 snail shell beads	0
0	3 shell pendants	0
0	3 mussel shell	0

Rice studied specifically Windust Phase components. He suggests that fish remains are slight, with no salmon faunal remains present in the sites he investigated. This research supports Rice's conclusions about early Windust Phase sites.

CHAPTER V

8,000-4,500 B.P.

The period from approximately 5,000 to 2,500 B.C. has been proposed by Antevs as a warm, dry episode, labeled the Altithermal in his neothermal sequence (Antevs 1948:176). Temperatures are considered to be "distinctly warmer than at present" (Antevs 1948:176). In conjunction with Antevs' study, Hansen's climatic research (1942; 1947) suggests an arid period during the 8,000 to 4,500 B.P. phase.

In association with Antevs' Altithermal, the occurrence and subsequent deposition of volcanic tephra from Mt. Mazama, at approximately 7,000 B.P. (Kittleman 1979: 58), may have posed a potential hazard for anadromous resources.

Bense (1972) and Brauner (1976) have suggested that the effects of primary tephra deposition from Mazama were minimal for subsistence systems of the Plateau. Bense investigated preceding and post-Mazama ash components from the Cascade Phase and indicated the components reveal no break in the cultural continuity. Brauner suggests that the effects of Mazama ash would come primarily from secondary deposition at approximately 4,000 B.P., caused by a significant increase in precipitation.

Environment

Correlations have been drawn between the temporal

TABLE 7. TEMPORAL ASSOCIATIONS: 8,000-4,500 B.P.

5,000-2,500 B.C.	Altithermal (Antevs 1948:176). Plateau.
6,000-3,000 B.C.	Cascade Phase (continuation of the Pioneer period), (Leonhardy and Rice 1970).
8,500-4,500 B.P.	Cascade Phase (Ames and Marshall 1980: 40). Lower Snake River region.
6,000-2,500 B.C.	Cascade Phase (Brauner 1976:2). Lower Snake River region.
	Vantage Phase (Nelson 1969:16). Central Washington.
8,000-6,500 B.P.	Indian Well Phase (Nelson 1969:22). S.W. Plateau.
6,500-4,000 B.P.	Cold Springs Phase (Nelson 1969). S.W. Plateau.
5,500-4,500 B.C.	Hell's Canyon Creek Phase (Pavesic 1971:130). N.W. Idaho.
6,000-3,000 B.C.	Cascade Phase (Lyman 1976:5) Lower Snake River region.
8,000-5,000 B.P.	Cascade Phase (Bense 1972:vi, 38)[4]. Lower Snake River region.
4,500-1,500 B.C.	Squaw Creek I (Pavesic 1971:130)[5]. N.W. Idaho.
5,500-3,000 B.C.	Early Period (Sanger 1967:189). Interior British Columbia.
4,500-2,000 B.C.	Cold Springs Pattern (Warren 1968:48). Central Washington.

4. Bense (1972) investigated 13 sites with Cascade components, discussed at the end of this chapter.
5. This material is included in the next (4,500-2,500) temporal period.

placement of cultural phases and the Altithermal (Rice 1965:39) for the southern Plateau.

Archaeological research supports the general climatic sequence proposed by Antevs for the 8,000 to 4,500 B.P. period. Gustafson's research on faunal remains at Marmes Rockshelter, in southwest Washington, led to the suggestion that "the basic Anathermal, Altithermal, Medithermal sequence of Antevs (1948) is well illustrated by the data" (Gustafson 1972:33). Gustafson suggests a change in ratios of pronghorns to elk at Marmes Rockshelter and Granite Point after 7,000 B.P. More pronghorn and less elk are represented above Mazama ash levels (Gustafson 1972:127).

Harvey Rice, in research at Windust Cave, used Antevs' and Hansen's climatic studies to correlate his culture period I and II. Rice suggests that adaptive changes reflected in the artifact assemblages for the early and late Altithermal "was probably linked to an adaption to an even more rigorous environment than was characteristic during the proceeding phase" (Rice 1965:45).

The arid Altithermal period has been supported by research in Idaho at Birch Creek and Wilson Butte Cave (Swanson and Bryan suggest "evidence of increasing aridity at about this time was recorded in the deposits at Wilson Butte Cave" (1964:10). At Birch Creek, it is suggested that prehistoric occupation was directly related to climatic conditions (Swanson, Butler, Bonnichsen 1964: 107). Associated climatic data have been correlated by Gustafson (1972) for southeast Washington (Figure 7).

In studies of the Lower Snake and Palouse River alluvial chronologies, Marshall suggests that the climate curve of Antevs and Hansen is supported by alluvial data reflecting less run-off and precipitation for the 7,000 to 4,000 B.P. period (Marshall 1971:iv). The period immediately prior to 7,000 B.P. reflects a wetter climate than the Altithermal period. The 7,000 to 4,000 B.P. Altithermal period reflects a dryer climate than the following period.

The climate of this period reflects a warming trend with continued greater run-off and precipitation (relative to current conditions) until approximately 7,000 B.P. From 7,000 to approximately 4,500 B.P., the climate is warmer with less river discharge and precipitation than prior or later periods. Some lakes and small tributaries would have dried completely while others carried significantly less volumes of water. A concurrent event featured the disappearance of mountain glaciers (Daugherty 1956:226-227).

Technology

Culture changes are reflected in the technology during this period as new projectile types developed, referred to as lanceolates and side-notched points. Atlatl weights also occur in the assemblages associated with the Cascade Phase in the southern Plateau (Leonhardy and Rice 1970).

The technology also reflects another addition with the introduction of edge-ground cobbles (Leonhardy and Rice 1970), indicating food grinding. During the late Cascade, Brauner suggests "the presence of hopper-mortar bases and well made pestles implied the use of root crops" (Brauner 1976:294).

Nelson (1969:103) and Daugherty (1962) suggest that populations focused on waterways during this period reflecting a settlement change from the preceding period.

Thus, temporal correlations have been drawn between the Altithermal and specific culture phases such as the Cascade Phase. (There is considerable temporal and technological variation between cultural phases in the Plateau; see Sanger 1967 and Grabert 1974). However, causal relationships between the arid Altithermal and specific culture changes from the preceding period have yet to be established.

At approximately 8,000 to 7,000 B.P., salmon appear in significant numbers at The Dalles (Cressman 1960), in the southwest Plateau, at Bernard Creek Rockshelter, Idaho (Randolph and Dahlstrom 1977), and at the Drynoch Slide Site, British Columbia (Sanger 1967). Leonhardy and Rice propose that "large salmonid represent an apparently new economic resource - but, the techniques for catching fish are not represented in the artifact inventory" (Leonhardy and Rice 1970:9). One questionable fish hook shank was found at Granite Point, however, Sanger suggests;

> that salmon were fished in early post-glacial times in both the Fraser and Columbia Rivers, but during the period between 4,000 B.C. and the Christian era, there is little evidence of salmon fisheries in Columbia River components upstream of The Dalles (Sanger 1967:193).

Cressman has noted that after the "Initial Early" period at The Dalles, there occurred a lowering of the river level and a diminishing of turbulence and siltation associated with glacial outwash (Cressman 1960:67). Large numbers of salmon at The Dalles and Bernard Creek attest to an environment favoring salmon runs throughout the Columbia and Snake River systems. However, after the 7,000 B.P. period at The Dalles, salmon bone disappear from the assemblage. At Bernard Creek Rockshelter, only five salmon vertebrae are noted after approximately 7,000 B.P. (Randolph and Dahlstrom 1977). In relation to total fish bones, salmon make up a small percentage of the total aquatic resource assemblage for the Bernard Creek site.

Potential Effects of 7,000-4,500 B.P.: The Altithermal Period

A central problem, as related to salmon use during this period, involves attempting an explanation for the sudden disappearance of salmon faunal remains at Five Mile Rapids (WS-4) and what appears to be a significant drop in salmon occurrence at Bernard Creek Rockshelter.

Bense (1972) investigated 13 Cascade components and notes that three components contain Salmonidae. However, whether these are trout, salmon, or steelhead is unclear. Sturgeon, chub and sucker are identified specifically. Of the 20 components selected for analysis in this report, (appear at end of chapter), four sites contain potential salmon bone. One site (Pavesic 1971), which has "salmonoid" vertebrae, but are not considered to be salmon. Two sites, not included with the four salmon sites, have been noted by Bense as having salmonidae (45FR46 and 45FR50). However, the site reports for these sites are not specific in salmon identification.

In relation to the total assemblage of artifacts and faunal remains, outside two specific locales (WS-4 and Bernard Creek), salmon make up a minor part of the overall components' assemblages for the middle and southern Plateau. With the exception of WS-4, where a reported 125,000 salmon vertebrae occur (Cressman 1960), in all sites containing salmon vertebrae their numbers make up such a small number of bones that their appearance may represent simply a random, occasional catch with essential hunting and gathering practices geared to other pursuits such as plant procurement or hunting mammals, which make up the largest faunal assemblages for these components.

Altithermal: Potential Effects on Salmonids

The effects of a 3,000 year arid Altithermal on anadromous resources is open to speculation. The archaeological sites of this period reflect a minor emphasis on salmon. The possibility exists that salmon runs were severely impacted by the effects of warm temperatures, diminishing of seasonal floods, accumulation of sediments, or loss of river spawning grounds, as a result of Altithermal conditions suggested by geologic and archaeologic data;

> localized destruction of salmon spawning beds and increased water temperatures undoubtedly lowered the carrying capacity of Plateau river systems as far as salmon populations were concerned (Brauner 1976:305).

An increase in water temperature affects the salmon in numerous ways. As suggested in the preceding chapter, the salmon's metabolic system is related directly to water temperature. An increase in temperature correlates with an increase in swimming speed and general activity up to a certain point, i.e. when temperatures are above 21° centigrade, sockeye growth rates diminish (Straty and Jaenicke 1980:259). Lethal temperatures for some stocks of sockeye and coho salmon are 24° and 25° centigrade (Straty and Jaenicke 1980:259).

As water temperature increases and salmon activity increases, the opportunity of salmon predators, such as the Piscivorous, or northern squawfish, is increased also (Casteel 1972:404-414). Physiological and morphological adaptations of salmon are related directly to water temperatures and cold, high elevation streams are a direct requirement for specific inland spawning species of salmon (Casteel 1972; Hubbs 1948:459). The arid Altithermal, accompanied by a drop in flow and levels of spawning streams might be expected to have impaired salmonid resources, specifically in upriver tributary locales.

> A stream's potential to produce fish, would seem to be a function of the amount of the accessible spawning habitat and rearing area in the drainage (Schalk 1977:217).

Schalk also states that "low discharge periods are when spawning is difficult or impossible due to insufficient stream flow" (Schalk 1977:225).

Sanger has suggested that the effects of the Altithermal were significant enough that "increased aridity in the Columbia Plateau combined with a rapid downcutting Columbia River, created a drop at Celilo Falls which was too high for salmon to ascend" (Sanger 1967:194). The small number of salmon vertebrae at Bernard Creek Rockshelter (after 7,000 B.P.), may refute this concept. However, the small number (approximately five vertebrae) may raise more questions than it answers (see Randolph and Dahlstrom 1977).

Several implications might apply to Shirazi's study (1979) of salmon spawning gravels in relation to the proposed arid Altithermal. First, yearly floods are essential to upriver spawning grounds, as they flush the river of silts and sands accumulated through air and water deposition. An approximately 3,000 year arid period (relative to present environmental conditions) could be devastating to spawning grounds, allowing tremendous accumulations of siltations, which could effectively raise embryonic mortality rates. In conjunction with increased temperature, predation, and lower oxygen content, a negative impact on spawning grounds would be expected.

Extensive aeolian deposits as proposed by Marshall (1971), in conjunction with decreased stream flow, may reflect a greater silt deposition in spawning beds. The loss of mountain glaciers provides a further indication for lower run-offs and higher water temperatures. In conjunction with the above, the Altithermal would appear as a high stress period for local anadromous resources of the Plateau.

The area of particular stress would be the inland spawning tributaries which were lower and warmed by less flow and higher temperatures. If seasonal flooding lessened significantly, one might expect higher siltation accumulations of small (geometric mean diameter) gravels (see preceding chapter). When accompanied by higher temperatures and lower oxygen content, this could significantly raise embryonic mortality rates; that is, if the small inland tributaries were accessible.

The minimal effect of the Altithermal on anadromous fish would occur in streams where salmonid existed prior to the Altithermal in "marginal baseline substrate conditions" (Shirazi 1979:31). Salmon that have adapted over a long period to a spawning area with marginal gravel and flow conditions might maintain "high population levels in the presence of rather low embryo survival rates" (Shirazi 1979:31). However, any additional mortalities caused by a further impacted spawning locale would be expected to be detrimental to the existing population.

Potential Impacts of Volcanism

A further impact on anadromous fish has drawn considerable attention from researchers (Brauner 1976; Malde 1964; Daugherty 1967). The deposition of the 7,000 B.P. eruption of Mt. Mazama tephra has been recorded throughout the Plateau from 7,000 year old components (i.e. Marmes Rockshelter, Bernard Creek Rockshelter).

The view suggested is that the eruptions of Mt. Mazama, considered as a single event, would have minimally impacted anadromous resources. Short term effects would have occurred principally as a result of silt deposition in spawning grounds. Long term effects would result from secondary deposition.

When the event is considered in relation to the Altithermal, the eruption and its associated siltation becomes one more addition negative factor added to a list of Altithermal variables that individually and cumulatively impacted the anadromous resources during the 7,000 to 4,500 B.P. period. To what degree salmon were impacted, again, must be inferred, since absolutes such as temperature variations (Kirk and Daugherty estimate five degrees Fahrenheit warmer than before and after Altithermal; 1978:56) and the degree of stream discharge are unknown.

Archaeological information may provide an assessment of the presence of salmon based on the technological emphasis of fishing and faunal occurrences. Archaeological data may also provide an assessment of salmon in the Plateau based on geologic and hydrology inferences drawn from studies such as Marshall's (1971). However, faunal and artifact occurrences might be poor indicators of the occurrence of salmon. As Grayson has suggested: "The precise mechanism by which such accumulations occur are rarely, if ever, known" (Grayson 1979:433). Since we cannot know the absolute degree of cultural emphasis placed on securing salmon during the Altithermal, it is difficult to equate the lack of salmon occurrences in archaeological sites with general salmon occurrences in nearby streams. The Cascade Phase does not appear to emphasize salmon use, based on technological and faunal inventories. Is this related to a low occurrence of salmon in the streams or a lack of cultural emphasis on securing the resource? The general trend has been to argue that salmon were impacted by the Altithermal conditions, including the Mazama eruptions (i.e. Sanger 1967; Brauner 1976).

The Mazama eruptions included three depositional episodes over a three year period, with approximately 7.3 cm of ash deposited at least 750 km northeast of Mt. Mazama (Bullard 1979:18).

The effects of the Mazama eruption on riverine resources has been dealt with in two divergent propositions. Harold Malde (1964) suggests that the eruption and subsequent ash deposits would have been catastrophic to the riverine populations. Current research at Mt. St. Helens shows salmon and steelhead runs in the river during the eruption were impacted severely. However, runs not due in the river for several years would suffer fewer side effects as temperature and siltation drop from their initial high levels. Within months from the initial eruption, the first steelhead ascended the Toutle River. In the north and south forks of the Toutle River, all fish were killed by the May 1980 eruption. By the following spring, both chinook and steelhead had returned to the rivers (Richards 1981:C2). However, an absolute assessment of spawning success for these species cannot be applied to the Mazama eruption since human intervention is assisting the return of sizable runs to these rivers through hatchery an enhancement propagation programs.

The initial effects of Mazama are considered here to have been significantly less than those inflicted on the Toutle River system due to proximity and temperature levels. The effects of the Katmai eruption on salmon at Kodiak Island (1912) have been studied by William Workman (1979:339-372). His findings suggest that from 1912 through 1920, salmon were severely impacted. After this period, "rapid full recovery thereafter led them to the conclusion that in the long term significant ashfalls enhance red salmon productivity by injecting new nutrients into the aquatic ecosystem" (Workman 1979:346). This parallels long term conclusions regarding volcanism's effect on terrestrial vegation (Sheets and Grayson 1979).

A second proposition (Brauner 1976:306) correlates with the information presented above. Brauner suggests that the initial deposition of ash would have minimally impacted salmon over a long period. However, Brauner links the Mazama ash fall with potential Altithermal conditions (low precipitation) and suggests that much of the ash "remained in depositional environments near the location of primary ash fall" (Brauner 1976:307). The serious effects on salmon populations are not considered to have occurred until approximately 4,000 B.P. when a climatic change brought increased precipitation to the region; "the greatest impact would have been on the aquatic resources, primarily the salmon" (Brauner 1976:307). The combination of heavy precipitation, rapid downcutting of streams, and heavy siltation (loaded with tephra) would have served to destroy many spawning grounds of anadromous fish populations at approximately 4,000 B.P. Richard Daugherty also suggests that increased stream discharge at the end of the Altithermal was accompanied by greater tephra depositional rates (Daugherty 1967).

Blinman, Mehringer, and Sheppard (1979:393-425) have studied sedimentary deposits from Lost Trail Pass, Bitter Root Mountain, Montana; Wild Horse Lake, Steens Mountains, Oregon; and Wildcat Lake, southeast Washington. Their research at Wildcat Lake, based on pollen percentages, substantiates a dry condition from immediately prior to the Mazama eruption until approximately 4,200 B.P. (1979:413). Their research also focused on the redeposition rate of Mazama ash into the lake. Based on C14 samples, redeposition of Mazama ash occurred until 5,380 C14 years ago. A long deposition period at this locale may substantiate evidence for tephra remaining even longer in primary depositional locales where topographic gradients, precipitation, and air currents differ from the Wildcat Lake locale.

In summary, the effects of Mazama ash on anadromous resources is still a problematic issue. It would appear that effects of Mazama ash had differing localized effects on aquatic resources based on specific locales' topographic gradient, localized precipitation levels, and wind direction and velocities. Anadromous resources already utilizing spawning locales with a minimal spawning substrata, and thus higher mortality rates, might expect higher embryo mortality rates which could effectively elimate that locale's spawning potential. The variation between topographic and environmental locales in the Plateau leads one to suspect that certain locales were negatively impacted immediately by the ash fall. Other locales would have been minimally impacted. Higher precipitation rates at the end of the Altithermal would have acted as a "flushing agent" for the accumulated sediments of an approximately 3,000 year dry, low precipitation period. The effects of greater precipitation would have impacted anadromous resources for a short period. The occurrence of salmon soon after the late Pleistocene flooding episode at The Dalles and Bernard Creek Rockshelter would tend to substantiate this proposition.

Ash Effects on Plateau Cultural Systems

Changes exhibited in Plateau cultural systems during the 8,000 to 4,500 B.P. period appear more related to the climatic conditions associated with the Altithermal than with tephra deposits from Mazama.

Short term effects on cultural groups by volcanism has led Workman to suggest "the major damage and suffering may well be more psychological than physical, caused by panic and fear of the unknown" (Workman 1979:347). Workman also suggests that the effects might have been more drastic during prehistoric times.

Vern Ray recorded the effects of an early historic eruption of Mt. Baker while studying the Sanpoil and Nespalem. Ray found starvation during the winter following an eruption, primarily as a result of ceremonial activities replacing normal resource gathering (Ray 1933:107). Unfortunately, short term effects such as the above would be difficult to gather from archaeological data. (See also Teit 1930:291-292, on the effects of 1770 eruption on Nespalem).

Don Dummond (1979:373-390) studied the potential effects of volcanic tephra deposits found in association with archaeological components in the Alaska Peninsula area. Dummond suggests that beyond occasional short term abandonment of sites, major culture changes "bore no direct relation to specific volcanic events" (Dummond 1979: 389).

Studies of the effects of the Paricutin volcanic eruption on five communities (Nolan 1979:238-293) found volcanic eruptions do cause changes in human life and habitation and that "similar groups of people affected by the same physical event may adjust to changed conditions in quite different ways" (Nolan 1979:335). Nolan also suggests that the variety of adaptation was diverse between local communities to the degree that it was impossible "to be discussed in terms of simple cause and effects relationships" (Nolan 1979:333). Nolan's study focused on five communities in west-central Mexico impacted by ash fall from Paricutin volcano in the 1940's.

Nolan's study indicates varied responses can occur between similar communities. The study also reflects the short term effects of an eruption of tephra upon communities that exist in close proximity to tephra sources.

Implications of these studies are that the proximity of Mazama was too great a distance to have effected long term culture changes, or significant changes in the archaeological record of the Plateau. This suggestion is supported by Bense's research on pre- and post Mazama ash components in the southern Plateau (Bense 1972). Short term cultural effects might be expected in relation to the effects of volcanic ash on localized terrestrial and aquatic resources (Workman 1979; Sheets and Grayson 1979).

The Archaeological Data: 8,000-4,500 B.P.

The following data reflects a selected sample of archaeological data from 20 components with temporal associations in the 8,000 to 4,500 year range. This sample is taken from the 114 sites noted at the beginning of this research.

Salmon faunal remains:

Of the 20 components, four contain potential salmon bone. "Salmonoid" bone at Hell's Canyon Creek Rockshelter is not considered salmon (Pavesic 1971). Salmon bone identified at 35UM5 is questionable. Bense (1972)identified three sites out of 13 Cascade components as containing salmon bone. Specific faunal identifications are not given.

Pisces:

Four components contain small quantities of fish bone. 45FR50 is included under this category since fish bone are only noted in the site report. Bense identified these bones as salmonidae.

Shell:

Burned shell, mussel shell, gastropod or olivella have been identified in seven of the 20 components.

Other faunal remains:

Twelve of the 20 components contain mammal and/or bird bone. Generally, mammal bones far outnumber other faunal remains in these components.

Fishing implements:

One possible harpoon prong, two notched points, 14 possible netweights, and one possible leister are the artifacts specifically recorded as potential fishing implements. These occur in five components.

Artifacts:

Ten of the 20 components contain bone or antler artifacts. Included under this category are numerous artifacts for which a functional purpose has not been established. A bone projectile point (35UM3), barbed bone (10IH483), and an antler point (45FR50) are such artifacts. Presumably, these artifacts could be used for hunting or fishing.

Archaeological sites for the 8,000 to 4,500 year period reflect a diversified economy. Based strictly on faunal occurrences, mammal procurement is reflected as the dominant activity. Grinding stones and hopper mortars reflect plant utilization; however, ethnobotanical analyses from site reports is lacking, thus the degree of importance placed on plant materials is still questionable for this period.

Salmon remains occur at four of the 20 components analyzed in this report. However, outside of WS-4 (an anomaly) and Bernard Creek Rockshelter, salmon identifications appear tentative and non-species-specific. Whether trout or salmon appear in the faunal record is left to speculation. What appears as significant is the tremendous volume of mammal bone in relation to riverine resources. At Bernard Creek Rockshelter, mammal bone outnumbers Pisces significantly with salmon bone occurring in the smallest percentage. Other sites that contain salmon bone give no specific counts, except 45AS82, where two bones make up the salmon inventory.

Outside of The Dalles and Bernard Creek, the general subsistence pattern for the southern and middle Plateau areas at this time does not reflect an emphasis on salmon procurement. Faunal resource utilization appears to represent a dominant focus on those resources that would not be affected by anadromous fluctuations and would have inhabited the Plateau on a year-round basis, such as deer and elk. At Bernard Creek Rockshelter, riverine resource utilization may reflect a similar trend, with mollusk and Pisces occurrences recorded in greater frequency than anadromous fish remains.

Faunal remains, in conjunction with the occurrence of bone, antler, and shell artifacts, appears to rule out the factor of artifact or faunal preservation as playing a very large role in accounting for a general lack of fishing implements or salmon remains. Preservation would be expected to account for a general lack of fibrous materials which may have been utilized with the identified net sinkers. However, the techniques for catching fish generally is not represented in the artifact inventory, nor is an emphasis on fishing.

Therefore, the 8,000 to 4,500 year period, as reflected in the archaeological record, does not reflect a predominant utilization of salmon. An occasional net sinker shows up in the late Cascade which indicates fishing, not specifically salmon. Owing to the lack of fishing implements, faunal remains, and in conjunction with the proposed climatic variables, it appears that salmon was of minor economic importance for the middle and southern Plateau during this period.

Bense (1972) investigated 13 sites with Cascade components (45FR32, 45FR46, 45WW61, 45CO1*, 45WT2, 45FR50*, 45GA3, 45WT7, 45WT31, 45WT35, 45WT36, 45WT41*, and 45GA61B). Three assemblages contained faunal remains of Salmonidae (not specific as to whether bones were salmon or trout). Sturgeon (Acipenser spp.), chub (Mylocheilus caurinus), and squaw fish (Ptychoeilus oregonenesis) were specifically identified (Bense 1972:41). No specific counts were noted. Bense notes 4,034 artifacts from these components, of which eight possible net sinkers were identified (Bense 1972:50-53). Of the three sites with fish remains, two (45FR50 and 45CO1) had the lowest statistical correlations with the other 13 sites subjected to analysis. Bense suggests the net weights are "characteristic of later cultural manifestations associated with Cascade Phase" (Bense 1972:185).

*Contained fish bone.

TABLE 8. 8,000-4,500 B.P. - ASSOCIATED SITES

	Salmon	Pisces	Shell	Other	Artifacts
45WT41[6] (Leonhardy 1968)	N.M.[7]	N.M.	Shell, "burned shell"	288 mammal bone, dog bone, 277 mammal bone	0 fishing implements, 7 cylindrical pointed tool fragments, 21 total bone tools, 248 total artifacts
WS-4 (35WS8RBS) (Cressman 1960)	"enormous number of salmon vertebrae" "125,000 salmon vertebrae"	fish bone present	gastropod	bird, animal	"rich bone and antler industry," 1 possible harpoon prong?
WS-1 (Cressman 1960)	N.M.	N.M.	N.M.	N.M.	No count
45FR50 (Rice 1969)	N.M.	[8]fish vertebrae	mussel shell, olivella	660 mammal bone, bird bones, duck bones	1 antler point, 460 bone/shell/antler artifacts, 1,198 total artifacts*
45FR46 (Rice 1965)[6]	N.M.	N.M.	mussel shell occurs	"bits of bone"	2 notched pebbles, 0 bone artifacts, 95 artifacts

*Approximated number.

6. For further information, see Bense (1972).
7. Bense (1972) suggests salmonidae appear at 45WT41 during the Cascade Phase. Not specific as to whether salmon or trout make up the salmonidae remains.
8. Bense (1972) suggests salmonidae appear at 45FR50.

TABLE 8 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
Hell's Canyon Creek Rockshelter (Pavesic 1971)[10] layer C1-E1	[9] 2 salmonidae vertebrae	N.M.	N.M.	"rich amount of bone detritus"	0 fishing implements, 2 bone/antler artifacts, 41 total artifacts
35UM5 Hat Creek (Shiner 1961)	salmon bone?	?	Mussel shell	[11] rabbit, deer, bird	0 fishing implements, 7 bone artifacts, 97 total artifacts, 3,000 flakes*
35UM3 (Shiner 1961)	N.M.	N.M.	N.M.	animal bone	flakes occur, leaf shaped point, 1 bone fragment
35UM7[12] (Shiner 1961) (questionable temporal placement)	N.M.	N.M.	Mussel shell	N.M.	9 possible netweights, 1 bone projectile point, 200 total artifacts*
Nahas Cave (Plew 1980)	0	0	0	0	N.M.

9. "Of all the fish remains, none are believed to be salmon" (Pavesic 1971:115).
10. Squaw Creek I phase has probable association with this period, but its assemblage was included with Squaw Creek II material.
11. In order of occurrence, salmon listed as third in occurrence.
12. Questionable temporal placement, based on Shiner's comparison with Hat Creek (35UM5). Late Cascade or early Tucannon Phase appears probable for this component.

TABLE 8 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
[13,14] 45OK29 (Grabert 1974)	N.M.	N.M.	N.M.	N.M.	0 fishing implements, 4 artifacts, not specific as to bone
10IH483 (Randolph and Dahlstrom 1977)	143 vertebrae	610 approx.		6,460 approx. total	1 leister? 3 bone barbs, 23 approx. bone artifacts, 390 approx. total artifacts
45AS82 (Brauner 1976; Lyman 1976)	0	2 bones	River mussel abundant	17 bones	5 net sinkers, 4 unidentified bone tool fragments, 3 bone artifacts, 480 artifacts
45KT28 (Nelson 1969)	0	0	0	N.M.	0 fishing implements, 0 bone artifacts, 150 total artifacts
45CH64 (McCoy 1971)[15]	N.M.	N.M.	N.M.	N.M.	0 fishing implements, 0 bone artifacts, total artifacts not specific
45GA61 (Leonhardy and others 1971)	0	0	0	a few fragments	0 fishing implements, 1 bone fragment, 457 total artifacts

13. Questionable temporal placement.
14. 45OK145, strat. 4-5, may fall within this period. Ten salmon vertebrae and one possible net gauge are present in these assemblages, see Grabert 1974.
15. Tentative temporal placement.

TABLE 8 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
45DO174 (Rice and Brauner 1974)	N.M.	N.M.	N.M.	N.M. (not specific)	0 fishing implements, 0 bone artifacts, ? total artifacts
45FR39 (Daugherty, Purdy, Fryxell 1967)	N.M.	N.M.	N.M.	bone fragments	0 fishing implements, 0 bone artifacts, 37 total artifacts
45ST201 (Chance and Chance 1979)	N.M.	N.M.	N.M.	N.M.	0 fishing implements, (see Chance and Chance 1979 for totals)
45CH204 (Valley 1975) Component I	N.M.	N.M.	N.M.	N.M.	Not specific as to # per level

TABLE 9. 8,000-4,500 B.P.:
BONE ARTIFACTS AND POTENTIAL FISHING IMPLEMENTS

Site	Artifacts and Implements
45WT41	7 cylindrical pointed tool fragments, 21 total bone tools.
WS-1	No count.
WS-4	1 possible harpoon prong, (rich bone and antler industry).
45FR50	1 antler point, 460 bone/shell/antler artifacts.
45FR46	0 bone artifacts; 2 notched pebbles.
Hell's Canyon Creek Rockshelter	2 bone/antler artifacts.
35UM5	7 bone artifacts.
35UM3	1 bone fragment.
35UM7	1 bone projectile point (questionable temporal placement, possibly later than Cascade Phase); 9 possible netweights.
Nahas Cave	0 bone artifacts.
45OK29	0 bone artifacts.
10IH483	1 leister (?), 3 bone barbs, 23 total bone artifacts.
45AS82	4 unidentified bone tool fragments, 3 bone artifacts; 5 net sinkers.
45KT28	0 bone artifacts.
45CH64	0 bone artifacts.
45GA61	1 bone fragment.
45DO174	0 bone artifacts.
45FR39	0 bone artifacts.

TABLE 9 (cont'd).

Sites	Artifacts and Implements
45ST201	0 bone artifacts.
45CH204	?

Artifacts/Implements	Occurrence
Net sinkers	7 net sinkers, 9 net sinkers with questionable temporal placement.
Harpoon prong	1 harpoon prong with questionable temporal placement.
Cylindrical pointed tool fragments	Seven.
Antler points	One.
Bone projectile points	1 with questionable temporal placement (35UM7).
Leister barbs	One.
Bone barbs	Three.

Total Bone Artifacts: Over 500 (approximately), excludes WS-4, which reports many bone artifacts, but gives no counts.

CHAPTER VI

4,500-2,500 B.P.

Antevs' (1948) climatic sequence suggests that at approximately 4,500 B.P., the arid Altithermal drew to a close and was replaced by the Medithermal with temperatures gradually lowering while precipitation increased. In conjunction, mountain glaciers and lakes saw a rebirth.

Antevs' general sequence is supported by geologic and archaeological data from a variety of sources, such as variations in G. menardii, taken from oceanic cores, that indicate cooler ocean temperatures at approximately 4,000 B.P. (Laporte 1968:86-89). A moister period is reflected in alluvial sediments analyzed by Marshall (1971) in the lower Palouse River of eastern Washington, associated with the close of the Altithermal.

At approximately 3,600 B.P., there is "evidence for a surge in effective precipitation immediately following the Thermal maximum" (Brauner 1976:304). B. Robert Butler has also analyzed archaeological components from this period and suggests a "return to cooler, moister conditions" (Butler 1978:44) from approximately 3,800 to 2,800 B.P.

In conjunction with the proposed climatic changes, Brauner has suggested that a correlation exists between "the inception of the Tucannon and the surge in effective precipitation has only recently been recognized" (Brauner

TABLE 10. TEMPORAL ASSOCIATIONS: 4,500-2,500 B.P.

2,500 B.C.-present	Medithermal (Antevs 1948:176). Climate.
2,500-500 B.C.	Tucannon Phase (Brauner 1976:2). Lower Snake River region.
3,000-500 B.C.	Tucannon Phase (Lyman 1976:5). Lower Snake River region.
3,000-500 B.C.	Tucannon Phase (Leonhardy and Rice 1970). Lower Snake River region.
3,000-500 B.C.	Initial Snake River Period (Leonhardy and Rice 1970). Lower Snake River region.
2,000 B.C.-500 A.D.	Selah Springs (Warren 1968). Central Plateau.
4,500-500 B.C.	Squaw Creek I&II[16] (Pavesic 1971:130). N.W. Idaho.
3,000 B.C.-1 A.D.	Middle Period (Sanger 1967:189). S. British Columbia.
4,000-1,000 B.C.	Indian Dan Phase (Grabert 1974:70). Okanagan.

16. Squaw Creek I&II material identified by Pavesic (1971) included in this period.

1976:304). A culture change exhibited in the lower Snake River settlement and economic systems might be related to the climatic change inferred from archaeological and geological data.

The 4,500 to 2,500 B.P. period offers a considerable number of problematic issues that need to be resolved prior to the establishment of any direct relationship between the environmental and cultural changes suggested.

During the 4,500 to 2,500 B.P. period, an apparent paucity of archaeological sites in the southern Plateau may suggest movement away from river sites, or a movement within river canyons, or simply a lack of an adequate sample (see Brauner 1976; Ames and Marshall 1980).

The establishment of villages, as evidenced by pit houses, occurs at approximately 4,000 to 4,500 B.P. (Ames and Marshall 1980). The first large camas ovens, associated with the pit houses, are noted by Brauner (1976), indicating a subsistence change from the preceding period.

The emergence of the present ethnographic pattern has been associated with an intensification of resources and technology, principally involving salmon use, and the emergency of the winter village as a settlement pattern (Daugherty 1962; Sanger 1967; Nelson 1969). Charles Nelson suggests that the emergence of the present ethnographic period may be associated with the movement of Salish people across the northern Columbia Plateau between 100 B.C. and 100 A.D., presumably bringing with them an emphasis on salmon reliance and a village settlement pattern. However, field work in the lower Snake River region during the 1970's has shown that housepits, associated with the developing village pattern, date to between 4,000 and 5,000 B.P. (Brauner 1976; Ames and Marshall 1980). Ames and Marshall suggest that "the settlement pattern was directly related to environmental patterns" (1980:34).

Ames and Marshall offer an alternative explanation for the settlement and subsistence changes reflective of this period. Rather than salmon productivity acting as the significant variable associated with the development of the village pattern, Ames and Marshall suggest "that intensification of plant exploitation was the critical subsistence change" (Ames and Marshall 1980:25). Their suggestions regarding the importance of plant utilization are difficult to document from the archaeological record since ethnobotanical analysis has only recently gained the attention of Northwest field researchers. Of the site reports analyzed in this study, ethnobotanical analysis as a research tool was totally lacking. However, data from this study may support Ames and Marshall's assessment of the overemphasis placed on salmon productivity during the development of the village pattern.

Leonhardy and Rice (1970) suggest that a high percentage of salmon bones occur during the Tucannon Phase, along with netweights. Leonhardy and Rice also note the occurrence of a bone shuttle, indicating net use, at the Tucannon site (Leonhardy and Rice 1970:11).

In summary, the occurrence of a single net gauge and bone shuttle were the only significantly different potential fishing implements indicated in the 4,500 to 2,500 B.P. period, as opposed to the 8,000 to 4,500 B.P. period. In fact, the number of potential fishing implements and salmon faunal remains does not vary significantly between these two periods. This suggests that the development of the village pattern was related to resources other than salmon.

Ames and Marshall's suggestion that "in the southeastern Plateau the intensified resources were not salmon, but plants" (1980:26), may be supported by a general lack of archaeological data that would indicate an emphasis on salmon resources, and by the occurrence of large camas ovens and grinding implements.

The effects of a changing environment at the end of the Altithermal period, in conjunction with increased precipitation and conjunctive flooding at approximately 3,800 B.P., may have posed problems for anadromous resources. The potential effects of flooding and temperature change on salmon has been dealt with in the previous two chapters.

The Archaeological Data: 4,500-2,500 B.P.

The following data reflect a synthesis of information from 17 sites and approximately 29 features, components, or strata. This is a selected sample from the 114 sites inventoried.

Salmon faunal remains:

Five components contain Salmonidae remains. One component of the five has Salmon gairdnerii (steelhead). One site (Hell's Canyon Creek Rockshelter) has three "salmonoid" bones, not believed to be salmon (Pavesic 1971). This component was not included with the five components containing salmon. Twenty-two bones are noted, plus a "handful of salmonid," from the 29 components. This compares with over 2,500 mammal bones.

Pisces:

Six components contain a small amount of other fish species (no specific quantifiable counts possible).

Shell:

Twelve components, or nine sites, contain river mollusk (burned), gastropod, or olivella shell. Eight components note mussel shell specifically. Four components identify only "shell." Seven components from the previous period (8,000-4,500 B.P.) have mollusk, river mussel, or shell. Thus, the per site occurrence appears to increase between the two samples.

Other faunal remains:

Fourteen components note the occurrence of mammal bone. Over 2,500 counted bones occur, with many components containing no specific counts. Mammal bone makes up the greatest part of the faunal assemblage for this period.

Fishing implements:

Four net sinkers occur in the assemblage, along with one net gauge, one bone net shuttle and one harpoon valve.

Artifacts:

Sixteen components contain bone, shell, or antler artifacts. A complete listing appears on the next page. Several potential fishing implements occur in this assemblage, but functional attributes have not been established.

TABLE 11. 4,500-2,500 B.P. - ASSOCIATED SITES

	Salmon	Pisces	Shell	Other	Artifacts
45WT41 (Leonhardy 1968)	N.M.	N.M.	[17] shell	218 mammal bone, approx.	1 notched net sinker, 1 barbed bone point, 21 bone/antler, 257 total artifacts
45FR50 (Rice 1969) Strat. VII	N.M.	N.M.	shell	bone, 241 mammal bone[18]	1 pebble sinker, 10 bone/antler/tooth artifacts, 62 shell artifacts, 333 total artifacts[19]
Strat. VI			shell, mussel, olivella		0 fishing implements, 49 shell artifacts, 247 total artifacts
45FR46 (Rice 1965) 2,500 B.C.-Historic Period	N.M.	N.M.		bones occur	0 fishing implements, 8 bone/antler artifacts, 126 total artifacts, 8 cordage fragments

17. Found in every stratum.
18. Occur from 4,000 B.P. to late Prehistoric.
19. Strat. VII and VI contains one C14 date of 4,250±150 B.P. It also contains dates as early as 0±110 B.P.

TABLE 11 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
Hell's Canyon Creek Rockshelter (Pavesic 1971) Squaw Creek I&II[21]		[20] 3 salmonoid bones, 2 poss. minnow	mussel	bone occurs	3 bone points, 19 bone/antler artifacts, 176 total artifacts
Nahas Cave (Plew 1980) 2,990±70 B.P.	1 vertebra, Salmo gairdnerri (steelhead)	1 possible sculpin	N.M.	N.M.	N.M.
45OK145[22] Strat. 3&4 (Grabert 1974)	10 salmon vertebrae + ribs and vertebrae	N.M.	shell	655 gm of bone	1 possible net gauge, 4 bone tools, 1 bone punch point? 9 total artifacts
45OK29 Zone 1, 2,000-4,000 B.P. (Grabert 1974)	N.M.	N.M.	shell fragments		0 fishing implements, 1 bone tool
DiQw2 OS-18E 40-60 cm (2,500±100) (Grabert 1974)	N.M.	N.M.	N.M.	1 lb. of bone	0 fishing implements, 0 bone tools

20. Not believed to be salmon (Pavesic 1971).
21. Squaw Cr. I phase would find more probable placement with the 8,000-4,500 period, however, artifact totals are given for both Squaw Cr. I&II together.
22. Placement based on association with a post Mazama eruption, predating 3,000 B.P.
23. Based on artifact and stratigraphic placement, my own tentative assessment.

TABLE 11 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
10IH483 (Randolph and Dahlstrom 1977), possible layer 3-5[23]	4 vertebrae	13 vertebrae	41 mussel shell fragments, 76 gastropod	1,625 bones, approx.	0 fishing implements, 2 bone artifacts, 132 total artifacts
45AS82 (Brauner 1976), House 3 2,500 B.P.	0	?	river mussel	?	0 fishing implements, 2 unidentified bone tool fragments, 1 bone artifact, 24 total tools
House 4A 4,000 to 2,000 B.P.	0	6 bones	river mussel	39 bones	4 bone artifacts, 39 total tools
Feature 82-C-3	7 Oncorhynchus species	11 vertebrae		35	1 net sinker, 1 bone bipoint, 2 end points, 20 total bone artifacts, 582 total artifacts
Feature 5-6 Block B	N.M.	N.M.	mussel	N.M.	48 total tools, 1 bone tool
45KT28 (Nelson 1969), Component 3 1,600-2,000 B.C.	0	0		bone	0 bone tools, 199 artifacts, (300 flakes per square foot)
45CH204 (Valley 1975) Component 2 2,000-1,600 B.C.	0	0	0	0	Not specific

23. Based on artifact and stratigraphic placement, my own tentative assessment.

TABLE 11 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
45CH64 (McCoy 1971), Component 2 500 B.C.-2,000 B.C.	?	?	?	?	Not specific
45DO172 (Hartman 1975), Component 1-2, "dating between 4,000 and 2,000 B.P."	0	vertebrae (species?)	mussel shell	439	0 fishing implements, 491 bone artifacts, 3,018 total artifacts
45AS41 (Brauner 1975), Tucannon/Squaw Cr. II Phase	"handful of salmonid vertebrae"[24]	occur	mussel shell	deer, elk, rabbit, rodent	1 netsinker, 1 bone net shuttle, 10 bone artifacts, 74 total artifacts
45DO174 (Rice and Brauner 1974), Component II 2,000 B.C.-500 B.C.	N.M.	N.M.		not identified	0 fishing implements, 0 bone, total artifacts not specific
45FR39 (Daugherty, Purdy, Fryxell 1967) Component 3-6 3,000-4,000 B.P. 2,760±240 B.P.	0	0	0	fragmentary bone and animal	1 harpoon valve, 25 bone artifacts, 127 total artifacts

24. Not species specific.

TABLE 12. 4,500-2,500 B.P.:
BONE ARTIFACTS AND POTENTIAL FISHING IMPLEMENTS

Site	Artifacts and Implements
45WT41	1 barbed bone point, 21 bone/antler artifacts; 1 notched net-weight.
45FR50	10 bone/antler/tooth artifacts, 62 shell artifacts, 49 shell artifacts; 1 pebble sinker.
45FR46	9 bone/antler artifacts; 8 cordage fragments.
Hell's Canyon Creek Rockshelter	3 bone points, 19 bone/antler artifacts.
Nahas Cave	
45OK145	1 possible bone net gauge, 4 bone tools.
45OK29	1 bone tool.
DiQw2	
10IH483	2 bone artifacts.
45AS82 (3 components)	2 unidentified bone tool fragments, 1 bone artifact, 1 bone bipoint, 2 end points, 21 total bone artifacts; 1 net sinker.
45KT28	
45CH204	
45CH64	
45DO172	491 bone artifacts.
45AS41	1 bone net shuttle, 10 bone artifacts; 1 net sinker.
45DO174	
45FR39	1 harpoon valve, 25 bone artifacts

TABLE 12 (cont'd).

Artifacts/Implements	Occurrence
Net sinkers	4 net sinkers.
Barbed bone points	One.
Bipoint	One.
Bone points	Five.
Net gauge	One.
Net shuttle	One.
Harpoon valve	One.
Cordage	8 fragments (1 component).

Total Bone/Shell/Antler artifacts: Approximately 700.

CHAPTER VII

2,500 B.P. to Contact: Historic Period

Following the post-Altithermal moist episode (approximately 3,800 to 2,500 B.P.), the climate is considered to have gradually evolved to present conditions in the Columbia Plateau. Current conditions may have been preceded by a short drying trend (Marshall 1971). This period falls within Antevs' (1948) Medithermal period, 2,500 B.C. to present.

There appears to have been no serious environmental factors that could have significantly impacted anadromous resources during the late prehistoric period. Volcanism, such as the approximate 3,200 B.P. St. Helens eruption (Mohs 1981:29), would not appear to have deposited tephra, nor raised water temperatures of a significant enough magnitude to have affected riverine resources outside of close proximity locales. This inference is drawn from the discussion developed in Chapter V, and recent observation (Richards 1981) of the May 1980 eruption of Mt. St. Helens, in southwest Washington. Within a year, the Toutle and Cowlitz rivers, immediately west of the eruption, have seen a return, though small in numbers, of anadromous fish.

Emergence of The Present Ethnographic Pattern

At approximately 2,500 B.P., several distinct cultural phases appear in the Plateau. In the southern Pla-

TABLE 13. TEMPORAL ASSOCIATIONS:
2,500 B.P.-CONTACT/HISTORIC

2,500 B.C.-present	Medithermal (Antevs 1948:176).
500 B.C.-1,300 A.D.	Harder Phase (Leonhardy and Rice 1970; Lyman 1976:5).
1,300-1,700 A.D.	Piqu'nin Phase (Leonhardy and Rice 1970).
1,700-1,900 A.D.	Numi'pu Phase (Leonhardy and Rice 1970).
2,000 B.C.-500 A.D.	Selah Springs Phase, Plateau pattern (Warren 1968:48).
500 B.C.-C.A. 180	Big Bar I and II (Pavesic 1971: 130).
1,000 B.C.-1,850 A.D.	Chiliwist Phase, Cassimer Bar Phase (Grabert 1974:70).

teau, the Harder Phase is distinguished from earlier Tucannon components by a change in technology, as projectile points diminish in size. Large corner and basal notched points initiate the Harder Phase and are then replaced by smaller, triangular points with basal and corner notching during the latter part of the middle and late Harder Phase.

A second prominent feature of the Harder Phase is an apparent areal expansion of "pit house clusters" (Ames and Marshall 1980:45). Leonhardy and Rice suggest that house pit villages characterize the second sub-phase of the Harder Phase, a distinct change from preceding phases where "camps" predominate (1970:14).

The Harder Phase is included in the Snake River Period (Leonhardy and Rice 1970:1) which dates from approximately 500 B.C. to A.D. 1,700. Ames and Marshall (1980) have characterized the Snake River Period as one that "marks a technological and settlement shift and the appearance of the present ethnographic pattern" (1980:38) in the southern Plateau.

Pavesic (1971) has further elaborated on the importance of the establishment of house pit villages, in conjunction with a changing lithic technology, as representing an important "transition from the earlier phase leading into the Plateau pattern" (1971:141). Pavesic suggests that both the Hell's Canyon region and lower Snake River region correlate in experiencing the development of the Plateau pattern during this phase.

In the northern Columbia Plateau, Grabert has suggested that the Chiliwist Phase (1,000 B.C. to 1,100 A.D.) "represents the appearance of or transition to a generalized Plateau cultural aspect" (Grabert 1974:74). A feature of the Chiliwist Phase is the appearance of steep-walled house pits, a lithic change in projectile points, and "fish bone is abundant in some components" (Grabert 1974:70).

Charles Nelson suggests that the winter village pattern may date to betwen 1,000 B.C. and 2,000 B.C. in the Canadian Plateau and 500 B.C. in the northern Columbia Plateau (Nelson 1969:59). Nelson proposed that these dates indicate that the winter village pattern diffused from the Canadian Plateau as a result of Salish migration. As discussed in Chapter III, Sanger has also suggested an interior Salish movement southward as early as 2,000 B.C. Whether these proposed Salish migrations can be attributed to the emerging ethnographic pattern at approximately 2,500 B.P., in the middle and southern Columbia Plateau, is still a speculative pursuit. The proposed effects of the Salish expansion, bringing an already developed emphasis on salmon and possibly a developed village pattern, were concepts developed prior to the 1970's when excavations in the lower Snake River at Alpowa located house pits dating to the late Cascade (approximately 5,000 B.P.) There may be a correlation between the suggested Salish migrations and the lower Plateau's emerging village pattern. However, it may also be coincidental, with the emerging village pattern developing from within the Plateau area (Daugherty 1962). Salmon fishing already was established prior to 7,000 B.P. at The Dalles and Bernard Creek Rockshelter, and it appears that salmon were utilized at least randomly throughout the intervening period, until more emphasis developed during and immediately preceding the 2,500 B.P. period.

In summary, the initiation of the present ethnographic pattern appears during the 2,000 to 3,000 B.P. period in the middle, southern, and northern Plateau regions. In the southern Plateau, house pits have been dated to between 4,000 and 5,000 B.P. In the Canadian Plateau, house pits may date to 4,000 B.P. Thus, house pits and a developing village pattern date to approximately 4,000 to 5,000 B.P. The emerging ethnographic pattern appears at approximately 2,000 B.P. to 3,000 B.P., with its conjunctive emphasis on salmon resources, root plants such as camas, and the winter village settlement pattern. Ames and Marshall sum up the late period of Plateau prehistory as exemplified in the southern Plateau in suggesting "the Snake River Period, including Harder and Numi'pu phases, marks a technological and settlement shift and the appearance of the ethnographic pattern" (Ames and Marshall 1980:38).

The role that salmon utilization played in the development of the winter village pattern has been discussed in Chapter VI. Generally, an emphasis has been placed on the utilization of salmon and other river resources to explain the emergence of the village pattern in the Plateau. The sample of components from the 4,500 to 2,500 B.P. period, utilized in Chapter VI, did not reflect a significant increase in salmon utilization for that period. However, during the succeeding period (2,500 to contact), salmon use increases significantly and is reflected in larger occurrences of faunal and artifact material reflecting salmon utilization. The sample utilized in this chapter also may reflect the continuing, expanding importance of this resource, as it appears that sites show progressively more emphasis on salmon use with latter components (i.e. post-1,500 B.P.; refer to end of chapter synthesis of data).

An alternative explanation for the emergence of villages in the Plateau has been proposed by Ames and Marshall (see Chapter VI). They suggest that "the initiation of villages was accompanied by the intensification of root crop exploitation" (Ames and Marshall 1980:44).

David Sanger also has suggested that the overall importance of roots, berries, and seed plants have been underestimated in relation to the total economy of Plateau people (Sanger 1966:16). Root crop utilization (i.e. camas) has been documented for the 4,500 to 2,500 B.P. period by several sources. Brauner (1976) documents large camas ovens at Alpowa on the lower Snake River. Leonhardy and Rice (1970) note the presence of hopper mortars during the Tucannon Phase, suggesting intensified use of plants. Charles Nelson has suggested that grinding implements, indicating root utilization, occur at least 2,000 years prior to the Cayuse Phase (100 B.C. to 100 A.D., beginning). The Cayuse Phase was associated with the emergence of the present ethnographic pattern which is, in turn, associated with an emphasis on salmon use and the village pattern (Nelson 1969:54-62). Grinding stones with a problematic functional purpose have also been noted in the earlier Cascade Phase (8,000 B.P. to 5,000 B.P.) (Leonhardy and Rice 1970).

A substantial body of data exists which may support Ames and Marshall's contentions regarding the correlation between the initiation of villages and an intensified use of root crops. However, as Leonhardy and Rice have suggested, riverine resources were an important aspect of the Tucannon Phase (5,000 to 2,500 B.P.) If one assumes that some of the shell noted in the Chapter VI data, which is not specifically labeled mussel, is in fact mussel, the use of mussel during the Tucannon may be an indicator of a more intensified riverine adaptation (Leonhardy and Rice 1970:4). This research found an increase in mussel sell occurrence after 4,500 B.P. Prior to 4,500 years ago, the use of river mussel appears consistent. Leonhardy and Rice also suggest that salmonid remains are a high percentage of the total fish remains for the Tucannon. The component sample utilized in this study did not appear to reflect Leonhardy and Rice's supposition. However, this may simply reflect the difference in the two studies samples.

The 5,000 to 2,500 B.P. period is still very problematic regarding the role salmon played in the establishment of the village pattern in the Plateau. If weirs and traps were in use by at least the Harder Phase time period (2,500 B.P.), as suggested by Leonhardy and Rice (1970:17), then one might assume a developmental period prior to 2,500 B.P. As suggested in a prior discussion (Chapters V and VI), the degree of cultural emphasis placed on procuring salmon may not be dramatically reflected in the faunal and artifact inventories. However, the technological and economic inventory does not appear to reflect a strong emphasis on salmon use during the 5,000 to 2,500 B.P. period. After 2,500 B.P., the use of salmon appears to intensify at an expanding rate up through the contact period.

The Archaeological Data: 2,500 B.P. to Contact

Archaeological components from this temporal period reflect a greater emphasis on riverine resources, including salmon, mussel, and other fish species. Faunal and artifact inventories that indicate fishing increase, both in number of sites, variety and number of implements, and in total salmon remains.

Of the 21 sites utilized in the sample (end of chapter), 15 contain stone sinkers. Five sites contain bone artifacts identified with fishing implements such as leisters and composite harpoons. Four sites contain bone implements that presumably could be used for fishing or hunting; these include antler points, barbed points, bipoints, and bone points. Seventeen of the 21 sites included in the sample of late prehistoric sites contained identified fishing implements.

Ten of the 21 sites contained salmon bone. No specific identifications were attempted. This is the highest percentage of salmon faunal occurrence in number of remains and total sites for any of the temporal periods dealt with in this study. This figure does not include WS-1 or WS-4 at Five Mile Rapids, The Dalles. Ethnographic data (see Chapter III) supports the contention that fishing for salmon took place at these locales. The archaeological data is vague however. Salmon remains occur at approximately 50% of the sites included in the sample for this period.

The following data represents a selected sample from 21 sites with temporal association from 2,500 B.P. through the contact period.

Salmon faunal remains:

Ten of the 21 sites contain faunal material identified as salmon remains. No specific identifications have been recorded. The sample may include salmon, steelhead, or trout.

Pisces:

Ten of the 21 sites contain other fish remains. Identification is not a general occurrence.

Shell:

Thirteen of the 21 sites contain shell, primarily river mussel. This reflects an increase in per site occurrence from prior periods.

Other faunal remains:

Twelve sites contain mammal or other bone in numbers that make up the greatest percentage of the total counted sample.

Fishing implements:

Seventeen sites contain identified fishing implements. This is by far the greatest occurrence of fishing implements for all periods dealt with in this study.

TABLE 14. 2,500 B.P.-HISTORIC - ASSOCIATED SITES

	Salmon	Pisces	Shell	Other	Artifacts
45WT41 (Leonhardy 1968) Area A 955±155 (WSU-666)	N.M.	N.M.	shell	dog, deer, 8 mammal bone	4 notched sinkers, 27 total artifacts
Strat. 2	N.M.	N.M.		2 mammal bone	1 notched sinker
Strat. 3	N.M.	fish gill plate	shell	29 mammal bone	1 cylindrical pointed bone tool
2,440±170 (WSU-667) ca 500 B.C.-A.D. 500				Bison bison	39 total artifacts, 1 fragment worked bone
Area B Strat. 1 955±155	N.M.	N.M.	N.M.	27 mammal bone	0 fishing tools, 1 cut bone, 47 total artifacts
Area C Strat. 1 A.D. 1,500 age	N.M.	N.M.	N.M.	0	1 cylindrical bone tool, 4 total bone tools, 29 total artifacts
WS-4, WS-1 (Cressman 1960) Contact/Historic Period; Full Proto-Historic	N.M.	N.M.	N.M.		2 sturgeon hooks, 2 composite harpoons, 1 fish scaler, carved bone, no count

TABLE 14 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
45FR50 (Rice 1969) Strat. VII, VIII[25]	N.M.	N.M.	oli-vella, shell	bone	1 pebble sinker
45FR5 (Cleveland and others 1976) 530±80 B.P. 610±90 B.P.	192, head, verte-brae[26]	56, head, verte-brae (suckers) 281 rib/ spine frag-ments (iden-tity?)	mussel shell	977 approx. 747 (lg. concen-trate)	2 net weights
	528 total salmon and non-salmonid remains				
Hell's Can-yon Creek (Pavesic 1971) Layer A&B		2 bone	mussel	bone	0 fishing implements, 4 bone arti-facts, 215 total arti-facts
35UM17 (Shiner 1961) Late Pre-historic		consid-erable number of fish bone	shell-fish	vari-ety of mammal bone	19 net weights, 4 bone tools, 100 net weights, 6 net weights, 280 arti-facts
45BN53 (Shiner 1961) Late Pre-historic	occur	fish bone occur[27]		vari-ety of mammal bone	net weights, no count

25. C14 dates range from 0±110 to 4,250±150. Strata VIIB included in 8,000-4,500 B.P. summary.
26. Salmonid bones appear to be predominantly represented by chinook, however, "fish remains represent a small portion of the total food resources exploited at this site" (Cleveland and others 1976:57).
27. "Suckers were more common than salmon" (Shiner 1961: 200).

TABLE 14 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
45WW6 (Shiner 1961) Late Prehistoric	vast numbers				31 notched netweight, 18 net-weights (4 notches), 3 grooved net-weights, 3 bone projectile points, 350 total artifacts (not specific)
Nahas Cave (Plew 1980)	0, 3 steelhead vertebrae	7 vertebrae	N.M.	N.M.	N.M.
10IH483 (Randolph and Dahlstrom 1977)	4 vertebrae	2 vertebrae	1 mussel shell, 6 gastropod	1,355 approx. bones	1 leister, 11 bone artifacts, 163 total artifacts (approx.)
45AS82 (Brauner 1976) House 1 2C, 2B, 2A Harder Phase	5 vertebrae (salmonidae)[28]	33 bones/vertebrae	river mussel	approx. 374	6 net sinkers, 1 barbed bone point, 1 bi-point bone object, approx. 21 unidentified bone frags., approx. 46 bone artifacts, approx. 1,620 total artifacts

28. Not specific as to species.

TABLE 14 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
House Fl. 82-4-1 82-4-2 Harder Phase	4 salmonidae[29]	15 bones	river mussel	approx. 99 bones	1 bone end point, 1 barbed bone point, 2 net sinkers, 19 bone artifacts, 8 unidentified bone frags., 1,282 total artifacts (approx.)
45AS82 (Brauner 1976) Feature 82-P-P2, 82-P31 Numi'pu Phase	N.M.	N.M.	N.M.	N.M.	11 net sinkers, 20 bone artifacts, 6 unidentified bone frags., 1,321 artifacts
45AS80 (Brauner 1976) House 1-2 1,330±110 B.P. Numi'pu Phase	N.M.	2 bone	river mussel	279 bone	1 net sinker, 8 bone artifacts, 8 misc. uniidentified bone tool frags., 553 artifacts
45AS78 (Brauner 1976) Feature A2-A5	N.M.	N.M.	river mussel		2 net sinkers, 6 bone artifacts, 9 unidentified bone artifact frags., 1,181 artifacts (approx.)
45AS78 Feature B1-B3	N.M.	N.M.	river mussel		1 barbed bone point, 1 bone artifact, 45 artifacts

29. Not specific as to species.

TABLE 14 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
Block E	N.M.	N.M.	?		1 net sinker, 50 artifacts
45AS78 House 1 Harder Phase	1 salmonidae	N.M.		34 bone	13 net sinkers, 6 unidentified tool frags., 1,174 artifacts
45KT28 (Nelson 1969) Component 4-7K	(many salmon bone, fishing implements, and mussel shell)				
45AD2 (Deaver 1973)	salmonid remains occur	25 frags.	crayfish and river mussel abundant[30]	15,439 total	N.M.
45WW25 (Combes 1969) Late Pre-Historic 2,000 B.P.[31]	N.M.	N.M.		beaver teeth	1 sinker, 5 antler points, (point of toggle harpoon?), 2 composite harpoon valves, 27 total bone artifacts, 204 cordage (on a spool), 421 total artifacts

30. Mussel "10% of the total identified remains" (Deaver 1973:28).
31. "Artifacts are of styles common in the last 500 to 1,000 years" (Marshall 1971:44).

TABLE 14 (cont'd).

	Salmon	Pisces	Shell	Other	Artifacts
45CH64 (McCoy 1971) Component 3-5 500 B.C.- 1,800 A.D.	N.M.	N.M.	N.M. mussel present in recent house floors		net weights? total not specific per level
45GA61 (Leonhardy and others 1971) Area A 1,300 A.D.- 1,800 A.D.	N.M.	N.M.	N.M.	a few frags.	7 notched sinkers, 2 perforated stones, 3 harpoon tips? 1 net gauge, 55 bone/antler artifacts
45D0174 (Rice and Brauner 1974) Component 3 1,500 A.D.- 500 A.D.	--- not identified ---				1 notched pebble, total artifacts?
45FR40 (Kenaston 1966)	possible salmon vertebrae		shell occurs		6 possible fishing implements

TABLE 15. 2,500 B.P.-CONTACT/HISTORIC:
BONE ARTIFACTS AND POTENTIAL FISHING IMPLEMENTS

(Presumably, some of the bone artifacts could be used for fishing or hunting. Functional attributes are still largely speculative.)

Sites	Artifacts/Implements
45WT41	1 cylindrical pointed bone tool, 1 fragment worked bone, 1 cut bone, 1 cylindrical bone tool, 4 total bone tools; 4 notched sinkers, 1 notched sinker.
WS-4, WS-1	2 composite harpoons, carved bone, no count; 2 sturgeon hooks, 1 fish scaler, (net sinkers only in late period).
45FR50	1 pebble sinker.
45FR5	2 net weights.
Hell's Canyon Creek Rockshelter	4 bone artifacts.
35UM17	4 bone tools; 19 net weights, 106 net weights.
45BN53	Net weights, no count.
45WW6	3 bone projectile points; 31 notched net weights, 18 (4 notches) net weights, 3 grooved net weights.
Nahas Cave	
10IH483	1 leister, 11 bone artifacts.
45AS82	1 barbed bone point, 1 bipointed bone object, 21 unidentified bone fragments, 46 bone artifacts; 6 net sinkers.
45AS82 (2nd component)	1 bone end point, 1 barbed bone point, 19 bone artifacts, 8 unidentified bone fragments; 2 net sinkers.

TABLE 15 (cont'd).

Sites	Artifacts/Implements
45AS82	20 bone artifacts, 6 unidentified bone fragments; 11 net sinkers.
45AS80	8 bone artifacts, 8 miscellaneous unidentified bone tool fragments; 1 net sinker.
45AS78	6 bone artifacts, 9 unidentified bone artifacts; 2 net sinkers.
45AS78	1 barbed bone point, 1 bone artifact.
45AS78	1 net sinker.
45AS78	6 unidentified bone tool fragments; 13 net sinkers.
45KT28	Many fishing implements and bone artifacts, i.e. composite harpoons, valves, tips, barbs, bone projectile points; notched weights.
45AD2	
45WW25	5 antler points, 2 composite harpoon valves, 27 total bone artifacts; 1 sinker, 204 cordage fragments.
45CH64	Netweights?
45GA61	3 harpoon tips? 1 net gauge, 55 bone/antler artifacts; 7 notched sinkers, 2 perforated stones.
45DO174	1 notched pebble.
45FR40	6 possible fishing implements.

CHAPTER VIII

Discussion and Conclusions

It does not appear that the emergence of the present ethnographic pattern can be attributable to any single event or variable; more likely, a cumulative series of events associated with the post-Altithermal climatic changes, in conjunction with specific cultural variables, provided the impetus for the evolving ethnographic pattern. The increased precipitation, along with a lowering of temperatures, could have provided for expanded camas, anadromous resources, and potentially, an increased human carrying capacity for the region. If ecological changes were directly related to the increased cultural emphasis on these resources is still a very problematic issue. I would assume that there is a correlation. However, the degree of cultural emphasis affected by the changing environment would appear to be related to specific localized adaptive systems. One would expect that environmental changes of the late prehistory period in the Plateau would have affected localized groups differently. As an example, in studies of the effects of volcanism on a variety of Mexican communities, Nolan has suggested "individuals and communities responded differently to similar physical and social forces" (Nolan 1979:333). The Columbia Plateau, and particularly the southwestern region, consisted of a linguistic polyglot, with Chinookan, Sahaptan, and Salishan influences affecting a range of diverse groups. One would expect that each group responded to changing resources based on first, the existing social and economic systems, and second, on the degree of intergroup contact and influence. This "localized response" might be exemplified by Ames and Marshall's (1980) discussion involving the emergent village pattern of the southern Plateau. Regarding localized adaptive responses, Ames and Marshall suggest that;

> villages represent one of several alternative strategies which is followed under the conjunction of the appropriate environmental, demographic and social processes. While these processes may be universal, they will operate through local scale mechanisms. Thus societies within the same cultural tradition may display differing degrees of sedantism, as on the southern plateau (Ames and Marshall 1980: 26).

The archaeological record reflects a general increase in emphasis on riverine and root crop resources during the post-Altithermal episode. The ethnographic and archaeological record reflects a significant degree of diversity between Plateau cultural systems, based on localized environmental and cultural situations. Deward Walker (1967) substantiates this position by suggesting that the establishment of alliances between groups, by way of trade partners and marriage affiliations, were directly related to localized cultural and resource differentiations. The persistence of the autonomous village pattern, exemplified by the ethnographic Plateau pattern, further substantiates the importance that localized cultural and environmental variations had in the development of the ethnographic pattern.

The general ethnographic Plateau pattern thus reflects an increasing utilization of salmon and vegetable crops in conjunction with the establishment of the winter village pattern. The emphasis on mammal hunting continues up through the contact period. The present ethnographic pattern also suggests a significant degree of diversity regarding both localized environments and specific social and economic systems.

The subsistence patterns of the ethnographic Plateau reflect diversified economies making use of riverine, botanical, and mammal resources, indicating upland and riverine adaptations. This is consistent with the theoretical propositions presented earlier in this paper in Chapters I and II. The increased significance of salmon and camas allowed the storage of vast quantities of winter food essential for the winter village pattern. Adaptation was diversified, as reflected in the more sedentary villages at The Dalles, as opposed to a greater seasonal pattern of movement for those groups outside The Dalles, such as the Yakima, Klickitat, and Southern Okanagan.

The utilization of specific anadromous resources by pre-contact cultures throughout the Plateau is related to the degree of cultural emphasis placed on securing the resources, the accessibility to that resource, and the physical condition of particular anadromous stocks at a given fishing locale (see Chapter IV). The degree of emphasis placed on securing salmon resources during the ethnographic period probably relates heavily to the latter two points: acessibility and the condition of the resource.

At The Dalles, year-round fishing was supplemented by other economic pursuits, such as hunting and berry gathering. Spring salmon arrive as early as March, with fall runs ending in October. During an eight month period, intermittent salmon runs ascended Celilo Falls. In contrast, the salmon runs in the southern Okanagan region do not begin until June (Spier 1938:11), ending in October. This left a majority of the year for other resource pursuits such as camas digging in the summer, with deer and bear hunting in the late fall.

The proportions of resources utilized in a year, for the southern Okanagan, has been suggested to have varied "from family to family, and from year to year" (Spier 1938:12). Spier suggests that generally, resource use per family for a year consisted of one third vegetable foods, one third game (especially deer), and one third salmon. However, Spier also suggests that upon further examination, vegetable food may take up one half of a year's resources. Winter storage of meat and fish was of approximately equal proportions (Spier 1938:12). Therefore, between diverse Plateau locations, the degree of salmon's economic importance can vary significantly between specific groups of people.

Deward Walker, in research on Nez Perce fishing practices, has suggested that the degree of emphasis on salmon resources by aboriginal Plateau peoples, was reflected in their yearly movements, which were associated with a "reliance on anadromous fish" (Walker 1967:1). As an example, Spier has noted that some southern Okanagan would leave their locale and travel to Kettle Falls in order to fish for salmon, prior to their arrival in June to the Okanagan region (Spier 1938:11).

Walker has also suggested that exogamous marriage patterns and the forming of trade alliances between groups, were directly related to accessibility factors involving resources which diverse groups utilized. Since few localities offer suitable situations for the use of aboriginal fishing gear (Cressman 1977), and many groups may vie for these locales, Walker suggests the forming of alliances alleviated conflict and allowed accessibility by various groups. By the nature of the anadromous resource, some localities are far better for harvesting practices than others, based on the already discussed characteristics of the resource.

Walker also suggests that Plateau people had a 50% dependence on aquatic resources (Walker 1967:39). This conflicts with Spier's assessment, but may simply reflect the diversity between the two groups Walker and Spier studied. Walker, however, generalized about the entire Plateau from the Nez Perce studies. Ames and Marshall's research (1980) may suggest that Walker's emphasis on salmon dependence in the Plateau was extremely high, ignoring the importance of plant resources. This research tends to support Ames and Marshall's conclusions.

Spier's model of the yearly subsistence practices of the southern Okanagan appears to reflect the assessment discussed in prior chapters regarding the importance of a diversity of resources in the Plateau, with variations occurring between families and groups, based on their particular resource emphasis and group location within the Plateau area. The underlying pattern of resource utilization, based on archaeological and ethnographic data, reflects a general subsistence pattern in the Plateau dominated by diversity. The dominance of the salmon resource was more pronounced at locales such as The Dalles and Kettle Falls. It appears that "other" resources supplemented The Dalles locale's emphasis on salmon, while salmon was more supplemental in the general Plateau subsistence pattern. This concept does not negate the important role of salmon in the establishment of the winter village pattern. However, it does reflect an emphasis on diversity as opposed to singular causal relations as have been emphasized regarding the role of salmon in Plateau economic systems.

Numerous important issues have been raised in this study of salmon utilization and its importance for aboriginal Plateau people. It is hoped that the conflicting viewpoints expressed by researchers have been clarified in a manner which reflects the difficulties involved in assessing the relative importance of the salmon resource. The rich diversity exhibited by the many cultural groups of the Plateau and the lengthy occupation of the region allows for many more questions than answers regarding the lifeways of these past people.

The conclusion drawn from archaeological and ethnographic data in this research is that salmon have been overemphasized in reconstructions of Plateau subsistence patterns (as related strictly to economic patterns) for all but the most recent prehistory and ethnographic period. Even with the ethnographic period, there appears to be considerable diversity both in economic pursuits and between specific cultural systems. That salmon is associated with the ethnographic pattern, reflected in the social, economic, and ideological systems of Plateau cultures is not to be denied. However, other resources such as plant and mammals played important roles also, with plant use possibly associated along with salmon in the development of the ethnographic pattern. The storage of quantities of winter food was directed towards salmon, plants, and mammals. The degree of emphasis on each resource was based on location, resource availability and accessibility, and the degree of individual and group emphasis on a particular resource. It appears that the emphasis on salmon expanded throughout the late prehistoric period where it gained its most pronounced influence on the social and economic systems of the Plateau.

Prior to the present ethnographic period, salmon was of a localized importance at such locales as Bernard Creek Rockshelter and at The Dalles. However, prior to the ethnographic period, salmon does not appear as a significant resource in the general Plateau subsistence systems. Faunal and artifact assemblages support this judgement. Salmon does appear to have been in the river system, however, as sporadic occurrences of salmon faunal remains appear in sites from each temporal period dating to the 8,000 B.P. period.

Environmental factors have been shown to have posed potential problems for anadromous resources throughout the history of Plateau habitation. Significant occurrences of salmon remains appear during two distantly separated periods in the Plateau. During the 8,000 B.P. to 7,000 B.P. period, salmon remains occur as reflections of localized adaptations at several locales. However, the general occurrence per site during this period reflects a general Plateau subsistence pattern with little, if any, emphasis on salmon use. During the intervening 7,000 to 4,500 B.P. period, salmon remains and fishing implements occur randomly, with the general subsistence pattern dominated by a reliance on mammals, riverine, and plant resources. Riverine resources are largely mollusk, non-anadromous fish, and occasional salmon. The environment proposed for this period may have severely limited the number of spawning locales in the Columbia River system.

Between 4,500 and 2,500 B.P., the occurrence and use of salmon is still a problematic area of concern. This research found little evidence for a significant growth in salmon use for this period. Again, an environmental change, as evidenced by the moist, flooding episode at approximately 3,800 B.P., may have restricted the spawning potential of streams in the Columbia system.

At approximately 2,500 B.P., an increase in salmon use is evidenced by Harder Phase components in the S.E. Plateau region. However, the significant expansion of salmon use appears to develop gradually with latter components of the last 1,000 years showing the greatest numbers of fishing gear and salmon remains.

The theoretical propositions in Chapter II outlined the cultural ecology perspectives that provided the framework and focus of this research. Environmental and cultural determinist positions were not considered viable because they appear to ignore specific biological, ecological, or cultural factors. The cultural ecology position was selected in an attempt to assume a position to the center of cultural and environmental dialectics, realizing however, that each theoretical position offered important considerations in the study of culture and culture change. Cultural ecology emphasizes the symbiotic nature of culture's position in relation to the environment, culminating in a system reflective of both cultural and environmental components.

First, the environmental periods that have been proposed for the Columbia Plateau appear well documented though absolute temporal conclusions are impossible at this time. The changing adaptive strategies exhibited by Plateau cultures during the past 11,000 years appear to correlate, though variability exists, with the proposed environmental periods. The variability between different archaeological sites of similar and differing temporal associations appears reflective of specific environmental changes that have occurred, and variable as a result of the different groups and cultures responding to change. This is based on cultural, social, and ideological response systems and the demands placed on those systems by their environmental locale. The response to change also depends on the degree of inter-group contact. The temporal periods show considerable variation between sites of similar cultural phases. When viewed ethnographically, the Plateau is dominated by a diverse number of linguistic and cultural elements. Adaptive and economic systems reflect this diversity. The ethnographic analogy that might be drawn from this observation may lead one to expect exactly what has been viewed from the archaeological record of Plateau prehistory. Cultural phases, though correlating with specific environmental changes, also reflect varied and diverse aspects in regard to temporal, spatial, and cultural considerations. I feel this may account for the many difficulties encountered by Plateau archaeologists in attempting to explain the often times subtle, or not so subtle, artifact or faunal differences encountered within similar time periods but different locales of the vast Colubmia Plateau.

A second focus of the theoretical discussion presented in Chapter II dealt with hunting and gathering systems in general and the success these systems have had under a variety of ecological situations. In the Columbia Plateau, for the greater period of prehistory, the use of salmon appears to reflect a more opportunistic use as opposed to dependence on the anadromous resource. This is characteristic of hunting and gathering systems in general and may, in fact, reflect the primary economic consideration in effective adaptive systems in general, that being the utilization of a diverse number of resources. As this study has shown, the salmon resource is subject to a variety of environmental factors. A change in any one of these may significantly affect the presence of the resource and demand a major cultural adjustment. There is an exceptionally delicate relationship between a cultural system's reliance on single resources. A diversity of subsistence activities in the Plateau has allowed for the survival and change of cultural patterns through time and major climate and geologic changes.

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