PEOPLE OF THE NORTH CASCADES

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ABSTRACT

The mountainous lands within the North Cascades National Park Complex are the most rugged and inaccessible in the lower 48 states. This portion of the North Cascades Range remains virtually unstudied by archaeologists and ethnologists. Approximately one percent of the National Park Complex area has been surveyed, and in this area, 17 archaeological sites have been recorded on site inventory forms. During the implementation of this study, 11 additional sites were recorded.

Review of a variety of published literature indicates that prehistoric and historic populations have inhabited mountainous environments in widespread areas around the world for many thousands of years. There is some evidence to suggest that prehistoric people used areas in today's Park Complex for at least 8,000 years. The archaeological record of prehistoric use of the North Cascades can only be understood within the contexts of regional environmental and cultural changes spanning the last 12,000 years. It is predicted that hundreds of unrecorded archaeological sites exist inside the Park Complex boundaries.

A zonal landscape classification is devised to aid in the management of prehistoric cultural resources. The six zones encompass all lands within the Park. Each zone is described according to landform, biota, archaeological sites and features, and estimated density of sites (number/km^2). The zonal classification constitutes a nonexplanatory model of land use.

Reconnaissance level and intensive, inventory level surveys are recommended in order to find additional sites. Five sites are recommended for testing and evaluation of significance according to criteria for inclusion in the National Register of Historic Places; ten sites should be recorded in more detail; six sites should be revisited; no action is recommended for seven sites. Other recommendations are made concerning the long term management of prehistoric cultural resources in the National Park Complex.

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CHAPTER 1

INTRODUCTION

Each part of this chapter explains a different aspect of the study. The first gives technical details about the contractual requirements and purposes of this study. The next is a more general summary of the approach taken in attempting to meet the study's needs. A final part outlines the organization of this report.

I.

This study was done for the Pacific Northwest Region, National Park Service, US Department of the Interior, by the Center for Northwest Anthropology, Washington State University, under Contract No. CX-9000-4-E076 and subsequent Purchase Order No. PX-9000-5-0328. The contract could not exceed the firm total cost of $24,676. In June of 1984 the Pacific Northwest Region of the Park Service invited priced proposals on a Request for Proposal for an archaeological and ethnographic overview, basemap, and research design for the North Cascades National Park Complex. Major objectives are the establishment of basic data for use as a basis for long range planning to inventory all archaeological resources in the project area. This report, a series of US Geological Survey topographic maps with site locations plotted on them, and the field notes, photographs, and collected artifacts altogether, constitute the results of this study and have been submitted to the Park Service. The report is technical and scientific in nature, but an attempt has been made to keep the level of the narrative less so.

The following physical description of the project area has been taken from the Park Service's Request for Proposal:

> North Cascades is comprised of four contiguous units. Two of these units make up North Cascades National Park. They are separated by the third unit, the Ross Lake National Recreation Area. The fourth unit is the Lake Chelan National Recreation Area which lies directly below the southern portion of the national park. The entire complex encompasses 271,584 hectares or 671,096 acres.
>
> North Cascades straddles the northern reaches of the Cascade Mountain Range which extends south from the Fraser River in British Columbia to below the Oregon border. The complex is characterized by high peaks, alpine meadows, glacial lakes and forested valleys and hillsides. The entire complex is traversed by only one road, the North Cascades Highway, which follows the Skagit River Valley. North Cascades National Park Service Complex was established by law in 1968 to preserve the natural wilderness of the national park units and to provide recreational opportunities to the public at the Ross Lake and Lake Chelan National Recreation Areas.

II.

A variety of approaches could have been used in meeting this study's objectives, that used here being one of these. Some aspects of this approach are fairly standard, others are not. In order to summarize this approach, its main aspects are listed in the following points.

1. The study's objectives are viewed as anthropological problems, which are best understood with the help of a comparative look at the general nature of cultural adaptations to mountain environments in widespread areas. More so perhaps than for most lowland environments, the prehistoric human use of resources in rugged mountainous landscapes is influenced by environmental factors. This report considers archaeology from the perspective of the mountains, not the lowlands. In so doing, it accepts as fact the idea, widespread in ethnographic and historic reports, that bands of mountain-dwelling people were intimately familiar with landscapes that are today labeled and managed as wilderness.

2. The distinction used here between "prehistoric" and "historic" simply divides two different time periods. The first includes the entire timespan prior to European exploration and colonization of North America. The exact beginning of the historic period in different regions is dated to the earliest written records for the area. These two time periods are not used here to signify different stages of cultural development. Instead, the prehistoric and historic periods represent two different kinds of cultural development, each one struggling in an evolutionary way to adapt to drastically different environmental and cultural circumstances.

3. Strong emphasis is placed on geomorphological processes for modeling human use of steep, mountainous landscapes. Changes in river flood plains or terrace growth, for example, can lead to important changes in the distribution of food and utilitarian resources used by different cultures. The intent is to recognize and begin to model the interaction of climatic change, ecological dynamics, and cultural patterns. For rugged mountainous terrain, social and technological flexibility are seen as cultural necessities.

4. Detailed descriptions of prehistoric artifacts, artifact classifications, and cultural taxonomies are avoided here, although some chapters discuss selected ones of these in greater detail. More than any other reason this is because so little archaeological work in the Park and adjacent areas has been done. However, because the intent of the study is to offer a basis for planning, a general context and direction is provided for the studies that will follow.

5. Although there are no detailed ethnographic or ethnohistoric studies of Indian people living inside the Park Complex, there are some detailed studies from adjacent areas of Indian people who used today's Park lands. These relatively detailed descriptions and discussions of selected groups of mountain Indian people are considered crucial for understanding the prehistory of the Park Complex. Today's Park Complex boundaries are seen as administrative and management borders, but the

ultimate goal of this study requires that the area be placed within much larger bioregional contexts.

III.

The archaeological and environmental portions of this study are organized in the following chapters and appendices. Chapters 2 and 3 provide background information about how the Park environment and previous archaeological research are related to the study of the Park's prehistoric archaeological resources. Chapters 4, 5, and 6 offer a broad speculative context in which to view these resources, a methodology for inventorying and managing them, and a series of recommendations for how to get started. Included in a series of appendices are summary descriptions of each confirmed archaeological resource in the Park Complex boundaries, of annotated bibliographies, and of known archaeological collections from the Park lands.

Each main chapter ends with a short summary of the main points made in the preceding sections. The body of each chapter presents and discusses information according to various topics identified by chapter subheadings. Numerous references and page numbers, cited in parenthesis in each chapter, are listed in either of two bibliographies for environmental and archaeological sources. These bibliographies immediately follow Chapter 6.

The ethnographic and ethnohistoric portions of this study have been reported in a separate companion volume by Allan H. Smith and entitled "Native American Tribes of the North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area." This report has been prepared as Contributions in Cultural Resource Management No. 14, Center for Northwest Anthropology, Washington State University, Pullman, and has been submitted to the Pacific Northwest Region, National Park Service, Seattle.

CHAPTER 2

THE NORTH CASCADES ENVIRONMENT AS A PLACE TO LIVE

Introduction

Beginning in the early nineteenth century, Euroamerican explorers and travelers to the North Cascades left a written record of their observations and experiences. The record forms a striking collection of aspirations and ambitions; the words and phrases glow with inspiration from the mountains, and each traveler returned from the experience with a special awareness. There is a double meaning in this historic record, which describes the landscape of each observer's attitudes and beliefs, as much as it describes the outward appearance of the North Cascades landscape.

In his 1814 attempt to cross the North Cascades enroute to the Pacific, Alexander Ross believed that "A more difficult route to travel never fell to man's lot" (Ross 1956:38). During an 1877 trip across Cascade Pass, Otto Klement was awed as "a more enchanting scene our eyes had never before gazed upon. Mountains piled upon mountains stretching away in every direction, presenting the most startling scene imaginable" (reprinted in Stone 1983:4). In a somewhat exaggerated account from 1891, Isaac Tillinghast was inspired by the Cascade Mountains, which "tower up to a height of from 10,000 to 15,000 feet above the sea . . . . This condition of affairs makes the ranges along the lake appear to be, if indeed they really are not, the highest mountains to be found anywhere in the Union" (reprinted in Stone 1983:48). This record of experiences and observations from the earliest Europeans is helpful for understanding how people utilized this extreme mountain environment, but it cannot be taken literally. Each record of observations, thoughts and experiences reflects a particular viewpoint toward the environment, and speaks a cultural heritage that colors how mountains are perceived. Although she sought adventure and challenge in the North Cascades, Mary Roberts Rinehart feared the mountains and through her novelist eyes saw the roaring rivers, forests, and glaciers as ominous and malevolent (reprinted in Stone 1983:157-158); DeWitt Britt exaggerated the mineral wealth of the North Cascades and predicted economic development and settlement at a scale that never came to be (reprinted in Stone 1983); hunters were attracted to the seemingly inexhaustible wildlife, especially the mountain goats, which were so common that for a time the hides were used as a ready means of cash (Byrd 1972:18, footnote 35).

From the perspective of prehistory, the views expressed in nineteenth and early twentieth century historic documents about the North Cascades are those of strangers to the mountains. These documents were written by lowland-dwelling people who had traveled a long distance to visit the mountains or to settle there, but they came with a cultural heritage rooted in distant environments. As is still true today, the undeveloped and pristine North Cascades environment during the early historic period was considered wilderness, unexplored, unaltered, and even unseen by previous humans. Nothing could be farther from the truth (Nash 1982). This viewpoint, expressed as it was by members of a developing agri-industrial market economy, is quite understandable and acceptable to those of us who also are members of this same economic system. However, a switch in thinking is required if we are to understand prehistoric use of these mountains by Indian people who practiced a hunting, gathering, and fishing economy for thousands of years. To these people, the North Cascades was not a wilderness, it was a part of their homeland. Their view of the landscape recorded the cumulative wisdom of thousands of generations of mountain dwellers. These original inhabitants possessed a detailed knowledge of their environment; they knew the locations and times of availability of minerals, animals, and plants that were important to maintaining their way of life. The rivers, peaks, meadows, lakes, and camps all had names, to which the people formed strong personal bonds; they also had a history that was passed on by oral traditions. Neither were the mountains roadless: a well-developed system of trails, rivers, lakes, and ridgelines provided access and travel routes throughout. Being active participants in the larger mountain ecosystem, prehistoric people were skilled in the manipulation of their environment and its resources, such as through intentional burning of forests in order to increase the production of important resources. In this chapter, aspects of the North Cascades environment are examined that would have been important to prehistoric people having a successful hunting, gathering, and fishing lifestyle in the North Cascades. This is done by first describing the environment as it is known today. Following this is a review of the changing North Cascades landscape for the 20,000 years before Europeans arrived based on scientific studies by botanists, geologists, and others. Other sections discuss how aspects of the mountainous environment influence the study of archaeological sites in the Park.

The Modern Landscape

The North Cascade mountains are a distinctive range located in north-central Washington state (Figure of northwest, state, mountains, and park boundaries). They are considered by many to be the most inaccessible and rugged range in the lower 48 states. Although geographically close the mountain ranges of the Northwest are ecologically different from one another (Price 1978:447), and this was so in ways that were important to prehistoric inhabitants. To understand how prehistoric people lived in the North Cascades it is necessary to understand what controls this distinctive environment, its seasons and climate, the distribution of plants and animals used by prehistoric people, and the landforms available for occupation. These factors are important not only in comparison with populations in the surrounding lowlands, but in order to understand prehistoric use of different parts of the mountains, such as between drainage basins or east of the Cascade crest versus west of it.

A good overall summary of the Cascade Range, its distinctive environment, and its relation to other mountains is this one:

> The striking characteristic of the Cascade Mountains of Washington is their vivid contrasts. They are majestically alpine, with compact groupings of many spectacular peaks, immense local relief, dazzling snowfields and glaciers. Their contrasts can be sublime, with a range of subtle and strong earth colors emanating from the

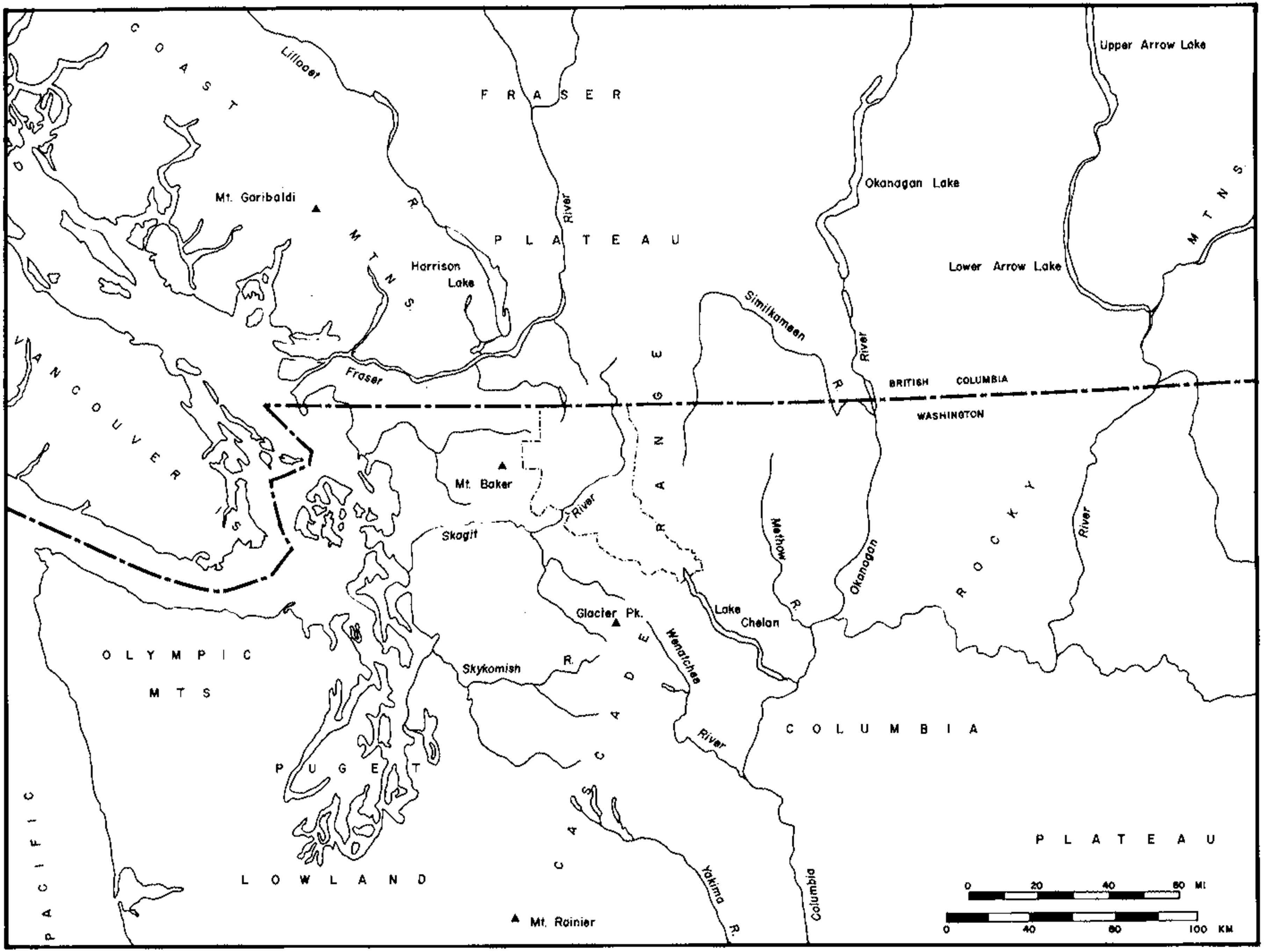

Figure 2-1. Map of Washington and British Columbia.

great variety of vegetation, the dark forest shadow, and the myriad rock formations of the alpine regions. Their intriguing landforms have been produced by the interaction of Pacific winds, ice, and complex geologic forces. Crowned by five great isolated strato-volcanos, which are stationed like sentinels at regular intervals, the Cascades are quite unlike any other American range. From Lassen to Garibaldi, the big volcanos stand above a very characteristic setting of old-rock crests of strikingly regular altitude. The Chilean Andes may be closely analagous, but such landscapes are otherwise unique.

Washington's Cascades have the most glaciers, densest and most magnificent forests, and least disturbed wilderness in our contiguous western states. They are the southern limit of a typical Northwest Coast alpine topography which extends to Prince William Sound in Alaska (the North Cascades have much more affinity with the southern British Columbia Coast Mountains than with the Oregon Cascades). In spite of the contrasts cited, certain consistent characteristics and many individual peak similarities create a strong impression of regional unity (Beckey 1973:6-7).

The crest of the Cascade Range runs north-south for approximately 1,100 km (650 miles) from southern British Columbia to northern California (Denton 1975). The northernmost segment between Snoqualmie Pass on the south and the Fraser River on the north constitutes the North Cascades. To the west lies the Puget Lowland at sea level, and to the east lies the Columbia River which at this location is below 300 m elevation. Only the northern portion of the North Cascades are within the National Park and Recreation Area boundaries. Although the Cascade Range is noted for its volcanos none occur within the Park Complex. The mean altitude of peaks in the North Cascades is 2,500 m (Post et al. 1971:2); the highest peaks within the Park Complex are Goode (2,804 m), Shuksan (2,782 m), and Buckner (2,768 m).

Most of the Park Complex is drained by two main river systems, the Stehekin-Chelan flowing southeasterly to the Columbia River and the Skagit flowing westerly into Puget Sound. A small portion drains north into the Fraser River in British Columbia (Figure 2-2). The Stehekin-Chelan system is about 126 km (76 miles) long, and above the lower end of Lake Chelan drains an area 2,393 km^2 (924 miles square); 90 km (56 miles) of this distance is taken up by Lake Chelan. The lake's upper end is fed by the Stehekin River while the Chelan River drains it. Most of the Park Complex land area is on the west side of the Cascade crest within the 260 km (162 miles) long Skagit River basin; the northernmost 22 km (35.3 miles) of the basin are in British Columbia. The Washington portion of this basin is about 7,070 km^2 (2,730 miles square) (Drost and Lombard 1978). The Skagit is the largest river in northwestern Washington and the largest between the Fraser and Columbia Rivers. Both the Skagit and Stehekin-Chelan river valleys and their tributaries are narrow with precipitous forested rocky walls that terminate in sharp ridges and peaks.

Figure 2-2. Diagram of the Park Complex boundaries showing the major river drainages of the Park.

There are 231 natural lakes and ponds within the Park Complex, most being west of the crest. There are three artificial lakes (Ross Lake, Diablo Lake, and Gorge Lake) and one artificially-raised natural lake (Chelan) (Wasem 1974).

One of the most important characteristics of the North Cascades that affects human use of the landscape is their extreme relief. The steepness of these mountains has been described as follows:

> Main valley floors are usually not above 3000 ft. except at their heads, and many equally deep tributary gorges incise the range, almost to their origin on high divides. Comparative studies have shown that the 4000- to 7000-ft. local relief is quite extensive in the old-rock areas of the Cascades (55 to 108 miles over an east-to-west span between the 48th and 49th parallels) and involves a broader region than is found elsewhere in mid-latitude North America outside nearby British Columbia. Equal relief does exist in a few other places in the western United States, but the area involved is much less (Beckey 1973:6).

It is not uncommon for the mountains to rise over 2,000 m vertically over a horizontal distance of 5,000 m or less (Post 1971:1). At the western edge of the Park Complex, a 2,538 m rise separates Mt. Shuksan from the Baker River, a horizontal distance of 8,000 m. At the eastern end, a 2,031 m rise separates Mt. McGregor from the Stehekin River, 3,500 m distant. These elevational gradients, some of the steepest in North America, are reflected in similarly steep gradients of rainfall, snowfall, temperature, and length of growing season. Generally, valleys west of the Cascade crest are more deeply eroded than those to the east (Beckey 1977:12). The steep gradients so characteristic of these mountains result in a high diversity of plant and animal communities and microclimates between the valley floors and ridge crests. Hunting, gathering, and fishing people who used or lived in these mountain valleys had a wide variety of plant and animal foods available at short distances from their settlements. At the same time, however, the steep terrain made travel difficult and transportation costs high. Fortunately, the North Cascades are not high altitude mountains and populations living within them were unaffected by hypoxia, the physiological stress caused by decreasing oxygen above 2,500 m (8,200 feet) elevation and that has important effects on people living in high mountains around the world (Pawson and Jest 1978:18).

As mountains go, the North Cascades are warm and wet. This reflects their proximity to the Pacific Ocean and the moist maritime air masses that drench the western slopes and peaks. East of the Cascade crest, average annual precipitation and temperature lower as the maritime climate gives way to drier and colder conditions of the intermontane part of Washington. West-to-east precipitation changes are shown in Figure 2-3. Climatological stations in the North Cascades are few and at low elevations, hence Stevens Pass is used to approximate conditions in interior parts of the Park. Much of the yearly precipitation occurs as snowfall which accumulates to great depths at high elevations. At Chelan, on the dry eastern edge of the mountains, January snowfall averages 332 mm (13 inches) compared with a January mean of 2,200 mm (87 inches) at Mt. Baker Lodge, located near the western, wet edge of the North Cascades. The average snow depth at Mt. Baker Lodge for April 1 is 4,350 mm (14 feet) and at Stevens Pass it is 2,650 mm (8.7 feet).

The present and past North Cascades climate is ideal for the formation of mountain glaciers, such that 77 percent of the glacier area in the coterminous United States is within the State of Washington and 63 percent of this portion is within the North Cascades (Meier 1961, cited in Post et al. 1971:1). Of the 756 glaciers inventoried for the North Cascades, 318 cover an area of 117 km^2 and are within the National Park boundaries; and of these, only 36 are east of the range crest (data from Post et al. 1971)

Glaciers within the Park Complex vary in size, the largest being the 7 km^2 (2.5 square miles) Boston Glacier; however, most glaciers are smaller than 1 km^2 (0.36 miles square). The average elevation of glaciers is 1,600 m on the west slope of the Cascades and increases inland to 2,200 m. For individual glaciers, size, mean altitude and shape are controlled by topography and exposure to solar radiation. The largest generally occur on north and northeast exposures or where snow and ice masses are sheltered by high cliffs (Post et al. 1971:5).

The heavy North Cascades Range precipitation drains west to the Pacific Ocean by two routes:

> Cascade moisture drains into a complex network of rivers and secondary streams. The western slope is drained by nineteen important rivers, most of them flowing to the Puget Sound basin. East of the main watershed all drainage is directed to the Columbia, which turns to bisect the range. The hydrologic boundary of the Cascade divide is erratic and often obscure; it rarely follows one individual ridge any great distance (Beckey 1973:6).

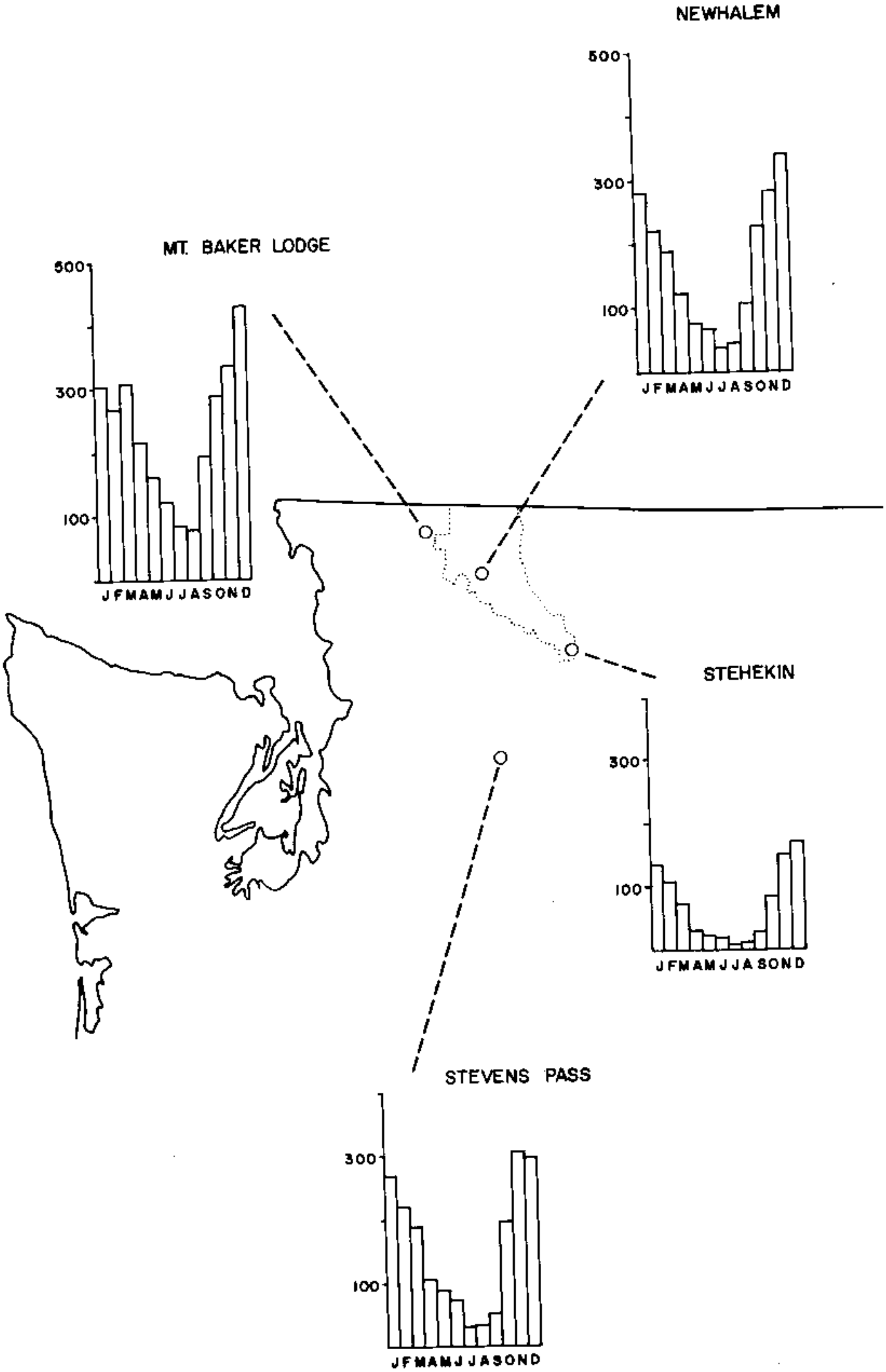

Figure 2-3. Average monthly precipitation (in mm) for selected stations in and adjacent to the Park Complex. The average annual totals are: Stevens Pass 1,920; Stehekin 858; Mt. Baker Lodge 2,790; and Newhalem 1,987 (data from Phillips 1966 and Donaldson and Ruscha 1975).

Flooding of streams is a recurring and important aspect of humid mountainous areas and adjacent lowlands around the world. It is especially true of the glaciated Cascades which have the ability to both store and release large amounts of glacial and snowpack meltwater (Meier 1969). Although many factors influence river behavior, evidence from different regions of the United States suggests that the magnitude and frequency of floods are directly controlled by climate (Knox 1983:40). On the dry east side of the Cascades, a flood peak occurs during melting of winter snowpack in May and June (Donaldson and Ruscha 1966). The highest flood on record for the Stehekin River (and many others in the upper Columbia River drainage) occurred in 1948 (US Geological Survey 1983:103). Not only did the flood cause tremendous property damage, it also reshaped the floodplains and river channels through erosion of old landforms and deposition of new ones. Many archaeological sites in widespread areas of eastern Washington were lost through flood plain erosion and others have been buried under flood deposits (Mierendorf 1981). Although occurring before detailed records were kept, the flood of 1894 is known to have far exceeded the 1948 flood in magnitude (US Geological Survey 1949) with attendant destruction to the Stehekin flood plain (Byrd 1972:1-2). There is no way of knowing at present how many archaeological sites were destroyed or buried by these floods, but the number is probably high.

Unlike east side rivers, those draining the west slopes of the North Cascades have two peak flows yearly, one in late spring and one in late fall (Stewart and Bodhaine 1961). When warm spring temperatures melt the winter's snowpack, the resulting floods crest at low levels but are long-lasting. By comparison, rain-fed late fall floods crest at higher levels but are short-lived. The largest spring floods on record occurred in 1894, 1880, and 1882. The highest individual fall floods along the Skagit River occurred between 1805 and 1825, in 1856, 1896, 1897, 1906, and 1909. The first two of these occurred prior to Euroamerican settlement and record keeping. However, James Stewart estimated the time and magnitude of these two floods using information from Skagit Indian informants, and by examining the elevations of watermarks and sand deposits along the Skagit gorge above Newhalem, and silt stains and other flood debris on old trees within the Skagit River flood plain (Stewart and Bodhaine 1961:21-31).

Just as they do to modern communities, large floods often destroyed or buried prehistoric Indian settlements. Stewart's informants noted that the great flood that occurred sometime between 1805 and 1825 inundated Indian settlements, destroyed food reserves, and caused deaths through drowning and starvation. For rivers draining the heavily glaciated North Cascades, flooding and its affects on the flood plain landscape have always been a prominent aspect of the natural environment. For the thousands of years that prehistoric people lived in the North Cascades, the climatically-controlled patterns of river flooding must have influenced the locations of the most permanent settlements and other aspects of the ways that Indians used the riverine landscape (Mierendorf 1983a).

The North Cascades are within the most heavily forested portion of the United States and when first seen by Euroamericans, nearly the entire area west of the Cascade crest was covered by dense moist evergreen forests. Today, 82 percent of western Washington and northwestern Oregon are forest covered (Franklin and Dyrness 1973:55). Most of the Park Complex is on the mild west slope, where once existed stands of trees with some species living well beyond 500 years and attaining heights of 50-75 m (164-250 feet). Prominent tree types include coastal Douglas fir, coastal western hemlock, Pacific silver fir, Alaska yellow-cedar, and mountain hemlock. East of the Cascade crest, forests in the Park are a mixture of coastal and Rocky Mountain tree types, which include ponderosa pine, interior Douglas fir, Englemann spruce, subalpine fir, alpine larch, and mountain hemlock. Western red cedar, aspen, cottonwood, big-leaf maple, and lodgepole pine are found on both slopes. East of the Park Complex, along the lower end of Lake Chelan and in the Methow River valley, is found the dry bunchgrass zone so characteristic of the semiarid regions of the interior that form in the rainshadow of these mountains (Price 1981). In Figure 2-4, a generalized east-west section through the North Cascades, Olympics, and Rocky Mountains is shown the changes in elevation of the near timberline zone (see Chapter 5). The eastward rise in elevation of both the lower and upper treelines is due to the drier inland climate. The lower forest boundary is marked by drought resistant trees, such as ponderosa pine; the upper forest boundary occurs where winter snowpack so shortens the growing season that seedlings cannot survive (Arno and Hammerly 1984). It is because of this influence of late-melting snowpacks on seedling growth that upper treelines are lower on the snowier west slope.

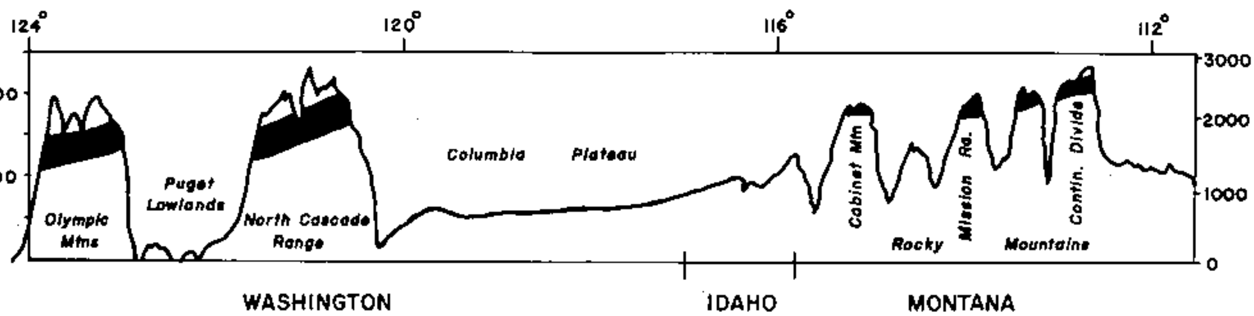

Figure 2-4. Generalized east-west cross-section of the northern Northwestern states, showing the approximate elevations and distributions of the near timberline zone (in black). (Adapted from Arno and Hammerly 1984).

Even though the patterns of precipitation distribution, vegetation zonation, glacier elevations, and stream discharges are known for the North Cascades generally, how these environmental factors actually affect specific localities within the Park Complex is not. Each river valley or segment of a valley, each cirque lake, and each ridge line has its own unique combination of solar exposure, topographic features, bedrock types, wind direction and other characteristics. This results in a patchy distribution of valley forests, subalpine meadows, brushy avalanche chutes, rocky talus slopes, and alpine tundra. Dense and impenetrable forests carpet the U-shaped valley bottoms where whitewater tumbles across bouldery channels or through narrow-walled rock gorges. In upper valleys, cirque walls and rock buttresses rise steeply to the lower ends of gravelly moraines deposited during the Little Ice Age, the recent glacial advance that occurred between the fifteenth and nineteenth centuries (Denton and Porter 1967; Leonard

1974). Above the moraines, snowfields and glaciers sit beneath aretes, cols, horns, and other rock forms sculptured by moving ice.

Resources and Their Prehistoric Use

Prehistoric people of the North Cascades knew well the locations and abundances of food and utilitarian resources within the thousands of microenvironments, the small ecosystems created by combinations of environmental factors noted above. The kinds of plants, animals, fish, rock, and water resources, at times crucial to their long-term and short-term survival, are not spaced evenly throughout the mountains. Because of this, different cultural strategies and tactics were adjusted to the use of these different resource areas. These differences influence the kinds of archaeological sites found in different resource areas; therefore, the kinds of sites are not expected to be distributed evenly either. For example, soapstone (a naturally-occurring form of talc) outcrops only in restricted Park areas west of the Cascade crest (US Geological Survey 1966). This distinctive, soft material was easily carved and polished, and artifacts made from various types of soapstone have been found on both sides of the Cascade Mountains (Swanson and Bryan 1960). One such item is a carved figurine that was found on the Courtney ranch in the Stehekin River valley (Figure A-10). The complex bedrock geology of the North Cascades has left an uneven distribution of many different rock types in the Park. Some of these types have a concoidal fracture, which permitted Indians to shape pieces of naturally-occurring stone into delicate knives, points, scrapers, and a variety of other tools. Some of the flakeable stone materials available within the Park are chert, quartzite, mudstone, argillite, dacite, and others (Misch 1954; Staatz et al. 1972; Staatz et al. 1971), and some basalt (Bryan 1963).

Many plants occurring in abundance in various Park localities were important sources of food and medicines to Northwest Indians. Some of the more commonly used ones, such as Lomatium (also called biscuitroot), grow in various Park localities and throughout the Stehekin drainage. This root was dried, baked, or pounded into flour, the latter process being done with a cylindrical stone pestle. Examples of stone pestles found within the lower Stehekin Valley are shown in Figure A-10. Another food plant that grows at all elevations of the Park is huckleberry (Vaccinium). In late summer huckleberries abound in subalpine and alpine meadows and basins. Additional references on the Indian use of native plants common to the North Cascades can be found in Gunther (1973), Turner (1976; 1978), and Turner et al. (1980). Native plants were valuable sources of minerals, vitamins, and carbohydrates for Indian diets (Norton et al. 1984).

Table 2-1 lists some native plants in the Park Complex known to have had important uses to Indian populations living in areas adjacent to the North Cascades. A more complete plant inventory for the range is available (Naas and Naas 1978).

Table 2-1. A Partial Listing of Plants in the Park Complex, and Used by Indian People in and Adjacent to the North Cascade Range.

Common Name	Scientific Name	Common Name	Scientific Name
Glacier lilly	Erythronium grandiflorum	Kinnickinnick	Arctostaphylos spp.
Tiger lilly	Lilium columbianum	Indian hemp	Apocynum
Riceroot	Fritillaria spp.	Red elderberry	Sambucus racemosa
Spring beauty	Claytonia spp.	Hazelnut	Corylus cornuta
Balsalmroot	Balsamorhiza sagittata	White bark pine nut	Pinus albicaulis
Raspberry	Rubus spp.	Bleeding heart	Dicentra formosa
Blackberry	Rubus spp.	Biscuitroot	Lomatium spp.
Huckleberry	Vaccinium spp.	Ironwood	Holodiscus discolor
Salmonberry	Rubus spectabilis	Cedar	Thuja plicata
Currant	Ribes spp.	Trillium	Trillium ovatum
Salal	Gaultheria spp.	Wild rose	Rosa spp.
Skunk cabbage	Lysichitum americanum	Serviceberry	Amelanchier anifolia

The many animals living in the Park were important to prehistoric people, not only for their contribution to the diet but also because they provided the raw materials to make tools and other utilitarian objects necessary to life in the forested mountains. A list of mammal species and subspecies in the Park Complex has been made (Bjorklund 1981). A complete listing of the animals used by Indian people is not given here. Instead, only those that seem to have been particularly abundant or in demand are noted. This does not mean, however, that the many smaller fur-bearing animals and upland and aquatic birds were not hunted by prehistoric people. Birds were particularly abundant along Puget Sound, the lower Skagit River valley, and other wetlands (Buechner 1953; Blukis Onat 1980).

Probably the most important and common animal species hunted were the deer which occur throughout the mountains. On the west slopes these are black-tailed deer, and on the east slopes mule deer; these are two different races of the same species (Taber 1984). Although found throughout the Park, deer migrate between the upper montane forests in summer and the lower river valleys in winter. Other hunted animals are not so evenly distributed throughout the Park Complex. Roosevelt elk, an animal of lowland rainforests, were present historically in the northern and western portions of the Park Complex in the Skagit and Nooksack River drainages (Bjorklund 1981). Although large numbers of elk did not occur in higher elevation portions of the Park, they are inhabitants of timberline zones during the short summers (Bjorklund 1981). Rocky Mountain elk apparently were not numerous in the Stehekin River drainage in the last 200 years; however, elk bones from archaeological sites near the mouth of the Chelan River show that some type of elk was hunted by Indians at least 1,500 years ago (Bobalik 1983). Other animals that may have been hunted, but have no record of observation during the historic period, include moose and mountain sheep. (Archaeological excavations east of the Cascade Range, along the Columbia River, have shown mountain sheep to have been an important food in the diet of Indian people for many thousands of years [Swanson 1956; Lothson 1982; Schalk and Mierendorf 1983]). There is one twentieth century account of caribou entering the upper Skagit River drainage from the north (Taber 1984). Black bear (Ursus americanus) and grizzly bear (Ursus arctos) are native to the North Cascades (Jonkel 1978). Grizzly bear bones have been found recently with other archaeological food remains from a 1,000 year old Indian house at the mouth of the Wenatchee River (Lyman 1985).

Many mammals hunted by Indian people occur in abundance in subalpine and alpine zones within the Park Complex. Some of these are permanent residents and others are summer migrants that follow the annual snowline retreat to high elevations. Two permanent residents are the mountain goat (Oreamnos americanus) and the hoary marmot (Marmota caligata).

So abundant were mountain goats in the North Cascades, they were considered inexhaustible by the earliest sport hunters (Byrd 1972). The extensive alpine landscape provided ideal goat habitat and distribution maps of native goat populations show the North Cascades to one of the largest contiguous areas of mountain goat habitat in the continental United States (Rideout 1978:158; Chadwick 1983:40). Although they prefer steep slopes and cliffs in alpine tundra and subalpine areas, mountain goats migrate in the winter to areas where snow does not accumulate, these being either high windy ridges or lower elevation south-facing cliffs (Rideout 1978:153-157; Ingles 1965:440). According to numerous ethnohistorical accounts, goat wool was in high demand among Puget Sound Indians and was one of the important Park resources used by them.

Marmots, members of the squirrel family, are permanent residents of alpine areas within the North Cascades and hibernate a large portion of the year. During the summer they eat green vegetation and accumulate layers of body fat that may equal half the body weight (Ingles 1965:166-167). Marmots live in dens dug under rocks, boulders, or in the open. The contribution of marmots to the diet of mountain people is unknown, but they were hunted for food and fur by Northwest Indians (Haeberlin and Gunther 1930:25, 37) and bones of marmots have been recovered from archaeological sites in widespread areas of the Northwest.

Fish was a major food of Indian people, but the different kinds of fish were not evenly distributed throughout the Park Complex. The abundance of Pacific salmon in Northwest streams, both inland and coastal, and the predictability of their spawning runs exerted an important influence on where Indian people chose to establish winter villages (Nelson 1973; Schalk 1977). On the west slopes of the North Cascades, annual runs of salmon occurred within the Skagit River and its tributaries as far as the Skagit gorge above Newhalem and within the Nooksack and Chilliwack Rivers (see Table 2-2). In addition to the Pacific salmon, a wide variety of other fish were important to Indian people, including rainbow and cutthroat trout, squawfish, whitefish, sucker, peamouth, lamprey, and smelt. Eulachon (Thaleichthys pacificus), a type of smelt that spawns in coastal streams (including the Nooksack River) (Wydoski and Whitney 1979:65), was processed for the oil it contained. This nutritious oil was in great demand and was traded to Indians east of the Cascades (Stewart 1977:149-150).

Table 2-2. The Timing of Salmon and Searun Trout Runs in the Skagit River (from Fish and Wildlife Technical Committee 1978).

Species	Fresh-water Life Phase	J	F	M	A	M	J	J	A	S	O	N	D
Spring chinook	Upstream migration				—	—	—	—					
	Spawning								—	—			
Summer-fall chinook	Upstream migration							—	—	—			
	Spawning									—	—		
Coho	Upstream migration							—	—	—	—		
	Spawning	—									—	—	—
Pink	Upstream migration							—	—				
	Spawning								—	—	—		
Chum	Upstream migration									—	—		
	Spawning	—										—	—
Sockeye	Upstream migration						—	—	—				
	Spawning								—	—	—	—	—
Summer steelhead	Upstream migration				—	—	—	—	—	—	—		
	Spawning		—	—	—	—	—						
Winter steelhead	Upstream migration	—	—	—	—	—	—					—	—
	Spawning	—	—	—	—	—	—						—
Searun cutthroat	Upstream migration	—					—	—	—	—	—	—	—
	Spawning	—	—	—	—								—
Searun Dolly Varden	Upstream migration						—	—	—	—	—	—	—
	Spawning									—	—	—	

Most accounts note the abundance of large trout in Lake Chelan and the Stehekin River, but salmon were apparently unable to swim the Chelan River gorge between the Columbia River and Lake Chelan (Byrd [1972:15], however, noted that salmon had on occasion been able to swim the gorge to the lake). Some fish believed to be native to Lake Chelan and the Stehekin drainage are Cutthroat trout, Dolly Varden, Peamouth, Northern squawfish, Redside shiner, suckers, and ling (Wasem 1972).

Resource Distribution

From a broad geographical viewpoint, the major food resource combinations relied upon by prehistoric people using the Park are grouped into three different resource areas. These areas are geographically separate:

1. Skagit River drainage above Skagit gorge,
   a. abundant land mammals including deer, elk, goat, bear, caribou(?), and moose(?),
   b. trout and other smaller lake and river species,
   c. montane forest and alpine plants,

2. Skagit River drainage below Skagit gorge,
   a. land mammals including deer, elk, and goat,
   b. abundant Pacific salmon, trout, and other smaller lake and river species,
   c. montane rainforest and prairie, and alpine plants,

3. Stehekin-Chelan drainage,
   a. land mammals including deer, elk, goat, and mountain sheep (?),
   b. abundant lake trout and other smaller lake and river species,
   c. plants ranging from xeric, lower montane forests to alpine communities.

These different resource areas are likely to have had an influence on prehistoric subsistence strategies, and therefore on the kinds and densities of archaeological sites within them. Site assemblages, and the overall adaptations they represent, are likely to contrast when compared between these resource areas.

Environments of the Prehistoric Past

Climate, vegetation, glaciers, and landforms are constantly interacting, and over the last 20,000 years, the North Cascades and adjacent areas have changed so dramatically that even a detailed familiarity with Park areas as they are today might not enable one to recognize these same areas if they could be seen at various times in the prehistoric past. Understanding past climatic changes is helpful for understanding how prehistoric people lived on the changing landscape. This is because the plants and animals used for food and utilitarian purposes are sensitive to climatic change, so that their numbers and kinds in any one locality was not constant. It is known, for example, that bison and pronghorn antelope were once common in the arid part of eastern Washington and were hunted by prehistoric Indian people (Osborne 1953; Schroedl 1973). These animals became extinct in eastern Washington about the time Europeans arrived.

In addition to biotic changes, the landforms, rivers, and lakes where people camped, fished, hunted, gathered, and traveled also underwent changes. Many Northwest rivers at the end of the Ice Age, for example, flowed in channels with beds higher in elevation than modern rivers (i.e., before dams were built) and left remnants of earlier flood plains perched many feet above modern ones. During building of these flood plains, Indian camps and villages often became buried. Such buried archaeological sites are often subject to cycles of erosion and deposition which cause sedimentary layers to be laid down over them. These erosion-deposition cycles are often related to climatic changes.

The Last Ice Age

A major climatic event that affected the prehistoric North Cascades, the Fraser Glaciation, began about 22,000 years ago. During this time, glaciers formed in the high mountains of British Columbia the North Cascades, and other high mountain ranges. This glacial period, called the Evans Creek Stade, saw alpine glaciers flow rapidly down valleys as the climate cooled. In parts of the North Cascades, the glaciers during the Evans Creek Stade were about 900 m (2,900 feet) in elevation below present ones (Porter 1977). These mountain glaciers grew to their largest size before 17,000 years ago and had dwindled much in size by 15,000 years ago when another kind of glacier, the Cordilleran Ice Sheet, reached its largest size (Clague 1981; Waitt and Thorson 1983). This Vashon Stade, between about 17,000 and 14,000 years ago, encompasses the growth and retreat of the Cordilleran Ice Sheet, which consisted of a thick (over 2,000 m) mass of ice that covered most of British Columbia and the northern portions of Washington, Idaho, and Montana. This ice mass was built of many smaller glaciers that originated in British Columbia as ice caps and mountain glaciers between the coast mountains on the west and the Rocky Mountains on the east. These smaller glaciers combined to form an ice sheet that flowed along south trending valleys and lowlands and that covered all but the highest peaks and ridges. At its greatest extent, the Cordilleran Ice Sheet covered nearly all of the area within today's Park Complex except Mt. Shuksan and other high peaks, and possibly a small area of the Park around Cascade Pass (Figure 2-5). The ice mass covered the crest of the North Cascades and sent ice tongues into the Skagit and Chelan valleys (Waitt 1977; Waitt and Thorson 1983). By 13,000 years ago the ice sheet had nearly disappeared below 49° north latitude; and by 9,500 years ago, glaciers in British Columbia were near modern limits (Clague 1981).

The Holocene

Melting of the Cordilleran Ice Sheet coincided with a worldwide warming trend, the interglacial period that we live in today and which is called the Holocene. The Holocene is not a period of climatic stability, however, and the geologic record shows cycles of change in temperatures, precipitation, vegetation, and glacier activity. Although not as great as the change from a glacial to an interglacial, these fluctuations could be abrupt, frequent, and

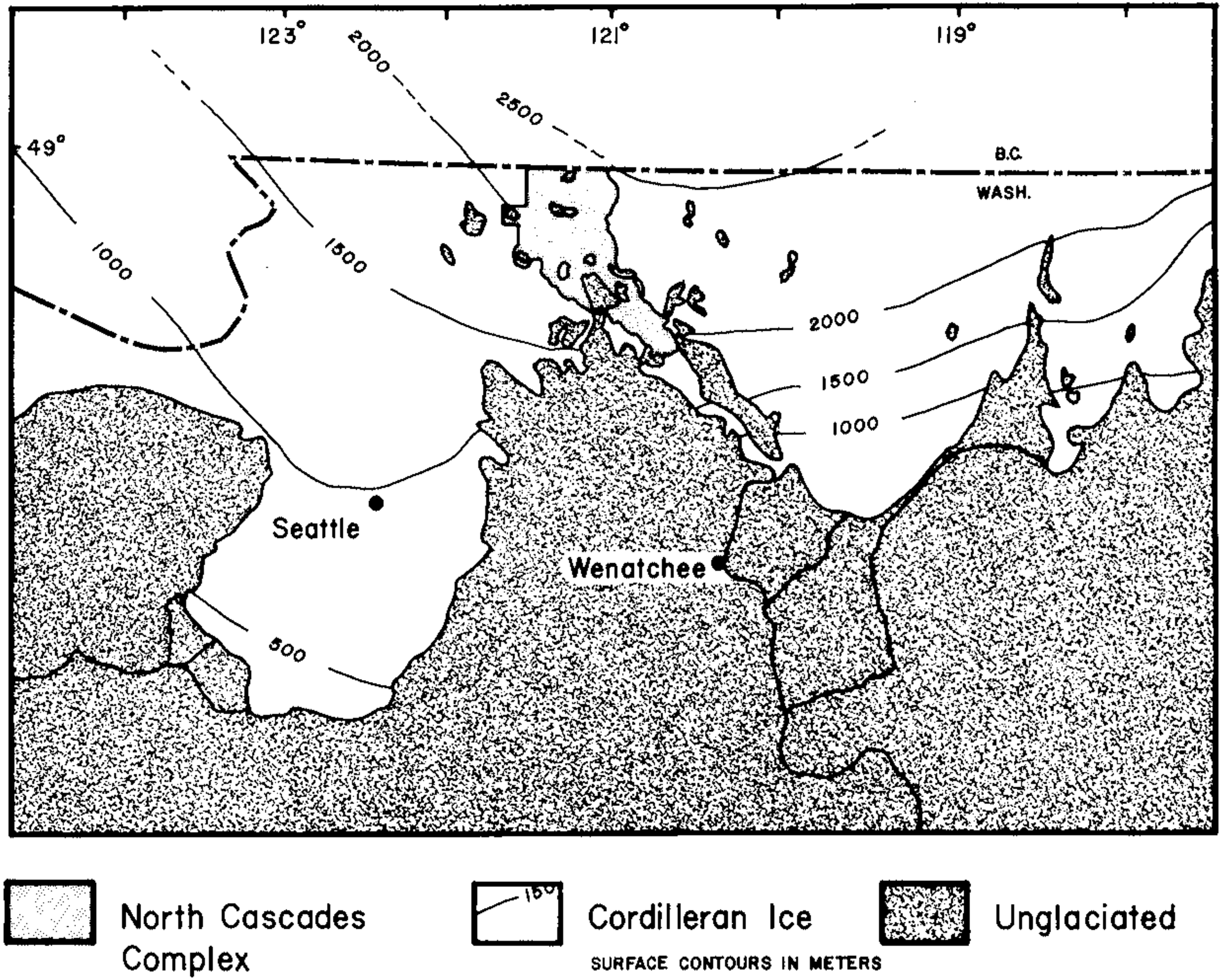

Figure 2-5. Map showing the estimated distribution of the Cordilleran Ice Sheet at its maximum extent about 15,000 years ago. Note that one small portion of the Park Complex was ice-free (modified from Waitt and Thorson 1983).

large enough in magnitude to drastically alter the food resources that prehistoric people depended upon. One fluctuation, for example, was a short readvance of alpine glaciers sometime between 12,000 and 11,000 years ago. In the southern part of the North Cascades Range, small glaciers during this time extended 500 m (1,640 feet) or more lower in elevation than modern glaciers (Porter et al. 1983:86). An early Holocene glacial advance may have occurred between 8,500 and 7,000 years ago (Burke and Birkeland 1983). During the middle Holocene, between about 8,500 and 5,000 years ago, climates around the world became milder and many alpine glaciers retreated or disappeared altogether. This interval, variously called the Altithermal (Antevs 1948; Hansen 1947) or the Hypsithermal (Deevey and Flint 1957), expressed itself differently in different parts of the world or even in different mountain ranges. This mid-Holocene mild climate is considered to have ended with onset of a period of renewed glacial activity called the Neoglacial. This is a time when glaciers alternately expanded and contracted, the main advances occurring around 4,600, 2,800, 1,100, and 450 years ago (Denton and Karlen 1973; Clague 1981). The North Cascades were one of the most heavily glaciated areas of the western United States in the most recent of these advances, called the Little Ice Age, between about 450 and 150 years ago. North Cascades glaciers at this time may have been larger than at any in the previous 4,000-5,000 years (Porter et al. 1983:8-9). A study of glacial moraines in the North Cascades estimated that during this time, glaciers were 1.5 to 2 times their present size (Miller 1969:60). In most areas of British Columbia, Little Ice Age glaciers were the largest of the postglacial period (Fulton 1971:24; Clague 1981:24). Some of these Little Ice Age glaciers flowed a few thousand meters downvalley from present positions (Denton and Porter 1970). Since the middle of the last century, alpine glaciers in the North Cascades and around the world have retreated up valleys. It is possible that these Little Ice Age glaciers overran and destroyed earlier landforms (Burke and Birkeland 1983:9) and any prehistoric campsites on them. Also, flood activity associated with the Little Ice Age may have destroyed or buried archaeological sites far downstream from the glaciers.

Effects of Landscape Change to Prehistoric Use of Mountains

During the Fraser Glaciation and the subsequent Holocene, the North Cascades and adjacent areas underwent dramatic environmental changes.

> "Most sites in the western mountains indicate that the upper treeline was lowered substantially during the time of glaciation and that alpine vegetation prevailed over large areas. Lower-elevation forest zones were accordingly depressed by the cooler climate and, in some cases, were forced southward," (H. E. Wright 1983:XV).

Studies of plant pollen from the Puget lowland and the Coast show that tundra-parkland vegetation grew on lands bordering the Cordilleran Ice Sheet, as it may have in a few ice-free portions of the North Cascades and adjacent areas. As the ice disappeared, a subalpine-like woodland of pine, spruce, fir, and hemlock covered the Puget lowland and migrated up mountain slopes (R. G. Baker 1983:111). East of the Cascade crest, a tundra of sagebrush, grass, other herbs, and possibly with scattered pines existed until about 10,000 years ago. Early people hunted the late-glacial animals roaming the Northwest landscape; these probably included mastadon, mammoth, bison, muskrat, caribou, marmot, camel, horse, ground sloth, moose, lynx, beaver, fox, deer, elk, and birds (Buechner 1953; Mathews 1979; Gustafson et al. 1979; Lyman and Livingstone 1983). As the climate became milder some large mammals became extinct while others evolved into different forms. In some areas, animal populations must have increasingly reflected forest habitats as trees invaded what had earlier been tundra or glaciated terrain.

By 10,000 years ago, remnants of the Cordilleran Ice Sheet were found only in British Columbia. Before this time, it seems that the ice sheet "retreat" had occurred as an in place melting and shrinking of ice masses confined to mountain valleys. These ice chunks and the gravelly debris that melted out of them blocked some rivers, causing new lakes to form and changing the courses of many rivers. At the peak of this glacial retreat, huge volumes of meltwater were released annually from the melting ice. Many meltwater rivers draining the North Cascades and other Northwestern mountains flowed many feet above their modern channels as the loads of mud, sand, and gravel they carried were deposited on floodplains or as lake deltas and terraces. The eroded remnants of these landforms, representing various stages of deglaciation, are preserved in and adjacent to portions of the Park Complex, such as along Lake Chelan and the Skagit River valley (Waters 1933; Barker 1968; Waitt 1977). As deglaciation became complete, some rivers established new courses and some of the lakes drained. Lake Chelan and other glacial lakes at the ice margin drained about 13,000 years ago. In British Columbia, however, the glacial version of Okanagan Lake drained 2,000 years later (Fulton 1969; Kershaw 1978). Accompanying the decrease in meltwater, river channels downcut through the higher terraces while building new floodplains at successively lower elevations (V. R. Baker 1983). These deglacial processes created a rapidly changing landscape. Deposition of river bars and islands was common, as was the erosion of these landforms. The freshly exposed terrain was unstable and the frequency of landslides, debris flows, and floods reflected adjustment to the changing environmental conditions (Ryder 1971; Mathews 1979). For the most part, archaeological evidence is lacking for the use of newly deglaciated landscapes in the North Cascades and adjacent areas of Washington and British Columbia for the time period between 14,000 and 11,000 years ago. Although humans may have inhabited the Northwest during this time period, populations were small and mobile and the land was not intensively used. Furthermore, changes in the unstable landscape probably tended to erode or deeply bury these early sites. Archaeological sites from this period are rare in the state of Washington.

About 10,000 years ago, a warming climate in the Puget lowland is reflected in increasing percentages of grass, sagebrush, and Douglas fir pollen found in lake cores. The warmest and driest of these times was about 8,000 years ago (Heusser 1985). As this warming trend continued, prairies expanded until about 7,000 years ago. After this time, the forests became more closed and with the presence of coastal hemlock and western red cedar, suggests a climate moister and cooler than before. West of the Cascade crest, the 10,000-7,000 year time period was the warmest part of the Holocene (R. G. Baker 1983; Heusser 1985). Things were different east of the Cascades. Here, grass and sagebrush expanded their ranges northward and presumably to higher elevations as the low treeline shifted up mountain slopes. In contrast to the west side, the drier and warmer part of the Holocene on the east side lasted from about 8,000-5,000 years ago, at which time fir, spruce, Douglas fir or larch, and hemlock became more abundant. The onset of this cooler climate was accompanied by forest replacement of some steppe and grassland habitats (R. G. Baker 1983). Although climate and vegetation in the Northwest (as reconstructed from pollen cores) shows no significant long-term changes in the late-Holocene, there were short-term fluctuations of varying magnitude that appear to have been important to the way people lived off the prehistoric landscape (Schalk 1983).

Archaeological sites of early Northwest inhabitants become somewhat more common after about 10,000 years ago. The people who left these remains developed skillful ways of using the abundant marine mammals and fish, large and small terrestial mammals, and the plants in each of the various regions. The times of appearance for various animal, fish, and plant species in the North Cascades in an abundance suitable for exploitation by people is unknown. Furthermore, it is uncertain how biotic communities fluctuated in density and composition during the changing Holocene climates of the North Cascades. However, if the broad pattern recognized in adjacent areas and other western mountain ranges applies, the North Cascades was populated with animals, fishes (including salmon), and plants that are closely related to or identical with modern species by at least 8,000 years ago.

Some Environmental Influences to Archaeological Site Locations

How might landscape changes over the last 11,000 or so years effect modern archaeological site distributions? To understand this, it is helpful to look at what happens to rivers in the change from an ice age to a non-ice age, such as occurred in the North Cascades between 15,000 and 10,000 years ago. River basins that drain ice sheets or valley glaciers, or unglaciated periglacial basins make adjustments during the transition between these climatic extremes. The changes are summarized here in four stages (Schumm 1965:790-791):

1. At the end of a nonglacial period, rivers are stable; there is erosion and deposition in flood plains, but no overall net change.

2. In the early and full glacial periods, the now much larger rivers deposit sediments released from the melting glacier front, filling the valleys with thick outwash deposits and raising the level of the river bed.

3. In the late glacial and early nonglacial phases, the decreased volume and sediment load causes rivers to downcut through the earlier outwash deposits, thus lowering their beds and eroding the valley bottoms.

4. River stability returns during the next nonglacial.

The late glacial downcutting stage is important because this is when many of the landforms are built that were used by prehistoric people for thousands of years after. As a river downcuts, it leaves a step-like series of flat surfaces with abrupt edges on either side of the valley. These surfaces are actually old flood plains, each one abandoned as the river drops to successively lower levels. These abandoned flood plain surfaces are called "climatic terraces" (Schumm 1965:790) and can be found in most valleys throughout the mountainous west. (Terraces are most easily seen in nonforested areas of the Northwest, and were for example considered remarkable features of the landscape along the Methow, Columbia, Okanogan and Wenatchee rivers before extensive Euroamerican settlement [Duncan 1854:213]). Although common also in mountainous valleys west of the Cascade divide, they are obscured by closed forests so that study of them requires detailed on-the-ground inspection combined with aerial photography and remote sensing. Many such terraces occur within the Stehekin, Skagit, and other valleys of the Park Complex. In Washington State, many archaeological sites occur on climatic terraces or other deposits that cover them (such as sand dunes or alluvial fans). Furthermore, relatively few climatic terrace surfaces have been studied by archaeologists and nearly all that have are the inner terraces consisting of the historically active flood plain and the first terrace level above it. With some important exceptions, most Northwest archaeological research generally has been confined to the study of inner river terraces.

The emphasis here on terraced valley landforms is because this is where most known archaeological sites are presently found, and as shown in Chapter 6 (Zones 1-3), this is where most of the Park's archaeological sites are expected to occur. Knowing how these terraces were used by prehistoric people and how the archaeological remains of their campsites are preserved on terraces would be helpful in finding many of the sites in the Park in a setting similar to the North Cascades. In northwestern Montana, the relationship between archaeological sites and climatic terraces was studied along a forested mountainous river valley. Here it was found that shortly after retreat of the Cordilleran Ice Sheet, the Kootenai River cut its channel into the thick outwash deposits that filled the valley until it reached its modern base level. Using volcanic ash layers and radiocarbon dates, it was estimated that the river channel had cut through 100 m (320 feet) of mud, sand, and gravel in less than about 3,000 years, so that beginning sometime before 8,200 years ago and up to the construction of Libby Dam, the topographic appearance of the valley showed little overall change (Mierendorf 1984a). Deeply buried archaeological sites were not found on these older terraces. Instead, archaeological sites representing different time periods were found scattered on the terrace surfaces. The results support the idea of rapid glacial-to-nonglacial river changes and should be helpful for understanding river and valley landscapes in other glaciated areas (Mierendorf 1984b).

What about river and landscape changes that occurred after the Fraser glaciation, in response to Holocene climatic changes, such as the Neoglacial mountain glacier advances? These and other climatic variations also caused fluctuations in river channel elevations and terrace formation; however, these events were so reduced in scale (both time and geographic extent) compared with the Fraser Glaciation that the effects were confined to the inner terraces immediately adjacent to the modern rivers. Knowing these relationships helps in understanding two characteristics of archaeological stratigraphy. First, it is easy to see why archaeologists encounter extremely complicated geologic and cultural layering when digging sites found in inner river terraces. During periods of readjustment, rivers use older landforms as a medium on which to sculpture new ones as they erode flood plains and terraces, abandon old channels and cut new ones, and create new flood plains on top of old terraces. (The record of historic floods noted earlier in this chapter for the Skagit and Stehekin drainages are only a few of the hundreds of such events that have sculptured the inner terraces of Northwest rivers during the Holocene.) As a result, archaeological test pit walls often show complicated layering that is nothing more than a window into the remains of earlier river channels, sand bars, eroded flood plain surfaces, and a variety of related geologic features. The complex stratigraphy of inner terraces became the focus of the search by Northwest archaeologists for deep, well-stratified sites. These have traditionally been considered more important than most other kinds of archaeological sites because the complicated stratigraphy often includes multiple layers of cultural remains sandwiched between the river deposits. By radiocarbon dating the associated organic remains (e.g., wood, charcoal, seeds, shell, animal bones), a time series of dated archaeological layers (called components) was established and the artifacts in them compared with those from dated components elsewhere. A large portion of what is presently known about Northwest prehistory is due to the success of this approach. However, the attention given to riverine sites by archaeologists means that very little is known today about the archaeology of highland parts of the landscape.

It is unlikely that many deep, well-stratified sites exist within the Park. Those that do will be important for understanding the area's prehistory. Some of these should be datable by the layers of the many volcanic ashes ejected during eruptions of Cascade Range volcanos (Porter 1981). Other stratified sites may have layers of archaeological remains that have been eroded by rivers and redeposited in a new location. These are common occurrences along inner flood plains.

So far this discussion has been confined to climatic terraces; what about all the other parts of the landscape that were used by prehistoric people? A method for studying land use is covered in Chapter 6, where a variety of landforms, of which terraces are only one kind, are discussed. Rivers and their flood plains are important to understanding human adaptations because their response to rapidly changing climates is one of our strongest links of the present with the past. River adjustments, in turn, can activate or otherwise influence subsequent landscape changes. The second point is important because those places where water flows or stands marks the low point in any locality. In high relief mountains like the North Cascades where downslope movement of rocks, snow, glacial ice, soil and other things can dominate other processes, the river and its flood plain at any one time mark the local base level. The building of alluvial fans and changes in hillslopes (e.g., avalanches, debris flows) and tributary streams are related to and sometimes influenced by changes in river base levels. This is because as base level changes, vertical gradient changes. With increased gradients, streams adjust by changing the sizes and volumes of transported sediments, which in turn are reflected in changes in the growth of alluvial fans at their mouths and growth of downstream flood plains. It may be possible to date alluvial fans by knowing the age of the terrace remnant on which the fan was built, or vice versa. In the Northwest, archaeologists and geologists are able to date changes in landforms and the archaeological sites they contain by combining radiocarbon dating with volcanic ash identification.

The preceding discussion of climatic terraces is a simplification of some complex geomorphic and climatic relationships. Terrace formation along rivers is also influenced by factors other than climatic change, such as tectonic movements and sea level changes (Ruhe 1975) or episodic erosion and loss of vegetation cover (Schumm 1977) which occurred in the Northwest prehistorically by natural and human caused fires, and historically by overgrazing (Daubenmire 1970; Galbraith and Anderson 1971). By combining paleoenvironmental and archaeological studies, the influence of these factors on archaeological site distributions can be determined.

Dating Landforms

Many different methods exist to date archaeological assemblages, such as seriation, obsidian hydration, radiocarbon dating, and others. One of these, identification of dated volcanic ashes, is likely to be useful for studying North Cascades prehistory. The times of eruption of many ash layers have been dated and their geographic distribution has been mapped. Because most Cascade Range volcanoes have an eruptive history that spans the last 12,000 years, numerous ash layers are found inside of and on top of landforms such as river terraces, moraines, lake bottoms, and marshes and bogs. Combined with the dating techniques noted above, time stratigraphic ash markers can date the building of moraines, alluvial fans and other landforms (Porter 1981), and buried archaeological components. Some of the more common and well-dated volcanic ashes of the Cascade Range that are known to have fallen inside or near to the Park boundaries are shown in Table 2-3.

Table 2-3. Some Volcanic Ashes in the North Cascades and Their Estimated Times of Eruption.

Ash Layer	Date of Eruption (before present)
Glacier Pk. G and B	12,000-11,000
Mt. Mazama O (Crater Lake)	6,800
Mt. St. Helens Yn	3,400
Mt. St. Helens Wn	450
Mt. St. Helens T	150

Summary and Conclusions

The Park Complex includes a part of the steepest, most glacially active mountains in the lower 48 United States. The western slopes of the Cascade Range are wet and mild, while those on the east are drier and colder. Plant, animal, fish, and other naturally occurring resources used by historic and prehistoric Indian people were abundant, but their distributions throughout the Park were uneven. Resources seem to be distributed according to a combination of factors, including the geography of major mountain river valleys and ridge lines, the east-to-west climatic differences, and more localized environmental effects related to elevation, drainage, and topography. Because prehistoric foragers used different strategies in exploiting different resource areas, it is likely that the kinds of archaeological remains, their locations on the landscape, and their density (number/km^2) will vary between resource areas. Three broad, geographically defined resource areas seem to occur within the Park. These are the Skagit River drainage above the Skagit gorge to the international boundary, the Skagit drainage below the gorge, and the Stehekin-Chelan drainage.

Most archaeological sites within the Park Complex are expected to occur on river flood plains and higher valley terraces. The origin of these terraces, their different ages, and their relationships to erosion-deposition cycles of the glacier fed rivers, are all seen as factors useful to understanding how they were used by prehistoric people and the distribution of archaeological sites on them.

CHAPTER 3

EARLIER STUDIES OF THE PARK COMPLEX

Introduction

This section reviews all previous archaeological work within the Park Complex and adjacent areas. These studies are listed by author and date of publication. Each review includes a description of the type of study, the sponsoring agency, the parties that did the work, and a summary of the results if such information was provided. A general summary at the end of the chapter makes conclusions about archaeological sites in the Park based on information compiled in the review. The conclusions help establish baseline data as it is known today and, as management tools, help in the planning of future studies.

Studies in the Park Complex

Thompson 1970

A literature search and review was made of the Park Complex in order to gather historic background data. This was done by a staff member of the Eastern Service Center of the National Park Service, US Department of the Interior. The study noted that Park areas had been extensively used by various Indian people, coastal and inland. It recommended that surveys for archaeological sites in the Park be conducted. An appendix contains completed nomination forms to the National Register of Historic Places for selected historic resources in the Park. One of these, for the Cascade Pass and Trail, lists prehistoric significance as contributing to the importance of the site (Thompson 1970:293).

H. S. Rice n.d.a

An archaeological survey of a proposed road and recreational development in the vicinity of Roland Point to be located along lower Ross Lake was done during 1971 and 1972. This work apparently was done by Washington Archaeological Research Center for the National Park Service.

Archaeological sites were not found during the survey, but they may be present. The results are difficult to interpret because the size of the surveyed area, the level of coverage, and the specific survey techniques are not described. Also, the forested environment and the associated duff led the archaeologist to believe that it would be "impossible" to locate sites not having surface features. Finally, the archaeologist noted that sites were probably located "on the banks of the Skagit River" which were submerged by Ross Lake, and thus implied that Native Americans had not made use of areas inland from the river, which would include the present reservoir edge.

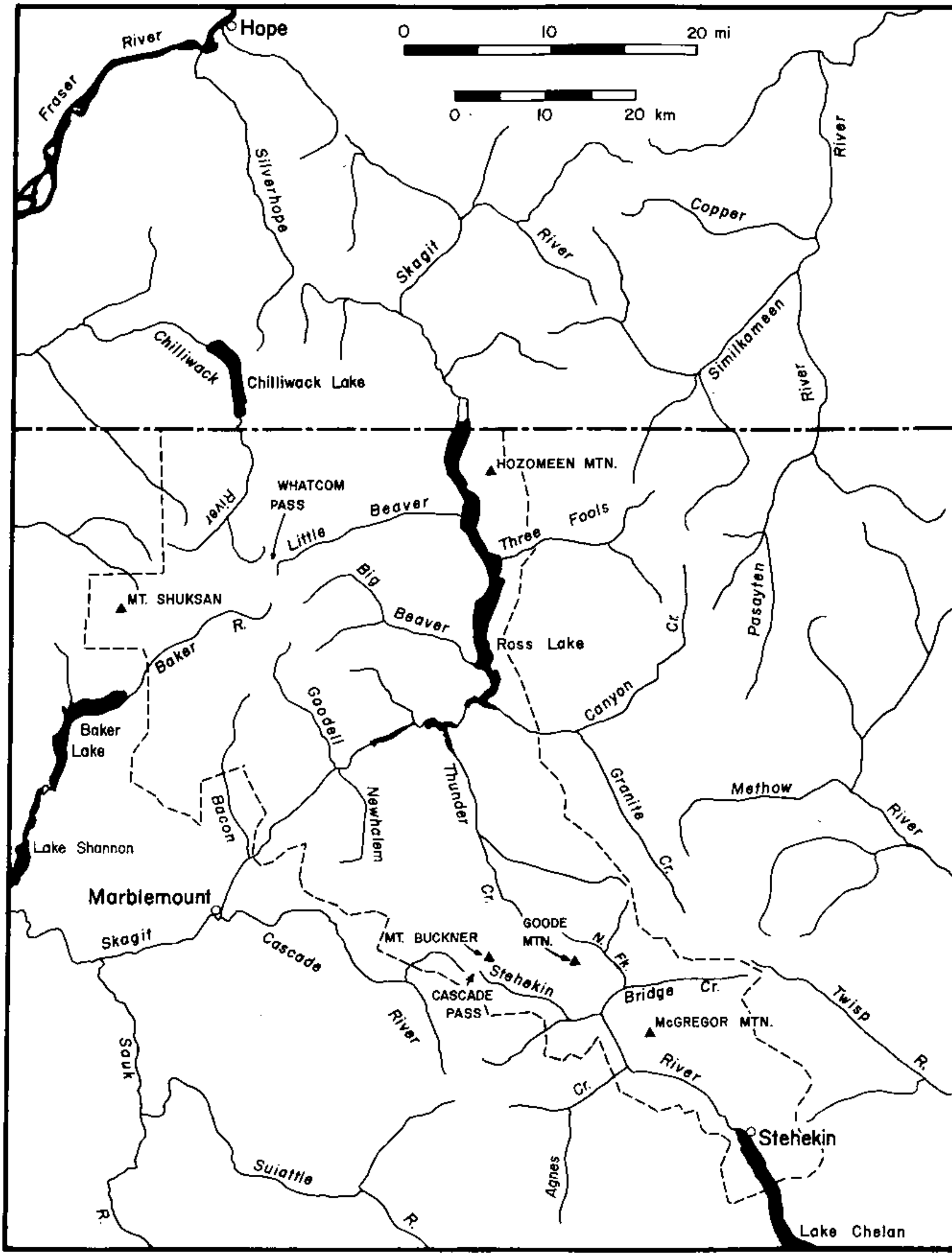

Figure 3-1. Map of Park Complex and adjacent areas. Park Complex boundaries are shown by the dashed line.

H. S. Rice n.d.b.

The shoreline of Ross Lake, between the present reservoir level (about 1,600 feet above sea level) and the 1,725 feet level was surveyed for archaeological sites from Ross Dam to the US-Canada border. Presumably, this work was done by the Washington Archaeological Research Center (but the sponsoring agency is not identified) in response to plans to raise the level of Ross Lake.

Again, details of the survey methodology and coverage were unstated. The survey was done over a 12 day period by the author. The entire lake shoreline was examined by boat, but only "the most likely areas for aboriginal use were surveyed on foot." Reasons were given as to why Native American use of land along the present lake shoreline had not occurred. These are:

1. Habitation sites should be found only along the now submerged river banks.

2. Steep slopes and cliffs are unlikely places for sites.

3. Native American use of this segment of the Skagit River would be unlikely due to the absence of anadromous fish.

4. The Skagit River tributaries were unlikely to be inhabited, with the exception of Big Beaver Creek where an abundance of beaver occurred.

The conclusion was that "there are not many places where archaeological sites might logically be expected." A recommendation followed that should the lake level be raised, clearing crews should watch for archaeological sites and another archaeological survey should be made of the Big Beaver valley after vegetation has been cleared.

Grabert 1975

In May of 1975, a reconnaissance survey to find cultural resources was conducted for the National Park Service in the Newhalem vicinity. The survey was conducted as part of the planning for development of campground facilities.

Description of the survey techniques is lacking, although it is stated that it was done on foot and some shallow shovel pits were dug. Details of survey transect spacing and locations, the number, location, and content of shovel pits, and the boundaries of the surveyed areas are not provided. Three different concentrations of cultural remains were found.

1. East of Goodell Creek on the north side of the Skagit River burned rocks, a flaked stone tool made from a river cobble, and pieces of flaked stone debris were seen. The area had been disturbed by highway construction. A portion of this area was designated archaeological site 45WH63.

2. A small number of "possible" burned rocks was seen south of the Skagit River across from the mouth of Goodell Creek.

3. West of Goodell Creek and north of the Skagit River concentrations of thermally altered rocks, a ground stone serpentine adz, two other tools, and flaked stone debris were seen. The area containing these remains was the largest prehistoric campsite found and was designated site 45WH64.

This study provided a useful beginning for understanding and managing Park cultural resources. From the results, it was clear that remains of Indian camping and cooking activities could be found along the densely forested river margins and that remains of a village might also be present in the area. Estimating the ages of the sites was a problem. Grabert thought the sites were late prehistoric to historic in age and he related them to an historic upper Skagit Indian village reported by Collins (1974). He also noted a preference on the part of Indians for landforms exposed to sunlight and having easy access to the river when they chose settlement locations. Finally, he could find no evidence for occupation of higher (than the active) Skagit River terraces which he believed to be post-Pleistocene in age.

Although described as "limited," Grabert thought these sites had a potential to add information about Indians on both sides of the mountains, and he noted that these were the only known sites in that part of northwestern Washington. He recommended that a trained archaeologist reexamine all three areas (presumably through on-the-ground examination) during clearing and other construction activities.

H. S. Rice n.d.c.

An archaeological survey was made of the Stehekin Valley Road within the Lake Chelan National Recreation Area from the vicinity of the Stehekin boat landing to an unspecified distance beyond the High Bridge Ranger Station This work was done by Washington Archaeological Research Center for the National Park Service. The purpose was to determine if planned road improvements threatened archaeological sites. Because the kinds of road improvements are unspecified, it is uncertain as to what types of activities (e.g., road grading and widening, ditching, or placement of culverts and other drainage facilities) would be likely to disturb archaeological sites.

Details of the survey methodology and coverage are not given. The author found that no sites would be threatened by the planned improvements; however, local residents noted the presence of a variety of artifacts and potential archaeological site types within the vicinity of the road alignment. Seven of these are specifically mentioned in the report and are summarized below:

1. Artifacts have been and continue to be exposed near the mouth of Purple Creek during intermittent periods when the level of Lake Chelan is lowered. This area is recorded as site 45CH65.

2. A rock-walled feature of uncertain origin and age, and reportedly associated with several pestles was found and removed from the present road alignment during construction sometime around 1929.

3. Several large cedar stumps and logs, possibly associated with arrowheads in the vicinity, may be the remains of Indian activity near the mouth of Rainbow Creek. The area is reported to be disturbed by Stehekin River erosion.

4. Arrowheads were reportedly found during construction of footings for the community hall.

5. A human skeleton was reportedly removed during construction of the present road a half mile east of its intersection with Company Creek Road.

6. Artifacts have been found on both sides of the road the Courtney ranch. Photographs of these artifacts accompany the report and include two symmetrically shaped stone pestles, a carved "soapstone" object, and a slate club (these are shown in Figure A-10, this report).

7. A quantity of small flaked stone pieces were observed by Rice between the road and the High Bridge Ranger Station (site 45CH69) where four projectile points were also found.

In addition to these seven, two more sites are noted near the head of Lake Chelan. These are the well-known Lake Chelan Pictograph Site (45CH66) and a reported, but unexamined, site at the mouth of Hazard Creek (45CH67). Neither of these two is located near the proposed road improvements.

Archaeological testing was recommended for the vicinity of the Courtney ranch should road construction go outside the existing alignment. Finally, it was suggested that the site at the High Bridge Ranger Station (45CH69) could be developed into an interpretive public display; however, it is unstated as to what information is embodied within the site or what interpretive values the site has.

This report is frustratingly incomplete, but at the same time useful. Generally, a substantial archaeological data base is implied for the lower Stehekin River area, yet absent is any discussion of the survey methods, of Indian uses of the area, of the kinds of prehistoric activities represented by the remains, or of general conclusions.

Grabert and Pint 1978

This study was to inventory archaeological sites in the Park and to get information needed to assess their significance. This work was done for the US Park Service by Western Washington University. The survey was done by choosing a biased sample of land areas, with priority assigned according to the likelihood of disturbance by future development. Such areas were surveyed, some artifact collections made and some test pits dug. A small but unspecified percentage of the total Park acreage was thus examined.

Survey activities were in two main areas, one west and one east of the Cascade crest. On the west, 16 localities within the upper Skagit River drainage were surveyed between the US-Canada border and the town of Newhalem, Washington. All of these localities are within the Ross Lake National Recreation Area and some partially overlap with previous surveys of Rice. In addition, localities (number and location unspecified) were surveyed in the northern unit of the National Park near Mt. Shuksan. To the east, nine localities between the head of Lake Chelan and Cascade Pass in the Stehekin River drainage were surveyed. The latter, at 5,400 feet, was the highest elevation area surveyed. These localities are within the Lake Chelan National Recreation Area and the southern National Park unit and partially overlap with Rice's surveys (Rice n.d.c.).

Eight archaeological sites were recorded or rerecorded in the surveyed localities. These sites, including their Smithsonian number, name, estimated age, observed artifacts, inferred use or purpose, and evaluation are listed in Table 3-1. Artifacts were collected from the surface of all eight sites and subsurface test excavations were made at three: 45WH79, 45WH80, and 45CH69.

The authors note that an absence of sites within survey tracts does not mean none are present and it is possible that unseen sites occur in some of these localities (Grabert and Pint 1978:6). The problem arises from the dense, obscuring vegetation so characteristic of the North Cascades. It's not surprising that the majority of archaeological sites found by the authors occurred where some type of ground disturbance had removed the vegetation (Grabert and Pint 1978:5).

Dating the sites is difficult. Age estimates are based on the few artifacts considered to be good time markers; however, few of these have been found. Nevertheless, Grabert and Pint thought the eight archaeological sites together spanned time periods ranging from the early prehistoric (perhaps as early as 8,000 years ago) through the late prehistoric (shortly before A.D. 1800).

Generally, most sites described by Grabert and Pint appear to be hunting camps, although possible habitation sites were also found in the lower elevation valleys. One problem is that most previous archaeological and ethnographic studies in the Northwest are not oriented toward understanding prehistoric use of rugged montainous areas and how the remains of such use will appear archaeologically. This is because most earlier studies in the state have been in low elevation, river settings (Grabert and Pint 1978:67). As a result, overall knowledge of the kinds of sites, their distribution on the landscape, and their frequencies reflects use of rivers in broad, low valleys removed from the mountains, which are likely to have been used differently and to have different site types and densities than rivers interior to the mountains. Also, ethnographic accounts generally minimize the importance of mountain "hinterlands" as places utilized and permanently inhabited by prehistoric people (Grabert and Pint 1978:67). Nevertheless, Grabert and Pint believe at least some of the prehistoric settlements within the Park may have been occupied the year around.

The authors conclude that archaeological sites within the Park may contribute important information about two broad topics of prehistory:

Table 3-1. Summary of Archaeological Site Information from Grabert and Pint (1978).

Number	Name	Age Estimate	Artifact Assemblage	Type	Assessment and Recommendations
45WH79	Hozomeen Campground	ca. 8,000 B.P. and more recent	High density of flakes	Hunting station	Significant*; site should remain unaltered, but if Ross Lake is raised, data should be recovered
45WH80	Big Beaver Campground	Less than 1,000 B.P.	One arrow point and possible housepits	Habitation	Significance is questionable; should remain unaltered, but if Ross Lake is raised, further assessment is recommended.
45WH81	Newhalem Site	Unspecified prehistoric to early historic	Flakes struck from river cobbles	Occupation?	Significant, recommends extensive excavation
45CH65	Purple Point Site	Unspecified, possible historic	Large quantity of stone artifacts, both flakes and unflaked; several stone circles	Residential or Habitation	Significant; evaluate through testing.
45CH69	High Bridge Ranger Station Site	ca. 2,000 C.P. and older	High density of flaked stone tools, including cores, bifaces, a drill, and a microblade fragment, and flake tools.	Camp or semiperman-ent habitation, possibly related to hunting.	Significant; avoid any alteration through building or road construction; test prior to any construction.
45CH219	High Bridge Campground Site	Unspecified	Chipped stone flakes and flake tools	Unspecified	Significant; avoid any alteration through construction; test prior

Table 3-1. (Continued)

Number	Name	Age Estimate	Artifact Assemblage	Type	Assessment and Recommendations
45CH220	Bridge Creek Site	ca. 3,000 B.P. possibly older	Flaked stone, including a point, cores a flake tool, and unmodified flakes.	Unspecified	Significant; avoid any alteration or development; test prior to any alteration.
45CH221	Cascade Pass Site	Unspecified	A flake scraper and an unmodified flake.	Hunting or travel camp	Significant; avoid alteration, including testing; protect from erosion through Park Service revegetation program.

*Use of the term "significance" in this table is not necessarily according to the criteria used to nominate sites to the National Register of Historic Places.

trans-Cascades interaction between Indians on both sides of the range; and the nature and intensity of use of montane upland environments made by prehistoric Northwest populations spanning a wide time range. The information relevant to these topics is found not just in each separate site assemblage, but also in the combined picture of all sites occurrances on the land as related to environmental and cultural factors (Grabert and Pint 1978:76).

Finally, it was recommended that the sites be protected from disturbance and destruction. The kinds of disturbances mentioned include motor and foot traffic, construction of Park facilities, channeling of runoff water through sites, and unauthorized collecting of artifacts. Site 45WH65 should be tested, and 45CH221 at Cascade Pass should be protected from erosion through continuation of the Park Service's revegetation program.

Grabert and Chesmore 1979

This report describes the results of archaeological excavations at site 45WH81, located on the south side of the Skagit River across from the mouth of Goodell Creek and originally found on the basis of a few burned rocks (Grabert 1975). The site, which is in the Ross Lake National Recreation Area, was excavated by a crew of archaeologists from Western Washington University through a contract with the US National Park Service. Although the purpose of the work is not clear (was it testing or full-scale excavation?), it is apparent that the excavation and analysis acquired new information before construction of Newhalem Creek Campground. The significance of the site is not evaluated according to National Register criteria, there is no record of it being nominated to the National Register of Historic Places, and there is no determination of the affects of campground construction and maintenance to the site. Had 45WH81 been determined eligible to the National Register, then the excavation and analysis would have been for the recovery of information that made the site significant. The excavations described in Grabert and Chesmore (1979) served to remove adverse impacts to the site caused by campground construction, through data recovery (excavation and analysis that results in gathering of the significant information from the site).

Overall results of the excavations were the recovery of artifacts representative of two kinds of occupation by former inhabitants of the landform. One was the remains of a historic structure with associated metal, glass, and bone artifacts. This structure probably was occupied sometime between 1880 and 1920. An earlier prehistoric Indian occupation was indicated by an assemblage of flaked stone fragments.

This work constitutes the most excavation so far done to investigate an archaeological site within the National Park Complex. The results provided the first information available to archaeologists about the characteristics of buried archaeological sites that previously had been observed and described only on the basis of low visibility, surface remains. The results showed that for at least some site types, the kinds of artifacts seen on the surface may represent the kinds of artifacts buried in the site. This information is useful because a number of other similar archaeological sites occur in the vicinity.

Most of the fieldwork at the site occurred in July and August of 1978. Field Methods included intensive surface survey, planview mapping of artifacts and features on the surface, and excavation of numerous test pits (21 appear to be 1 x 2 m test pits, an additional 34 are unspecified as to size). The range of artifacts found at the site was relatively small and consisted mostly of flaked stone debitage, a few flake tools, and a few isolated finds (a ground stone celt, a ground flake tool, an incised pebble, and a carved soapstone effigy). Only historic age animal bone was preserved at the site; presumably any older bone fragments had weathered away in the acidic soils. Compared generally with archaeological sites from better studied areas outside the Park, a low density of archaeological remains were found.

One part of this study was the analysis of soil samples in order to find chemical evidence of human activity. The authors found the results to be influenced by many other factors and believed that no clear conclusion could be made. All sediment samples were weakly to moderately acidic. This means that any remains composed of carbonates, such as shell and bone, will rapidly disintegrate.

All cultural remains (prehistoric and historic) were dug from the upper 20-25 cm of all test pits and could not be separated into different components or geologic layers. All artifacts were found in the uppermost, mineral soil horizon capping the second river terrace (cf. Grabert and Chesmore 1979:6-43). Cultural remains were not found on the third or on higher river terraces. In areas lower than the second terrace, the cultural remains appeared to have been eroded by the river. In fact, only a small portion of the original culture bearing deposits on the second terrace seemed to be uneroded. This fit with the stratigraphy showing in the walls of some of the deeper test pits, which indicated three flood episodes, each one adding sediment to the vertical growth of that portion of the river terrace. The flood deposits were believed to reflect ongoing natural activity of the Skagit River and Newhalem Creek.

Table 3-2 is a summary of information presented in Chesmore and Grabert (1979:p. 58 Table 2) for the sample of flaked stone artifacts found both on the surface collection and in the excavated test pits.

Most of this flaked stone assemblage is made from a dense dark-colored, moderately fine-grained metamorphosed sedimentary rock type. (The authors use the term "graywacke" to describe this raw material; however, due to lack of agreement concerning this term (see Travis 1955:22-24) and the absence of any petrographic definition and analysis of the samples, the term is not used in this report.) This flaked stone assemblage consists mostly of the manufacturing debris left over from the intentional production of flakes or other simple tools made from locally available river gravels. Presumably, making flakes from river gravels was a simple, efficient means of creating a large number of sharp cutting edges useful in the preparation of food resources. The authors note that such "pebble spall tools" were probably used for cleaning fish. This kind of artifact assemblage, which lacks variety and carefully manufactured or decorated tools and is without features such as hearths, storage pits, or dwelling remains is characteristic of areas where people collected local resources for immediate use or for processing (butchering, cleaning, cooking) before transport to nearby camps or villages.

Table 3-2. Number and Percentage of Generalized Flaked Stone Artifact Categories from 45WH81 (Grabert and Chesmore 1979:58).

Artifact Category	Number	Percentage
1. Flakes with modified edges and flake tools	23	22
2. Unmodified flakes	52	51
3. Cores and core fragments	20	20
4. Hammerstones	3	3
5. Ground stone celt	1	1
6. Pebble chopper	1	1
7. Carved steatite effigy	1	1
8. Other	1	1
TOTAL	102	100 %

Thus, Grabert and Chesmore (1979) suggested that the artifacts represented the remains of small task groups that exploited resources along the river's edge. These groups probably lived at a village located in the Newhalem vicinity where most of their domestic activities took place. The authors were unable to date the site but estimated it to be no more than 400 or 500 years old. They also suggested that the prehistoric inhabitants were ancestors of the historic Upper Skagit Indians.

The authors concluded that although additional undiscovered artifacts are likely to be present, the site has been adequately sampled and described. They recommended that proposed campground development would not significantly damage remaining portions of the site.

Skolnik n.d.

This report was prepared in response to a proposal by Seattle City Light to construct a hydroelectric dam on the Skagit River in the vicinity of Copper Creek, which is within the extreme southwestern portion of the Ross Lake National Recreation Area. The study is a preliminary cultural assessment by the Conservation Company in conjunction with the Office of Public Archaeology at the University of Washington through a subcontract with CH2M-Hill.

The study used archival and bibliographic sources, informant interviews, and field survey to gather information about archaeological and historic sites. Eight historic and seven archaeological sites were found. Of the latter, four were found within the boundaries of the Ross Lake National Recreation Area. These are sites 45SK102, 45SK106, 45SK107, and 45SK108. All were located along the bank of the Skagit River within the modern flood plain. Visibility of artifacts was obscured by dense brush growing under the closed forest. Most of the artifacts were flakes (reportedly made of basalt) and fire-cracked rocks. Also noted were some cryptocrystalline flakes, a few stone tool fragments, and a core (Larson 1978). Along the eroding river banks, it looked like some of these sites had remains buried a half meter below the ground surface. In addition, three previously recorded archaeological sites were noted within the proposed hydroelectric project boundaries and within the Ross Lake National Recreation Area.

The possible effects of project plans to the sites include inundation, destruction through bank erosion and recreational access, and decay of water-saturated archaeological plant and animal remains. Because the study did not involve test excavations, site specific evaluations and recommendations were not made. The author recommended such tests be conducted early in the planning process if a license to construct the dam is granted.

Blukis-Onat 1982

A small archaeological survey was done by the Institute of Cooperative Research, Seattle, for the Pacific Northwest Region of the Park Service. Size of the surveyed area is unspecified; it is near Thornton Creek within the Ross Lake National Recreation Area. No cultural resources were found.

Other Studies in Areas Adjacent to the North Cascades

Smith and Stratton 1976

An archaeological survey of Wapeto Point, along the north shore of lower Lake Chelan, was done in 1976. This work was done for the Bureau of Indian Affairs by National Heritage, Inc. Evidence for prehistoric use of this peninsula existed in the form of nearly a dozen scattered pieces of chipped and ground stone tool fragments and flakes. The authors recommended that an archaeologist be available should archaeological remains be found during construction and that the lakeshore be surveyed during lowered lake levels.

Hartmann 1979a and 1979b

A site survey was done at Lucerne Bar by Central Washington University for the Wenatchee National Forest. Lucerne Bar is located at the mouth of Railroad Creek, which enters the west shore of Lake Chelan about 8 km (5 miles) outside of the southern boundary of the Lake Chelan National Recreation Area. In the survey, two chipped stone flakes were found at an archaeological site on Lucerne Bar.

The site was later tested by excavation of three 1 x 2 m test pits and found to contain burned rocks, a granite pestle, a biface fragment, and flaked stone debitage consisting of a wide range of stone raw materials, including obsidian, cryptocrystalline quartz, quartzite, basalt, andesite, and granite. All artifacts were within the upper 30 cm of the surface. The site was assessed as eligible for inclusion in the National Register of Historic Places and recommended for protection and preservation.

Blukis Onat 1980

This overview study was done to provide management information for cultural resources located on lands nominated for classification to the Wild and Scenic Rivers Act of 1968. The Institute of Cooperative Research, Seattle, did this work through a contract with the Mt. Baker-Snoqualmie National Forest. The study area covers 34,650 acres along portions of the Skagit, Sauk, Suiattle, and Cascade rivers. The eastern boundary of this area joins the Ross Lake National Recreation Area at the mouth of Bacon Creek.

Data was collected from published literature and documents, informant interviews, and a field survey to locate prehistoric, ethnohistoric, and historic sites. The survey covered approximately 15 percent of the study area. Of the 72 sites identified, only the ten prehistoric sites will be discussed here. All but one of these sites is located along the Skagit and Cascade rivers.

Not much is known about these sites because they were obscured by vegetation or the effects of historic activities such as farming and residential development. Most artifacts were flakes and pebble tools (made from a material identified as basalt) and burned rocks. Artifacts reported to have come from some of these sites, but not seen by the survey crew, include a celt, a pestle, and burials (presumably human). Artifacts seen at the sites include a maul, a stone having a painted design, biface fragments, a core, and at one site a probable fire hearth, cryptocrystalline quartz flakes, and bone and shellfish remains. Locations likely to have archaeological sites, based upon the results of this survey, include river terraces above the 100 year flood zone of the Skagit River. Old river terraces having archaeological sites were at the mouths of tributaries adjacent to the present Skagit River channel and adjacent to old river channels now filled by oxbow lakes (Blukis-Onat 1980:160-162).

All but two of the ten sites are evaluated to be potentially eligible for inclusion in the National Register of Historic Places due to their possible significance in local Skagit prehistory, Cascade region prehistory, and in the development of ethnohistoric Northwest cultures. Because these evaluations are tentative the author recommended that all but one of the sites be test excavated to find the size and significance of each.

Grabert 1983

This is the report of excavations by Western Washington University at the Ferndale site (45WH34) which is on the flood plain of the Nooksack River approximately 80 km (50 miles) west of the Northern Unit of the Park. This small site has been used repeatedly for almost 5,000 years, initially as a seasonal camp related to fishing, hunting, and plant collection. Archaeological remains included numerous chipped stone and bone tools and artifacts. A single deep housepit was radiocarbon dated (on charcoal) to about 1,100 B.P. and suggests semipermanent habitation. Food remains included abundant salmon bones, mussel shells, and charred plant parts (possibly native blackberry). Features such as hearths, trash pits, and the housepit also occurred, but their creation and use by the inhabitants resulted in mixing of artifacts and stratigraphic layers.

The artifacts from the site indicated that ". . . typically coastal characteristics of occupation here appear in an inland context" (Grabert 1983:59). The results of the excavation raises questions concerning cultural relationships between lowland areas to the west and inland areas to the east and northeast.

Schalk and Mierendorf 1983

As part of a study of cultural resources of Rocky Reach and Rock Island Reservoirs, eight archaeological sites were tested along the Columbia River. This work was done by Washington State University for the Public Utility District No. 1 of Chelan County. The tested sites are located about 80 km (50 miles) southeast of Stehekin. Here the Columbia River flows through a narrow rocky canyon cut through the eastern slopes of the North Cascade Range.

One of the sites was radiocarbon dated (on shell) to about 8,200 B.P. thus suggesting human occupation since the end of the early Holocene. Most of the sites dated between about 1,400 and 1,000 radiocarbon years ago and were the remains of hunting camps where bighorn sheep, elk, and deer were butchered and cooked. At one of the sites was found a single, flared-bottom cache pit that had been filled with rocks, sand, broken tools, and butchered sheep and other animal bones. The terrace in which this cache pit was made is located opposite the mouth of the Chelan River about three miles east of the lower end of Lake Chelan. The distinctive cache pit was of a kind that was used much later during the historic fur trade to store items transported throughout the mountainous west (Irving 1976:201-202).

The study demonstrated the existence of many more archaeological sites than had been previously suspected by Daugherty's (1956) earlier work. It also questioned the dietary importance of fish as compared to sheep, deer, and other animals used by the prehistoric people living along this segment of the Columbia River valley. The sites were considered important because they contain information about the relationship between the type of food resources and settlement patterns for the late prehistoric period, which along other reaches of the main rivers was a time of intensive exploitation of salmon.

Summary of Results of Park Studies

Based on these studies, some conclusions are made about the management of Park archaeological resources. These conclusions offer a basis for planning surveys, tests and excavations, and other types of site treatment. They also are a means by which to begin to understand what kinds of important information Park sites may contribute to regional research designs (McGimsey and Davis 1977). Some of these conclusions will be discussed in later sections of this report, but for now are summarized below.

1. The dense vegetation obscures the ground surface, making artifacts and other site remnants difficult to find during archaeological surveys. For this reason, cultural resources are likely to exist in some previously surveyed areas and special or time-consuming survey techniques may be needed to find new ones.

2. Archaeological sites are common on terraces along wide valleys draining the mountainous interior and at the mouths of tributary streams. With few exceptions, these are the only landforms that have been examined for sites. A single high elevation site, located near timberline on the crest of the Cascades, had been recorded and nominated to the National Register of Historic Places, partially on the basis of its prehistoric significance (Thompson 1970:293). It is unknown how many such sites are in the Park.

3. The artifact assemblages found in archaeological sites are the kinds described for people living with subsistence economies dependent on use of fish, land mammals, and plants. The few sites tested so far show little diversity in artifact types and indicate hunting and activities related to the preparation and consumption of food. Some lower elevation valleys in the Park may have been occupied year round, so that the remains of residential sites having greater diversity of artifacts may be expected. These lower valley settings are along the Skagit and Stehekin Rivers.

4. Artifacts found at archaeological sites in the Park may span time from the end of the early prehistoric, roughly 8,000 years ago, and show continuous occupation into late prehistoric and possibly historic times.

5. The areal coverage of previous archaeological studies, taken together, is so small that basic questions about prehistoric life in the North Cascades cannot be answered with the limited available information. More than any other single factor, this is because less than one percent of the total Park area has been surveyed for archaeological sites (this figure is computed in Chapter 5). It is also related to the fact that no probabilistic surveys have been done. This means that no attempt has been made to find archaeological remains representative of all environmental zones of the Park Complex. Previous surveys have not recorded the exact areas covered and have not computed the number of sites found per unit of land area (site density). Site densities provide a way of roughly estimating the number of sites that might be found in an unsurveyed area of known size. Finally, except for the small area around Cascade Pass, there have been no archaeological surveys of alpine or subalpine environments or any other areas above 850 m (2,800 feet) elevation. The restricted area of survey coverage constitutes a serious deficiency in the present site inventory.

6. Finally, it can be seen that archaeological sites and other remains in the Park Complex have been treated differently by different professional archaeologists. This is because each brings his or her own set of biases, expectations, and appreciations of the capabilities of the prehistoric foragers who lived in the North Cascades. These different views of the relationships between culture and the landscape are why each professional archaeologist records some kinds of information but misses other kinds. It is beneficial to cultural resources that different archaeologists work with Park staff. The problem is that archaeologists do not generally state their biases and expectations clearly. The absence of these statements is important to archaeological studies in the Park because it is such biases that have determined which areas were looked at in surveys to find new sites, what and how many kinds of remains were found before a site form was filled out and submitted to the Park headquarters and appropriate state agencies, what kinds of sites were recommended for testing and excavation, and what kinds of information from testing was thought important enough to record and interpret. The view taken here is to consider cautiously any statements or ideas that the North Cascades environment is too severe for human habitation and that is was of limited use to prehistoric people. Although it is true that prehistoric population densities were lower in the North Cascades than in the lowlands to the east and west, in the following chapters it will be shown that many natural resources of the North Cascades were used by these same lowland populations. If after much study the North Cascades are shown to have been as little used as some archaeologists have suggested, then they will probably stand out as unique among mountainous areas of the world.

CHAPTER 4

PREHISTORY AND NORTH CASCADES LAND USE

Introduction

All that has been discussed this far is the known archaeological record left by prehistoric people who used the Park Complex and adjacent areas, and how these were viewed by the archaeologists who discovered them. The following discussion shows how these remains are related to the cultural world outside of the Park boundaries. This study was designed to do this by taking into account certain factors and requirements as stated in the Request for Proposals: (1) environmental change over the last 20,000 years; (2) review of archaeological studies in and around the Park Complex; (3) prehistory of the same area beginning with the earliest people; (4) future research that combines different fields of study (e.g., climates, plants, animals, geology); (5) scholarly methods of work but with a nontechnical presentation; and (6) a means of using the overall results to help future studies and treatment of sites inside the Park Complex (US Department of the Interior 1984).

The first step in considering these needs was to learn what information could be applied to the problem. A result was recognition of the almost bewildering variety of ways that information and technical research results are collected, stored, and otherwise made available to researchers and the public. Sources of information are of these general types:

1. publications by research and academic departments of anthropology, geology, geography, botany, zoology, history, quaternary research, climatology, environmental studies, and ecology (partial list);

2. technical reports from private research institutes and contracting and consulting firms, archaeological but including some engineering and geology;

3. technical reports from federal, state, and other governmental land managing or data collecting agencies;

4. scholarly books and journals from fields of study in item 1 above;

5. meetings of professional socieities and other public and mass media presentations;

6 newspapers, popular magazines, and others;

7. unpublished records, field notes, archive collections, and artifact collections;

8. informants

The quantity of information in these sources combined with the oftentimes narrowly focused and contrasting perspectives of the authors created problems in use of the data. It could not all be summarized, yet much of the information seemed important to understanding life in the North Cascades and was in some ways related, as certain themes on the interaction between people and their environment were repeated among the various sources. The problem then became one of gaining some distance from the wealth of data in order to find a way to simplify and organize it in a manner that would show its relevance to the needs of the study as requested by the Park Service. This was done by using fairly simple and accepted ideas about how groups of human beings live in the environment at large, and by applying some of these to the detailed information about the Park Complex. Many tenets of anthropology, geology, ecology, evolution, and other fields are the basis for this approach but their use here has been highly selective rather than comprehensive.

Land Use Defined

The term "land use" appears often and seems to have an underlying, common meaning when used by authors of various kinds of general and technical publications such as are found in anthropology, geography, natural sciences, engineering, history, planning, agriculture, and others. Yet, it is unclear as to what meaning might be inferred from this common usage. For the purposes of this report, some basic assumptions about land use, though highly simplified, are summarized in the following points. Simply defined, land use is concerned with how human groups live in an environment and leave archaeological remains (and other physical traces) as a result of their presence (Dancey 1973).

1. Differences in the ways that food gathering economies habitually use the resources in an environment creates distinctive kinds of physical remains that archaeologists can recognize if they are studied in appropriate ways (Binford 1980).

2. These food gathering economies are basic types that are known to have existed in many parts of the world for thousands of years. As studied by some cultural geographers and archaeologists, food gathering economies act according to general principles of land use, as do other seemingly more complex economies (Wagner 1960; Butzer 1971 and 1982).

3. Land use is a way of looking at how human groups use resources in their environment and the many reasons why these uses are not the same everywhere. For foraging food gatherers of the Northwest, land use involves the resource area exploited and the way this effects how people move about the the landscape during each season (Schalk 1978b:3). The earliest prehistoric foragers here underwent evolutionary changes in land use, as seen in their archaeologial remains, that resulted in the late prehistoric and finally the historic patterns of land use described by the first Europeans on the continent (Schalk and Cleveland 1983).

4. The climatic and environmental changes of the past thousands of years, as studied by geologists, botanists, and other Quaternary scientists, is important for estimating changes in landscapes and the probable abundance of human food resources in them. The record of environmental change for the last 12,000 or so years is generally known (H. E. Wright 1976 and 1983).

5. Although human land uses are known to affect landscapes, environments are not passive recipients because they respond to land uses and in turn affect them. Furthermore, these mutual influences can be studied with archaeological and environmental data (Butzer 1971 and 1982).

6. Landscapes and all the cultural remains on them "large and small, grand and commonplace," are cultural resources that, when viewed in appropriate contexts, are meaningful to our lives today (modern land use) (Lipe 1984).

Land Use Patterns

Human societies are related to their environment, among other ways, through a dependence on natural resources for food and other necessities for survival. This dependence is reflected in two basic ways: societies either produce the resources they need or they simply take what is naturally available. Prehistoric agricultural and modern agri-industrial societies are food producers. Prehistoric groups that hunted, fished, and gathered natural resources, called foragers here, formerly covered all of the inhabited world and some foraging societies exist yet today. The possible 12,000 or so years of human land use in the North Cascades, but for the last 200, is a story about foraging societies. Different kinds of foraging patterns are found around the world. In looking at Northwest prehistory, two different kinds of forager land uses are considered. Many of the following ideas about foragers are drawn from Schalk and Cleveland (1983), Wagner (1960), Butzer (1971 and 1982) and Binford (1980), and references cited therein.

The first and simplist forager land use pattern is one wherein small groups composed of families traveled year around within a territory and used the natural resources they needed where they found them. In climates with cold winters such, "broad spectrum foragers" have a land use pattern with these characteristics:

1. During each year there are many seasonal camps, with much traveling between them because the entire groups moves from one resource locality to another,

2. The group generally processes only those food resources that will be used on the spot and while traveling, but does not store food for winter. A wide variety of resources are used that are distributed over a large geographic area,

3. Hunting provides most winter food,

4. Material possessions are simple and few; tools and other gear are portable and houses are temporary shelters.

Such foragers know a lot about the plants, animals, and the entire environment within their territory and their use of the landscape depends on where and when resources are ready to use. This creates a close dependence on the productivity of the territory's habitats so that fluctuations can threaten group survival. Flexibility in survival strategies and high mobility are important adaptations. Traces of the small, short-lived settlements disappear soon after abandonment. Houses are small and made of locally available resources. This pattern of land use causes little impact to the environment. Such foragers are believed to have occupied the Northwest in the early Holocene and are culturally similar, for example, to some early historic Paiute Indians who lived in the Great Basin of western North America.

In a second, more complex type of forager pattern, groups of people live in a semipermanent or permanent settlement during winter. Small work parties or individuals leave and return often. Natural resources at their sources are collected, cleaned, and made ready for the return trip; sometimes this is done in steps along the way. Sometimes resource collection and processing is done by relatively large groups of workers that gather where staples, such as salmon or root crops, are particularly abundant. Here a variety of other kinds of social activities also take place. Compared to broad spectrum foraging, such "semisedentary forager" land use is characterized by:

1. Work parties use temporary camps when needed to bring resources to the entire group, which repeatedly occupies relatively few large seasonal camps during any one year,

2. Although there is intensive use and manipulation of the most abundant natural resources in the territory, a wide variety of other resources are also used but the territory exploited may not be large; resources from widespread territories are distributed through trade networks,

3. These become staples that are stored for winter use, when hunting is supplementary,

4. Material possessions are more numerous and complex, tools are bulkier, and houses more permanent (and may be portable).

Although resource abundance is dependent on cycles of plant and animal activity, storage evens out the fluctuations. Intensive exploitation and manipulation of the environment can significantly alter the landscape in different ways, some of these resulting in increased production of staples (Williams and Hunn 1982). Houses and their yards are places for final work on resources used for food, tools, storage, and other domestic uses. There is often a sexual division of labor in work parties and there are specialists in hunting, fishing, woodworking, basketry, and other tasks. As can be seen, these different roles make individuals dependent on each other, leading to kinds and degrees of social relationships not found among broad system foragers. Compared with them, semisedentary groups have more leisure time. Societies of semisedentary foragers occupied the Northwest in the late Holocene and during the historic period in those groups uninfluenced by the introduction of horses. This includes all of the historic Indian groups who used lands that are today inside the Park boundaries.

The ways in which foraging people use the landscape is more flexible and complex than implied by the discussion here. Human uses of the land are easily modified as social and environmental conditions change. Considering mountain environments generally, and especially those with abrupt environmental changes between seasons or with elevation, a high degree of flexibility is required in the ways that natural resources are handled by the people living there (Thomas 1979). Studies of land use patterns in mountainous areas around the world show many strategies for such flexibility. Examples include such things as rotating use of resource areas, population control, mixing the kinds of habitats used (especially across altitudinal levels), and migration (Rhoades and Thompson 1975; Thomas 1979; Guillet 1983). Knowing this, it is better to view forager land use patterns as changing, sometimes slowly or not at all, and at other times rapidly so. The social and cultural bag-of-tricks used by Northwest foragers during the Holocene is just beginning to be appreciated (Lee and Devore 1968; Suttles 1968; Schalk 1977; Ames and Marshall 1980; Williams and Hunn 1982; Price and Brown 1985).

To understand prehistoric land use in the Northwest, broad spectrum and semisedentary foraging should not be seen as opposites. They are instead simple models showing basic relationships. The real-world, fleshed-out land use patterns of present (and past) forager societies are impressive in their complexity and efficiency, and it is expected that similar complexities characterized the prehistoric people of the North Cascades. For these reasons, the two forager land use patterns should be seen as ideal types that help to show what is known about changing Holocene land use in the North Cascades.

Early Archaeological Sites and Peopling of the New World

Although much study has been given to the first people of the American continents, archaeologists are yet uncertain where and when they first appeared. The studies that address these problems are often the object of professional controversy and debate. It is commonly accepted by many archaeologists today that the New World was inhabited at least by 20,000 years ago (Shutler 1983). Overall populations densities during this time were extremely low, probably less than 0.5 people per km^2 (Hassan 1981:202).

Even though many old sites are known to exist, few such "early man" sites meet the requirements that archaeologists use to judge the scientific reliability of great age. The criteria generally include: (1) a series of dates (preferably from measuring the radioactivity of wood or charcoal) that do not contradict one another and that are directly associated with artifacts; (2) the artifacts' exact, original locations are known, as is the geologic layering of the deposits in which they are found; and (3) the artifacts are unquestionably made by humans. In addition, credibility is enhanced: (4) if the artifacts are directly associated with the remains of animals that are today extinct; and (5) if the results do not contradict the prior beliefs of the research archaeologist or other authorities who pass judgement on the scientific credibility of the results. Although the last criterion may sound inappropriate or unscientific, it is often the way archaeologists test out competing ideas and open them to debate (Willey and Sabloff 1974). These factors, along with the fact that early sites tend to be deeply buried and are usually found by accident, mean that the archaeological sample left by early foragers is small and that not much is known about their cultures. Based on the presence of early sites elsewhere in the Northwest, it is not impossible that today's Park lands were used as long ago as 12,000 years. However, there is no evidence presently available to support this claim.

Early Broad Spectrum Foraging

The first people to occupy North America had to contend with a dramatically changing landscape by today's standards. The last major ice age was just beginning 20,000 years ago. Between 15,000 and 18,000, the enormous ice sheets (Continental and Cordilleran) covered most of Canada and the northern United States (including nearly all lands within the Park Complex). By 14,000 years ago, the ice sheet was getting smaller; between 11,000 and 14,000 years ago, ice melting and other landscape changes were rapid and affected the resources used by prehistoric people (Mathews 1979). Large areas of the northern hemisphere that had supported cold tundra and steppe 15,000 years ago underwent rapid change as they were invaded by boreal forests. Meanwhile, tundra and steppe invaded the newly deglaciated landscapes bordering the melting ice. Foragers using a wide range of natural resources were the first to use this new but continually changing environment. It is commonly accepted that these foragers mostly hunted the abundant terrestrial browsers and grazers, which included elephants (mammoths and mastadons), caribou, deer, elk, bison, sheep, and others (many of which are now extinct) or perhaps sea mammals along coastal areas. No consensus yet exists among archaeologists as to when "Early Man" or "Paleoindians" came here, but sometime between 13,000 and 20,000 years ago is an acceptable range (Shutler 1983). From source areas in eastern Siberia, the possible routes of migration crossed the Bering Sea and turned south through the interior of North America or along the coasts (Fladmark 1979, 1983). Most archaeological remnants of earliest foragers are found south of the ice limit (some of these sites are shown in Figure 4-1). These include a site in Pennsylvania dated to 20,000 years ago (Adavasio et al. 1983 and references therein), Wilson Butte Cave in southern Idaho dated at 14,000 years (Gruhn 1961, 1965), Ft. Rock Cave in southern Oregon dated to 13,000 years (Bedwell 1969 and 1973), and possibly the Manis Site on the Olympic Peninsula of Washington also dated 13,000 years ago (Gustafson et al. 1979). Many other archaeological sites may be as old or older, but the scientific acceptibility of their estimated ages is questionable. After about 11,000 years ago, many more remains, most having acceptable age estimates, are known from north and south of the by then smaller ice sheets. The remnants of early foraging land use, consisting of tools and food parts in layers below ground or scattered on the surface, are found across large areas of North America. None are presently known within the Park Complex, but broad spectrum foraging probably characterized the land use of people near to the Park as it did in other parts of the Northwest (Schalk and Cleveland 1983).

Most of the simple tools found at early Northwest forager camps are related to hunting, and include stone and bone spear points (these were probably attached to a wooden spear shaft by insertion into a socket formed in one end of the spear [Bryan 1980]), spear-thrower weights, and regularly and irregularly shaped cutting and scraping tools. The bow and arrow was not yet in use (it is possible that people who made more intensive use of resources and who used the bow and arrow to hunt the smaller animals of the late glacial forests, entered Alaska 12,000 to 14,000 years ago [Turner

1983:156]). Dogs may have been used for hunting in the nearby Rocky Mountains as early as 10,000 years ago (Butler 1978:62).

These early foragers knew their environment well, and were adapted to traveling long distances in the cold and sometimes subarctic or subalpine conditions. They made small, eyed boned needles for sewing, which may be related to their need for tight-seamed, waterproof clothing. At each camp the group would use the variety of nearby resources for food and other needs and then move on to another camp. Being highly mobile, not a lot of gear could be carried between camps. As might be expected, the food remains left at each camp differs in quantity and type from that left at other camps, depending on the kinds of resources that were used at that place. One such early site near Goldendale, Washington, more than 50 grinding and milling stones were excavated (Warren et al. 1963) that probably had been used to process plants (what kind is unknown, but some possibilities include camas and acorns of garry oak, see Schalk and Cleveland 1983). Near Lind Coulee in eastern Washington, an extinct form of bison along with elk and a variety of smaller animals were hunted about 9,000 years ago (Daugherty 1956; Irwin and Moody 1978). A large type of elk, other animals, and freshwater mussels were used at the Marmes Site near the lower Snake River more than 10,000 years ago (Gustafson 1972). The pieces of human skeleton found at this last camp show that these early people were identical to modern people (Fryxell et al. 1968; Krantz 1979).

Unlike food remains, which are of local origin, many of the points, knives, scrapers, and other stone tools and fragments at the widely separated early forager camps are surprisingly similar. This is to be expected of a widespread land use pattern practiced by small groups of traveling hunters. The tools of these hunters are characteristically made of high quality chipped stone ("high quality" in this sense means the stone has properties important to tool making and serviceability, such as ease of shaping or holding a sharp edge). Often the natural source of the stone material found at early archaeological sites in the west is known to be hundreds of kilometers away. It is likely that foragers living in widespread areas of the west sought to get stone materials from source areas known for producing high quality raw materials. Some well-known source areas include the Alibates Quarry in Texas or the Knife River Quarry in South Dakota. Much closer to the study area is an obsidian quarry in southwestern Idaho that supplied chipped stone to foragers living in an area that today covers parts of Washington, Montana, Idaho, and Oregon. Some of the camps where this obsidian was found have been radiocarbon dated to 10,000 years ago (Sappington 1984). In northwestern British Columbia, obsidian from the Mt. Edziza area is known to have been widely distributed as early as 9,000 years ago (Fladmark 1985). East of the Cascades, the quality and size of chipped stone tools is much greater for early foragers compared to late foragers, who used the landscape more intensively and made more use of local rock types that were not always comparable in quality. West of the Cascades, few early stone tools of any type have been found and at some kinds of camps, bone may have been used for cutting and butchering tools (Gustafson et al. 1979).

The houses of early foragers were temporary shelters built of local materials. As with most types of gear, the mobile lifestyle made transport of bulky things impractical. Brush, poles, rocks, and naturally formed caves and shelters were sometimes used for temporary shelters. Except for these

Figure 4-1. Names of numbered sites and localities shown.

1. Ferndale
2. Olcott Site
3. Manis Mastadon
4. Rocky Reach
5. Kettle Falls
6. Calispell Valley
7. Glenrose Cannery and Fraser Delta
8. Hat Creek
9. Arrow Lakes
10. Methow Valley
11. Lind Coulee
12. Marmes
13. Strawberry Island
14. Dalles
15. Fort Rock Cave
16. Wilson Butte Cave
17. Bitterroot Mountains
18. Colorado Rockies
19. Kootenai River
20. Mt. Edziza

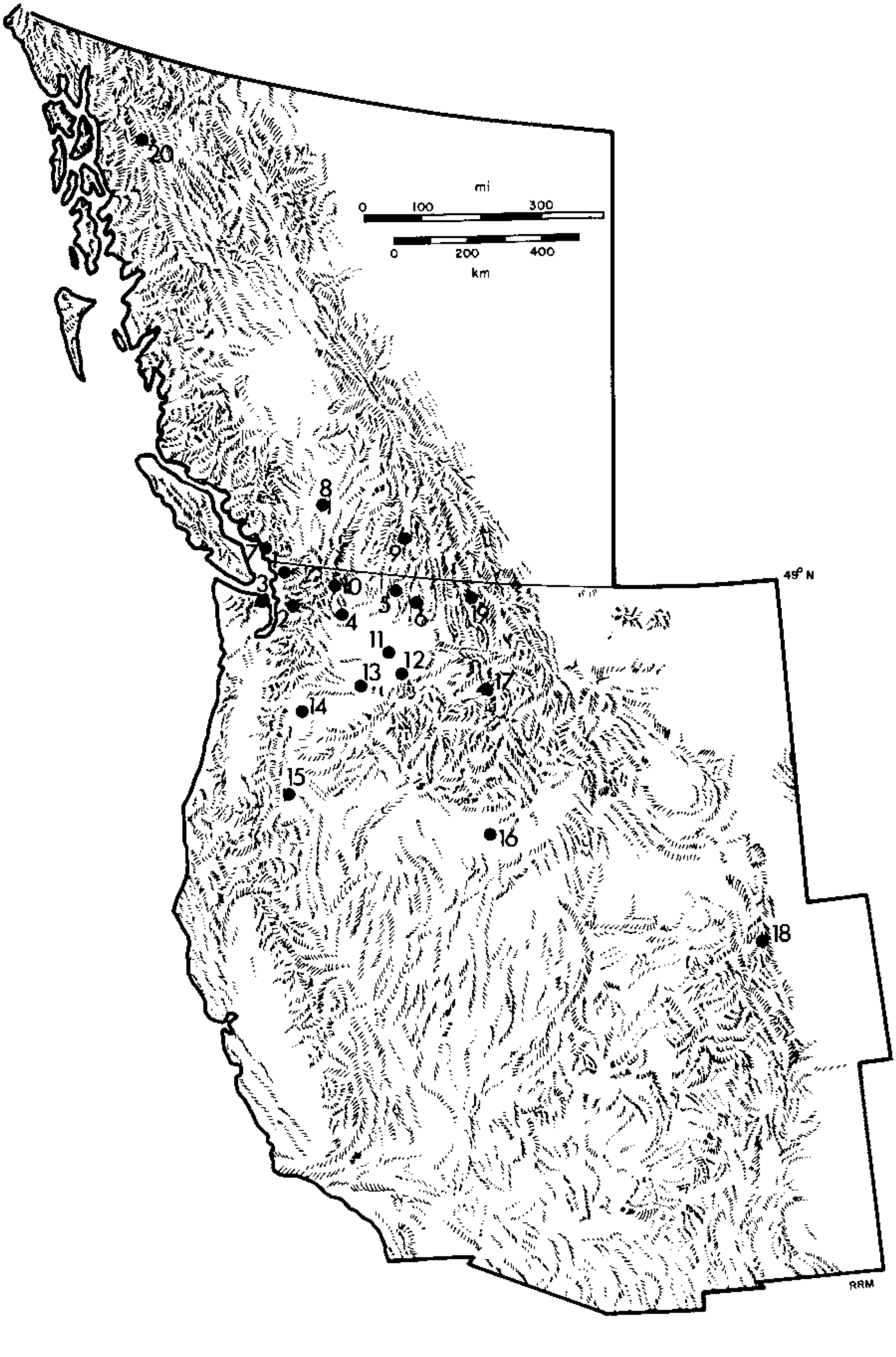

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Figure 4-1.

last two types, shelters or houses (and related structures, such as storage features) of early foragers have not yet been found in North America. (A recent excavation in southern Chile, however, has uncovered parts of shelters in a semipermanent settlement that is radiocarbon dated at about 13,000 years old [Dillehay 1984]).

The changing late-glacial landscape in the Northwest 11-12,000 years ago was a difficult one to live and travel in. Crossing many Northwest rivers may have been difficult during the summer melt, when some rivers swelled an estimated ten times or more in volume of water as compared with winter (Clague 1975). Where terrain was least affected by glacial ice is where some of the earliest Northwest archaeological sites seem to be found, such as in the unglaciated Snake River basin. At the same time, more northern valleys closer to the melting glaciers remained filled with hundreds of feet of glacial debris (Mierendorf 1984). Landscapes uncovered by the melting glaciers or near to them were wet and poorly drained places. Compared with any time since then, including today, local water tables were high and wet meadows, marshes, and boggy places were common in places that are today dry. As late as 8,900 years ago, lakes draining the remnant Cordilleran Ice Sheet were still sending water down the Columbia River through Washington (Fulton 1969). At 8,700 years ago, flood plains formed along a perennial stream where beavers lived in the present Lind Coulee, which is today one of the driest areas in Washington (Moody 1978). As the environment changed, new landscapes formed and were colonized by new plants and animals. The people who first used these landscapes were probably skilled in exploiting the productive but widely different game and resource habitats. This deglacial environment may have destroyed many early archaeological sites. For example, the waters flushed down the Columbia River by the remnant glaciers in British Columbia 9,000 years ago may be related to problems that archaeologists have had in recognizing the remains of early campsites between the Wenatchee and Vantage areas (Swanson 1956, Avey 1972, Mierendorf 1983b). Such glacial meltwater draining down the Columbia River may have eroded flood plains and resculptured terrace surfaces. These factors may account for the presence of early archaeological remains (radiocarbon dated between 10,000 and 8,300) found recently near Wenatchee and there associated with river deposits on a terrace high above the modern Columbia River (Galm and Masten 1985). Such late-glacial river processes probably influenced human use of the North Cascades and surrounding areas, and may, for example, be related to the absence of archaeological sites north, east, and west of the Park Complex that are earlier than about 8,200 years ago.

Human use of different alpine areas in western North America probably began at different times. Mountains that sustain glaciers today, such as the coast and interior mountains of British Columbia, have taken longer to be clear of ice than ranges to the south and east. In the Colorado Rockies, alpine passes, ridges, and valleys might have been used 11-11,500 years ago (Husted 1974). Farther north in the Canadian Rockies, human use spans about 10,000 years (Reeves 1978). One archaeologist has suggested that alpine areas of Washington would not have been economically significant to early man (Daugherty 1965), but this supposition was made in the absence of reliable data.

Adjusting to a Nonglacial Environment

By 8,000 years ago, the climates and landscapes of the Northwest were more similar with today's than at any time since the glacial advance. This similarity lasted only shortly in the lowest interior basins and valleys east of the Cascades where it became drier and warmer (Hansen 1947), a condition that lasted until 5,000 years ago. Other parts of western North America, such as the Great Basin (Mehringer 1977), southwestern Montana, Yellowstone National Park, southeastern Idaho (R.G. Baker 1983), and the Okanogan valley of British Columbia (Kershaw 1978) also became more arid. This mild mid-Holocene climatic interval is often called the Altithermal, although the term Hypsithermal is preferred (Deevey and Flint 1957; Porter and Denton 1967; Wright 1976).

About 8,000 years ago, prehistoric land use patterns in widespread areas began to change, although the causes are uncertain. The extinction of the late glacial large game animals under predation by larger human populations may be involved (Martin and Wright 1967). At the same time, animal extinctions and other biotic changes were natural adjustments to the changing climates. It is not surprising then, to learn that Northwest foragers changed along with the environment, but exactly how is not known. Land use changes left distinctive tools and artifacts that archaeologists recognized by various names, such as the Old Cordilleran culture or Cascade Phase. These are found over a large area of the Northwest (on all sides of the North Cascades) and include campsites found throughout the landscape (Butler 1961; Kidd 1964; Grabert 1968; Browman and Munsell 1969; Leonhardy and Rice 1970; Matson 1976, 1981; Fladmark 1982a; and others). Not much is known about these camps. West of the Cascades, there are scatters of crude-looking tools and flakes made from locally derived river stones. These are often associated with distinctive flaked stone knives and points, shaped like a willow leaf with a point at each end. Due to poor preservation (especially the acidic soils) in the rainforest, camp debris other than stones and charcoal are rare. In southwestern British Columbia, at the Glenrose Cannery Site, one Old Cordilleran camp contained food remains of deer, elk, small marine mammals, fish, and shellfish (Matson 1976 and 1981). Along the low west slopes of the Cascade Range, chipped stone scatters dating to this time period, such as the Olcott Site, are found on high terraces well above the modern river flood plains (Kidd 1964). East of the Cascades, this distinctive land use has many local phase names (such as Cascade, Vantage, Okanogan, and others). Here, because of better preservation (nonacid soils and aridity), food resources from a variety of land animals, fish, shellfish, and plants are common in archaeological sites. The distinctive leaf-shaped point along with tools made from river rocks are also found at these camps.

These foragers apparently still relied on high mobility but they made more intensive use of local resources. The number of different yearly camps and the total distance traveled probably became smaller. This seems to show in the switch to use of many more local rocks for tools and in the more specialized tools (fishhooks, grinding stones) needed to exploit resources in the different habitats. House remains are unknown and simple features of any kind are rare. This general cultural shift did not happen everywhere at the same time. It may have started nearly 9,000 years ago west of the North Cascades, a little later to the southeast, and after 8,000 years ago to the north and northeast (Fladmark 1982a; Leonhardy and Rice 1970). One archaeological site inside the Park Complex may reflect this pattern of land use. This is the Hozomeen Campground Site (45WH79) which may be the remains of a hunting camp (Grabert and Pint 1978). Other similar camp remains near to the Park Complex have been found along the Columbia River between the mouth of the Okanogan and Wenatchee rivers (Grabert 1968; Avey 1972; Mierendorf and Bobalik 1983; Chatters n.d.) on the west slopes of the Cascade Range (Kidd 1964; Grabert 1983); and in British Columbia (Matson 1976; Grabert and Pint 1978).

Some archaeologists believe that cultural change at this time was caused by drought that forced foragers to abandon dry, warm basins of the mountainous west (Benedict and Olson 1978), including parts of the Great Basin (Baumhoff and Heizer 1965), the northern Plains (Husted 1969), and the Columbia Plateau of eastern Washington (Chatters 1982). Others disagree and believe there was no such abandonment (Reeves 1973; Fagan 1974). Daugherty (1962) believed that populations concentrated in the river valley at this time. In one eastern Washington study of this problem, no evidence was found that land use had changed during this dry interval (Bense 1972); however the measures of change used may not have been appropriate to the problem (Ames and Marshall 1980). Presently, this dry interval is not seen as the overriding factor in land use change, and its effects in any one location may have been related to many local environmental and cultural factors (Aikens 1983).

Mountainous areas of the west may have become refugia during this interval (Husted 1974). It has been characterized as a time of rapidly fluctuating climate and human populations, causing foragers to migrate long distances to moist mountain ranges because effective moisture became too low to support existing land use patterns (Benedict and Olson 1978). In one part of the Colorado Rockies, periods of lowest effective moisture occurred 7,000-6,500 and 6,000-5,500 years ago with a cooler, moist period in between. By about 5,800 years ago, traces of a new land use pattern appeared there. In the camp remains are found large, corner-notched points and a wide variety of flaked and groundstone tools. Stone tool raw materials are local in origin and of poor quality. These alpine and subalpine camps are found along with drive lines (structures of rock and wood, arranged in lines, used to funnel game to hunting stands) and animal butchering areas. These archaeological remains showed a type of mountain land use more intensive than any that had come before. Although still using a wide range of resources, it is more "intensive" because compared with before, more time and work was spent in living off the resources of a smaller part of the landscape. A similar change in land use pattern has been suggested for mountains throughout the west, including the Cascades (D. Rice 1965; Benedict and Olson 1978).

Beginnings of a More Sedentary Way of Life

By 6,000-5,000 years ago, foragers in many parts of North America left camps and debris indicative of new and different land use patterns. They were different not only for their greater quantity but also for the variety of artifacts and features and the amount of work needed for their manufacture as compared with earlier times. The increasingly complex and descriptive classifications made by archaeologists of the remains from such sites won't be covered here except as needed to trace the evolution of land use into the historic period.

The use of more or less permanent houses by foragers is an important aspect of the new land uses because it means that for at least part of the year Indians did not need to travel as far or as frequently between habitations as before. For a long time, archaeologists thought houses to be no older than about 3,000 years (Nelson 1969, 1973), but a few have been found that are nearly 6,000 years old. Some of these include houses in California dated about 5,500 years ago (O'Connell 1975); ones in eastern Washington and northern Idaho dated 5,500 to 4,000 (Ames et al. 1981; Brauner 1976), and ones in central and southern British Columbia dated 5,000-4,000 (Fladmark 1982a). All are semisubterranean, meaning the roof and walls of each structure are built over a hole dug in the ground.

Houses are related to other aspects of land use that also changed with intensification. West and north of the Cascades, for example, thick middens (refuse dumps) of mussel shells mixed with bones of food animals and other artifacts are found to date after 5,000 years ago. Although leaf-shaped points were still used, a large variety of more specialized tools were used to process food and utensils from the different habitats exploited by people. Some of these are heavy and bulky items that are not portable. Specialized tools include ground slate knives and points, barbed harpoon points, grinding and pounding stones, woodworking tools (hammers, adzes, and splitting wedges), dart points, basketry, and small chipped stone tools with specially shaped edges for specific cutting, engraving, scraping and drilling purposes. Many artifacts with designs and decorations had ceremonial rather than utilitarian uses. Trade networks evidently served to distribute many locally available raw materials to distant users. These included Dentalium shells, obsidian, and other high quality stone, soapstone, nephrite (a jade-like rock), and native copper (Fladmark 1982a).

Houses are only one of the many types of structures that were built. Others include pits for storing food, burial pits, rock-piled walls and cairns for various purposes, large hearths and ovens for cooking, and special purpose structures for ceremonial and other nonhabitation activities. Compared with the temporary houses of broad spectrum foragers, these semisedentary people spent more time modifying the environment (intentionally and unintentionally) around their semipermanent communities and at other selected places on the landscape. Many daily activities that previously occurred at the many seasonal camps and at other key places in the landscape now became concentrated for a longer time at one spot. The habitation debris left by these two kinds of land use systems is different. For example, where food is repeatedly cooked and eaten in a habitation with even a few permanent dwellings, burned rocks and charcoal are often more common than other debris. Burned rocks are found in archaeological sites of all ages and are one of the most common artifacts found anywhere. They are almost always of natural rocks found nearby and were used to transfer and store heat, such as by stone boiling (placing heated rocks in water) or baking in an earth oven (sealing the heated rocks under earth). Either cooking method, if done repeatedly at one spot, usually leaves a lot of charcoal which varies in size from nearly invisible particulates to large chunks. Because charcoal is chemically unreactive in most natural environments near the earth's surface, it preserves well in archaeological sites everywhere. Both burned rocks and charcoal are not randomly scattered, but are instead related to the locations of housepits, hearths, workshops, earth ovens, storage pits and other features. They are also found mixed with earth and garbage (broken tools, household furnishings, food scraps, unwanted raw materials, and other kinds of waste made while living at the camp). Sometimes the trash accumulation area has distinct boundaries and a certain thickness, in which case it is called a midden (these can also occur away from camps and villages). By far most of the archaeological work done in areas adjacent to the North Cascades has been in midden and housepit remains of semisedentary foragers.

Semisedentary Foraging

Semisedentary foraging eventually became the dominant land use pattern in the Northwest for thousands of years. Through classification of site assemblages, years of archaeological studies have shown that subsistence technologies became more complex with time and were for the few thousand years before Europeans arrived, similar to those of Indians living in the Northwest at the time that written records became available. But subsistence technologies and the remains they leave are only one aspect of land use systems and it is known that profound social changes took place also. Recent studies in Northwest prehistory seek to understand the "cultural complexity" of semisedentary foragers. Aspects of cultural complexity include social stratification (such as wealth status and slavery), specialization of roles (artisans, craftsmen, religous leaders), ownership and inheritance of resources, labor groups, trade arrangements, and warfare. The use of archaeological data to study these problems is in its infancy in Washington. Such studies are based on the idea that different social aspects of forager cultures can be distinguished through the proper analysis of archaeological remains. Such studies recognize that sedentary foraging based on food storage is a major evolutionary change that is similar in importance to the adoption of agriculture in other parts of the world (Testart 1982; Schalk and Cleveland 1983). Generally, foraging adaptations of the Northwest Coast became less migratory (from one season to another) than did those of the interior Plateau.

For much of the time that archaeologists have studied Northwest prehistory, culture change has been viewed as something that happens because of the migration of groups of people or the diffusion of ideas from one group to another. More than anything else, it was argued that major climatic changes acted as a trigger to set in motion either of these mechanisms of culture change. With this viewpoint, archaeologists tried to explain geographic similarities and differences in the habitation debris they were finding. This was done by making detailed classifications of only the finished tools and built structures found at prehistoric villages and arranging them according to earlier and later time periods and phases. These were then compared with ones from different areas (for example between some part of the Columbia River with some part of the Snake River) and the degree of similarity was then believed to measure how closely related the two "cultures" were. If the assemblages were dissimilar, the cultures had not influenced one another. Much useful information was gathered and much was learned by this approach.

However, one limitation is that no attention the other kinds of cultural remains found at archaeological sites. Eventually, more of the excavated habitation debris was saved and studied. The importance is now recognized for the identification and quantification of bones and other organic remains to infer prehistoric diets; of chipped stone waste to find out where the raw material came from and how it was used; and of the chemical makeup of earth from around hearths, camps, and villages to learn about how foods were prepared and stored. Such studies take more time and involve collection and analysis of more of the site remains.

Another problem with this approach is that only sites from a very small part of the prehistorically used landscape were looked at. These were almost always low elevation sites along the largest rivers, almost always villages with housepits, middens, or some type of structure. In parts of British Columbia an estimated 90 percent of excavated sites are this kind (Fladmark 1982a:123). Yet along many Northwest rivers, 80 percent of the known sites have no house or other known structural remains (Schalk and Cleveland 1983:37). This means that much of the evidence for prehistoric land use has been ignored (Dancey 1973). It is therefore not surprising that most archaeological sites known in Washington are below 610 m (2,000 feet) elevation. Much will be learned about prehistoric land use when higher elevation mountains, such as the North Cascades, are studied.

The Late Prehistoric Period of Semisedentary Foraging

The first summaries of Northwest prehistory, which appeared in the 1960s, described little or no culture change in the last 3,000 years. The tools and technologies showed continuity with the past and it was argued that change occurred from the gradual addition of new traits (Daugherty 1962). Except for some local specializations and changes due to the historic appearance of iron and the horse, prehistoric Indian life was seen as not significantly different from the life of Indians as described in the early eighteenth century. Most geographical differences in Indian cultures were attributed to influences from adjacent regions. Although climate during the late prehistoric was known to have returned to cool and moist conditions (Hansen 1947; Fryxell and Daugherty 1963) and although it fluctuated back and forth during this time, these were thought to have had no important affect on land use patterns. The overall subsistance of Northwest people was believed to be based almost exclusively on salmon runs along interior rivers and on marine fish and mammals along the coast. With these abundant and concentrated resources, mountains or alpine areas seemed of little value except for summer hunting and berry picking (Daugherty 1965; Relander 1965).

This view of late prehistoric cultural stability does not fit more recent evidence and ideas about changes in forager societies. It is believed that important changes can occur in societies yet not be apparent from the study of a small sample of archaeological remains. Foragers' high degree of social flexibility and adaptibility to rapidly changing conditions is better understood by looking at changes in how the entire landscape was used. This is why exact location of all sites, no matter how small or devoid of tools and structures, is important. A noted bias in archaeological site sampling has been to ignore small sites that are not deeply buried in order to get at old deeply buried sites (Talmage and Chester 1977). In cases where all artifacts on the landscape are recorded, a larger variety and number of prehistoric remains are found than might be expected from the results of more traditional studies in the same area (Dancey 1973; Thoms 1983).

Some archaeologists suggest that the change to semisedentary foraging resulted from the mutual effects of abundant and storable food resources, social interaction among Indian groups over large areas, population growth, and the ways that forager groups organize seasonal activities in order to collect resources. Intensification, a more thorough way of using natural resources, was an important part of this change beginning 4,000-5,000 years ago. It was based on local abundances of salmon, roots, and marine and terrestrial animals (Schalk 1977, 1984; Ames and Marshall 1980). Intensification is easier to understand if the differences in various Northwest habitats of the relative abundances of these foods is considered. Staple foods are not uniformly distributed throughout the area. For example, certain geographic locations in historic times were known and sometimes named for the staples used by local Indian people. These include the major Indian fisheries at the Dalles and Kettle Falls of the Columbia River, the large camas collecting meadows in the Willamette River Valley of western Oregon and the Pend Oreille River valley of northeastern Washington, the hunting and fishing village at Cape Alava so near to migration routes of whales and other sea mammals, and the sheep hunting camps of central Idaho and many other mountainous areas throughout the inland Northwest. Because of the distinctive combinations of resources in the variety of Northwest habitats, a "localism" developed in foraging economies that amounted to a lifestyle adjustment to the natural resources of the habitat. Groups living in these habitats formed strong social and personal identities with the places in their environment. Where there is variety in peoples' habitats there is variety in peoples' adjustments to them (Ames and Marhsall 1980). But not only are staples distributed unevenly on the landscape, they also become available at different times. Their abundances fluctuate in cycles that span months, years, and decades. These two factors, the spacing and timing of food staples, changed over hundreds of years as the climate changed. This may help to explain some of the changes in human land use in the late prehistoric period. For example, the recurring world-wide advances and retreats of mountain glaciers between 5,000-5,300, 3,800-3,200, 2,800-2,500, about 1,200, and 400-100 years ago influenced intensive land use systems around the world. So did the recurring warm, and in some places, dry intervals between 900 and 600 years ago (Denton and Karten 1973; Bryson and Murray 1977; Bryson and Padoch 1981; Bartholomew 1982).

Exactly how such fluctuations affected the staples of Northwest Indians is unknown. For example, in higher mountains, deeper snows during Neoglacial advances may have lowered the elevation of game wintering grounds (Benedict and Olson 1978). Changes in the sedimentation rates, frequencies, and size of floods in Northwest rivers during these advances probably affected the food resources and landforms used for habitation along river flood plains (Mierendorf 1983a). Because the North Cascades glaciers were strongly effected by neoglacial climatic changes, rivers in the Park and adjacent areas may have influenced Indian subsistence and settlement. Also, different river valleys and flood plains react differently to such changes. In many areas of the Northwest, even small water table fluctuations in flat-lying meadows and flood plains can significantly change the pattern of drylands and wetlands, and in other areas not. Camas, for example, a staple root crop of Indian people throughout the Northwest for thousands of years (Ames and

Marshall 1980), would have been sensitive to such changes because it lives in meadows and other moist habitats on the border between wetland and dryland. Such areas are some of the first affected by changes in water tables and drainage. (In later historic times, intensive land use practices altered drainage and local watertables, causing drastic changes in the landscape). In another example, different sedimentation patterns may alter salmon spawning beds which would in turn affect the food productivity of rivers for human use (Fladmark 1982a).

If semisedentary foragers were successfully adjusting to increasing population densities and the social "rules" that resulted (Ames 1985); to short, rapid environmental changes that affected production of staples (Fladmark 1982a; Schalk 1983); and to regional geographic differences in productivity and distribution of staples (Schalk 1981), then the evidence for it should show in the locations of the different kinds of archaeological sites in all parts of the landscape. In more intensive land use systems where the natural ecology was affected, evidence is also found in geological, chemical, botanical, and other environmental data (Butzer 1971 and 1982). It is known, for example, that foragers all around the world regularly set fire to parts of the landscape in order to increase food and animal productivity (Lewis 1982). Such burning was done regularly to maintain open prairies in the rainforests of western Washington (Norton 1979) and on mountain slopes throughout the west, including the North Cascades (Collins 1974). In northwestern Montana, detailed studies of fire histories led to the conclusion that intentional burning by prehistoric foragers accounted for higher fire frequencies on slopes along large populated valleys (Barrett and Arno 1981). At a high elevation bog in the Bitterroot Mountains, the fire frequency over the last 2,000 years may also be related to Indian-caused burning (Mehringer et al. 1977). Regular burning to maintain game browse may reflect an intensification of land use in some forested, mountainous areas of the Rocky Mountains for the last couple thousand years or more (Schalk 1984a).

Within the Park Complex, Indian-caused burning has been suggested as a likely explanation for the short (10-15 year) fire frequency for thé Skagit River valley bottom in the Hozomeen vicinity (Taylor 1977). By comparison, frequencies averaging 100 years have been measured on nearby Desolation Peak (Agee et al. 1986). Not far to the north of here, also in the Skagit River valley, Henry Custer in 1859 noted a high fire frequency and believed this to be the result of Indian hunters setting fire to the forests in order to clear them of underbrush and make travel easier (Majors 1984:140, note 28).

Population Size

Relative changes in Northwest forager populations during the late prehistoric are unknown. Population-influenced curves have been made by plotting the total number of radiocarbon dates from camps and villages in a given geographic region. The resulting curves show peaks in radiocarbon date frequencies during certain time periods, but it is uncertain that these peaks are due to larger populations. They may, for example; also reflect more concentrated and fewer dispersed settlements (Randall Schalk: personal communication). If they are related to population size, this is what they show. In British Columbia, populations may have been highest 3,500-1,500 years ago on the coast and 2,000-1,000 years ago in the interior (Fladmark 1982a). Although they fluctuated, relatively low populations occurred after 1,000 years ago. These same relative differences are found east of the North Cascades (Salo 1985) and may be true for other parts of North American. What caused the possible population changes is unknown.

Such curves give no indication of absolute population and do not show which Northwest regions had the largest prehistoric population densities. It is likely however, that lands inside today's Park boundaries always had low populations compared with lowland areas to either side, just as occurs today. There may even have been short intervals in the late prehistoric when very few people used Park lands. It is also likely that larger overall populations lived along coastal areas and Puget Sound as compared with interior lowlands east of the Cascades (Kroeber 1939; Duff 1964). Finally, it is possible that changes in population distribution and density in lands east versus west of the North Cascades influenced use of Park resources or other aspects of overall land use.

Population changes may correlate with changes in settlement and subsistence. At Strawberry Island, one of the largest known late prehistoric villages east of the Cascades, study of food scraps from in and around semisubterranean houses showed changes in the relative frequencies of animal food remains between 2,000-1,000 years ago. Here, in the driest and lowest inland basin in the Northwest, a change from high salmon bone frequencies to higher frequencies of antelope and jackrabbit bones suggest some sort of shift in subsistence (Schalk 1983). Although the exact causes are uncertain, this change may be related to others occurring at about the same time in eastern Washington. At two archaeological sites along the Columbia River, a few miles east of lower Lake Chelan, changes in the river flood plain between 1,500 and 1,000 years ago were correlated with changes in sedimentation rates and land use. One of these sites is the remains of a camp that was placed in a sand dune sometime around 1,200 years ago. Prior to then, the river repeatedly flooded the area and no evidence for its use by people could be found. At the other site a few miles down river, an alluvial fan was the location that Indians used to butcher and cook mostly mountain sheep and elk about 1,400 years ago, a use that was not interrupted after the fan began to spew sands and gravels across its surface (Mierendorf 1983a). Studies from other eastern Washington river segments also show either changes in sedimentation rates, land use, or both at about this time (Marshall 1971; Hammatt 1977; Cochran 1978; Mierendorf 1981). The timing of these and similar changes over widespread areas suggests that they are connected, but the degree to which population, intensity of land use, resource productivity, or other factors are responsible is uncertain. Where population pressure is reflected in larger communities, such as seems to have occurred after about 1,500 years ago, archaeologists expect to find artifacts distributed in ways that reflect community and social aspects of land use, including control or ownership of resources; communal labor groups; ceremonalism; social classes; and specializations in economic pursuits such as trade, warfare, and hunting, fishing, and gathering. Archaeological studies of community structure are rare in the Northwest and require more research planning and different excavation methods than have been traditionally used (Stryd 1971; Schalk 1983; Schalk and Cleveland 1983; Hayden et al. 1985).

Population, Trade, Resources, and Archaeological Sites

The various Indian villages and bands throughout the Northwest did not live in isolation from one another. Instead, they interacted through a widespread subsistence network that involved the exchange and trade of many food and utilitarian items (Anastasio 1975). Trade networks were established for thousands of years before Euroamerican contact. There even developed a prehistoric trade language, in historic times called the Chinook jargon, that was used along the Pacific coast from California to Alaska (Griswold 1970). Trade networks also extended far inland and involved the exchange of resources from the lower Columbia River valley, through the intermountain interior, and into the Great Plains (Griswold 1970). According to Anastasio (1975:169).

> "there was a similarity in the concept of 'commercial' trade of the traders and Plateau Indians. Of the Salish, Teit [1930:255] writes that 'everything in use had more or less of a value, which varied in different parts of the country, according to the demand and supply of the commodity.'"

In the historic period, bands of mountain-dwelling Indians along the east sides of the Cascade Range, including the Chelan, produced a surplus of animal and plant products which formed the basis for their involvement in the trade network (Anastasio 1975:138, 186). There is no reason to doubt that this was equally true for mountain-dwelling bands of the west Cascade Range slopes.

The geographic distribution of the largest and densest prehistoric populations may have affected widespread trade networks. Under more intensive land use systems of the late prehistoric, the exchange of resources between different lowland and valley populations may have occurred on a larger scale than ever before. Estimates of population density for the early historic period show that the Gulf of Georgia, Puget Sound, and the Lower Columbia River areas sustained between two and nine times the population density of the interior plateaus (Kroeber 1939:142). Such differences in densities are likely to have existed in the prehistoric past also. Densities for some of the most heavily populated coastal regions between California and British Columbia have been estimated to be between 3.9 and 1.7 persons/km^2 (Dobyns 1983:38). The most important distribution centers of the trade network tended to be located at major salmon fisheries, especially those with access to both the coast and interior (Fladmark 1982a). In the Northwest, this occurred at two strategic places where interior draining rivers cut through the rugged mountain ranges separating low coastlands from interior valleys and plateaus. These trade centers were at the Dalles on the Columbia River and near Yale on the Fraser River. The North Cascades Range is the least accessible and most glaciated portion of the mountainous divide separating this part of the coast from the interior and is located between these two trade centers, but much closer to the one at Yale.

Given the North Cascades' apparent remoteness and inaccessibility, it might seem that even during times when prehistoric populations were largest in the lowlands on either side, the mountains would not have been much used, especially to feed anything but very small groups. It is believed, for example, that the large villages and communities, where populations were greatest, were seldom found above 2,000 feet elevation in the interior (Nelson 1973:378-379) or above 500 feet along the coast. Should we expect people who were more or less sedentary most of the time to have used the North Cascades environments, most of which are far above the lowlands?

The possible answers to this question are that, (1) there may have been times in the prehistoric past when people did not use the North Cascades, but there are other times (2) when small, comparatively dispersed groups of mountain people regularly used the area and may have permanently resided in some Park valleys, especially the Skagit and Stehekin, (3) when lowland populations moved nonbulky but valuable items of trade across the mountains (Price 1981), and (4) when natural resources from the mountains (including the present National Park Complex) were sought and used by lowland populations. The degree to which adaptive strategies mixed resource zones or specialized in key resources is unknown. Strong trade partnerships are liekly to accompany a specialized strategy (Rhoades and Thompson 1975:547).

Late prehistoric archaeological sites within the Park, which is most of those that have been dated, represent some combination of the last three land use strategies noted above, but they cannot always be distinguished by an archaeologist. Unless remains of houses, features, or specific kinds of artifact groupings are found, it is hard to separate permanent from temporary use. Archaeological sites with house remains have not been found within the Park. In only two nearby mountain valleys in the North Cascades have houses been found and virtually nothing is known about them. These occur in the upper Wenatchee (Cleveland 1974; Hollenbeck and Carter 1986) and Methow River (Swanson 1959) drainages. The two most likely locations for prehistoric house remains in the Park are the lower Stehekin River valley and along the Skagit River below Newhalem. The large archaeological site described in this report at the head of Lake Chelan (Table 5-1, Site No. 27) has a good chance of having evidence for houses. Even if the site turns out to lack houses but to show use as a temporary residence, then it will be the most interior to the Cascades of any such site presently known in the state.

Cascade Pass, the only major east-west crossing within the Park boundaries has been a trade route under a variety of land use systems. This is because the Cascades have always formed a major obstacle to east-west travel (Price 1981) and the few low passes in the range have necessarily become important travel routes. In the North Cascade Range, the most important passes, from north to south, were Rainy, Cascade, Indian (Lindsley?), and Snoqualmie. Passes are important places on the landscape for intensive land use systems:

> A curious fact about mountain passes is that they are generally more important to those living in surrounding areas, or even far distant, than they are to the mountain dwellers themselves. This is because the value and use of the pass depend on demand for a route across the mountains at that point, which, in turn, is created and controlled by factors outside the mountains, rather than by local resources. Passes do take on local economic value when the inhabitants exploit their strategic location (Price 1981:372).

There are other important passes within the Park, such as Whatcom, Beaver, War Creek, and Twisp, but none of these are quite as strategically located as Cascade Pass. The archaeological sites at Cascade Pass described in this report show some evidence of use in hunting for at least the last few thousand years. Archaeological information about prehistoric use of passes in the Cascades of Washington, especially for one in an alpine setting, does not presently exist. That trade items were carried from the coast, over the Cascades, is suggested by their possible presence in the Stehekin River valley (see Figure A-10).

Most of the known archaeological sites in the Park resulted from prehistoric use of locally occurring resources. These are usually the remains of hunting and fishing camps along the rivers. However, the small pits and burned rock features along the north shore of Lake Chelan (Table 5-1, Site No. 14) may be from preparing and storing a local resource. Also, the site at the mouth of Little Beaver Creek (Table 5-1, No. 6), along the shore of present day Ross Lake, looks like a collecting locality for flakeable chert.

The use of North Cascades resources, as reflected in these and other archaeological sites, may at times have had significance beyond their immediate use by local foragers. This is because the Cascades, like many mountain areas around the world, have resources that are wanted by, but which do not occur among, lowland populations. Under conditions wherein the local inhabitants can process and store more of these resources than needed for their own use, their surplus has value in proportion to the demand placed on it by others (Anastasio 1975:139). A number of North Cascades resources may have been used by lowland populations, but a commonly mentioned one in the historic period was goat wool (Coleman 1869; Gibbs 1877). Wool was in demand among populations along the wet, maritime slopes of the Cascades and the Puget Lowlands and along with the hair from dogs, was woven into blankets and clothing. Mountain goats were also hunted by a number of interior groups (Ray 1942:117). Spindle worls, which are used in weaving technology, have been found in archaeological deposits on the west side dating to about the last thousand years (Borden 1970; Fladmark 1982a). In the Fraser Delta area, mountain goat horn cores and spores of an alpine moss have been found in archaeological deposits (Borden 1970:111). Use of the North Cascades in this case resulted from an abundant but restricted resource (North Cascades alpine zones encompass as large an adjoining area of goat habitat as any in the lower 48 states) in close proximity to population centers along the coast.

The demand for goat wool should not divert attention from other important mountain resources, used either directly or indirectly, by late prehistoric foragers. For example, it is unlikely that goats even approached deer and elk in importance as a meat source. In fact, the sophisticated and elaborate hunting technology of historic North Cascades Indians, which included blinds, snares, traps and nets, and group hunting strategies (including use of dogs) is indicative of the importance of fur-bearing and feathered animals of all sizes. The same can be said for the variety of fishing strategies used by Indian people (Stuart 1977).

The dependence of Northwest foragers on plants was seen by the first European visitors, but only recently has the role of plants in land use systems been examined. One estimate is that plant foods supplied approximately 70 percent of the energy needs of Indians living in the southern Columbia-Fraser River drainages (Hunn 1981). Although hundreds of plant species from all portions of the Northwest landscape were used by foragers, mountain environments, especially subalpine and alpine zones, have plant communities not found in the lowlands. Because they are limited to a short growing season, alpine plants are highly productive and the July-August alpine zones of mountains are known for their abundant edible roots and berries (Price 1981).

The role of plants in the lives of historic Northwest Indians is important for understanding their prehistoric use. Many anthropologists have noted that Northwest Indians had a diet rich in proteins, due to the abundance of meat available from freshwater and marine fish, sea mammals, and land mammals. High protein, low energy diets can be problems to forager survival, but these could have been solved through different subsistence strategies (Speth and Spielmann 1983). Diets of Northwest Indians, especially those west of the Cascade Range had a tendency to be deficient in carbohydrates (Suttles 1968; Collins 1974; Turner 1975; Norton et al. 1984). As a result plant foods were in high demand and were traded widely between groups (Gibbs 1877). This is especially true of roots and berries, which have about the same carbohydrate value when dried and which can be easily stored or transported (Norton et al. 1984). Some western Washington Indians close to today's Park were known to depend heavily on roots, such as the Nooksacks (Smith 1950) and Upper Skagits (Collins 1974). The dependence on plant staples was so great that plant production was reportedly enhanced through ownership of berry patches and root fields, burning to maintain open meadows, and possibly planting of seeds and sprouts (Smith 1950; Buechner 1953; Kidd 1964; Collins 1974; Norton 1979; Norton et al. 1984). It is likely that during prehistoric periods of high population densities in the lowlands, plant resources of the North Cascades may have had greater significance than at other times.

Evidence for intensive prehistoric plant use in the Northwest is widespread and common but has not until recently been studied by archaeologists. Except for plant parts that have been used for fuel or to make tools, plant use, especially for dietary needs, is often difficult to recognize in the archaeological record. This is because uncharred plant parts quickly decay in most camps and villages after short exposure to the elements and because plant use is either so dispersed, such as at a collection area in a meadow, or so unobtrusive, such as in small cooking and storage pits, as to be archaeological invisible to many site survey techniques. Over the years, numerous rock features and pits, often called earth ovens, have been found at archaeological sites in lowland areas east and west of the Cascades. However, these are usually associated with large camps and villages, and were most often left unexcavated so that more effort could be spent on the much larger house remains and deeply buried artifact-bearing layers. Also, effort spent on studying the remains of intensive plant use is not considered "productive" by many archaeologists because, (1) plant use does not leave many "diagnostic" tools, such as arrowheads, and the ones it does leave, such as milling stones or digging stick handles, are rare compared to the large diagnostic inventory sought by many archaeologists, (2) it is difficult to positively identify plant-related archaeological features because most often the associated specialized tools or actual plant parts are missing, (3) the analysis and identification of plant remains can be costly (however, no more so than other kinds of special analyses routinely done by archaeologists).

Archaeological evidence of intensive plant use in Northwest mountains is rare. In the Hat Creek Valley of British Columbia, not far north of the Park, late prehistoric cooking pits have been radiocarbon dated between 2,250 and 600 years old. These pits were filled with a mixture of earth, charcoal, ash, and burned rocks. Tree and shrub parts from nearby were used for fuel and matting and the food plants included onions, composites, and lillies. The most intensive root gathering in Hat Creek Valley seems to have occurred between 2,000 and 1,200 years ago (Pokotylo and Froese 1983:152).

An archaeological survey in alpine and subalpine zones of the Potatoe Mountain Range of British Columbia found hundreds of roasting pits, mostly on ridges, hilltops, and midslopes between 1,700 and 1,900 m (5,500-6,200 feet) elevation (Alexander et al. 1985). These were probably used in the late prehistoric period to roast mountain potatoe (Claytonia lanceolata) and other roots. Generally, the roasting and cache pits described from these mountains are visible on the ground surface as shallow depressions. The diameter of these depressions, which is between 0.5 to 8 m (1.6 to 26 feet), depends on whether they were used as cache or roasting pits, on the quantity of roots, and on the kind of soil they were dug into (Alexander et al. 1985:96-103). Features similar to these have been recorded at Site No. 14 (Appendix A, Figures 4-7 through A-9).

Far east of the Park, in a low forested valley between mountain ranges in northeastern Washington, intensive use was made of camas roots (a type of wild lilly) for over 4,000 years. Here, along the sandy edge of a large flood basin, dozens of earth ovens, filled with charred plant parts, organic cooking residues, and burned rocks have been found. A series of radiocarbon dates from one site shows continuous use of camas and other plant foods from 4,200-700 years ago. The ovens contained numerous whole, charred camas bulbs and in one case, an extremely high percentage of camas pollen (Thoms and Mierendorf 1984; Thoms and Burtchard 1986). Presently, archaeological remains of prehistoric plant use from within the Park are known only from part of a small cooking hearth found eroding from the bank of the Skagit River. Here, charred red elderberry seeds were found in the hearth, along with burned salmon bones, burned animal bones, burned rocks, and flake tools. The hearth was dated 475±65 radiocarbon years ago (Appendix A, Site No. 11).

Influence of Climate

Although long and short-term climatic changes have influenced Northwest land use systems during the entire span of human use (and will continue to do so in the future), the importance of such changes in the late prehistoric should not be underestimated. Periods of environmental fluctuation are known to have influenced land use systems all around the world. Some of these periods of world-wide change, in approximate years before present, occurred 5,800-4,800, 3,000, 1,700, 880, 550, 450-500 (Bryson and Padoch 1981). Some of these correlate with short periods of mountain glacier advances during the neoglacial (Denton and Karlen 1973), but their affects on land use in separate regions was not necessarily the same.

Because glaciers are sensitive to even minor climatic fluctuations (Porter 1981), the North Cascades are ideally situated, both geographically and climatically, for the study of short-term climate effects on land use. Studies of North Cascades glaciers show much neoglacial activity, such as the advance of South Cascade glacier 4,700 years ago (Tangborn 1962), located not far south of Cascade Pass and the southern Park boundary. In the North Cascades and some other mountain regions of the world, the largest glacier advances since the Cordilleran Ice retreated more than 13,000 years ago occurred in the last 1,000 years, during the Little Ice Age (Porter and Denton 1967; Porter 1981). However, other climatic changes during the last 1,000 years may be related to periods of glacial retreat and the onset of droughts. A detailed study of tree rings from mountainous south-central Idaho shows that major droughts occurred 760-750 years ago (AD 1240-1250) and about 520 (AD 1430s) (Pearson 1978). Analysis of pollen from the bottom of Clear Lake in eastern Washington showed that it dried up from possibly as early as 900 years ago (AD 1100) until 600 (AD 1400) (Bartholomew 1982). Both studies show this last period to be the driest of the last 1,000 years and suggest it may have influenced human land use in the inland Northwest. However, any effects to North Cascades environments are uncertain. In other parts of North America, such as the southwestern USA, a drought during this time is known to have strongly influenced intensive agricultural systems.

Glaciers in the North Cascades are known to have been strongly affected by a climatic change called the Little Ice Age, which lasted about 550 to 150 years ago (AD 1450-1850). Using tree rings to date forested moraines below Coleman glacier on Mt. Baker, it was shown that glaciers advanced about 500 years ago (AD 1500), about 260 (AD 1740), 177 (AD 1823), 145-144 (AD 1855-1856), 114-113 (AD 1886-1887) years ago, and 1908-1912, about 1922, and 1978-1979 (Heikkinen 1984). Also from tree rings, in addition to using sizes of lichens for dating, Price glacier on Mt. Shuksan is known to have gotten larger about 550 years ago (AD 1550), 400 (AD 1600), 190 (AD 1810), and 50-100 years ago. Price Lake was uncovered from ice after 1910, after the glacier had became shortened by 750 m (about one-half mile) (Leonard 1974). It is unlikely that these individual glacier advances are representative of all North Cascades glacier expansions during the Little Ice Age, but taken altogether, it was a time of greater glacial activity than any since semisedentary foragers began to intensively use the Northwest landscape 5,000-4,000 years earlier.

What affects the Little Ice Age climates may have had on land use near the North Cascades is unknown. It is believed that sea levels fluctuated little if at all during this time (Porter and Denton 1967) and any changes in plant and animal communities probably occurred close to the glaciers, high in the mountains, or along river flood plains draining glaciers. In Europe, where Little Ice Age effects on land use are recorded in historic records, glaciers in the early 1600s overran some mountain villages (Denton and Porter 1970). However, compared to the North Cascades, the glaciated mountains of Europe were used by people much more intensively. Here, the affects to land use patterns were in some cases dramatic, especially in agricultural areas. In western Norway, for example, farm records show abrupt increases in avalanches, landslides, rock falls, and floods beginning in the late 1600s and lasting until the 1800s. In farms that were marginal under better conditions, these climatic affects reduced the occupants to beggars (Grove 1972). Many agricultural lands located downstream of the glaciers were destroyed by the floods. Although only the marginal mountainous agricultural lands of Europe were adversely affected by the Little Ice Age, some adjustments in land use were required in more temperate parts of Europe also (Appleby 1981).

The Little Ice Age might have affected intensive use of the North Cascades in different ways. Even at their largest, the glaciers did not travel far. The lower ends of most glaciers today are some hundreds of meters shorter than their largest size in the Little Ice Age and it is unlikely that timberlines were lowered significantly in elevation. Little Ice Age glaciers of the North Cascades stayed in cirque basins and upper valleys and never traveled to modern valley bottoms (except perhaps as exceptional avalanches and ice falls). However, even such a comparatively small scale change could have affected human use of the mountains by changing the locations and sizes of wet meadows and other seasonal wetlands that produced the many resources used by prehistoric people. The more frequent build-up of deep snows may at times have become deep enough to force some game animals downhill for a longer part of each year (Benedict and Olson 1978). Also, large game animals differ in their ability to cope with deep snow and predators, with caribou, moose, sheep, elk, and deer being most adapted (Telfar and Kelsall 1984). It is probable that any changes in the habitual movements and yarding behavior of these animals in the North Cascades was used to advantage in the hunting strategies of the mountain people. It is certain that human travel through the North Cascades would have been influenced during the Little Ice Age. Glacial streams, which today carry two-thirds of the yearly meltwater during the short warm season (Post et al. 1971), would often have been impassable torrents in summer. Except for a higher incidence of avalanches, winter may have been an easier time to travel through some parts of the mountains (Grabert and Pint 1978). This is so because in many northern latitudes, frozen rivers (or snow deep enough to cover brush in the North Cascades) can make travel easier to people with snowshoes (Wagner 1960:130). (Hunting on snowshoes was widespread among Northwest Indians [Teit 1930:249; Ray 1942:117].) Avalanches and floods would generally have caused numerous small scale changes by sculpturing landforms, such as alluvial fans, talus fields, and river terraces. Under these conditions, trails and other travel routes might change, as might the suitability of some camp locations.

If the Little Ice Age had had an affect on land use, it would probably have been felt most along lower valleys inside and outside of the Park, such as along the Stehekin, Skagit, and Chilliwack Rivers. Here, floods would have destroyed the many fishing structures built in and alongside the river channels. New channels would be cut, old ones abandoned and new river terraces formed. During times when flood plains are building, even small rises in average water table can effect how the land is used. Areas that were previously well-drained become poorly so, with the result that some flood plain segments become too wet to use as campsites, for caching gear, or as overland travel routes. At the same time, more available moisture to plants can trigger new and more productive wetland plant communities. Whether such changes affected only the use of individual river segments and localities, or necessitated a significant shift in the way that certain parts of the landscape are habitually used by people, is uncertain. Based on a study of archaeological sites and resource distributions in Grand Teton National Park and adjacent areas, it was concluded that the Little Ice Age did not affect prehistoric use of the high country (Wright 1984). On the other hand, Benedict (1986:63) has hypothesized that after 6,000 years ago, human population declines in the Colorado Front Range correlate with periods of alpine glacier advances.

Complex Land Uses and the Historic Period

With the historic period begins a dramatic change in land use all around the North Cascades. It changed the lives of foragers using the mountains, and like earlier land use changes, it happened at different times and under different circumstances on the varying Northwest landscapes. It was dramatic because it was the beginning of a more intensive land use change than any previously known. The change was most extensive along the lowlands surrounding the Cascades, whereas the area of today's Park Complex remained one of the least affected places in the Northwest. Other nearby and less affected land parcels include other US National Parks, Wilderness Areas, Provincial Parks, and land areas whose use is restricted to "wilderness" by our present land management controls.

By modern North American standards this land use change started out modestly and its beginning is known as the "fur trade" (Note: New World land use patterns were affected by earlier trans-oceanic influences, but these are less relevant to the North Cascades; this does not include introduction of the horse, which is discussed below). The Northwest fur trade was actually one part of the larger North American one, which in turn was part of an European land use strategy based on international economies and the demand created for furs (for this and much of the following interpretation, see Wolf 1982). In North America it started in the early 1600s along the Atlantic coast and moved west across the continent in about 300 years. It first affected foragers and food producers of the eastern woodlands and subarctic, then the Great Lakes, and then the western subarctic and the plains. It reached the Northwest coast by ship about 1774, and from land and river routes it reached east and south of the Park Complex in 1811 when Forts Astoria and Okanogan were established. This last fort, located at the mouth of the Okanogan River, about 67 km (42 mile) east of the Park, is one of the first commercial establishments in the State of Washington and the first of many outposts of Euroamerican use of Northwest resources (interestingly, historic documents about Ft. Okanogan are virtually nonexistent and little is known about it, unlike other forts of the fur trade; however, the archaeological remains of the fort and its vicinity contain much information about early historic land use; these remains are just under the waters of today's Wells Reservoir). It was from Ft. Okanogan that Alexander Ross made the first recorded trip into today's Park and crossed Cascade Pass in 1814 (Ross 1849; reprinted in Stone 1983).

As the fur trade moved across the continent, it quickly changed local land use patterns. Eventually, the Native Americans became specialized and subordinate laborers, not only in directly supplying furs, but also in supplying food and other natural resources to support the new system. From a general land use viewpoint, the main resources used included (from Wolf 1982, except for numbers 1, 8, and 9):

1. Native American labor,
2. beaver (everywhere),
3. cod (along the Atlantic coast before AD 1600),
4. whitefish (from the Great Lakes in the mid-1600s),
5. maize (same as 4),
6. bison (from the Great Plains, beginning in the late 1700s, to make pemmican, an important food staple of the trade),
7. sea otters and seals (Pacific Northwest in the late 1700s),
8. salmon (Pacific Northwest 1800s),
9. and a wide variety of game animals and other natural resources that supplied food and tools.

Regional and local changes to Native American land use took many forms. One of the most devastating of these was the near extermination of Indian populations (Willey and Sabloff 1974:48), initially from the introduction of European diseases. As the fur trade became established, the economic activities and social relations of local Indian groups changed, partly from their desire to exchange furs for European technology. Some groups, such as the Iroquois, became middlemen in supplying furs from other Indian groups to European traders. Warfare and competition between Indians increased, and many local groups were destroyed, decimated, and driven from their original habitats. During this time of complicated and confusing social upheavals, new land use patterns were established. Rufugee Indians, often of diverse ethnic identity, banded together and formed new economies in response to the new cultural environment, of which the fur trade had become a fact. The mixed members of these new land use systems changed their identities, were referred to under a larger group name, and used ritual to recognize their common interests. An example of one such fusion was the village of Chequamegon, formed of Ojibwas on the south shore of Lake Superior in 1679 and which had a population of between 750 and 1,000 by 1736 (Ritzenthaler 1978; Wolf 1982). "Many of the Indian 'nations' or 'tribes' later recognized as distinct ethnic entites by government agents or by anthropologists took shape in response to the spread of the fur trade, a process in which the native Americans were as much active participants as the traders, missionaries, or soldiers of the encroaching Europeans" (Wolf 1982:194).

As the fur trade moved across the continent, another entirely different land use system was developing, this one also under the influence of Europeans. It began when the Spanish brought the horse to Mexico about AD 1519. Beginning around AD 1730 horses were used by Indians of eastern Washington and adjacent areas. As in the case of the fur trade, the landscape had changed and so did Indian land use; however, in North America the change was largely confined to certain grasslands (Osborn 1983). This new type of land use, equestrian foraging, was characteristic of most Indians east of the Park Complex and adjacent areas when Europeans arrived and is that described by the earliest anthropologists working in the area (see

Schalk and Cleveland 1983). Indians living in the thickest forests of western and northern Washington were little or not at all directly affected by the horse (Ray 1933).

Compared to semisedentary foraging, the horse made it possible to habitually use and transport resources and camp gear much greater distances. Two horse foraging patterns have been noted east of the Washington Cascades. One involved increased reliance on winter hunting from dispersed winter settlements in foothills and the other involved formation of mounted, communal hunting parties that crossed the Rocky Mountains in order to hunt Great Plains bison (Anastasio 1975). Such parties were large and often joined Indians from distant regions with different languages and ethnic backgrounds. With the aid of the gun, sold to northern Indians by the Hudson Bay Company in the late 1600s, large quantities of dried bison meat and hides were obtained. It has been suggested that bison were more plentiful at this time than at any other in the Holocene because of the increased productivity of the plains grasslands during the Little Ice Age (Reher and Frison 1980).

At the time the first Europeans reached the Northwest from inland, these being, the Lewis and Clark expedition in 1805 and David Thompson's travels in the late 1700s, they experienced a mixture of semisedentary foraging and horse foraging land use patterns across the Northwest's grasslands and forested mountains. Although it had been practiced for only about seventy years by AD 1800, the horse foragers by this time had been making regular trips east to get bison (Anastasio 1975; Walker 1968). However, in Washington, another major change, started by European introduced smallpox, had preceded Lewis and Clark by about twenty years (about AD 1775):

> The destruction was greatest in the Columbia Valley, which as the main artery of travel and trade was peculiarly exposed to epidemics, and within a few years the greater part of the once teeming populations of the lower valley were practically wiped out of existence (Swanton 1952:413).

The effects to Native American land use were so devastating that one historian has described these epidemics as "an insidious form of unpremeditated biological warfare" (Munford 1979:7). On the Northwest Coast, Europeans arrived by sea starting in the late 1700s and immediately changed Native American land use patterns by involvement (with eventual control) in the already highly developed distribution system of Northwest resources (Wolf 1982). Cultural changes involved pervasive readjustments in the way resources and wealth affected kinship, ceremonalism, class ranking, and many other strategies related to the control of production. The fur trade, which influenced many Indians west and north of the North Cascades (Swanton 1952:413), ended after the middle 1800s. An interesting aspect of this new Native American land use, both maritime and inland, was the differences in control of resources and wealth resulting from the unequal distribution of guns. For a long time, bison hunters of the inland Northwest were thus affected by the Blackfeet who controlled grasslands of the northwestern Great Plains; sedentary foragers west of the Cascades were similarily influenced by slave raiders, such as the Nootka, from north of Puget Sound.

The ways that Indians living in the North Cascades used the land were also changed by all this. They too suffered population decimation from

European diseases, but they never supplied furs to the Europeans and they did not become horse foragers. After Alexander Ross' difficult trip across Cascade Pass in 1814, the North Cascades were left alone until mining began. Until that time, mountain people on both sides of the North Cascades were probably most strongly affected by events in the adjacent lowlands through their long-standing role as traders. It is also possible that population decimation caused some camps or villages to be abandoned. However, not much is known about those Skagits, Nooksacks, Chilliwacks, Thompsons, and Chelans who used the Park resources in early historic times. These people were not often visited by the early explorers, military expeditions, and naturalists, all of whom traveled easier routes through or around the mountains. Although the lower end of Lake Chelan is only about 4.8 km (3 miles) away, many early Euroamericans traveling the Columbia River were unaware of its existence or knew of it only from Indian informants. Relatively few Chelan Indians were seen along the Columbia River in this period because they spent most of their time along the lake and adjacent mountains (Smith 1983).

Between 1840 and 1850 Euroamerican land use became much more intensive. By this time the fur trade had nearly ceased to exist, but missionaries, government exploring parties, and gold miners had begun to use the land. Changes in land use were rapid. By 1880, the earliest Euroamerican settlements were in the lowlands, a larger military force had subdued Indians resistant to change; soon most Indian use of land was confined to reservations; and territorial governments assumed control of most of the landscape. After 1880, agricultural and industrial use of Northwest resources intensified and quickly changed the landscape.

Archaeological historic Indian sites are rare. They often are recognized by the presence of glass trade beads, iron and copper, gun flints, and clay pipes (Bordon 1970). The sites are not deeply buried and are easily disturbed by ground disturbing activities. As might be expected, cemeteries and burials are common for this time period (Sprague 1967).

A brief review of the last couple thousand or so years of land use changes will put the last century into context. Sometime after 3,000-2,000 years ago populations on both sides of the North Cascades may have been bigger than any time before or since, according to crude estimates. After 1,000 or so years ago, lowland populations around and presumably in the Park dropped and Indians changed the ways in which they used the Northwest landscape. The regional climate went through a series of short-term fluctuations, especially during the Little Ice Age. The densely glaciated Cascades at this time probably influenced use of mountain resources, especially along glacial rivers, all around today's Park Complex. The intensity of land use appears to have decreased. Before the glaciers retreated by the mid-1800s, most of this already reduced population had been nearly exterminated following European contact. Some of the Indians who survived, <u>in a lifetime</u> probably saw more intensive use of Northwest resources and more rapid changes in patterns of land use than had occurred in all the Indian lifetimes of the previous 3,000 years.

As had happened earlier (during prehistoric intensification in forager land use), the Northwest landscape reacted, but this time much more quickly than ever, except perhaps during earlier periods of strong and rapid climatic changes. Even by AD 1805, "vicious exploitation" of sea otters along the coast had so reduced their numbers that the trade soon ended (Buechner 1953:160). Between about 1750 and 1850, only remnant populations or signs of their recent disappearance, could be seen of pronghorn antelope, mountain sheep, mountain goat, and bison. These animals had already begun to dwindle in number before the European invasion and the combined effects of horse foraging and European land uses caused local and regional extinctions in them (Buechner 1953; Schalk and Cleveland 1983). As Europeans took control of the landscape, Indian burning of forests and meadows ceased, and the effects of this were seen in the decreased productivity of Indian staples and Northwest habitats (Buechner 1953:161). Changes in the pattern of forest burning might also be recorded in lake bottom deposits and other places where plant pollen is preserved (Peter J. Mehringer, Jr., personal communication). After 1880, landscapes changed fast as Euroamericans intensively used the Northwest's most abundant and accessible resources first. West of the Cascades, this began along Puget Sound with logging and the settlement of Seattle. Interestingly, studies of pollen from the bottom of Lake Washington show this history of settlement, beginning with only minor vegetation changes between 1860 and 1890, when logging began. After this, the townsite was cleared of trees around the lake as shown by early photographs and abrupt decreases in evergreen tree pollen, and increases in native deciduous trees and shrubs, especially alder (Davis 1973). The relative amounts of pollen even show that some town districts, such as Mercer Island, were allowed to revert to forest after logging. Starting around 1916 plantain pollen is found in the lake bottom; in eastern North American and Europe such pollen is associated with intensive agriculture. Changing land use during the growth of Seattle is also reflected in other chemical and biological changes in lake sediments after 1916 (Davis 1973).

The productive Northwest steppe and grasslands east of the North Cascades also reacted quickly to new land uses. In earlier times, they had supported antelope, deer, elk, bison, and Indian horses and were described as beautiful and lush (Stevens 1855). This productivity was quickly tapped. Small numbers of cattle were brought to the Northwest starting in the late 1700s and by 1860 there were 200,000 in Oregon and Washington Territory, three times the number of people (Galbraith and Anderson 1971). At Wildcat Lake in the grasslands of eastern Washington, pollen and sediments from the lake bottom showed that vegetation changes after grazing began in the late 1800s were greater than any in the previous 1,000 years (Davis et al. 1977). Ranges were soon overgrazed, deteriorated, and eroded (Galbraith and Anderson 1971; Davis et al. 1977; and Bartholomew 1982). Northeast of the Park, lake deposits in British Columbia show changes in the amounts of grass and sagebrush as a response to different burning patterns during settlement in the 1800s. Soon, competition between two similar uses of the grasslands, sheep and cattle grazing, resulted in struggles for control of the resource. As happened during earlier land use changes, weapons were used in attempts to control resource use. In the early 1900s, thousands of sheep were shot as "The Winchester ruled the range" (Galbraith and Anderson 1971:11). Grazing was not confined to lowlands, however, and alpine areas in many Northwest mountains were quickly overgrazed. Grazing was not controlled until after 1910 in this country and 1919 in British Columbia (Galbraith and Anderson 1971).

Use of the grasslands intensified, and by 1895, most of the tillable Palouse was plowed and planted to wheat, barley, and oats. Erosion became recognized as a problem by 1905; by 1920, gulley, sheet, and rill erosion was well underway (Kaiser 1961). A series of changes in the topography of the grasslands had begun. Many streams deepened their channels or eroded and widened their flood plains, requiring bridges to be built where earlier none had been needed. On northeast facing hill slopes, where snow packs are deepest, erosion made them steeper (Victor 1935). And like happened during a drought almost a 1,000 years earlier when Clear Lake dried up (Bartholomew 1982), the water table dropped:

> In a great many places, particularly near the eastern mountain boundary of the area, bottom lands and small meadows formerly were considered too wet to farm. When headward erosion of a stream had advanced through these meadows, the lowering of the water table permitted them to be farmed (Victor 1935:18).

These meadows were the habitat of camas, the wild lilly whose bulb was a staple for Indians throughout the Northwest. This fact is preserved in the widespread geographic occurrence of "Camas Prairie" place names in Oregon, Washington, Idaho, and Montana. More than one "Hog Heaven" was so named for the food it provided to the settlers' pigs, which quickly rooted out the nutritious bulbs.

Although the high productivity of the watered part of the Northwest landscape was obvious to the Euroamericans, its use was at first limited to fur bearing sea mammals and whatever fish and other aquatic foods that could be eaten or stored. Indians for at least 5,000 years had stored salmon by drying it and so did the Northwest pilgrims of the late eighteenth and early nineteenth centuries. The storage life of salmon meat is shorter in the wet climate west of the Cascades and longer in the drier climates to the east. Also, storage life gets longer as the oil content of the fish gets lower. Salmon that run far inland have the lowest oil content and because of this difference, were traded to Indians west of the Cascades (Gibbs 1877:170).

Intensive Euroamerican use of salmon began after salt was used as a fish preservative. A saltery for this purpose started in the late 1820s at Fort Langley on the Fraser River, not far north of the Park. Other salteries were soon started and by the mid-1800s, salt-preserved salmon from the Columbia River were being shipped to Hawaii, Chile, and the east coast (Netboy 1980). The use of salmon meat intensified with the replacement of salt preservation by canning in 1866. By 1890, numerous canneries west and south of the North Cascades had depleted Chinook and other smaller salmon. Fish productivity of both inland and coastal waters decreased steadily into the mid-1900s.

As Euroamerican land use intensified in the last 100 years, many more natural resources were used than the ones discussed here. As may have occurred in prehistoric times, historic use of the mountainous Northwest resources was regulated by supply routes and demand. Water routes along the coast and Puget Sound, and the openings of rivers draining the western Cascades were generally easier for moving commodities and resources than east of the Cascades, where river routes were interrupted by portages around falls, such as at Celilo on the Columbia River, by narrow canyons such as the Dalles on the Skagit River (Stewart and Bodhaine 1961:29), by numerous rapids and other topographic features of the rocky river bottoms, and by a grassland, steppe, and forest mosaic of high overland routes between drainages. Use of trails and overland roads was gradually replaced first by steamboat navigation up major rivers and then railroads. However, transportation and resource use became difficult approaching the interior of the North Cascades. Even the lowlands west of the Park were at first impenetrable to Euroamerican use except in canoes piloted by Indians (Coleman 1869). For example, the first inland settlement on the Skagit (the second largest river in Washington state) in 1870, was near Mt. Vernon. Upstream navigation was blocked by natural log jams until they were removed 1876-1877 by local settlers (Drost and Lombard 1978). After this, the founding of supply centers moved quickly inland, with the townsites of Burlington (1882), Sedro-Woolley (1884), and Concrete, Rockport, and Marblemount in the 1890s. Again, the more intensive land use triggered a landscape response. Clearing the log jams caused much flooding and damage to downstream settlements and farms until they were later controlled by large-scale levees and hydroelectric reservoirs (Drost and Lombard 1978:5). Supply lines through the interior were difficult to establish. South and east of the North Cascades, the main route was the Mullan Road. Begun in 1858 near Walla Walla, then head of Columbia River navigation at the eastern edge of the inland grasslands, this wagon road traversed the mountainous interior for hundreds of miles, across the Continental Divide, to another supply center at the head of navigation on the Yellowstone River in western Montana. These centers supplied mining operations of the interior mountains, especially gold.

Few Euroamerican supply routes have been built into the North Cascades, whose landscape charges a high cost to intensive users. Because the North Cascades were considered a barrier to commerce, the Washington legislature in 1895 appropriated money to build a road across them. By 1896 the "road" was completed across Cascade Pass but it was little more than a pack trail. Although marked on some maps as "Cascade Wagon Road" no wagon is known to have crossed it (Murray 1965:54). In spring of 1897, a year after construction had begun, the road had been made almost impassable by slides and washouts. Cost was more than $85,200 (Murray 1965:54). No more roads were built over the pass. In 1930, the Stevens Pass road, which crossed the North Cascades south of the Park, was opened. One of the most difficult routes used to get into the North Cascades interior was through the Skagit River Gorge above Newhalem. During the 1880s goldrush, the trail through the gorge was treacherous due to snow avalanches, and mud and rock slides. At one spot, a fixed ladder was used to scale a forty foot high rock face before the trail continued (Pitzer 1978:3). This trail, with some improvements, was used by settlers for many years. Eventually, transportation problems through the gorge and into the interior were solved with completion of a road in the early 1960s connecting Newhalem and Thunder Creek. Interestingly, the gorge like many other prominent physiographic features in the mountains, still forms a land use boundary. Today, the gorge itself and all of the Skagit River drainage above it is used for water storage, recreation, and wilderness. Below the gorge the valley is used for recreation, wilderness, settlement, and agriculture.

The Modern Period of Land Use

Beginning in the 1920s, Northwest water resources started to be managed more intensively than ever before. The first major dams built in the

Northwest, between the late 1920s and 1930s were either in or near today's Park Complex. These include Diablo Dam (Skagit River gorge 1929), Chelan Falls Dam (at the lower end of Lake Chelan, 1927), Rock Island Dam (on the Columbia River below Wenatchee, 1933), and Ross Dam (Skagit River above the gorge 1940) (Mermel 1958). The water impounded behind these dams flooded the valley bottoms and sides, and with these the traces of all previous land use patterns, including the geologic record of climatic and environmental changes.

About this same time began scientific study by anthropologists (which includes archaeologists) of the few living American Indian people and their earlier cultures. The first few studies began in the 1890s and were exploratory and descriptive accounts of Northwest Indians (Willey and Sobloff 1974), especially those west of the Cascades. Scientific interest in Indian people generally came from outside of the Northwest (such as from the Smithsonian Institution in Washington, DC, from eastern colleges, or from museums) because regional academic institutions here were just becoming established. Study of Northwest Indians and archaeological sites began in the 1930s, but not before the earliest reservoirs flooded traditional Indian homelands. Through the Historic Sites Preservation Act of 1935, the federal government gave the US Department of Interior authority to manage archaeological and historic sites (King et al. 1977). The first anthropological studies designed to precede flooding of valley segments were associated with Bonneville Dam on the lower Columbia River (Phebus 1978) and Grand Coulee Dam on the upper Columbia River (Hudson et al. 1942).

As these and other anthropological studies got going, the Northwest coast, Plains and other regions with distinctive and "complex" cultures including well-developed art forms, drew the interest of professionals. The dry interior east of the Cascades was considered marginal and "it failed to develop any great amount of culture of its own," (Kroeber 1939:55). It was considered to be "purely a transitional culture. Its elements were drawn in nearly equal proportion from the Plains and from the Pacific coast" (Spinden 1908:150). One anthropologist who studied Indians east of the Cascades disagreed (Ray 1939). He said the interior was distinctive and had cultural aspects not found in adjacent areas, and that many of the similarities between Indians east of the Cascades and adjacent areas developed in the last 200 or so years. By studying a small group of Indians little affected by the horse and living on the northern fringe of the unforested interior (the San Poil and Nespelem Indians), Ray described what Indian life was like east of the Cascades before the time that Europeans arrived (Ray 1933). However, he did not discuss aspects of prehistoric land use that occurred even a 1,000 years ago because anthropologists of that time questioned that Indian people had been here that long and little was known about North America in the times before Europeans arrived.

By the mid-1900s studies of Northwest Indians were well underway, especially east of the Cascades where a few archaeological sites were dug before each reservoir was impounded. In order to make sense out of what they dug, Northwest archaeologists compared the artifacts and features they found with the written descriptions of early historic Indians; they thus used ethnographic analogies to interpret prehistoric artifacts and sites. Eventually, Ray's description of the San Poil and Nespelem Indians became the model used by archaeologists to explain Indian land use for large areas of the interior and it was believed that the model "could, with the only exceptions being minor details, fit the entire Plateau culture area" (Lyman 1978:12). According to present knowledge about Northwest landscapes and prehistoric forager land uses, such a view oversimplifies the complex relationships between resources and subsistence activities, and is not useful for understanding Northwest prehistory.

As this review has suggested, Indians may have undergone significant changes in adaptions to Northwest environments over the 2,000 or more years before Europeans arrived. Land uses changed much more drastically and dramatically after they arrived. By the time anthropologists began to study Indian people, most were living on reservations and were participants in twentieth century cultures. The impact of these changes and the changing popular view of Indian people generally had an impact on Northwest anthropology. Verne Ray's oldest Indian informant, for example, was born about 1840 (Ray 1933:4), well after the occurrence of European-induced changes. During the early nineteenth century, popular opinion in this country was that an ancient race of people once inhabited North America and built the mounds of the Ohio and Mississippi River basins; American Indians or their ancestors were not even considered capable of having built them (Willey and Sabloff 1974:44). This question was of popular public concern well into the 1890s (when the first Northwest anthropological studies began). From a strictly anthropological viewpoint, historical and political events during the nineteenth century served to destroy most of the Native American culture and lifeways that came to be studied by later anthropologists. Ironically, in the same era that Thoreau pondered the burned rocks and hunting related artifacts in his bean field near Walden Pond, the US military forced the migration of large numbers of Indians from their southeastern homelands to reservations in Oklahoma, and missionaries began their intensive efforts to Christainize Northwest Indians. At the same time that Isaac Stevens was negotiating treaties to place Northwest Indians on reservations in 1855, "debates leading to a war to free slaves were taking place in the Senate Chambers in Washington, D.C." (Booth 1971:3). Even Darwin, in <u>The Descent of Man</u> (1873), adhered to ideas that viewed native people as representing earlier stages of human development (Stocking 1968:114). Generally, conceptions of the Indians as primitive served the larger purpose of westward European migration through destruction and displacement (Willey and Sobloff 1974:48). These historic facts and forces are noted here because it is only through their recognition that we can begin to understand the limitations in the knowledge about American Indian people and how it was acquired by anthropologists in the twentieth century. These limitations have biased the ways that archaeologists have viewed and interpreted prehistoric archaeological remains, but future refinements in anthropological methods and theories will certainly overcome some of these (cf. Hamilton 1982). This position has been strongly argued by Dobyns (1983:26):

> In short, most of the anthropological literature that refers[39] to an ethnographic present may be termed "divorced from reality." No such cultural phase existed; ethnographies written in the ethnographic present are like paintings of extinct birds based on hearsay and on the artist's imagination. The methods and techniques traditionally employed by ethnographers are not capable of recovering from a very small handful of survivors an accurate portrait of societies that have not functioned for decades--and in

many instances centuries--prior to the arrival of an ethnographer. Field workers who thought that they were describing stable cultural patterns to use as baselines for comparison and analysis of acculturation actually inferred a stability of precontact culture that had not existed. Demographic and consequent changes began in 1520-1524, and continued depopulation generated cultural changes that were often of a very fundamental order. These changes can be accurately studied with the techniques of archaeohistory and ethnohistory but not with those of traditional ethnography.

Summary and Conclusions

At present, the prehistory of the North Cascades is only very sketchily known. This general and sometimes speculative understanding of how humans have used the North Cascades environment since the last major glaciation is based mostly on knowledge gained from studies of archaeological sites from widespread areas outside of the Park, from theoretical ideas about hunter-gatherer adaptations, from descriptions of historic Northwest Indians, from reconstructions of changes in the prehistoric Northwest environment, and from the few known archaeological sites within the Park. It is unlikely that Park lands were used by prehistoric people earlier than about 12,000 years ago. Any such foragers probably hunted the abundant late Pleistocene game animals and supplemented the meat with a wide range of local plants and animals. Population densities were very low and such foragers left few scattered camps. The tundra-like vegetation and newly deglaciated landforms would contrast strongly with the appearance of the Park environment today. Although there were numerous fluctuations in climate, the maritime influence on the west side of the Park between 12,000 and 8,000 years ago tended to be warmer and moister than east of the Cascades. Archaeological sites representing this time period are unknown from within the Park boundaries.

The post-glacial climate continued to change and by 8,000 years ago many of the large game animals had become extinct. The composition and distribution of Northwest forests and other vegetation communities changed and so did the local resources available for human use. While coastal areas remained relatively moist, portions of the interior by 6,000 years ago had become warmer and drier than anytime since the last major glacial episode began, more than 15,000 years earlier. By about 5,000 years ago sea levels had stabilized and the warming and drying trend in the interior had moderated. It is uncertain as to how foragers adapted to these changes. On the one hand there seems to have been a more balanced use of the wide variety of resources available in the various inhabited Northwest environments, coastal and interior, yet at the same time, there seems to have been a greater dependence on the most abundant locally available resources. These included marine mammals and fish on the west side and terrestial mammals, fish, and plants on the east. Presently, only one site in the Park is known to possibly date to this time period between 8,000-5,000 years ago. This is a large hunting site in the Hozomeen vicinity of Ross Lake.

Beginning sometime after 5,000 years ago, foragers living on either side of the Park lands became more sedentary than they had been during any previous time. It is during this late prehistoric period that there appears the first archaeological evidence for relatively large aggregates of people living in large, seasonally occupied villages and communities. There developed a high degree of dependence on the great variety of food and utilitarian resources of the habitats within each group's territory, especially those that were most abundant and that could be stored for winter use. During the last few thousand years of this period, prehistoric populations in the Northwest may have been larger than at any time before or since. Archaeological sites are numerous and contain a variety of features and artifacts. Well-developed trade networks made food and utilitarian resources from widely separated environments available to populations in widespread regions of the Northwest and beyond compared to earlier prehistoric periods. Social complexity increased and began to show similarities to the cultures described during the historic period by European observers and living Indian people. The climate during the late-prehistoric period became cooler and moister, not unlike today's overall environment. There were, and will probably continue to be, short-term and abrupt fluctuations to warm and dry or cool and moist conditions, and in some localities these may have had profound effects on prehistoric populations. Also during this period, the intensive use and manipulation of the landscape and its resources was great enough to have left environmental effects that can be measured by detailed studies of certain aspects of the landscape's natural history. Although dating of the known archaeological sites within the Park is a problem, many of them appear to date within the period between about 5,000 and 200 years ago.

The historic period, beginning with the large scale invasion of the Northwest by Europeans, marks the appearance of extreme changes in how humans used the landscape. Abandonment of prehistoric land use patterns by Indian people and adoption of new ones rapidly followed such events as the introduction of horses, near extinction of Indian populations by European diseases, and the very intensive economic exploitation of the Northwest's abundant resources. These and many other changes had either run their course or were well underway before Indian lifeways became the objects of serious concern and study by modern Euroamericans. None of the known archaeological sites within the Park appear to be historic in age.

The review of prehistory as presented in this chapter has drawn attention to certain general patterns in human use of the Northwest landscape. It was also suggested that at a very general level, these patterns may apply to historic as well as prehistoric land uses. On the one hand, recognition of these patterns at such a general level reflects at least tacit acceptance of the idea that archaeological sites and the portion of human history and evolution represented by them are not unrelated to our lives today. However, the extent to which these can be used as general principles to provide insights into understanding the interactions of people with their environment or help to assess the future of these interactions, remains an open question. Two of these principles are summarized as follows:

1. Most often, the use and control of mountain resources is by the much larger populations residing in nearby lowland populations than it is by local mountain residents. From the perspective of the North Cascades, the largest populations always resided to the west, along Puget Sound and the Strait of Georgia.

2. There is a reciprocal relationship between components of the landscape and their use by cultural systems. Each affects the other. The more intensive the land use, the greater the potential response by the environment. Alternately, abrupt and extensive environmental changes, such as sometimes accompany changes in climate, have potentially significant effects on land use patterns.

CHAPTER 5

ARCHAEOLOGICAL RESEARCH DESIGN

Introduction

The purpose of this research design is to assist future archaeological work in the North Cascades Park Complex, whether this be site inventory, problem oriented research, or planning for undertakings such as road or campground construction. The guiding assumption is that archaeological sites and their remains have important scientific, ethnic, and Native American significance when viewed in appropriate contexts. The research design tells how archaeological sites and the data they contain are related to these values and so provide an answer to the question: why is the site important? Once the reasons for a site's (or a category of sites) significance are known, then a basis exists for deciding how the site should be managed. The adequacy of the research design rests in its ability to insure that all Park archaeological resources, whatever their manner of discovery, size, location, or type, can enhance understanding of the North Cascades, regional prehistory, and human use of mountainous environments. Potentially, this knowledge has relevance to populations living in or adjacent to the North Cascades today, i.e., to contemporary land use.

This chapter is designed to address three requirements stated in the Request for Proposal (US Department of Interior 1984):

1. stratification of the Park Complex into cultural or physiographic units that will aid archaeological research and management,

2. a strategy for predictive modeling to guide site management, yet be flexible enough to incorporate new information, and

3. a strategy for archaeological inventory to be used over a period of many years.

From an anthropological viewpoint, mountainous environments are distinctive landscapes presenting a complex and interrelated set of environmental problems to the human populations that inhabit them. The research design developed here assumes that the North Cascades environment was used for thousands of years by prehistoric people with a subsistence economy based upon the hunting, gathering, and fishing of natural resources. The different ways in which prehistoric people settled, traveled through, and utilized the landscape and its resources are called land use systems. But landscapes and land uses are not constant, and cultures over the last 12,000 years have undergone a series of evolutionary changes (Schalk and Cleveland 1983). Similar changes are known to have been widespread around the world, so that Park archaeological resources and the information they contain are not seen in isolation, but have relevance to a large portion of western North America and other north temperate regions.

In this chapter, a method is described wherein Park landscapes and their archaeological remains can be related to the broader problem of human adaptation to mountainous environments. This is done by developing a generalized, nonexplanatory model of land use and site location of the North Cascades according to a series of zones. The model is based on results of ethnographic and archaeological research within and adjacent to the Park, on archaeological and anthropological studies from other mountainous areas, and on selected studies from different scientific fields. The model is used to discuss known and unknown (but expected) archaeological sites within the Park boundaries and to show their potential scientific values. It does so by providing a basis for finding new sites, determining their importance, and deciding how to manage them.

Human Use of Mountainous Landscapes

Studies of human use of mountains are few and little is known about the prehistory or cultural ecology of most mountainous areas, especially the high relief ranges of western North America. Most studies of mountain populations have so far been concerned with high altitude adaptations, defined as occurring above 2,500 m (8,200 feet) elevation, the point at which decreasing oxygen becomes important to human physiology (see Pawson and Jest 1978:18). Also, most such studies are of food producing, mixed agricultural-pastoral land use systems (Rhoades and Thompson 1975). Studies of forager use of glaciated, steep mountains in north temperate environments, such as the North Cascades, are virtually nonexistant.

Mountainous environments can be defined in many ways. In this report, they are defined by the general characteristics that distinguish them from other kinds of landscapes (cf. Rhoades and Thompson 1975; Thomas 1979; Moran 1982). These are:

1. land masses that are elevated above surrounding plains, plateaus, and oceans;

2. from bottom to top there is a sequential arrangement of climatic, vegetative, and biotic zones;

3. distinctive landforms show the dominance of geologic processes that move materials downhill according to relief (steepness of slope);

4. daily and seasonal extremes of temperature and other climatic variables;

5. and fluctuating and sometimes unpredictable resources.

On a worldwide basis, mountains occupy about one-third of the land surface; about one-fourth of the earth's surface lies above 1,000 m elevation and contains about 10 percent of the world's population (Fedele 1984:688; Thomas 1979:142). In the northwestern US, mountains cover about 75 percent of the area (Booth 1971:4). However, most people don't live in the mountains, and in Oregon and Washington today, more than one-half of the population is concentrated in the Puget and Willamette lowlands (Northam 1979:19).

Although few mountainous areas anywhere have been studied by archaeologists, there is some evidence for their early prehistoric use. Perhaps the earliest archaeological record is from the Italian Alps and dates to the Mousterian period (Fedele 1978). These few sites, well older than 40,000 years, reflect a successful hunting adaptation by Neanderthal people having a middle Paleolithic stone tool technology. The use of higher alpine zones in the Alps and other mountains began 15,000-13,000 years ago (Fedele 1978; Price 1981). The highest sites found so far occur at elevations of 6,700 m (22,000 feet) in the South American Andes (Reinhard 1983). These sites, which are numerous, are Inca and pre-Inca in age and consist of rock-walled enclosures that appear to have been used for ceremonial purposes. This brief review of the archaeological record from mountains indicates generally a long standing ability of prehistoric peoples to cope, at least on a seasonal basis, with the problems posed by mountainous landscapes. For some mountainous areas, such as the Alps, severity of climate during most of the Pleistocene is not considered a limiting factor to human use of subalpine and foothill zones (Fedele 1978:322).

Modeling Human Use of the North Cascades

One way to begin study of prehistory of the North Cascades is by dividing the entire landscape into land use zones. In most mountainous areas, biotic or vegetation zones are clearly seen as bands or patches arranged along mountain slopes according to elevation. This pattern has been used often by naturalists, botanists and others to classify and study mountain plant and animal communities according to life zones. However, the life zone concept is not the best for understanding human use of mountains because it is only indirectly related to the main factors that control human interactions with the environment. An alternate approach is one that examines how the environment constrains the way human populations provide themselves with food and other critical resources and the ways in which small and large human populations organize themselves socially in order to do this (Guillet 1983:563).

The approach here uses the idea of production zones as the important link between the environment and cultural adaptations (Brush 1976; Soffer 1982; Guillet 1983). These zones are not always clearly visible and sometimes lack the more readily defined boundaries of plant or animal distributions for delimiting life zones. Instead, production zones are defined by cultural strategies used by human groups to get natural resources from mountain environments (Guillet 1983). Thus in many mountainous areas human groups have developed mixed strategies that use domesticated plants and animals (agri-pastoral economies) to exploit a number of production zones, such as alpine tundra and alluvial valley bottoms. However, in the case of the North Cascades and other western North American mountainous areas, no domesticated plants were used and the only domesticated animal was the dog. Here instead, a subsistence economy was practiced by foraging people that was based upon hunting, fishing, and gathering of naturally occurring resources. This required a detailed knowledge of game movements and behavior during each season of the year, of the availability and abundance of various plants and fishes, and generally of all of the various conditions that affect the availability of needed resources. Regardless of this basic difference between economies, the ways that mountain resources were used by foragers can be used to classify the land according to general zones.

In this chapter, the term "land use zone" is used to refer to spacially separate areas of the mountainous landscape classified according to physiography, subsistence resources, and the kinds of human settlement and subsistence activities that occurred there. These exploitation zones are modified and expanded from Watanabe (1968) to show the expected relationships between the North Cascades environment and how humans use it. The zones discussed below and mapped in Figure 5-1 are highly generalized and therefore show only broad patterns of land use. One way land use zones help to understand mountain adaptations is by making studies from different mountain ranges (or parts of the same range) comparable. For example, without detailed descriptions of the areas involved, it is difficult to compare archaeological sites in relation to resource use at 3,500 m (11,500 feet) in the Colorado Rockies with areas in the North Cascades at 1,700 m (5,500 feet). Yet, in both cases the sites are at or near upper timberline where prehistoric people made similar uses of the landscape. Absolute elevations above sea level are not useful when comparing land uses among widespread mountain ranges (Soffer 1982:397).

A zonal approach to the spatial classification of the land is appropriate, largely in recognition of the controls placed on cultural adaptations by the steep terrain and extreme climatic and biologic variability. By use of zones, altitudinal, climatic, geomorphic, biologic, edaphic, and hydrologic variables are considered in the management of cultural resources. Archaeological sites that may be eligible for inclusion in the National Register of Historic Places may occur in <u>any</u> zone.

Land Use Zones

In this section, the National Park Complex is divided into six zones. These are described beginning with the lowest in elevation and proceeding uphill from there. For each zone is described the geomorphology and environmental characteristics, the resources and other uses made of the zone by people, and the kinds of archaeological sites that are likely to occur in them. All portions of the Park area are covered by this classification.

It is possible for each zone to be subdivided into smaller units where necessary to understand human use of a particular area. This is important because every mountain range and the valleys in them may differ in the way they affect human use. For example, some very wide mountain valley bottoms may be covered with large areas of flat-lying glacial outwash terraces (Zone 3), whereas others may be narrow, with only small areas of Zone 3, but with extensive areas on either side of subalpine benches and meadows (Zone 5). In either case, the more expansive zone may be subdivided into smaller landforms and habitats to show details of intensive landscape use. In all low relief and low elevation mountainous areas and hilly uplands of Washington, Zones 5 and 6, as defined here for the North Cascades are not found.

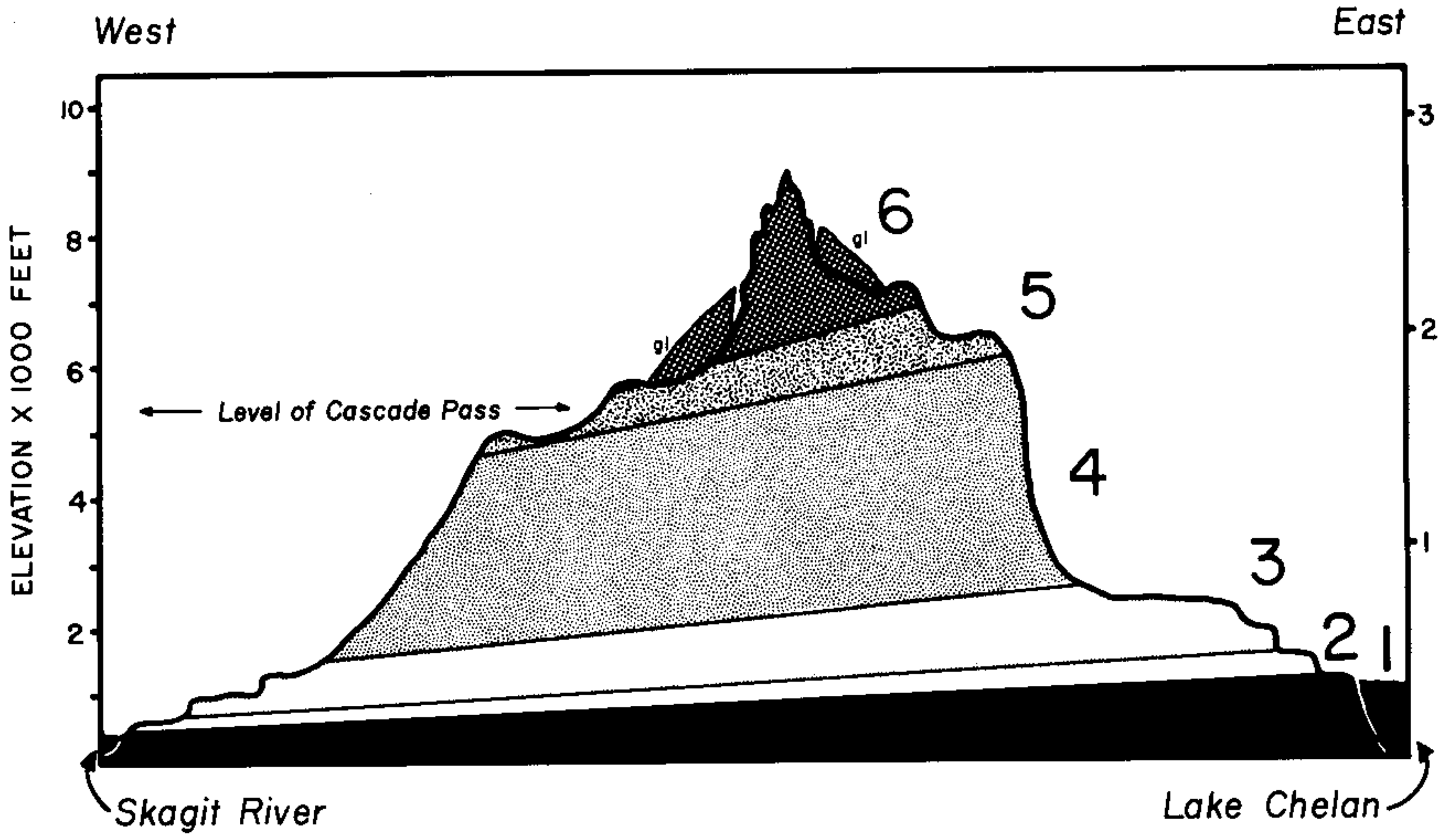

Figure 5-1. Schematic east-west cross-section showing the vertical arrangement of land use zones according to elevation and selected topographic features.

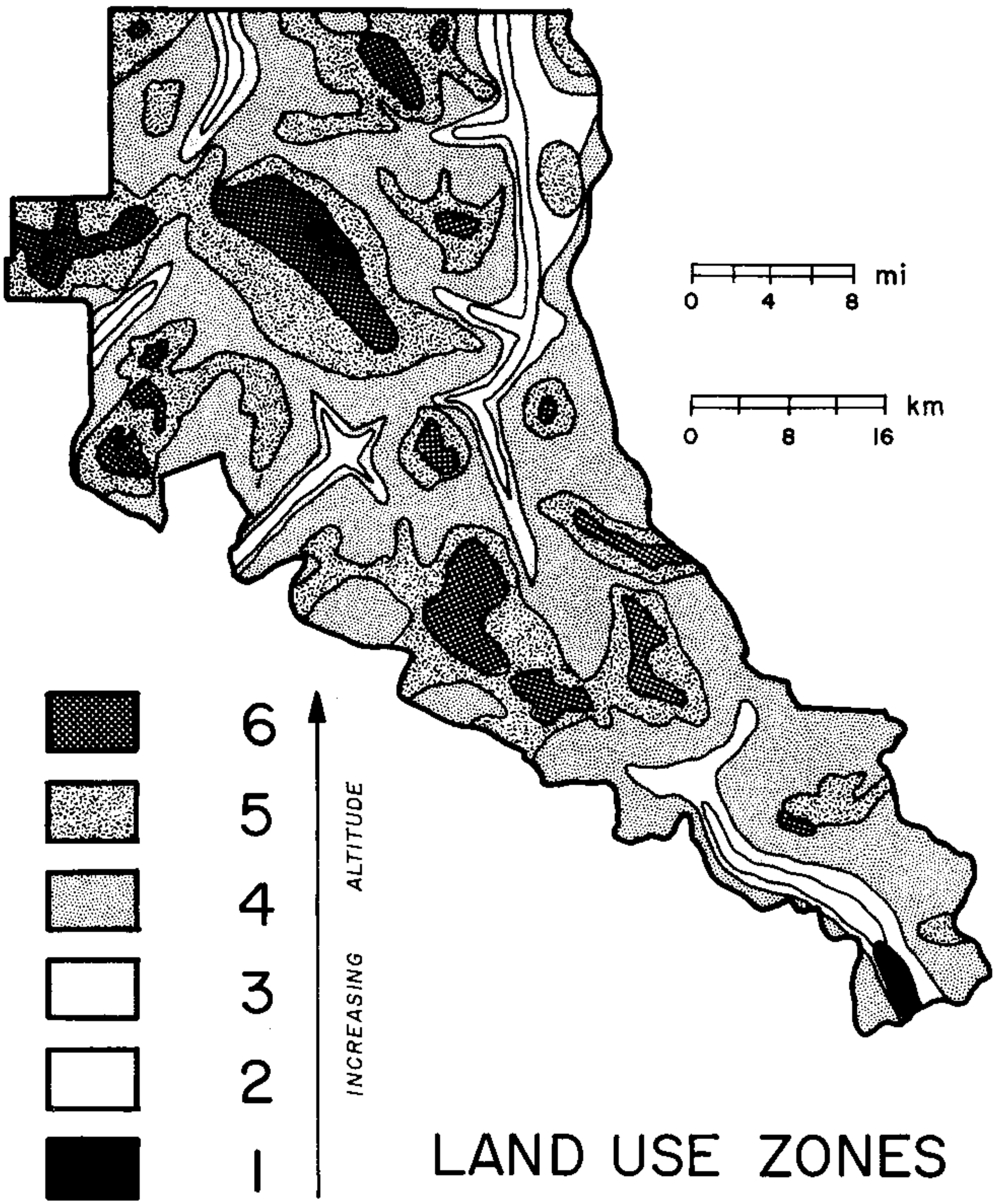

Figure 5-2. Schematic planview diagram of the Park Complex, approximating the distribution of the different land use zones.

These six zones are simplified and shown schematically for the North Cascades in Figures 5-1 and 5-2. As depicted, the zones approximate what are in reality complicated patterns of distribution. Figure 5-2, however, gives a rough idea of the makeup of the Park landscape by zone. They are described as follows.

River Channels, Lakes, and Their Shorelines--Zone 1

This zone includes river beds and lake bottoms and the water in them. Although most lake bottoms were seldom used because they were submerged, this is not true of lakes with fluctuating levels and shallow basins. Rivers, especially those draining the North Cascades, fluctuate seasonally and at different times uncover more or less of their gravelly channel beds. The width of the river channel and of the adjacent shorelines therefore change seasonally with the level of the river. For this reason, the boundaries of the zone are defined by an average river level and can be recognized in most cases by the absence of permanent vegetative ground cover, except for water-adapted riparian plants such as rushes, willows, alders, and others. This is the youngest zone and corresponds with the alder flats and gravel bars described by Fonda (1974) for a mountainous valley in the Olympic mountains.

Although this part of the landscape is often overlooked as a place used by people, its high resource productivity made it the center of intensive and sometimes elaborate land uses throughout the Pacific Northwest. Most of these are related to salmon fishing, but many other kinds of fish were used, including sturgeon, eulachon, trout, whitefish, squawfish, and others. Other important resources found here include shellfish, aquatic birds and mammals, and aquatic and riparian plants. In many areas, the river gravels from this zone were the source of the raw materials used to make chipped and ground stone tools (Flenniken 1978). For treeless environments, river driftwood may be the only source of structural materials for houses, fish scaffolds, drying racks, and related facilities. In virtually all but the steepest segments of upper drainages, rivers and lakes were the principal routes of travel and commerce.

Within the Park complex and its immediate vicinity, Lake Chelan and the Stehekin and Skagit rivers and their largest tributaries were most intensively used for fishing. Much of the human use of Zone 1 centered around the construction and repair of wooden and rock structures that were designed to concentrate fish in one part of a stream or lake in order to make them easier to trap, spear, or net. The construction and maintenance of these involved much woodworking. The structures were specially designed to use the shape of the river channel along with the water level and current flow in order to maximize fish production. The range of techniques and structures using rock and wood to fit such local conditions is impressive. Some of these are described in Ray (1942) and Stewart (1977) and include:

1. low dams built across rivers and made of stakes driven into the bed; brush, logs, and rock alignments;

2. tripods, scaffolds, and walkways built over and in river beds;

3. fences, baskets, and nets to trap fish;

4. wooden and stone walls used to control water and the fish in it through funneling, diverting, flooding, ponding, and draining, often aided by raising and lowering of rivers as controlled by tides or seasonal floods from melting snowpack or peak rainfall. These structures were often associated with others used to process the food, such as drying, smoking, and storage racks built along the shoreline or on the flood plain of the river.

Little is known about the archaeology of this zone, partially because the naturally high incidence of floods and their erosive power destroys or otherwise obscures structures and other physical remains. However, archaeological artifacts and features are occasionally found in this zone. Two such features have been reported within the Park, these being the canoes seen long ago at the head of Lake Chelan (Klement 1935:7) and the bridge across the gorge at Bridge Creek. This bridge was made of logs joined with cedar bark strips and ballasted with stones (Pierce 1883:20). Although apparently outside the Park boundaries, a salmon weir sixty feet long and made of stakes driven into the bed of the Nooksack River was observed in 1868 (Coleman 1869:799). Far north of the Park in British Columbia, remains of two fish weirs were found during an archaeological survey. The larger of these was over 100 m (330 feet) long and had been used to catch suckers and squawfish from one end of Eagle Lake (Alexander et al. 1985:111-112). Along some portions of the Northwest Coast, archaeological surveys have found hundreds of rock walled fish traps of various sizes (Pomeroy 1976). In extreme southeastern Washington, rock walls believed to be related to Indian fishing were found along the Snake River (Nelson and Rice 1969).

In most places, surveys to find archaeological sites in Zone 1 have not been done, or they are done differently than in other zones. In the inland part of Washington, some archaeologists believe that all artifacts and other remains seen along river shores have been eroded or otherwise disturbed by floods and are therefore not a useful source of information. However, in the semiarid south-central part of Washington, east of the Cascades, a survey was done along the Columbia River that included large areas of Zone 1. This survey described and recorded nearly all of the artifacts and features that were found along a 18 km (11 mile) stretch. A high density of artifacts and features showed intensive use of the river shoreline. These included hundreds of burned rock concentrations and scatters and thousands of tools made from the river gravels. Most of these show that this river marginal landscape was used mostly to catch and process fish, but other foods and resources from this zone were also used (Thoms 1983). Within the Park complex, somewhat similar kinds of artifacts and distributions (but in lower densities) have been found along the Skagit River shoreline between Newhalem and Bacon Creek.

The Flood Plain--Zone 2

This zone is bordered by the river banks on one side and on the other by the valley walls, or higher river terraces, or other landforms. In some cases, the inland boundary is not clear and may be defined by the average level of the one hundred-year or fifty-year flood.

In most Northwest river valleys, this is the most intensively used part of the landscape along with the adjacent parts of Zone 3. This is where permanent and semipermanent communities and camps were set up, either for summer fishing, winter habitation, or both. The permanence and intensity of use of floodplain segments depends on their stability (Swanson 1962). A large portion of daily and seasonal forager activities occurred here. A wide variety of plants, animals, and other natural resources from other zones were brought into this one because resources from more than one zone were used by large or closely spaced settlements.

Within the Park complex and most other areas, this zone has been studied more by archaeologists than any other. Because these are where the largest settlements were found, a variety of site types and artifacts reflect the different aspects of community life, including residential; ceremonial; food preparation, storage and use; manufacture of utilitarian items; cemetaries; and the collection of food and other resources (Nelson 1973). In the less used portions of this zone between settlements, there were connecting trails, temporary camps, access routes to other zones, and other special purpose land uses.

Intensive use of this zone is reflected in a diverse array of artifacts, features, and local alterations of the landscape. These include the following which have been described in detail and organized into elaborate classifications by archaeologists:

1. pits dug in the ground to be used as parts of houses, earth ovens, storage areas, sweat lodges, and menstrul huts,

2. above ground structures built over pits or used as sun shelters, drying racks, storage racks, and burial scaffolds,

3. cooking hearths and drying fires built on the ground,

4. scatters and concentrations of burned rocks, food bone scraps, broken and discarded tools, charred plant parts, and thick black midden (garbage) deposits containing mixed proportions of all of these,

5. cemetaries,

6. and rock art.

In eastern Washington, the remains of some of the largest individual settlements include well over a hundred large pits visible on the ground, most of which are believed to be from Indian houses (Osborne 1957, Cleveland et al. 1977). West of the Park, dense rainforest and its understory obscures house remains. In many narrow or rock-walled reaches of mountainous valleys, flat terrain is scarce so the few floodplain or lakeshore flats were important for use as semipermanent communities or temporary camps. Some of the flats that make suitable townsites are at the intersection of major rivers or overland travel routes, at major river crossings, at regular intervals along a major travel route, on the side of a valley that offers an advantage to certain resources (Flannery 1976), in a location that gets a lot of direct sunlight (Garnett 1937), in a well-drained place where the water table is low, or some combination of these. For example, in one such prominent terrace along the Columbia River opposite the mouth of the Chelan River, a 1,500 year old cache pit was excavated that apparently had been used to store a supply of meat (Mierendorf and Bobalik 1983). The size and shape of this cache pit, located at the junction of two strategic travel routes, was remarkably similar to those used hundreds of years later by early European explorers in the area (Thwaites 1959:Vol. II, 136-137; Irving 1976:201-202).

Park areas that might have been used for more or less permanent settlements are along the Skagit River below the gorge, near the head of Lake Chelan, and where the Chilliwack River leaves the Park. The present townsite of Newhalem was an early historic Indian settlement and may have been so prehistorically (Grabert and Chesmore 1979). One Indian informant has noted that habitations and villages were located all along the Skagit between Mt. Vernon and Newhalem (Blukis Onat 1980:28). A large site near the head of Lake Chelan (Table 5-1, No. 27) may also be the remains of a settlement. Generally, this zone of the Park will have the largest, deepest, and most complicated sites in terms of different kinds of artifacts and features.

It often happens that floodplain sites get buried or destroyed by river floods. The flood of 1948 destroyed prehistoric settlements along the Methow River, not far east of the Park (Swanson 1959). Digging archaeological sites that are in floodplains is often complicated by the many flood layers and erosion surfaces. Prehistoric artifacts and features are often buried to great depths. The rate at which some floodplains build up can be estimated from radiocarbon dates. A small cooking hearth found eroding out of the Skagit River bank (Table 5-1, No. 11) was buried by 1.5 m of river sands and it was dated about 475 years old, giving an average deposition rate of 0.3 cm/year. East of the Park along the Columbia River, 3 m of floodplain and alluvial fan deposits buried a butchering and meat cooking camp that was radiocarbon dated about 1,350 years old (Mierendorf and Bobalik 1983), giving a deposition rate of 0.2 cm/year. Along the Pend Oreille River of northeastern Washington, flood plain deposition rates measured between 0.6 and 0.26 cm/year (Mierendorf 1986). These rates do not seem fast, but it means that it is possible for a late prehistoric site, say one that is only 3,000 years old, to be buried 6-9 m (20-30 feet) below the surface at this rate of deposition and assuming no erosion. At best, these rates are meaningful only for the river segments from which they came and they should not be taken as representative of others. However, they do show that normal flood plain activity can deeply bury even young archaeological sites. River erosion can also totally remove archaeological remains from a floodplain; this is especially true of flood-frequent rivers such as those that drain the North Cascades.

Sites in this zone are some of the easiest to date accurately. One reason is that the rapid rate of depositon tends to bury charcoal before it is scattered and mixed. This also is true of volcanic ashes which have been used for many years by Northwest geologists and archaeologists to date landforms and the buried sites in them (Fryxell 1965).

River Terraces and Valley Margins--Zone 3

This is the area of flat to moderately sloping terraces, benchlands, alluvial fans, and other landforms between the floodplain and the steep valley sides. It is above the highest known floods and is generally well-drained (except where local and seasonal conditions keep the water table high). Most Zone 3 areas in the Park are in the lower and middle reaches of the Stehekin and Skagit Rivers, their main tributaries, alongside Ross Lake, and the lower Chilliwack River valley. In the widest Northwest mountain valleys that drained the Cordilleran Ice Sheet, this is a broad zone where multiple terrace levels formed as rivers downcut through their sediment filled valleys when glaciers became smaller in the early Holocene. On the tops of these terraces can be seen the remains of old river channels and bars of the earlier glacial meltwater streams. Sometimes these are dry, but in some cases the water table is kept high by bedrock just below the ground surface or other factors. When this happens, the zone in any particular valley can have a mix of different habitats, including lakes, ponds, bogs, marshes, and wet meadows interspersed with higher, well-drained landforms. Sometimes sand dunes are built on the old terrace surfaces. These varied local habitats and "geomorphic surfaces" have distinctive soils and other ecological properties that relate to archaeological site locations (McDowell 1984). The zone is productive of a variety of important food plants, such as Lomatium, tiger lily, salal, and many others. It supports waterfowl, upland game birds, small fur-bearing mammals, and large game year around, but especially in winter when deep snows cause deer and elk to yard in the valley bottoms (Schalk and Mierendorf 1984). Examples from the Park include the terraces and benchlands of the Hozomeen vicinity in the Ross Lake Recreation Area and the Coon Lake-High Bridge vicinity of the Lake Chelan National Recreation Area.

This zone in the Park was not likely used for semi-permanent habitation, but was intensively used for collecting plant, animal, and mineral resources, as trade and access routes to other zones, and for temporary camps associated with these uses. Camps are located according to the same criteria as Zone 2 settlements, however, as upstream valley segments get narrower and steeper, flats where streams meet or along travel routes to the main passes become important for sorting and repairing gear, caching supplies, and as base camps during resource collection from adjacent, higher elevation zones. Places in the Park where archaeological sites have been found in this zone are at the mouth of Bridge Creek, at the junction of Bridge Creek with its North Fork, and near the mouth of Little Beaver Creek and Hozomeen Campground along the edge of Ross Lake.

River terraces in this zone are older than zones 1 and 2. Age estimates from a study of one mountainous valley indicate terrace surfaces with ages of 400 to 750 years, with the oldest being post-Pleistocene (Fonda 1974).

Landforms in this zone change at different rates as compared with Zone 2. After the ice sheet melted away 12,000 or more years ago, the river beds cut down into the glacial deposits. This downcutting was probably complete 8,000-9,000 years ago, but this is a guess. If accurate, it means that such terrace surfaces could have been used by people for 8,000 or so years, and that any archaeological camps should be found close to the surface if deposition rates are slow after the river drops. Rates of artifact burial in such cases can be slow compared to active flood plains of Zone 2. If for example, 8,000 year old camp remains are found to be naturally buried under 50 cm of deposits, as may have occurred at the Hozomeen Site (Grabert and Pint 1978), the average rate of deposition after occupation would have been about 0.006 cm/year. Other kinds of landforms in Zone 3, however, may have faster deposition rates. These include alluvial fans, moraines, sand dunes, and other landforms that are sometimes rapidly formed and that can deeply bury archaeological sites. This happens in some areas of eastern Washington where prevailing winds sweep river sands from flood plains up onto older terraces and build dune fields. The depth at which sites in this zone are buried may vary drastically.

There should be clear differences in the archaeological remains found in this zone as compared with those in Zone 2 of the Park (in lower valleys outside of the Park, this may not be true). It is unlikely that house remains, middens, and other evidence reflecting semipermanent settlements will be found here. Instead, evidence should reflect hunting and butchering of animals, possibly fishing, collection and processing of plants, prospecting for and cleaning of local stone raw materials, and transportation of trade items across the mountains. In many cases, sites in this zone will tend to reflect the use of local resources and habitats. Examples might include earth ovens or pits used to bake roots near the meadows where they were dug. Stone chipping debris should show experimentation with and use of rock types found nearby. In these same areas, some camps (especially hunting and travel camps) will have broken tools and chipping waste made from high quality rock types from distant sources.

Valley Walls and Forested Mountain Slopes--Zone 4

This zone mostly consists of forested, steep valley and mountainside slopes. It also includes those narrow upper parts of stream valleys where avalanching, talus formation and other types of deposition below steep slopes is the dominant geologic factor along the valley bottom. Landforms in the zone are influenced by rock and snow avalanches, some ice falls below glaciers, mudslides and debris flows, soil creep, talus accumulation, and related downslope movements of materials. Within the Park this zone covers more area than any other.

Most generally, habitats in this zone were less used by people than the others so far discussed. Access was by game trails, many of which were along the network of ridge crests and other topographic features. Prehistoric uses centered around plant collection, hunting, and rock quarrying. Although travel routes crossed this zone, temporary camps are less common and are not naturally preserved for long. Where there are small areas of level terrain, such as saddles, bedrock spurs, and other restricted areas of low slope, there are likely to be sites (Marvin 1985; Reagan 1985). In historic times, traveling through this zone made the approach to Cascade Pass from either side of the mountains difficult, especially with horses. Attempts at road construction through this zone early in this century were unsuccessful (Murray 1965). The upper boundary of the zone is variable, but it occurs where the closed montane forests begin to open into subalpine meadows below the modern timberline, or at young unvegetated moraines, glaciers, or bare rock walls.

Archaeological remains here are difficult to find. The forest and understory vegetation combined with downslope movements either obscure, bury, scatter, or destroy the evidence. These factors are less severe on flat terrain and the likelihood of finding archaeological sites on them is greater.

Near Timberline--Zone 5

This zone is difficult to describe because it is less regular in shape, having a patchy and in many places discontinuous distribution. Human use of this part of the landscape is very much controlled by physiography, extreme relief, bedrock forms, and local habitats. Vegetation of the zone varies from subalpine forests interspersed with wet meadows, rock basins, and rock buttresses, to the upper limit of alpine tundra. This zone marks the regional upper timberline and may be comparable to the lower regional timberline for its ecotonal importance. Where trees grow or don't grow in this zone is controlled by length of time that deep snow covers the ground during the short growing season, wind, and other localized environmental conditions (Brooke et al. 1970). Small tree groupings and even their individual shapes are adjustments to harsh conditions, so that no clear timberline exists (Arno and Hammerly 1984). During the short growing season in this zone, surface water is abundant in many habitats while others are well drained. Traveling through these habitats and use of their resources, especially below larger glaciers, is influenced by the amount of water released from melting of ice. Melting is extremely variable from year to year and during the warmest part of summer, night and day differences can be extreme. Stream crossings made early in the morning are often impossible in the warmth of afternoons.

Landforms in this zone are as variable as the vegetation. They include ones from glacial erosion, such as aretés, cols (which are often used as passes), rock buttresses, and scoured rock basins (often containing cirque lakes). Depositional landforms include moraines (below the Little Ice age ones), solifluction lobes and terraces, protalus ramparts, and others formed at or near glacier margins. This zone includes a distinctive type of Park terrain that has been called "alp slopes":

. . . inclined meadow benchlands (alp slopes) at that level on the banks and buttresses of higher peaks. These include floors of many small Ice Age cirques. Many such timberline benches have moderate slopes, which contrast with steeper lower canyon walls. High alpine gradients and steep subalpine canyon walls allow wastes to be transported freely downslope by avalanche, stream transport, and solifluction, whereas detritus accumulates as a substantial mantle on the alp slopes. Such meadow slopes likely developed very slowly, and they have been moderated by frost-caused creep (Beckey 1973:7).

Much use was made by historic Indian people of the resources from this zone. The main ones in the North Cascades included goats, sheep, deer, elk, bear, marmots, ptarmigan, roots, berries, medicinal plants, possibly fish (?), and rocks such as chert and possibly serpentine. A more thorough listing of these is given in Allan Smith's companion volume. Some archaeological remains showing prehistoric use of these resources are present in the North Cascades and in alpine environments from mountain ranges all around the western USA and Canada. Relative to the North Cascades, examples of this are found in the Olympic Mountains to the west (Bergland 1983); the Edziza (Fladmark 1985) and Potatoe Ranges (Alexander et al. 1985) to the north in British Columbia; in the Rocky Mountains of British Columbia (Reeves 1975), Montana (Fredlund and Lacombe 1971; Husted 1974), Wyoming (Wright 1984), and Colorado (Husted 1974; Benedict and Olson 1978) to the east and southeast; and to the south on Mt. Rainier (D. Rice 1965) and in Yosemite National Park (Moratto 1981).

The kinds of archaeological remains found in these alpine environments include shallow pits dug in the ground and used to cook plants, pits hollowed out in rock slopes and used as hunting blinds, rock piles and other structures used to divert game animals when hunting, chipped stone tools related to hunting, ground stone tools related to plant processing, and small campsites occupied for short times during the use of these areas or while traveling through. Such archaeological sites in other mountains have been found on most of the landforms mentioned for Zone 5, including ridge crests and saddles (Fredlund and LaCombe 1971; Alexander et al. 1985; Benedict and Olson 1978), cirque lakes (Fredlund and LaCombe 1971; Reeves 1975); solifluction terraces (Benedict and Olson 1978), meadows (Pokotylo 1978; Alexander et al. 1985), and rock basins and benchlands.

Within the Park complex, only one small portion of this zone has been searched by archaeologists for remains. This is the vicinity of Cascade Pass (Grabert and Pint 1978; Site No. 19, Appendix A). The kinds of remains found here or reported by park visitors include chipped stone arrow and dart points, chipped stone knives, small flake tools, pits hollowed out of talus slopes, and a rock cairn. Most of the few flaked tools are made of high quality rock types from source areas outside of the Park.

Portions of this zone were probably used more intensively than any of Zone 4 and possibly as intensively as some portions of Zone 3. Archaeological evidence of this use is likely to be much more common than in Zone 4 because rates of deposition and erosion on the gently sloping benches are lower and sites should be better preserved. Archaeological site densities are likely to be significantly higher than in either adjacent zone.

Alpine--Zone 6

This is the steepest, highest, and most remote zone the Park. It consists mostly of glacially carved and frost shattered rock formations, glaciers, and the young and unweathered Little Ice Age and more recent moraines. Typical features include horns, aretes, cirques and cirque lakes, proglacial lakes, and related features (Nurettin 1976). The dominant landform processes in this zone include deep accumulations of snow, movements of glacial ice, rockfall, and fracturing of rock exposed to freeze-thaw cycles. Vegetation is sparse and occurs mostly as lichens on rocks and as small isolated patches of low growth tundra shrubs and trees.

The methods of human use of and travel through this zone are controlled almost entirely by physiography and very localized environmental conditions. Large parts of this zone are impassable today to humans without the aid of modern climbing equipment and wisdom (Peters 1982).

This does not mean, however, that prehistoric people made no use of some parts of this zone. Hunting of some animals, predominantly of mountain goats and bighorn sheep, probably occurred here. Another, and much different, was for "mapping" the landscape. This may be difficult to appreciate in a time when topographic mapping, aerial photography, and remote sensing record the detailed physiography of mountainous landscapes. In prehistoric times however, "mapping" large areas of the landscape could be done directly from atop high peaks. Although these "maps" were recorded only in memory, they clearly showed the relative locations of near and distant lakes, valleys, plateaus, oceans, mountain ranges, travel routes, and resource areas. Knowing in detail the geographic distribution of such areas was important to successful forager use of the landscape.

No evidence for prehistoric use of this zone has been recognized in the North Cascades or nearby mountains. Nevertheless, the "first ascents" of a number of North American peaks by Euroamerican climbers have found evidence of prior Indian use. Some reports of structures seen atop mountains by early Euroamericans include (from C. Jones 1976:22-23):

1. the first to ascend Mt. Whitney (4,420 m) in 1871 found a rock cairn with an arrow shaft stuck in it,

2. John Muir saw Indian hunting blinds on summits of the White Mountains of Nevada,

3. Indian structures were found atop Blanca Peak (4,380 m) in Colorado and Cloud Peak (4,000 m) in Wyoming, and

4. there is a first-hand account of an Indian ascent of Longs Peak (4,350 m) in Colorado where an eagle trap was built.

Rock cairns today are common along mountain summits throughout the west. Some of these were built by climbers, hikers, surveyors, miners, and others. It is also known that prehistoric Indian people built similar structures on summits (contrary to Jones 1976:23). Although it can be difficult to tell these apart, in many cases archaeologists have been able to recognize large numbers of these as archaeological features.

In addition to their use for hunting drive lines or markers, cairns in the mountains often marked the location of vision quest sites. The quest for guardian spirits was an important part of the spiritual life of many Northwest Indians (Ray 1939).

Although the least used zone of the Park by prehistoric people, it is probable that some were familiar with it, knew how to travel through it, and had experience with the conditions of climate and physiography of it. Such a familiarity perhaps shows in this account from 1870 of an early Euroamerican visitor glissading down the Cascades, as instructed by Indian guides:

> In coming down I practiced the plan pursued by the Indians, to wit, sitting down upon the snow and allowing the force of gravity to take me down, using a stout stick as a brake to regulate the speed (Linsley 1932:341).

Any archaeological remains in the Park Complex in Zone 6 are likely to underrepresent the actual extent of prehistoric use. This is because the severe environmental conditions here do not preserve sites well. Movements of snow masses, frost-fracturing of rocks, and wind and gravity scatter rock structures and other archaeological remains. It is also possible that any sites in the way of the Little Ice Age glaciers, were destroyed or buried.

Existing Site Distributions By Land Use Zone

In Table 5-1 archaeological sites in the Park are listed by elevation, site type (preliminary), and land use zone. In Table 5-2 are listed the frequency and percentage of these same sites within each zone. Eighty-six percent of all sites are in zones 2 and 3 with the remaining 14 percent in Zone 5. No archaeological sites are known in zones 1, 4, and 6. Because the total sample of sites is so small, the relative proportions in each zone will probably change after new ones are added. There are two basic reasons for this:

1. there is no archaeological sample from the full range of Park zones (4 and 6 have not been surveyed for sites), and
2. natural events such as glacier actions, floods, avalanches, fallen trees and vegetation growth make sites hard to find. The number of sites found is directly related to the amount of time spent looking for them.

Estimating the Number of Archaeological Sites in the Park Complex

There is presently no way of knowing how many archaeological sites are in the Park. Nevertheless, for planning future archaeological surveys or management studies, it is good to have an estimate of the number of sites in a given area. If the average number of sites per square kilometer (same as the site density) was known, then estimates for different areas of known size could be given. Using this basic method, the following sections show how the land use zones can be used to make such estimates.

First Method

One way is to total the size of areas already surveyed in the Park and divide the number of sites by that total. This will give the average site

Table 5-1. Inventory of Known Archaeological Sites Within the Park Complex by Type, Elevation, and Zone.

Field Number	Site Location/Name	Site Number	Site Type and Possible Function	Elevation m	(ft)	Zone
1	Goodell Creek	45WH63	Lithic scatter--?	152	(500)	2
2	Goodell Creek	45WH64	Lithic scatter--?	146	(480)	2
3	Hozomeen Campground	45WH79	Lithic scatter--hunting	488	(1,600)	3
4	Big Beaver Creek	45WH80	Lithic scatter--hunting	488	(1,600)	3
5	Newhalem Creek	45WH81	Lithic scatter--food processing	146	(480)	2
6	Little Beaver Creek	45WH220	Lithic scatter--stone working or hunting	503	(1,650)	3
7	Skagit River	45SK102	Lithic scatter--food processing	117	(385)	2
8	Bacon Creek	45SK106	Lithic scatter--food processing	107	(350)	2
9	Damnation Creek	45SK107	Lithic scatter--food processing	122	(400)	2
10	Damnation Creek	45SK108	Lithic scatter--food processing	122	(400)	2
11	Skagit River	45SK171	Hearth--food cooking	122	(400)	2
12	Purple Point	45CH65	Lithic scatter--?	334	(1,095)	3
13	Stehekin Pictograph	45CH66	Pictograph--ceremonial	335	(1,100)	4
14	Hazard Creek	45CH67	Pits--earth ovens?	335	(1,100)	3
15	Courtney Ranch	45CH68	Courtney artifact collection	396	(1,300)	2
16	High Bridge G.S.	45CH69	Lithic scatter--hunting	489	(1,600)	3
17	High Bridge Campground	45CH219	Lithic scatter--hunting	500	(1,640)	3
18	Bridge Creek	45CH220	Lithic scatter--hunting	640	(2,100)	3
19	Cascade Pass	45CH221	Lithic scatter--hunting	1,646	(5,400)	5
20	Cascade Pass		Talus pits--hunting	1,677	(5,500)	5
21	Rock Cairn in Rockshelter		Rock cairn--?	1,585	(5,200)	5
22	Lower Sahale Arm		Talus pits--hunting/storage?	1,451	(4,760)	5
23	N. Fk. Bridge Cr. Cmpg.		Lithic scatter--hunting	780	(2,560)	3
24	Goode Lookout Trail		Lithic scatter--hunting	658	(2,160)	3
25	High Bridge Cmpg. Turnoff		Lithic scatter--hunting	500	(1,640)	3
26	Buckner Orchard		Lithic scatter--hunting	350	(1,150)	2
27	High Lake Chelan Site		Lithic scatter, midden, rock features--habitation	332	(1,090)	2
28	Fourmile Creek		Rock cairns--storage	341	(1,120)	3

Table 5-2. Relative Distribution of Archaeological Sites in the Park Complex by Zone.

Land Use	Number of Sites	Percent
Zone 1	0	0
Zone 2	11	39
Zone 3	13	47
Zone 4	0	0
Zone 5	4	14
Zone 6	0	0
Totals	28	100%

density. Although the total Park area surveyed by archaeologists is unknown, it can be estimated. It is known from review of all earlier Park studies that nearly all surveys have been done in scattered parts along two corridors, one following the Stehekin River between the head of Lake Chelan and Cascade Pass on the east side of the Park, and on the west side along the Skagit River between Bacon Creek and the international boundary. Using river miles on published US Geological Survey maps (7.5' and 15' series) and trail distances provided by the Park Service, the eastern corridor is estimated at 35 miles long and the west side one at 60 miles long. Both of these distances are intentionally overestimated so that the eventual estimate of sites will be a minimum (meaning the actual number of sites is likely to be greater than this). Furthermore, it is assumed that both sides of the two rivers and two lakes in these corridors were surveyed and that the survey path was two hundred feet wide (also an overestimate). The total surveyed area would then be:

1. 35 miles + 60 miles x 2 = 190 miles,

2. 190 miles x 200 feet = 7.2 square miles,

converting to metric, this gives a total surveyed area of 18.6 km². In order to account for two small surveyed places that are not in the total and any other oversights, let's further assume that 30 km² was actually surveyed. This area is equivalent to a strip of land 200 feet wide and running almost the east-west length of the state of Washington. From now on, the total surveyed area within the Park is assumed to be 30 km², even though it is certain that the actual area is less.

Because the Park Complex's total area is 2,700 km², it is known that less than 1.1 percent of the Park has been surveyed for archaeological sites (30 km² ÷ 2,700 km² x 100). In this area, about 28 sites have been found (these are confirmed sites; the number of reported sites is larger), giving a density of 0.9 sites/km². The land use model in this chapter said that zones 4 and 6 were not as intensively used as the others and that archaeological remains in 1, 4, and 6 were more likely to be obscured by natural landscape changes than the other zones. So, for the sake of further restraining the estimate and until better information is available, assume that no sites can be found in zones 1, 4, and 6 and that these zones combined cover 70 percent of the total Park area. Then, if this 70 percent is ignored, a site density of 0.9/km² for the remaining 891 km² gives an estimated total of 800 sites within the Park Complex.

This estimate of 800 sites is not likely to be accurate, but it is the best that current information allows. The density of .9 sites/km² used to get this total can be compared with the prehistoric site density for the entire state of Washington. This is shown in Table 5-3 where density is broken down by county. These densities are all much lower than 0.9. This is not surprising because most of the land area in the state of Washington has not been surveyed for archaeological sites. Most of the county densities in the table reflect a relatively large number of sites found in lowland valleys, the only place where archaeologists have looked for them to any meaningful degree. Although the proportion of the state already surveyed for sites is unknown, estimates for one large area of northcentral Washington is for about 1 percent (Mierendorf et al. 1981). In Table 5-3, the highest site

Table 5-3. Archaeological Site Densities by County for the State of Washington[1].

County	Number of Sites/km^2	County	Number of Sites/km^2
AD	.009	LE	.02
AS	.06	LI	.02
BN	.07	MS	.02
CH	.01	PC	.02
CA	.02	OK	.03
CL	.11	PO	.01
CO	.01	PI	.03
CW	.004	SJ	.59
DO	.05	SK	.03
FE	.02	SA	.007
FR	.04	SN	.02
GA	.04	SP	.004
GR	.02	ST	.03
GH	.01	TN	.03
IS	.19	WK	.03
JE	.007	WW	.02
KI	.01	WH	.02
KP	.02	WT	.02
KT	.02	YA	.02
KL	.04		

Average density for all counties is 0.04 sites/km^2

[1]Data compiled from site files of the Washington Archaeological Research Center, Pullman, October, 1985.

densities occur in the smallest counties. These are San Juan and Island, which have densities of 0.59 and 0.19 respectively. These higher figures must reflect the smaller (as compared to other counties) area of unsurveyed lands in these counties. Site densities computed from current state site records are thus not that helpful for judging the reliability of total site estimates for inside the Park.

Second Method

Another way to estimate numbers of archaeological sites is potentially more accurate and meaningful than the first. It assumes that, because of different resource distributions and land uses, the density of sites, features, and other cultural remains is different for each zone (Mierendorf et al. 1981:81). Although these densities are unknown, they can be guessed at in order to show how the method works.

Table 5-4 shows the density of archaeological sites from different environmental settings in western North America. These densities were either published in each referenced study or were computed from data contained therein. In reality, these figures cannot be compared one to another because the studies they come from defined sites differently, because the areas were surveyed in different ways, and because the prehistoric land use systems that they represent may have differed significantly from one another. All of these factors influence the site density. Regardless of these problems, the densities can be used as relative indicators of degree of site visibility and possibly, intensity of land use.

Site densities in Table 5-4 tend to be highest in areas where vegetation is more open and covers less of the ground surface. Densities are lowest where large unsurveyed areas (such as occur when using county site records) are included in the density computations (see Greengo 1983). Some of the site densities can be roughly compared to zones within the Park. For example, the only one from a flood plain (zone 2) is 7.9 sites/km^2. Those that are analagous to Zone 3 include 4.7, 3.1, 1.6, and 5.6 sites/km^2. The only density for an alpine setting is 5.2. None of the densities in Table 5-4 apply to zones 1, 4, and 6.

Using similar but reduced values for estimation purposes, assume that the site densities and areal extent of Park zones as shown in Table 5-5 are real. Then the distribution of sites by zone can be computed. For this method to be useful, two kinds of detailed information are needed that are not yet available. First, the measured area of each zone is needed. These can be approximated in different ways, possibly using mapped distributions of soil types, vegetation, or terrain characteristics. The second need is for realistic estimates of site density for each zone. This is best obtained from intensive, archaeological site surveys in each zone within the Park Complex. Both of these data are easily manageable with computer-based systems that store and analyze large volumes of spatial information, such as the Geographic Information System (GIS).

Table 5-4. Some Archaeological Site Densities from Widespread Areas of the West.

Number of Sites/km²	Vegetation Cover and Location	Reference
4.7	Forest--British Columbia	Pokotylo 1978
14.8	Grassland--British Columbia	Pokotylo 1978
3.1	Forest/Wide Canyon--NW Montana*	Thoms 1984
1.6	Forest/Narrow Canyon--NW Montana*	Thoms 1984
5.6	Forest/Grassland--NW Montana*	Thoms 1984
0.025	Lowland Rainforest--Washington	Greengo 1983
0.012	Lowland Rainforest--Washington	Greengo 1983
5.2	Alpine Tundra--Colorado	Benedict and Olson 1978
3.3	Semiarid Steppe--Washington	Chatters 1982
1.2	Steppe Uplands--SE Oregon	G. Jones 1984
1.3	Steppe Uplands--SE Oregon	G. Jones 1984
1.5	Steppe Lowlands--SE Oregon	G. Jones 1984
2.5	Steppe Lowlands--SE Oregon	G. Jones 1984
7.9	Semiarid Steppe Riverine--Washington	Thoms 1983
2.4	Open Sagebrush--Central Oregon	Connolly and Baxter 1983
0.06	Heavily Forested--W Oregon	Connolly and Baxter 1983
0.0	Very Heavily Forested--W Oregon	Connolly and Baxter 1983
0.2	Heavily Forested--W Oregon	Connolly and Baxter 1983
3.8	Steppe--Central Oregon	Lyman 1985
7.7	Steppe--Central Oregon	Lyman 1985
9.4	Steppe--Central Oregon	Lyman 1985
1.5	Alpine Tundra--British Columbia	Fladmark 1985
2.4	Subalpine Forest--British Columbia	Fladmark 1985
7.8	Subalpine Forest--British Columbia	Fladmark 1985

*The original vegetation cover has been removed, leaving bare ground exposed annually in a reservoir drawdown zone.

Table 5-5. Hypothetical Computation of Total Number of Archaeological Sites in the North Cascades National Park, by Zone.

Zone	Site Frequency/km² (not real data)	Areal Extent (km²) (not real data)	Expected Site Number (not real data)
1	0.01	27	0.3
2	5.0	81	405.0
3	3.0	189	567.0
4	0.2	1,620	324.0
5	1.5	486	729.0
6	0.1	297	30.0
TOTALS		2,700 km²	2,055 sites

Discussion of Land Use Zones

The preceding description of land use zones is based on ideas and assumptions about how prehistoric people used the mountainous landscape. Some of these notions challenge long-standing beliefs held by archaeologists, historians, and others having a close familiarity with the mountains. One of the most firmly held of such beliefs is that Indian people made little or no use of mountainous highlands (areas encompassing zones 4, 5, and 6 as described here).

Most statements minimize the expected occurrence of archaeological sites in the highlands due to limitations imposed by topography and elevation (e.g., Holley and Ramenofsky 1979:48). Rice has claimed, for example, that "The zones of the higher mountain areas of the Olympics and Cascades have minimum potential for archaeological sites, but these areas may yield important finds on occasion." (H. S. Rice 1975:55). Even lowland areas, such as those portions of main river valleys not immediately adjacent to the river channel or that are heavily forested, are removed from consideration "with no good reason for sites to be there." (H. S. Rice n.d.b.:1). Others formed their conclusions at a time when systematic, careful exploration for highland archaeological sites was unknown. Relander, for example, stated that "The scarcity of archaeological findings high in the mountains makes it evident the Indians of Eastern and Central Washington were lowland dwellers who shunned the highlands." (Relander 1965:21).

As this overview study attempts to show, proper and successful exploration for archaeological sites in mountainous highlands may require extraordinary techniques and effort. Even Beckey, whose knowledge and on-the-ground familiarity with the North Cascades is unmatched, believed that "Indians of the region were tied to a local habitat and did not exploit the landscape." (Beckey 1981:20). The results of this study do not support these claims. On the contrary, they support the claim that sites are widespread in the near timberline zones of the Park and that some of these sites are discoverable through the use of appropriate survey techniques.

Archaeological Resources Known or Expected within the Park Complex

This section describes some of the more common kinds of archaeological remains likely to be found in the Park. The listing is not comprehensive, and there are likely to be other kinds of archaeological resources that are not mentioned. The purpose here is to suggest how archaeological resources may be distributed in Park zones and to show what kinds of information might be obtained from them about the prehistory of the Park and the larger region.

Trails

Access to mountain resources and the ability to transport them requires a system of travel routes. Although most parts of the landscape were used at one time or another for travel, including rivers, lakes, flood plains, terraces, and ridges, only in selected places is there likely to be found archaeological evidence for travel. A large number of trails connected the various land use zones of the Park Complex and were noted and used by most early Euroamericans (Gibbs 1877; Pierce 1883). The ways in which trails are related to land use in the North Cascades and other steep mountainous areas include the following:

1. they are economic transportation routes connecting places where food and other resources occur with places where these resources are consumed or put to other uses (Wagner 1960);

2. they are the lines along which many intertribal social relations take place, such as trade, alliances, warfare, kinship, and ceremonial activities (Malouf 1980);

3. they are routes of migration;

4. they are often the lines of least resistance to movement for both people and game animals like deer, elk, goats, and others; the "ecology" of trails is important because this is where many predators (including people) like to hunt; prey movements are constrained and are often predictable as to time and place, and are therefore where snares, traps, pits, and other hunting devices were used (Teit 1930; Buechner 1953:161; Collins 1974; Dancey 1973; Mierendorf 1983b; Wright 1984);

5. their location is often controlled by extremes of topography or other environmental or seasonal factors; physiography of the mountains is generally more important to travel than is altitude (Fedele 1984);

6. the many trails together formed a network that connected all of the main geographic features of the landscape (Malouf 1980); and

7. trails are constantly changing course in response to natural environmental factors, such as landslides, avalanches, and floods.

A variety of archaeological resources are found close to trails. These include habitation sites, caches, rock cairns, pictographs, game drives, burials, debarked trees, resource gathering areas, and open prairies maintained by regular burning (Malouf 1980; Norton et al. 1983). In the Park, no inventory of trails and related archaeological remains has been made, although such associations are known to occur, such as at Cascade Pass. Portions of this trail, at the pass and along the Stehekin River and Bridge Creek have been nominated to the National Register of Historic Places based partially on its prehistoric significance (Thompson 1970:291-299). There is evidence that prehistoric trails in the North Cascades were numerous and much used, but became less so even before Euroamerican invasion:

> In former times, before the diminution of the tribes and the diversion of trade to the posts, there were numerous trails across the Cascades by which the Indians of the interior obtained access to the western district. Of late, many of these have fallen into disuse, becoming obstructed with timber and underbrush which they have not industry enough to clear out. In fact all their trails through the forest, though originally well selected, have become excessively tortuous, an Indian riding around the fallen trunks of tree after tree sooner than clear out a road which he seldom uses (Gibbs 1877:169).

On the same page, Gibbs notes that by this time the trail between Lake Chelan and the Skagit River had been almost entirely abandoned. As Gibbs implies, use of trails in and near the present Park changed in response to use of the horse and Euroamerican trade centers. Near the northwestern part of the Park, this had an important affect on the Nooksack Indians, who were strategically located between the Hudson's Bay post on the Fraser River at Yale to the north and Puget Sound to the south (M. Smith 1950:331). Some of the kinds of resources traded between interior and west slope or coastal groups of Indians during the early historic period are listed in Table 5-6. Figure A-10 shows artifacts from the Stehekin River valley. Two of these may be trade items from the west of the mountains.

Any archaeological surveys or excavations inside the Park might encounter remnants of prehistoric and historic trails, especially at passes. These should be recorded as cultural resources. Some trails in the Park are known to be recent or have recent modifications (less than 100 years old) that may be impossible to distinguish from earlier uses. This is especially likely at places like Cascade Pass where recent "social trails" have scarred the fragile alpine environment (Thornburgh 1970; Miller and Miller 1978). Although trails have not been excavated and are not often recognized as archaeological features in Washington, this does not mean that they cannot contribute important information about prehistory. Where trails have been excavated by archaeologists, they show multiple layers of compact soil, ruts, and are associated with rock features and other artifacts (Loendorf and Brownell 1980:60-64). Figure 5-3 shows some of the main trail routes and passes within the Park that may have been important in prehistoric times. Trails are likely to be found in all Park Complex zones.

Burned Rocks

Burned rocks, also called "fire-broken," "fire-cracked," and "thermally-altered" by archaeologists, are probably the most common remains of prehistoric land use systems in North America. However, in Washington and

Table 5-6. Some Resources Traded Between Indians of the Interior and Those West of the Cascade Range.

	Resources Traded from West of Cascade Range to the Interior	Resources Traded from Interior to West of Cascade Range	Source
1.	Marine products	Dried deer, elk and other meat, nuts	Browne 1858:9
2.	Slaves, Dentalium shells, camas, dried clams	Mountain sheep (probably goat) wool, porcupine quills, grass (probable Indian hemp), dried salmon	Gibbs 1877:170
3.	Shell money		Hoeberlin and Gunther 1930:29
4.	Eulachon oil		Stewart 1977:149-150
5.	Marine shells and trinkets	Wild hemp	Ross 1956:37
6.	Dentalium, obsidian, steatite, nephrite, native copper, amber		Fladmark 1982:120
7.	Obsidian	Obsidian	Carlson 1982:22
8.		Slaves, skins, deer meat, hazelnuts, huckleberries, camas, cedar baskets, horses	Norton et al. 1983:123
9.	Mountain goat wool and horn		Blukis-Onat 1980:43

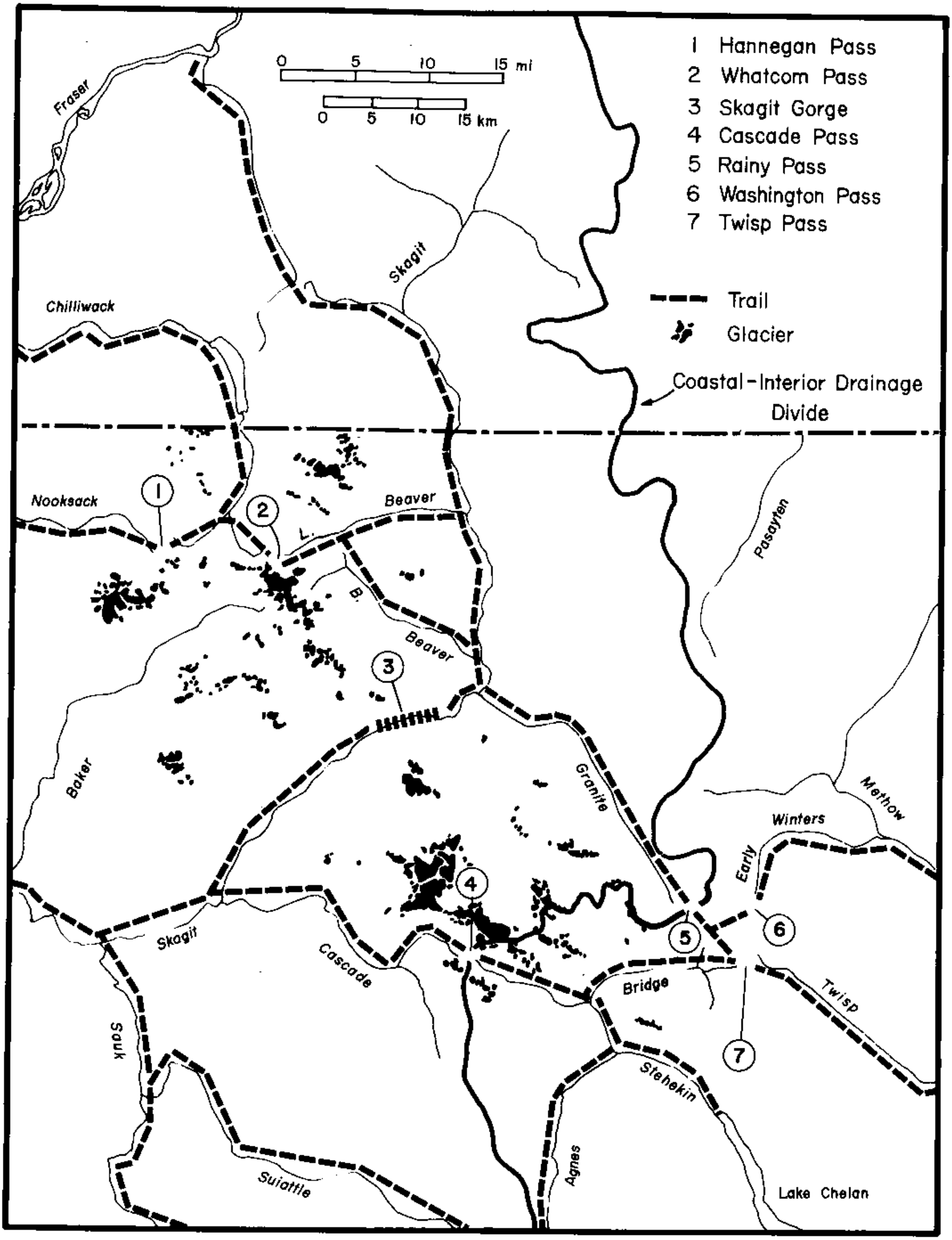

Figure 5-3. Main trail routes and passes through and adjacent to the Park Complex that were probably used in the prehistoric period.

other parts of the Northwest they generally have not been studied and are considered an artifact type that contributes little to the understanding of land use.

Small rocks and rock fragments were important to prehistoric people in cold climates because they could be used to store and transfer heat (Walker 1978). The ability to do this was especially important for cooking and drying foods, which often needed uniform temperatures to be held for many hours, something difficult to achieve by using heat directly from combustion. Rocks suitable for these purposes occur in nearly all parts of the landscape and did not need to be transported long distances. As with other common aspects of Indian life, early Euroamerican visitors to the Cascades and throughout the Northwest described the various ways that hot rocks were used for boiling, roasting, and drying. Once used, burned rocks undergo changes that leave distinctive properties, including breakage into characteristically shaped fragments, partially related to methods of heating the stones and cooking of foods. Colors show oxidation or reduction of minerals in the rocks, or carbon stains (cf. Shepard 1954; House and Smith 1975; Walker 1978).

Burned rocks may be important to understanding prehistoric life in the North Cascades in some important ways.

1. Because of their high frequency and relatively large size compared with other artifact types, they are often the first sign that an archaeological site exists in a given place. For this reason they are often one of the best ways of determining the size of a site. Where archaeological surveys have recorded all evidence of prehistoric land use, burned rocks are the largest artifact category represented (Jermann 1981; Thoms 1984).

2. Although usually associated with other kinds of artifacts, burned rocks can be the only artifact type present. This is especially true in cases where the rocks were used to bake only plant foods and are not associated with hunting, cooking of meat, or other activities. The site described near Hazard Creek (Table 5-1, No. 14) may be of this kind. In nearby mountainous environments similar to those within the Park Complex, sites with only burned rock features or with these in association with other artifact types have been found (Pokotylo and Froese 1983; Alexander et al. 1985).

3. Analysis of the breakage patterns of burned rocks may yield important information about how and what kinds of foods were cooked. Blocky, angular breakage planes may occur more frequently in stone boiling, a method of cooking food wherein hot rocks were placed in the water. Roasting in a pit or over a hearth, however, may be distinguishable because of the greater frequency of broken fragments of thin curving or flat pieces (Schalk n.d.).

4. The way burned rocks are either scattered or grouped at a site may show where different activities occurred there. For example, detailed mapping of distributions at some localities has shown different burned rock groupings. Tight clusters of many rocks may be where food cooking and preparation took place (Jermann 1981; Thoms 1983). Another more

"random" scatter of rocks (Jermann 1981) may reflect a different activity. These two distributional types were observed (this report) on the surface of the large site at the head of Lake Chelan (Table 5-1, No. 25). Here, the "random" scatter of burned rocks looked to be associated with dark colored, organic-rich ground, chipped stone fragments, and pieces of burned animal bones. This area may be where trash and other habitation remains were dumped. At other places on the site, rock clusters of various sizes and shapes are visible.

This artifact category is likely to occur in all zones of the Park Complex.

Rock Structures

There are archaeological features, visible on the ground, structures that appear as circular rock piles (cairns), as linear walls or alignments, or as depressions hollowed out of naturally-occurring rock fields, such as talus or scree slopes. Any locally available rocks were used and these show a wide variety of sizes and shapes. Rock features are numerous and widespread in Washington and throughout western North American (Malouf 1962), and were one of the first types of remains examined by early Northwest archaeologists (Smith and Fowke 1901). Although they are usually recorded as prehistoric or historic sites on archaeological surveys, rock features are problematic because they are difficult to date and are not always found with other artifacts, so that their function in any one place may be uncertain. Caution is required in the discrimination between prehistoric and historic features.

It is believed that rock features had a variety of functions and that they have the potential to contribute important information about land use in specific areas. Archaeologists and others have suggested some of the uses of these features as follows:

1. They were used to cover or seal human burials in many areas of the Northwest (Smith and Fowke 1901; Collier et al. 1942; Caldwell 1954; Bryan 1963).

2. They were used as markers of resource areas and other places on the landscape (Osborne 1967; Galm and Hartmann 1979).

3. Rock piles were made as part of ceremonial activities, such as the vision quest (Ray 1933; Osborne 1967; Chartkoff 1983). On top of White Mountain in the Colville National Forest, east of the Park Complex, hundreds of rock cairns covering an area of five to 10 acres are believed to be from vision quests (H. Rice n.d.d.).

4. Rock rings, alignments, and pits may have been used as fortifications during warfare (Malouf 1956; Osborne 1967; W. Smith 1977).

5. Rock cairns and pits may have been used to temporarily store food and other resources for later use or transportation (Eller 1980; Nicholson 1985).

6. Rock cairns were used as trail markers in various types of terrain (Heizer 1978; Loendorf and Brownell 1980 and others in this issue).

7. Rock walls and alignments of various shapes were built in and alongside river channels as parts of weirs, traps, and other fishing-related structures (Nelson and Rice 1969; Pomeroy 1976; Stewart 1977).

8. Rock structures of various designs were used to build blinds, traps, jumps, drive lines, and other devices for hunting game animals (references in following discussion).

Because of this range of uses, it is often difficult to determine how individual rock cairns may have been used. There are two basic approaches to this problem. One is to find other kinds of cultural remains along with the rock structures, such as hunting tools or actual remains of the hunted animals, and to be able to show that these are related. Rock structures, however, especially cairns, also are common to modern land uses and have been used as surveyor and location markers, as mining claim boundary markers, to support fence posts on rocky ground, and to mark the ascent of mountain peaks. In some cases where archaeologists have carefully examined rock features, prehistoric and historic artifacts indicative of their functions have been found. In the Rocky Mountains of south-central Montana, windblown sediments that had collected in the bottoms of some cairns were screened and found to contain such remains as a cache of 322 quartzite flakes in one case and a bison horn core and bones in another. Examples of other remains include chipped stone points and scrapers, prehistoric pottery, and glass (Loendorf and Brownell 1980). Rock structures associated with chipped stone also are reported from other areas, such as the Bitterroot Mountains (Fredlund and LaCombe 1971) and California (Heizer 1978). Rock features can on occasion be dated, although the meaning of the date may not be clear. A radiocarbon date of 1,620 ± 85 years ago was obtained from charcoal removed from beneath a cairn in the Pryor Mountains of Montana (Loendorf and Brownell 1980:32, 75-76). In the Salmon River Mountains of southern Idaho, rock pits and walled features believed to be sheep hunting blinds have been radiocarbon dated on pieces of wood to about 710, 660, and 490 years ago (Butler 1978:73). And in the Plains east of the Rocky Mountains, animal bones beneath a rock cairn dated it to 480 ± 100 years ago (Nicholson 1985).

Another way to study how rock features were used is to record in detail their locations and relevant aspects of the local environment, such as springs, trails, available resources, and local physiography (Osborne 1967:40; Eller 1980; Mierendorf 1983b:654-655). Rock features recorded on site forms are found in all parts of the landscape between rivers and mountain tops (Mierendorf et al. 1981:73), and it is necessary to look at their regional distribution and environmental context to begin to understand their uses. In some areas, for example, the locations of hunting blinds might be predicted from the association of game trails, water, and talus rock (Butler 1978:73). In other areas, natural topographic features, such as cirque headwalls, saddles, and ridges are important in the placement of hunting blinds and drive lines (Fredlund and LaCombe 1971). Hunting blinds consisting of cairns and pits and rock drive lines believed to be used by communal hunting parties have been found in the Absaroka Mountains of Wyoming (Frison 1978) and the Rocky Mountains of Colorado (Benedict and Olson 1978).

The ages and uses of rock structures found within the Park Complex are presently unknown. Cairns on many of the peaks are probably markers of historic ascents. However, the rock features shown in Table 5-1 are not of this type. The pits above Cascade Pass (Table 5-1, No. 20) are probably hunting blinds. Those on lower Sahale Arm (Table 5-1, No. 21) may be related to hunting or storage. The rock piles near Little Boulder River and Fourmile Creek (Table 5-1, Nos. 26 and 27) are most likely related to food storage or other uses. Because of the absence of detailed information about these various structures, such ideas are only possibilities at the present. Rock features are likely to occur in all land use zones.

Lithic Scatters, Quarries, and Stone Procurement

Lithic scatters are archaeological sites or parts of sites that consist of a more or less scattered distribution of chipped stone tools and flaking debris. Archaeological sites may also occur as quarries where some type of stone raw material was pried or excavated from a place where it occurs naturally, such as from a bedrock outcrop or some other exposure. Other sites may consist of locations where stone materials were simply collected, such as gravel bars along rivers, talus slopes, or bedrock exposures. These may be recognized by the nearby presence of lithic scatters consisting of discarded pieces of the weathered exterior rock surfaces, of poorer quality pieces, and of broken tools.

Most of the known sites in the Park are lithic scatters. Although they have not yet been found, a number of quarries and stone procurement sites are also likely to exist within the Park. Even small lithic scatters that lack other archaeological remains buried beneath them may contain important information about the prehistory of an area (Talmage and Chesler 1977). A variety of different kinds of techniques have been used by archaeologists to study lithic scatters. Some of these include determining the ratio of tools to nontools, the diversity of tool types, the ratio of exotic (nonlocal) to local stone material types, the ratios of material types from different known source locations, the exact spatial location of chipped stone debris across the site, and the different stages in the degree to which the original stone material has been altered. All of these techniques are potentially useful, depending on the problem being studied. Most of these techniques are likely to provide data relevant to questions about prehistoric use of the Park landscape. For example, it is likely that many lithic scatters in the Park were created by repeated visits to the site over a span of thousands of years. In such cases, mapping and recording of the locations of stone debris may be required to discriminate different kinds of site use (Binford 1982; Stevenson 1985). In another example, the frequency or even presence of certain stone material types may reflect the geographic or territorial boundaries of a particular adaptation (Binford 1979). It is in this context that a bifacially flaked tool, collected from the High Bridge Guard Station Site (Table 5-1, No. 16), may be significant. This tool was flaked from vitrophyre (a glassy obsidian-like material encasing small but easily seen crystals) which has been excavated from a small number of archaeological sites along the Columbia River, from Wells and Rocky Reach Reservoirs (Grabert 1968; Mierendorf and Bobalik 1983). For nearly all lands within the Park Complex, the various data categories embodied in lithic scatters will contribute much of the knowledge to be gained about the prehistory of the

Park and surrounding areas. Lithic scatters, quarries, and stone procurement areas are likely to occur in all land use zones.

Rock Art

These consist of figures, symbols, designs, and scenes applied to rock surfaces. If these are painted on the rock with pigments, they are called pictographs. If they are pecked into the rock surface, they are called petroglyphs. Sometimes these techniques were used in combination. Prehistoric and historic rock art is common throughout Washington and adjacent areas (Cundy 1983; Cain 1950; Hill and Hill 1974; Boreson 1976; McClure 1978). Presently only one rock art site is known from within the Park Complex boundaries (Table 5-1, No. 13), but others are likely to exist. To the east of the Cascades, rock art is oftentimes one of a number of different kinds of archaeological site types that occurred near to winter villages (Nelson 1973). The meaning of rock art is subject to varying interpretations, depending on the subject matter represented and other associated archaeological remains. Under some circumstances rock art can be dated (McClure 1979). Although most likely to occur in lower zones of the Park, rock art may occur anywhere.

Other Site Types

A wider variety of archaeological resources are known to occur within the Park than the more common ones discussed here. Examples include human burials, dwellings, caves and rockshelters, storage pits, and bark-stripped trees. Any of these are likely to contain information important for understanding local and regional prehistory, which means such sites are potentially eligible for inclusion in the National Register of Historic Places. Some, such as human burials, should be managed only after consultation with Native American tribal representatives. Others, such as remains of dwellings and dry rockshelters and caves, are almost certain to contain significant information about the Park's prehistory. Although these are not discussed here, a variety of published methodological and theoretical approaches are available for the excavation, analysis, and interpretation of such cultural resources.

Plant and Animal Remains

Although not discussed in detail here, plant and animal parts preserved at archaeological sites are also considered artifacts and can contribute to the National Register significance of sites. They are important for dating sites, for reconstructing prehistoric diets, for studying hunting strategies, and for reconstructing earlier environments. Bone preservation in Park Complex sites tends to be poor due to the acidic soils. Any sites having good animal bone preservation are significant. Description and analysis of faunal assemblages are considered an important and useful aspect of archaeological research designs. Such remains are known to occur in some Park sites.

Research Questions

Based on discussions in this and earlier chapters, many questions could be asked that can be answered from the data contained in archaeological sites within the Park Complex. In this section, only a sample of such questions will be listed. Many more than this could be formulated, but these were selected because they are either basic to initial archaeological work in the area or they seem to follow logically from current knowledge of the prehistory and anthropology of the region. It is necessary that some statement of research problems guide the planning and implementation of archaeological studies within the Park Complex. Some of these problems, listed below, address aspects of culture change, the role of trade, the role of climatic change, intensification, population change, landscape evolution, archaeological methods, and others:

1. During what time periods in the prehistoric past was the Park used by human populations? Were there definable time periods when there was little or no use? Were there times, such as during periods of drought, when the North Cascades sustained larger populations of people, as compared with nondrought episodes (Benedict and Olson 1978)? Can study of the archaeology of high mountain areas like the North Cascades help in understanding the prehistory of the greater Northwest region?

2. When was the Park first used by prehistoric people? Was it in the early Holocene or much later? In what time period did Cascade Pass, which may have been unglaciated during the last major Wisconsinan glaciation, become an important travel route?

3. Is the chronology of prehistoric use of the Park different for the Skagit versus the Stehekin drainages? Do the overall assemblages in different Park valleys differ from each other?

4. Were there time periods when there existed more or less permanent communities in any portions of the Park? Do all archaeological sites in the Park represent seasonal use only? Are there camps or villages that were occupied during the winter? Was "intensification" an important and recognizable process in prehistoric use of the North Cascades?

5. During the entire span of prehistoric occupation, did the resource base that people used for food and utilitarian needs change in ways that would have resulted in recognizeably different adaptations? If so, what factors controlled any changes in the resource base? Were changes in the resource base insignificant in the overall patterns in prehistoric use of the Park? What were the resources that attracted people to the Park environment?

6. Do archaeological sites cluster around Park localities that have an abundance of resources known to have been important to historic, and presumably prehistoric people? To what extent do the remains from sites (archaeological assemblages) reflect use of local resources? Are different assemblages found along salmon versus nonsalmon rivers?

7. Do archaeological sites cluster around strategically located points on the landscape, such as river junctions, broad valley flats, and high

elevation flats? What environmental and cultural factors define a "strategic" point on the landscape for prehistoric populations?

8. What is the archaeological evidence for prehistoric use of the above-timberline areas of the Park? Were resources from alpine zones sought by prehistoric Park users and if so, what were they? What was their importance compared with resources from lower elevation areas?

9. To what extent was the prehistoric use of Park resources influenced by larger lowland populations living in valleys to the east and west? Can these influences be measured archaeologically? What was the role of trade and exchange networks in the use of Park resources? Is the density of different kinds of archaeological sites different on the east versus the west sides?

10. To what extent can the locations of prehistoric sites in the Park be predicted? To what extent can individual site assemblages be predicted? What site survey and excavation methods are most appropriate for answering these questions?

11. What can be learned from the study of Park prehistory that is relevant to use of the Park today? Are there general principles about the ways that cultures and environments interact that apply to both prehistoric and historic Park uses? What were the solutions, both technological and social, that prehistoric populations used for the adaptive and survival problems dictated by the North Cascades environment? How do these compare with historic (including modern) solutions to these same problems?

12. How did prehistoric mountain dwellers in the North Cascades use the Park terrain? Can land use zones of Park use be defined? Does the density (number per square kilometer) of archaeological site types and features change between different zones? Are the land use zones equally applicable to all prehistoric time periods?

13. How does landscape evolution influence prehistoric site distributions? Have erosion cycles selectively removed flood plain sites of defineable time periods? What landforms are least affected by erosion-deposition cycles and the affects of climatic change? Can a chronology of landscape changes for the last 12,000 years be derived from radiocarbon dates and identification of volcanic ashes?

14. If indeed the "Little Ice Age" is the largest postglacial advance of alpine glaciers in the North Cascades, did this event leave a recognizable and datable set of floodplain deposits, like it has left recognizable and datable moraines? Is there a relationship between Neoglacial alpine advances and more or less use of some Park zones?

Expected Findings

In order to study archaeological sites in a research context, the problems and questions must be restated in ways that specifically describe or predict how the various archaeological resources in the Park will relate to one another and to others in the region. These hypothetical or expected results must be tested and compared against the actual findings. Given below is a partial list of expectations about archaeological sites in the Park Complex. They are hypothetical in that they have not been confirmed or denied, but they are not stated as a series of clear, testable hypotheses. Also, variables such as "artifact diversity" and "travel camp" remain to be defined according to artifact and data categories. However, most of the statements (but not necessarily all of them) could be converted into tests that could then be compared with results from ongoing Park studies. The sample below is provided only to give an idea as to how some of the archaeological remains and variables discussed earlier, such as burned rocks, stone raw materials, or site densities, can be related to the research questions. Prior to investigation of any site, goals, research questions, methodologies, and expected findings should be formalized into a research design and work plan according to current National Park Service regulations.

1. Residential sites, such as villages and large seasonal base camps, are likely to be located near the head of Lake Chelan on the east side of the Park and along the Skagit River from Newhalem and downstream from there, on the west side.

2. Park zones at high and intermediate elevations are likely to contain small seasonal base camps, travel camps, and special-purpose or task specific sites.

3. Villages and base camps are likely to be recognized by having the greatest intrasite diversity in artifact and feature types and in plant and animal remains.

4. Travel camps are likely to have a higher percentage of nonlocal stone raw materials and trade items than other site types.

5. Special purpose and task specific sites are likely to be dominated by locally derived stone raw material types and to show little intrasite variety in feature types.

6. Fish remains and fishing-related tools and features should be most abundant in archaeological sites mentioned in 1. above.

7. Sites related to hunting and gathering, and the processing of resources, should be most abundant in low elevation parts of the Park, but should also be abundant in high elevation zones.

8. Travel camps are likely to be located along major trails, trail junctions, and near passes.

9. Base camps are likely to be located near to areas of high and diverse food resource abundance, that have relatively easy access.

10. Tools and features, specialized for the processing of certain plant and animal resources, should be most common in late prehistoric sites. So should storage features.

11. More generalized tools and features, used for processing a variety of plant and animal resources, should be most common in early and middle prehistoric sites. Storage features should be absent.

12. During the late prehistoric period, the larger the estimated populations in lowland valleys adjacent to or inside the Park, the greater the use of nearby Park alpine resources.

13. The larger the prehistoric populations in lowland valleys adjacent to the Park, the larger the number of archaeological sites per square kilometer within the Park.

14. A higher frequency of burned rocks from archaeological sites on the west side were used to dry meat in preparation for storage as compared with those from sites on the east side of the North Cascades.

The procedure outlined above is often difficult to implement. Some variables, for example, are difficult to measure, such as "populations in the lowlands." Are these to be estimated from the number of archaeological sites of a given time period in the lowlands, or from the total number of radiocarbon dates falling within a given time period? It often happens that the archaeological remains in any particular site or group of sites can be related only to certain problems that are in turn unrelated to those of other sites. This is why testing a site is important. By this means, basic information is acquired that can be used to plan a site's treatment. This basic information is obtained by answering the following questions:

1. How big is the site (horizontal and vertical boundaries)?

2. What is the range of artifacts and features found in the site?

3. How old is the site? Can it be dated through the C-14 method, through identification of volcanic ashes, through cross-dating of artifacts, or other methods?

4. What kinds of organic remains are preserved at the site?

5. How many buried archaeological components or layers are present?

6. Is the site disturbed?

7. What kinds of special analyses could be done with the remains that would contribute important information?

8. How does the site compare with other known sites?

9. Is the site eligible for inclusion in the National Register of Historic Places-

Once this information about a site is known, the site's overall significance and relevance to research questions can be determined. This information is also important to determining how the site will be treated (i.e., will it be excavated, protected, left alone, or affected by development)?

Summary and Conclusions

Because they cover a large portion of the northwestern states, mountain areas are considered important to understanding regional settlement and subsistence models. Within the National Park Complex, this is especially true of alpine and subalpine areas. A traditional view, held by many archaeologists is that areas interior to the mountains were of little importance prehistorically. The view taken here is that all parts of the landscape must be studied in order to understand prehistoric settlement and subsistence.

Presently, nearly 30 archaeological sites are known to occur within the Park Complex. However, only about one percent of the Park area has been surveyed by archaeologists and it is likely that hundreds of sites yet exist undetected. These sites and the archaeological remains they contain can add important information (as defined by National Register significance criteria) about prehistoric forager use of mountainous environments. By stratifying the North Cascades environment into six culturally and environmentally defined land use zones, prehistoric resource use and site densities can generally be modeled. The land use zones also provide a basis for stratifying archaeological surveys and estimating site densities in the whole Park or poritons of it. Finally, data from the Park's archaeological resources can be used to address a variety of problems and questions concerning local and regional prehistory and land use.

CHAPTER 6

RECOMMENDATIONS

Introduction

This chapter makes management recommendations, as requested by the Park Service (U.S. Department of the Interior 1984), for archaeological sites within the Park Complex. Background information that provides the basis for the recommendations is found in the preceding chapters. Suggestions are offered that relate to pubic interpretation of archaeological resources; and for surveying, evaluating and protecting them; aspects of the larger public context of site management are noted; recommendations for each of the known 28 sites are made; and, finally, ideas for supporting studies are suggested. This recommendations reflect only the professional opinions of the author.

Interpretation of Park Archaeological Resources

There exist many different ways of using what is known about the prehistory of the Park for the public benefit. Most often archaeological data and artifacts are interpreted according to time periods, technologies, regions, or aspects of daily life. These themes are frequently and successfully used in museum displays and popularized publications that deal with archaeology. They also are likely to be appropriate themes for Park interpretation. The land use concept as discussed in this report is compatible with these themes because it is general to them all. For example, a display of prehistoric artifact types according to earlier and later time periods is interesting because it is a record of changing adaptations and resource use. However, prehistoric stone tools are likely to be perceived as unrelated and foreign to life in the 1980s. From a land use viewpoint, such a display ignores the important fact that Park users today (hikers, campers, residents, etc.) have much in common with those of the prehistoric past. Today's technologies, and the land use systems that manufacture them, are so outwardly different in appearance from prehistoric ones that any shared human behavior patterns they represent, regardless of time period, are overlooked (as are the important insights they provide to our lives today). An alternative approach would be one that shows how similar kinds of technologies and lifestyles of the prehistoric and historic periods evolved in order to solve the problems imposed on all human users of the severe North Cascades environment. The outward differences between today's modern manufactured technologies, say for backpacking equipment, and prehistoric ones that utilized only natural resources can be compared and shown to be solutions to similar land use problems. Many other such points of comparison could be found. Sometimes these lead to dramatic, if not poignant, reminders of the needs shared by all travelers of the North Cascades landscape, past and present. This may be especially true for the Park, dominated by a rugged alpine setting and having a history of appreciation by an environmentally aware and curious public. Some general examples of the kinds of relationships between human users and the North Cascades environment might include:

1. study of the roles of prehistoric and historic populations in intentionally managing the environment, such as through burning practices or the construction of waterworks, such as dams;

2. or common themes in human use of the Park and how the North Cascades environment has influenced these in the past and will continue to do so in the future. Using specific aspects of these ecological relationships it could be pointed out that:

    a. many campsites and trails used in the Park today by hikers were also used in exactly the same ways for thousands of years by prehistoric people;

    b. travel through the Park today involves many prehistorically used strategies, such as use of basecamps at key travel junctions and for temporary storage of gear for later use or for increased mobility through weight reduction;

    c. use of special clothing and gear: interestingly, modern and prehistoric users rely on similar materials, foragers having used mountain goat and dog wool for insulation in the wet climate and leather made from native animal hides because of its abrasion resistance for brushy and rocky backcountry travel, while modern users solve these same problems with clothes made from domestic sheep wool or artificial fibers and with leather made from domestic animals or artificial materials with similar properties, such as abrasion resistant cordura and ballistics cloth.

These are only a few examples of the ways in which adaptive strategies could be used as an interpretive theme that compares prehistoric with modern Park uses. Others might include use of mineral resources, use of plant resources, hunting strategies, and ceremonial activities. As noted in Chapters 3 and 4, a detailed and fairly complicated Park natural history is recorded in a variety of published and unpublished sources from a variety of academic disciplines and other kinds of institutions. The archaeology and prehistory within the Park Complex are only one aspect of the total picture. Land use may be able to show how aspects of the environment, along with past, present, and future human populations, are interrelated elements in the larger Park ecosystem.

Regardless of the specific approach to interpretation taken, it is recommended that artifact displays be made and located so as to be accessible to the largest number of Park visitors and users. The prehistoric artifacts used for display should be those collected from the Park Complex in this and previous studies. Other display items might include clothing, tools, and other utilitarian objects (or photographs of these) of authentic Native American design and workmanship.

In those cases in which prehistoric artifacts from the Park are in private collections, if acquisition is impossible, exact replicas can be made that are identical to the originals. Such replicas are perfectly suitable for display purposes.

Research and Management Needs

One of the long range planning goals of the Park is the inventory of all archaeological resources within its boundaries (US Department of Interior 1984). An inventory is the logical beginning for subsequent management of sites. "Management" as used here includes all the possible options available for preserving what is important about cultural resources, such as digging small archaeological test pits to learn the basic characteristics and importance of individual sites (evaluation); full-scale excavation; or protection or avoidance. The three basic activities (finding all the sites, determining their significance, and deciding what to do with them) are called identification, evaluation, and protection (US Department of Interior 1980). Recommendations for each of these activities follows.

Identification

In one sense, identification of archaeological sites began with the first historic descriptions of the remains of Native American use of the Park, such as the Stehekin Pictographs and the log bridge over Bridge Creek. Although these and numerous subsequent accounts are helpful, they are of little use in locating the anticipated large number of small sites hidden in the forested mountains. Most previous archaeological work in the Park has yielded important information about what kinds of artifacts and sites are present and how to go about searching for them. This type of "reconnaissance" level of survey is not yet complete because more information is required before "intensive surveys" can be planned and implemented. A goal of Park cultural resource management should be the selective use of unbiased probablistic surveys because it is known that "biased" surveys lead to different results when compared with probabilistic ones.

To solve this problem, it is recommended that inventory of Park archaeological resources be done in probablistically chosen sample survey units. Intensive surveys should be done in units of land of measured surface area and each unit should be randomly selected from a pool of equal sized ones, each having an equal probability of being chosen. Before this is done, the Park area should be stratified into land use zones as described in the previous chapter and the sample survey units chosen from within these zones. The number of survey units chosen from within each stratum (land use zone) will depend on the level of funding, practical and safety aspects of doing the survey, and the kinds of statistical methods considered appropriate to the analysis of data. Some sample survey units will be impossible to survey by on-the-ground inspection because access will require use of technical climbing equipment. In such cases, a combination of other survey techniques may be allowable, such as inspection of aerial photographs, direct examination from nearby points having better access, and on-the-ground inspection of only those portions of the survey unit with safe access. These decisions, along with the amount of on-the-ground inspection actually accomplished, should be made for each individual sampling unit. After this level of coverage, the sampling unit should be treated statistically like all others.

A second problem in the identification of Park archaeological resources is caused by dense vegetation covering the ground. Previous Park surveyors have noted this problem. Future archaeological surveys should use techniques that have shown success in forested environments, such as digging shallow test pits and moving survey transects closer together (Lovis 1976). But these techniques also will be impossible in some survey units, such as those on steep forested slopes of zone 4 or where windfalls and dense shrub growth make the clearing of vegetation down to mineral soil nearly impossible. In such cases, the few natural ground exposures afforded by tree-tip-ups, backdirt from burrowing rodents, or river erosion may have to suffice if successful alternatives cannot be found. Recent studies have shown that in some forested mountain areas, the cost of probabilistic surveys so far outweigh the results, that nonprobabilistic techniques may be more effective (Connolly and Baxter 1983; Alexander 1983).

Due to the extremes of topography and other environmental factors, an archaeological inventory of all Park lands is probably neither possible nor desirable given the costs involved. This is all the more reason for well-designed probabilistic sample surveys that are done in a uniform way throughout all Park zones, to the extent that local conditions in each survey unit make this possible. In some areas, this latter consideration will be limiting. Where local conditions require a change in techniques, these should be clearly described, along with the amount of actual surface coverage recorded.

Sample surveys and inventories should also include the drawdown areas of reservoirs within the Park boundaries. Archaeological studies from lands near the Park and other broad areas throughout the west have shown that important archaeological remains can be preserved and remain undisturbed under reservoirs (Lenihan et al. 1981). Important archaeological remains in reservoirs have been studied at widespread areas in the Northwest, including Libby Dam in Montana (Schalk et al. 1984), behind Grand Coulee Dam (Chance and Chance 1982), behind Wells Reservoir (Wells Reservoir Archaeological Project field excavation notes and forms; field notes in possession of the author), at Chester Morse Lake (Lewarch 1978), and at Coquitlam Lake Reservoir in British Columbia (Wright and Williams 1981). Archaeological sites are known to exist in two of the four reservoirs within the Park Complex. The Hozomeen Campground Site (Table 5-1, No. 3) is exposed annually in the large drawdown area of Ross Lake, which is the reservoir impounded by Ross Dam. This site is likely to contribute important information to North Cascades prehistory (Grabert and Pint 1978; Mierendorf and Thomson 1986) and there are likely to be other important sites exposed in the drawdown area of Ross Lake. Although Lake Chelan is natural, its level has been artificially raised about 21 feet. At least one archaeological site (Table 5-1, No. 26), which is presently the best candidate for a semipermanent habitation within the Park Complex, has been found in the drawdown area exposed annually at the head of Lake Chelan. An intensive archaeological survey of the drawdown areas of these two lakes will likely encounter more sites. However, this does not mean that such sites are necessarily undisturbed and retain important information. These questions are best answered on a case-by-case testing basis. This is because reservoir effects to inundated sites can be very localized depending on such factors as water depth, wind direction and intensity, sediment matrix, and many others (Lenihan et al. 1981; Wright and Williams; Mierendorf 1983c). The affects on archaeological remains of the other two reservoirs, Gorge and Diablo Lakes, is unknown but ought to be examined.

A final identification problem involves the erosion of archaeological sites from landforms along major rivers in the Park. The edges of the flood plains (Zone 2) along the lower reaches of both the Skagit and Stehekin Rivers will continue to erode due to natural river behavior. Such erosion is probably why some sites (Table 5-1, Nos. 7, 8, and 9) were unable to be relocated, while other new ones (Table 5-1, No. 11) were found nearby. These river-marginal sites are rapidly buried by sandy river bars or are exposed and removed through bank erosion. For these reasons it is recommended that an intensive survey be done along the banks of these rivers and that it be followed by periodic surveys (perhaps every 3-5 years) to monitor new erosion. The river segments recommended for monitoring surveys are the Skagit between Newhalem and the mouth of Bacon Creek and the Stehekin between Bridge Creek and the head of Lake Chelan.

Evaluation

Contrary to opinions held by nonprofessionals and even many professional archaeologists, the importance of archaeological sites is only indirectly related to the quantity of artifacts and features they contain. Importance (called "significance" in the language of cultural resource management) is instead directly related to the information that an archaeological site can contribute to understanding prehistory or history. Such information is embodied in artifacts, features, and other land use remains found on the landscape, but it can be derived only after the remains have been analyzed in relation to research problems and questions. These relationships between significance and artifacts are clearly stated in the National Register criteria which are used throughout this country for evaluating the importance of archaeological sites:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and;
>
> (a) That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) That are associated with the lives of persons significant in our past; or
>
> (c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinctions; or
>
> (d) That have yielded, or may be likely to yield, information important in prehistory or history (US Department of Interior 1981).

Criterion (d) above is the one most often used to assess archaeological remains as significant. The US Department of Interior has also provided more specific guidance on some of the qualities that make sites significant:

> Archaeological properties do not have to be large or rich in artifacts or categories of data to qualify for listing in the National Register, nor do they have to be suitable for public interpretation. An archaeological property is eligible for inclusion in the National Register if it is associated with cultural patterns, processes, or activities significant in our past or contributes to the understanding of the lives of persons or groups or of events that shaped the history or prehistory of a locality, region, or the United States (US Department of Interior 1977:29).

These guidelines help to clarify the scientific and research importance of archaeological sites within the Park Complex. Compared with the many lowland sites that have been studied in adjacent areas, archaeological sites in the Park are probably fewer in number, smaller, shallower, and contain fewer of the kinds of tools that archaeologists have traditionally used to fabricate cultural typologies. If the significance of Park sites was to be judged by the same criteria as most lowland sites, few of them would be considered important. Furthermore, their importance would likely hinge on some type of superlative quality: the largest, the first of a kind, the highest, the earliest, or the "richest" in artifacts. Superlative sites in the Park, for example, are at Cascade Pass, along Ross Lake, and at the head of Lake Chelan. But the guidelines quoted above clearly show that superlatives are not central to the determination of significance. The more common nonsuperlative sites in the Park have significance because of the information they can impart about forager land use in the interior of rugged mountains. It does not necessarily matter that a site has been disturbed or that its only remains are found lying on the present ground surface (Talmage and Chester 1977). If information from the site (the data categories, i.e., the specific characteristics recorded, described, and counted by archaeologists, such as tool frequencies, raw material types, radiocarbon dates, volcanic ash layers, species of animal bones, species of charred plants, dwelling types, fracture patterns of burned rocks, etc.) helps to understand cultural (land use) patterns, than it is significant according to the National Register criteria. From a significance viewpoint, Chapter 4 trys to show how the Park's archaeological resources may be related to what is currently known about the prehistory of landscapes adjacent to the Park, in the Northwest region, and to more distant mountainous environments. From a like viewpoint, Chapter 5 trys to show one way to go about studying Park archaeological resources so they can contribute to a general understanding of culture change and other land use processes. What this report does not do is make formal logical links between the theoretical ideas about land use and all of the data categories embodied in sites that are related to these ideas. Some of these links, however, have been casually discussed in chapters 4 and 5. Also, the expected relationships between many data categories have not been formalized into hypothetical statements so that confirming and denying tests can be made, nor have the methods of data recording and analysis been specified, although some examples have been provided in Chapter 5. These steps will need to be completed as part of the project-specific research designs and work plans that will guide future archaeological studies within the Park Complex.

Some sites may have religious significance to modern Native American people. This value must be considered in evaluating and managing such sites. For this reason, it is important that representatives of appropriate Native American tribal organizations be consulted regarding all phases of prehistoric cultural resource management activities.

Protection

Protection is a general term covering a variety of activities concerned with the wise management of cultural resources. The significant information in a site can be "protected" in a variety of ways, such as by making a detailed plan view map of a site and its artifacts; by digging and screening all or part of the site, describing, analyzing, and interpreting all or part of what was found, and making the results available to interested parties in the form of a written publication; by building a levee around a site in order to physically protect it from erosion; by building a fence around it to protect it from people; by just leaving it alone or avoiding it. These are only a few of the many activities, in various combinations, that constitute protection from the viewpoint of cultural resource management. What particular activities are considered appropriate to a site depends on what it is that makes the site significant and what is going to affect the site (such as road building or river erosion). As with significance, determining the affects to a site are only indirectly related to the number of artifacts and features and are more directly related to the information content. A formal "determination of affect" answers the question "how will a particular action affect the important information embodied in the site?" If it will destroy the significant information and if the particular action cannot be avoided, then the importance can be "protected" through excavation, analysis, and interpretation (or other appropriate ways that data is recovered) before the proposed action destroys it. Everything else being equal, it is preferred that excavation and other relatively expensive forms of data recovery be avoided. One way to do this is to change whatever is adversely affecting the site as long as this is less costly than data recovery.

Generally, there are few planned undertakings that are likely to affect large land areas in the Park containing archaeological sites. Undertakings may include the construction and maintenance of roads and attendant facilities, campgrounds, trails, and Park services facilities, and the regular operation of reservoirs. Natural landscape processes, which might be considered "unplanned actions," are also affecting archaeological resources through river bank erosion, flooding, burial in avalanches, and by other processes. The specific affects of these various "actions" on the significant information embodied in archaeological sites within the Park Complex is unknown. This is because the formal significance of sites within the Park has not been determined and neither have the effects of the various "actions" on this significance. Given the relatively large size of the Park, the fact that less than one percent of it has been surveyed for sites, and the fact that so few sites have even been test excavated, then it is likely that most of them will have important information to contribute to the understanding of prehistory for the locality and region. At some point after more is known about archaeological resources in the Park, more specific and detailed statements about significance or nonsignificance will be possible.

Public Context of Archaeological Sites

The management of Park Complex sites should not be seen as unrelated to cultural resource management throughout the state. All archaeological remains under authority of the federal government (such authority derives from federal ownership, licensing and permitting authority, and regulatory control) are managed according to a variety of laws and regulations, such as Section 106 of the National Historic Preservation Act, Executive Order 11593, and procedures and policies as published in Federal Codes of Regulations (Advisory Council on Historic Preservation 1980) and others (King et al. 1977). These policies and procedures are exercised in part, and coordinated among the various agencies, through the Office of Archaeology and Historic Preservation in Olympia in consultation with the Advisory Council on Historic Preservation in Washington, DC. Professional archaeologists and agencies working in Washington State often consult directly with a State Historic Preservation Officer in the Olympia office when nominating a site to the National Register of Historic Places, when seeking a determination of the effects of an undertaking on an archaeological property, when planning the cultural resource management programs of different kinds of public and private agencies, and for a wide variety of other related tasks. As a result, the state Office of Archaeology and Historic Preservation is crucial in determining how archaeological sites in the state are managed. This office is responsible for, among other things, considering the needs and concerns of many interest groups, including developers, environmental groups, land-managing agencies, Native American tribal organizations, amateur archaeologists, and professional and academic archaeologists. These groups often express different and competing concerns about archaeological sites (and other cultural resources) that ultimately determine how a large number of sites in the state will be managed. However, the particular manner in which the Olympia office fulfills its responsibilities, and the manner in which it chooses to weigh the competing interests, is made compatible with the political philosophy of the governor, at whose pleasure the director of the preservation office serves. For these and other reasons, it is important to know that the context in which archaeological sites in the state are evaluated and managed is subject to political change.

The public context of archaeological sites, only some aspects of which are outlined above, is too complex and involved to treat in detail here. A large measure of this complexity is related to the contradictory and oftentimes competing ideas held by practicing archaeologists in the state. This condition is typical in other states and in other scientific disciplines as well, and from a scholarly standpoint is considered healthy. Different professional archaeologists often disagree strongly as to the meaning and significance of archaeological sites. Unfortunately, the interested public is most often denied access to these debates or, through a facade of harmony, is led to believe that debate does not exist. Only rarely is the smooth surface atop the shallow waters of professional harmony broken, and even then the public ripples do not travel far. However, the competing ideas behind these debates are often used to make decisions that eventually determine how large numbers of archaeological sites will be managed. Ultimately, the issue is the control of a threatened and nonrenewable resource: archaeological sites.

Sites within the Park Complex are related to the larger context of archaeological sites throughout the entire state. In part, this is true because there is no tradition of archaeological research in the rugged mountainous areas that comprise over half of the state. The archaeological resource base for mountainous areas is unknown and what it can contribute to knowledge about prehistory is uncertain. Park archaeological sites are also important because they are some of the least disturbed in the state by historic land uses, including road building, timber cutting, and commercial and residential development. For this reason, the events that resulted in the establishment of the North Cascade National Park also established a relatively unaltered scientific preserve for the study of prehistoric adaptations to mountain environments. Furthermore, this prehistoric data base is in many ways representative of the large area of mountainous lands in Washington State and in this context will influence the management and interpretation of archaeological sites on state and federally owned lands.

Site Specific Recommendations

In this section recommendations are made for the treatment of each of the 28 known sites in the Park Complex. Four different kinds of recommendations are made and the sites are grouped accordingly. The recommendation categories are for testing, recording in more detail, revisiting and monitoring, and no action. These are listed in order from highest to lowest priority. The sites are identified according to their serial listing in Figure 5-1.

Sites to Test

Five sites should be tested in order to gather basic information needed to make National Register evaluations and management decisions.

1. Site no. 11 is exposed in a rapidly eroding cutbank of the Skagit River. It has yielded a radiocarbon date of 475 ± 65 B.P. in association with charred plant food and fish food parts and burned rocks in a hearth (see Appendix A). Although this and additional information about the site recorded in field notes could support the conclusion that it qualifies to the National Register of Historic Places, more detailed information about the data categories contained in the site and its boundaries is needed. An unknown portion of the site has alreay been lost to river erosion, which will continue unabated.

2. Site no. 14 is being eroded at the high pool level of Lake Chelan. Here two burned rock features and a small depression of unknown age and function are exposed along the eroding lake shoreline and two additional nearby depressions may be threatened. Basic information so far collected about the site is inadequate to determine its significance to local and regional prehistory, although the potential for it to qualify to the National Register of History is high.

3. Site no. 27 is being affected by the annual drawdown of Lake Chelan. Some portions of the site are being eroded by waves, wind, and current action; other portions are becoming buried, and some appear to remain unaffected. Basic information needs to be collected about site boundaries and data categories contained within the site. If this was a residential site as it appears to have been, it likely contains information useful for understanding key aspects about prehistoric adaptations to the lower Stehekin River-upper Lake Chelan area. The site is very likely to qualify to the National Register of Historic Places.

4. Site no. 3 was tested about eight years ago and appears to qualify for the National Register of Historic Places. Portions of the site are being eroded during the annual drawdown of Ross Lake, some are becoming buried, and others appear to be unaffected. Any future work plan at the site should include the following:

   a. an intensive resurvey of all portions of the site exposed in the drawdown zone;

   b. collection of tools and diagnostic artifacts from the site surface;

   c. excavation of 20-30 1 m^2 test pits to determine presence of datable charcoal, buried features and recognizable cultural components;

   d. detailed mapping of the site's surface, of its artifact distribution, of test pits, and including Grabert and Pint's (1978) detailed map area; and

   e. analysis and interpretation of all artifact collections known to have come from the site.

5. Site no. 19 is not in immediate need of testing. Cascade Pass has been severely eroded in the past by hiker and camper use and has been the subject of vegetation stabilization by the Park Service for some years. However, these past activities along with any future ones have a potential affect on cultural resources at the site. Because basic information about site boundaries, buried features and artifacts, preservation of organic remains and cultural stratigraphy are unknown, it is impossible to assess the cultural significance of the site relative to future management of the pass, such as revegetation programs, trail maintenance, and any others. The site is believed to be eligible to the National Register of Historic Places, partially on the basis of its prehistoric significance (Thompson 1970:231-236). I believe a carefully designed test plan needs to be constructed that is compatible with ongoing vegetation efforts and visitor use. Any buried archaeological remains at the site are extremely likely to contribute important information about the prehistory of the region.

Sites to Record in More Detail

Ten sites in the Park are incompletely recorded for various reasons. They should be revisited and descriptions should be made of their present status and distribution. Some specific recommendations are as follows:

1. Site no. 6 needs to be thoroughly and intensively surveyed and a sketch map made of its horizontal boundaries.

2. Site no. 13 needs to be as completely documented as possible. A single compilation should be made of all photographs, sketches, and historic references to these pictographs. This compilation could form the basis of an interpretive reconstruction of the unaltered panel's appearance. The feasibility should be investigated of removing pain applied by vandals while retaining the original pigment.

3. Sites nos. 20, 21, 22, 23, 24, 25, 26, and 28 were only briefly examined and recorded. These need to be more thoroughly examined, photographed, and need to have more exacting measurements made of the features present. These also need to have site forms prepared. All were found and informally recorded during implementation of the contract, although this was not requested by the contract.

Sites to be Revisited or Monitored

Six previously recorded sites could not be revisited because they have been eroded or buried by river action, or because they were not accessible during my Park visits. For sites 7-10, this could be accomplished during the recommended surveying and monitoring of the Skagit River banks. For 4 and 12, this needs to be done during the winter-early spring drawdown period.

Sites Having No Recommended Action

No action is recommended for seven sites. These include nos. 1, 2, 5, 15, 16, 17, and 18.

Supporting Studies

Management and interpretation of archaeological sites in the Park Complex can be enhanced by studies of other aspects of Park natural history. Three of these are suggested here.

1. The distribution of major food and utilitarian plant resources within the Park is unknown. Use of the techniques of ethnobotany would contribute much to an understanding of prehistoric use of the Park. The results of such a study could be combined and manipulated with GIS data bases to further refine predictive modeling.

2. A reference collection could be made of rock and mineral raw material types from throughout the Park that could have been used by prehistoric people. The precise description and mapping of stone raw material

source localities could help to locate quarry and lithic procurement sites and to interpret raw material counts found at individual archaeological sites.

3. Geomorphological studies, especially those that date terraces, moraines, and other landforms, are directly related to interpreting the archaeological record. Tephra studies that identify and date different volcanic ash layers are important to Park sites and others widespread from the Park. Some Park sites are likely to contain buried volcanic ash layers in association with archaeological remains, although too few sites have been tested to know this.

Summary and Conclusions

Archaeological resources in the Park have a high value for public interpretation. It is encouraged that artifact displays be organized according to interpretive themes that deal with adaptations to the North Cascades landscape. Based on archaeological reconnaissance surveys, intensive, probabilistic sample surveys should be designed and implemented if other if other overriding factors do not apply. Site evaluations should be made in order to plan how selected sites should be treated. Five sites are recommended for testing, 10 sites should be recorded in more detail, six sites need to be revisited, and no action is recommended for the remaining seven. Supporting studies of Park Complex ethnobotany, stone tool raw material sources, and geomorphology would enhance interpretation of archaeological resources.

REFERENCES CITED--ENVIRONMENT

Agee, James K., Mark Finney, and Roland de Gouvenain
1986 The Fire History of Desolation Peak. National Park Service Cooperative Studies Unit, College of Forest Resources, University of Washington, Seattle.

Antevs, Ernst
1948 Climatic Change and Pre-White Man. In The Great Basin: with Emphasis on Glacial and Postglacial Times. Bulletin of the University of Utah 38(20), Biological Series 10(7):168-191.

Arno, Stephen F., and Ramona P. Hammerly
1984 Timberline, Mountain, and Arctic Forest Frontiers. The Mountaineers, Seattle.

Baker, Richard G.
1983 Holocene Vegetational History of the Western United States. In Late-Quaternary Environments of the United States, edited by H. E. Wright, Jr., pp. 109-127, Volume 2, The Holocene. University of Minnesota Press, Minneapolis.

Baker, Victor R.
1983 Late-Pleistocene Fluvial Systems. In Late-Quaternary Environments of the United States, edited by H. E. Wright, Jr., pp. 115-129, Volume 1, The Late Pleistocene. University of Minnesota Press, Minneapolis.

Barker, Peter A.
1968 Glaciation of the Chelan Trough. Unpublished Master's Thesis, Department of Geology, Washington State University, Pullman.

Bartholomew, Michael J.
1982 Pollen and Sediment Analyses of Clear Lake, Whitman County, Washington: The Last 600 years. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Beckey, Fred
1981 Cascade Alpine Guide, Climbing and High Routes, Rainy Pass to Fraser River. The Mountaineers, Seattle.

1973 Cascade Alpine Guide, Climbing and High Routes, Columbia River to Stevens Pass. The Mountaineers, Seattle.

Bjorklund, Jonathan
1981a History and Present Status of Elk in the Northern Cascade Range. Miscellaneous Research Paper NCT-16. Ms. on file, US National Park Service, Pacific Northwest Region, Seattle.

1981b Species, Subspecies, and Distributions of Mammals in the North Cascades. Miscellaneous Research Paper NCT-14. North Cascades National Park, Sedro Woolley, Washington.

Brooke, Robert C., E. B. Peterson, and V. J. Krajina
1970 The Subalpine Mountain Hemlock Zone. Ecology of Western North America 2(2):147-349.

Buechner, Helmut K.
1953 Some Biotic Changes in the State of Washington During 1853-1953. Research Studies of the State College of Washington 21. Pullman.

Burke, R. M., and P. W. Birkeland
1983 Holocene Glaciation in the Mountain Ranges of the Western United States. In Late-Quaternary Environments of the United States, Vol. 2, edited by H. E. Write, Jr.

Clague, John J.
1981 Late Quaternary Geology and Geochronology of British Columbia, Part 2: Summary and Discussion of Radiocarbon-Dated Quaternary History. Geological Survey of Canada, Paper 80-35.

Daubenmire, Rexford
1970 Steppe Vegetation of Washington. Technical Bulletin 62, Washington Agricultural Experiment Station, College of Agriculture, Pullman.

Davis, Margaret B.
1973 Pollen Evidence of Changing Land Use Around the Shores of Lake Washington. Northwest Science 47(3):133-148.

Davis, O. K., D. A. Kolva, and P. J. Mehringer, Jr.
1977 Pollen Analysis of Wildcat Lake, Whitman County, Washington: The Last 1000 Years. Northwest Science 51(1):13-20.

Deevey, E. S., Jr. and R. F. Flint
1957 Postglacial Hypsithermal Interval. Science 125:182-184.

Denton, George H.
1975 Glaciers of the Cascade and Olympic Mountains. In Mountain Glaciers of the Northern Hemisphere, edited by William O. Field, pp. 561-594.

Denton, George H. and W. Karlen
1973 Holocene Climatic Variations--Their Pattern and Possible Cause. Quaternary Research 3:155-205.

Denton, George H., and Stephen C. Porter
1970 Neoglaciation. Scientific American, Vol. 222:101-110.

Donaldson, Wallace R., and Charles Ruscha
1975 Washington Climate for Chelan, Douglas, and Okanogan Counties. E. M. 3889. Cooperative Extension Service, College of Agriculture, Washington State University, Pullman.

Drost, B. W., and R. E. Lombard
1978 Water in the Skagit River Basin, Washington. State of Washington, Department of Ecology, Water-Supply Bulletin 47.

Duncan, J. K.
1854 Topographic Report of Lieutenant J. K. Duncan, USA, Topographer of the Western Division. In Report of the Explorations for a Route for the Pacific Railroad by I. I. Stevens, pp. 203-219. Senate Ex. Doc. No. 78, 33rd Congress, 2nd Session. 1855.

Fish and Wildlife Technical Committee
1970 Comprehensive Study of Water and Related Land Resources. Puget Sound and Adjacent Waters. Appendix XI, Fish and Wildlife. Puget Sound Task Force, Pacific Northwest River Basins Commission.

Flint, Richard Foster
1971 Glacial and Quaternary Geology. John Wiley and Sons, New York.

Fonda, Richard W.
1974 Forest Succession in Relation to River Terrace Development in Olympic National Park, Washington. Ecology 55:927-942.

Franklin, Jerry F., and C. T. Dyrness
1973 Natural Vegetation of Oregon and Washington. Pacific Northwest Forest and Range Experiment Station, Forest Service, US Department of Agriculture. General Technical Report PNW-8. Portland, Oregon.

Franklin, J. F., W. H. Muir, G. W. Douglas, C. Wiberg
1971 Invasions of Subalpine Meadows by Trees in the Cascade Range, Washington and Oregon. Arctic and Alpine Research 3(3):215-224.

Fulton, R. J.
1971 Radiocarbon-Geochronology of Southern British Columbia. Geological Survey of Canada Paper 71-~~73~~. 37

1969 Glacial Lake History, Southern Interior Plateau, British Columbia. Geological Survey of Canada Paper 69-37. Department of Energy, Mines, and Resources.

Galbraith, William A., and E. William Anderson
1971 Grazing History of the Northwest. Journal of Range Management 24(1):6-12.

Grove, Jean M.
1972 The Incidence of Landslides, Avalanches, and Floods in Western Norway During the Little Ice Age. Arctic and Alpine Research 4(2):131-138.

Hansen, Henry P.
1947 Postglacial Forest Succession, Climate, and Chronology in the Pacific Northwest. Transactions of the American Philosophical Society 37(1).

Heikkinen, Olavi
1984 Dendrochronological Evidence of Variations of Coleman Glacier, Mount Baker, Washington. Arctic and Alpine Research 16(1):53-64.

Ingles, Lloyd G.
1965 Mammals of the Pacific States. Stanford University Press, Stanford.

Kershaw, A.
1978 The Quaternary History of the Okanogan. 42nd Report of the Okanogan Historical Society, pp. 27-42.

Knox, J. C.
1983 Responses of River Systems to Holocene Climates. In Late-Quaternary Environments of the United States, Vol. 2, "The Holocene," edited by H. E. Wright, Jr., pp. 26-41. University of Minnesota Press, Minneapolis.

Krajina, V. J.
1969 Ecology of Western North America, Vol. 2, No. 1, Department of Botany, University of British Columbia.

Leonard, Eric M.
1974 Price Lake Moraines: Neoglacial Chronology and Lichenometry Study. Unpublished Master's thesis, Department of Geography, Simon Fraser University, Burnaby, B.C.

Lyman, R. Lee, and Stephanie D. Livingston
1983 Late Quaternay Mammalian Zoogeography of Eastern Washington. Quaternary Research 20:360-373.

Mack, Richard N., N. W. Rutter, and S. Valastro
1979 Holocene Vegetation History of the Okanogan Valley, Washington. Quaternary Research 12:212-225.

McGuirk, James P.
1982 A Century of Precipitation Variability Along the Pacific Coast of North America and Its Impact. Climatic Change 4:41-56.

Meier, M. F.
1969 Glaciers and Water Supply. Journal of the American Water Works Association 61(1):8-12.

1961 Distribution and Variations of Glaciers in the United States Exclusive of Alaska. International Association of Scientific Hydrology, Helsinki Assembly 1960, Publication 54, pp. 420-429.

Miller, C. D.
1969 Chronology of Neoglacial Moraines in the Dome Peak Area, North Cascades Range, Washington. Arctic and Alpine Research 1:49-66.

Misch, Peter
1952 Geology of the Northern Cascades of Washington. Mountaineer 45(13):4-22.

Moody, Ula L.
1978 Microstratigraphy, Paleoecology, and Tephrochronology of the Lind Coulee Site, Central Washington. Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman. Copyright 1978.

Murettin, Keser
1976 *Interpretation of Landforms from Aerial Photographs*. Province of British Columbia, Ministry of Forests, Information Services Branch, Victoria.

Naas, Ralph and Dorothy Naas
1978 A Check List of Vascular Plants of the North Cascades, Washington. Ms. on file, North Cascades National Park, National Park Service, Sedro-Woolley, Washington.

Paulsen, C. G. (preparer)
1949 Floods of May-June 1948 in Columbia River Basin. *US Geological Survey Water-Supply Paper 1080*. US Government Printing Office, Washington, D.C.

Pearson, Rob
1978 A Dendrochronological Study in South-central Idaho. Unpublished Master's thesis, Idaho State University, Pocatello. 66 pp.

Phillips, Earl L.
1966 *Washington Climate for These Counties: Northeast Clallam, Northeast Jefferson, Island, San Juan, Skagit, Snohomish, and Whatcom*. E.M. 2626. Cooperative Extension Service, College of Agriculture, Washington State University, Pullman.

Porter, Stephen C.
1981 Use of Tephrochronology in the Quaternary Geology of the United States. In *Tephra Studies*, edited by S. Self and R. S. J. Sparks, pp. 135-160. D. Reidel Publishing Co., Boston.

1977 Present and Past Glaciation Threshold in the Cascade Range, Washington, USA: Topographic and Climatic Controls, and Paleoclimatic Implications. *Journal of Glaciology* 18(78):101-116.

Porter, S. C., and G. H. Denton
1967 Chronology of Neoglaciation in the North American Cordillera. *American Journal of Science* 265:177-210.

Porter, Stephen C., Kenneth L. Pierce, and Thomas D. Hamilton
1983 Late Wisconsin Mountain Glaciation in the Western United States. In *Late-Quaternary Environments*, Vol, 1, The Late Pleistocene, edited by ~~H. E. Wright Jr.,~~ pp. 71-111. The University of Minnesota Press, Minneapolis. S.C. Porter

Post, Austin, Don Richardson, Wendell V. Tangborn, and F. L. Rosselot
1971 Inventory of Glaciers in the North Cascades, Washington. *Geological Survey Professional Paper* 705-A.

Price, Larry W.
1978 Mountains of the Pacific Northwest: A Study in Contrast. *Arctic and Alpine Research* 10(2):465-478.

Ruhe, Robert V.
1975 *Geomorphology*. Houghton Mifflin Co., Boston.

Ryder, J. M.
1971 The Stratigraphy and Morphology of Para-glacial Alluvial Fans in South-central British Columbia. Canadian Journal of Earth Science 8:279-298.

Schumm, Stanley A.
1977 The Fluvial System. John Wiley and Sons, New York.

1965 Quaternary Paleohydrology. In The Quarternary of the United States, edited by H. E. Wright, Jr. and David G. Frey, pp. 783-794. Princeton University Press, New Jersey.

Staatz, Mortimer, Rowland W. Tabor, Paul L. Weis, Jacques F. Robertson, Ronald M. Van Noy, and Eldon C. Pattee
1972 Geology and Mineral Resources of the Northern Part of the North Cascades National Park, Washington. Geological Survey Bulletin 1359. US Government Printing Office, Washington, DC.

Staatz, Mortimer H., Paul L. Weis, Rowland W. Tabor, Jacques F. Robertson, Ronald M. Van Noy, Eldon C. Pattee, and Dean C. Holt
1971 Mineral Resources of the Pasayten Wilderness Area, Washington. Geological Survey Bulletin 1325. US Government Printing Office, Washington, DC.

Stewart, James E., and G. Lawrence Bodhaine
1961 Floods of the Skagit River Basin, Washington. US Geological Survey Water-Supply Paper 1527. US Government Printing Office, Washington, D.C.

Taber, Richard D.
1984 Mammals of the North Cascades. Ms. on file, US National Park Service, Pacific Northwest Region, Seattle.

Taylor, Dan
1977 Some Preliminary Observations of the History of Natural Fires in Skagit District. Ms. on file, North Cascades National Park, Skagit District, Marblemount, Washington.

Telfer, Edmund S., and John P. Kelsall
1984 Adaptation of Some Large North American Mammals for Survival in Snow. Ecology 65(6):1828-1834.

Thornburgh, Dale A.
1970 Survey of Recreational Impact and Management Recommendations for the Subalpine Vegetation Communities at Cascade Pass, North Cascades National Park. Ms. on file, US National Park Service, Pacific Northwest Region, Seattle.

Travis, Russel B.
1955 "Classification of Rocks." Quarterly of the Colorado School of Mines, Vol. 50, No. 1.

US Geological Survey
1985 Water Resources Data, Washington, Water Year 1982. Volume 2, Eastern Washington. US Geological Survey Water-Data Report WA-82-2.

1966 Mineral and Water Resources of Washington. Report prepared by the US Geological Survey in colaboration with the Washington State Department of Conservation, the US Bureau of Reclamation, and other agencies. 89th Congress, 2d Session, Committee Print. US Government Printing Office, Washington, DC.

1949 Floods of May-June 1948 in Columbia River Basin. Geological Survey Water-Supply Paper 1080. US Government Printing Office, Washington, D.C.

Waitt, Richard B., Jr.
1977 Evolution of Glaciated Topography of Upper Skagit Drainage Basin, Washington. Arctic and Alpine Research 9(2):183-192.

1972 Geomorphology and Glacial Geology of the Methow Drainage Basin, Eastern North Cascade Range, Washington. Unpublished Ph.D. dissertation, Department of Geology, University of Washington.

Waitt, Richard B., Jr., and Robert M. Thorson
1983 The Cordilleran Ice Sheet in Washington, Idaho, and Montana. In Late-Quaternary Environments of the United States, Vol. 1, The Late Pleistocene, edited by Steven C. Porter, pp. 53-70. University of Minnesota Press, Minneapolis.

Wasem, C. Robert
1974 Topographic Map Survey of Reservoirs, Lakes, Ponds, and Tarns of the North Cascades National Park Service Complex, Washington. Miscellaneous Research Paper NCA-6, North Cascades National Park, Sedro Woolley, Washington.

1972 Preliminary Check List of the Fishes of Lake Chelan and the Stehekin River Drainage, Washington. Miscellaneous Research Paper NCA-1, North Cascades National Park, Sedro Woolley, Washington.

Whetten, John
1967 Lake Chelan, Washington: Bottom and Sub-Bottom Topography. Journal of Limnology and Oceanography, April:253-259.

Wright, H. E., Jr.
1983 Introduction. In Late-Quaternary Environments of th United States, Volume 2, The Holocene, edited by H. E. Wright, Jr., pp. xi-xvii. University of Minnesota Press, Minneapolis.

1976 The Dynamic Nature of Holocene Vegetation, A Problem of Paleoclimatology, Biogeography, and Stratigraphic Nomenclature. Quaternary Research 6:581-596.

Wydoski, Richard S., and Richard R. Whitney
1979 Inland Fishes of Washington. University of Washington Press, Seattle.

REFERENCES CITED--PREHISTORY AND LAND USE

Adovasio, J. M., J. Donahue, K. Cushman, R. C. Carlisle, R. Stuckenrath, J. D. Gunn, and W. C. Johnson
1983 Evidence from Meadowcroft Rockshelter. In Early Man in the New World, edited by Richard Shutler, Jr., pp. 163-189.

Advisory Council on Historic Preservation
1980 Treatment of Archaeological Properties: A Handbook. Washington, DC.

Aikens, C. Melvin
1983 Environmental Archaeology in the Western United States. In Late Quaternary Environments of the United States, Vol. 2, The Holocene, edited by H. E. Wright, Jr., pp. 239-251. The University of Minnesota Press, Minneapolis.

Alexander, Diana
1983 The Limitations of Traditional Surveying Techniques in a Forested Environment. Journal of Field Archaeology 10(2):177-186.

Alexander, Diana, Robert Tyhurst, Linda Burnard-Hogarth, and R. G. Matson
1985 A Preliminary Ethnoarchaeological Investigation of the Potatoe Mountain Range and the Eagle Lake Area. Report prepared for the Heritage Conservation Branch of British Columbia, the Canadian Ethnic Studies Program, and the Nemiah Valley Indian Band Council.

Ames, Kenneth M.
1985 Hierarchies, Stress, and Logistical Strategies Among Hunter-Gatherers in Northwestern North America. In Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity, edited by T. Douglas Price and James A. Brown, pp. 155-180. Academic Press, New York.

1981 The Evolution of Social Ranking on the Northwest Coast of North America. American Antiquity 46(4):789-805.

Ames, Kenneth M., James P. Green, and Margaret Pfoertner
1981 Hatawai (10NP143): Interim Report. Archaeological Reports No. 9, Boise State University, Boise, ID.

Ames, Kenneth M. and Alan G. Marshall
1980 Villages, Demography, and Subsistence Intensification on the Southern Columbia Plateau. North American Archaeologist 2(1):25-51.

Anastasio, Angelo
1975 The Southern Plateau: An Ecological Analysis of Intergroup Relations. 1972. Reprinted from Northwest Anthropological Research Notes 6(2):109-229.

Appleby, Andrew B.
1981 Epidemics and Famine in the Little Ice Age. In Climate and History, edited by Robert I. Rotberg and Theodore K. Rabb, pp. 63-83. Princeton University Press, New Jersey.

Avey, Michael Garland
1972 Problems and procedures of demonstrating the presence of an early assemblage at the Little's Landing Site (45CH64). Unpublished master's thesis, Department of Anthropology, Washington State University, Pullman.

Baker, Paul T. (editor)
1978 The Biology of High Altitude Populations. Cambridge University Press, Cambridge.

Barrett, Stephen W.
1980 Indians and Fire. Western Wildlands 6(3):17-21.

Barrett, Stephen W. and Stephen F. Arno
1982 Indian Fires as an Ecological Influence in the Northern Rockies. Journal of Forestry, Vol. 80:647-651.

Baumhoff, Martin A. and Robert F. Heizer
1965 Postglacial Climate and Archaeology in the Desert West. In The Quaternary of the United States, edited by H. E. Wright, Jr. and D. G. Frey, pp. 697-708. Princeton University Press, Princeton.

Beckey, Fred
1981 Cascade Alpine Guide, Climbing and High Routes, Rainy Pass to Fraser River. The Mountaineers, Seattle.

Benedict, James B.
1986 Man at the Montane Glacier Margin, Colorado Front Range. American Quaternary Association, Program and Abstracts of the ninth biennial meeting, 2-4 June, 1986, pp. 61-63. University of Illinois, Champaign-Urbana.

1981 The Fourth of July Valley. Research Report No. 2, Center for Mountain Archeology, Ward, CO.

Benedict, James B. and Byron L. Olson
1978 The Mount Albion Complex. Research Report No. 1, Center for Mountain Archeology, Ward, CO.

Bense, Judith A.
1972 The Cascade Phase: A Study in the Effect of the Altithermal on a Cultural System. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman. University Microfilm, Ann Arbor.

Bergland, Eric O.
1983 Summary Prehistory and Ethnography of Olympic National Park, Washington. National Park Service, Pacific Northwest Region, Division of Cultural Resources, Seattle, Washington.

Binford, Lewis R.
1983 Longterm Land Use Patterns: Some Implications for Archaeology. Anthropological Papers, Museum of Anthropology, University of Michigan, No. 72.

1982 The Archaeology of Place. Journal of Anthropological Archaeology 1:5-31.

1980 Willow Smoke and Dogs Tails: Hunter-Gatherer Settlement. American Antiquity 45(1):4-20.

1979 Organization and Formation Processes: Looking at Curated Technologies. Journal of Anthropological Research 35:255-273.

Blukis-Onat, Astrida R.
1982 Report of Cultural Resource Search and Field Reconnaissance Thorton Creek Hydroelectric Project. Ms. on file, National Park Service, Pacific Northwest Region, Seattle.

1980 Skwikwikwab: A Methodological Study of a Prehistoric Puget Sound Settlement. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Blukis-Onat, Astrida R., Lee A. Bennett, and Jan L. Hollenbeck
1980 Cultural Resource Overview and Sample Survey of the Skagit Wild and Scenic River, vol. I-III. Institute of Cooperative Research. Report submitted to Mt. Baker-Snoqualmie National Forest, US Forest Service, Seattle, WA.

Booth, Charles W.
1971 The Northwestern United States. Van Nostrand Reinhold Company, New York.

Borden, Charles E.
1970 Culture History of the Fraser Delta: An Outline. B.C. Studies, Nos. 6-7.

Boreson, Keo
1976 Rock Art of the Pacific Northwest. Northwest Anthropological Research Notes 10(1).

Brauner, David
1985 Early Human Occupation in the Uplands of the Southern Plateau: Archaeological Excavations at the Pilcher Creek Site, Union County, Oregon. Ms. on file, Department of Anthropology, Oregon State University, Corvallis.

Browman, David L., and David A. Munsell
1969 Columbia Plateau Prehistory: Cultural Development and Impinging Influences. American Antiquity 3:249-264.

Browne, John Ross
1858 Indian Affairs in the Territories of Oregon and Washington. Ex. Doc. No. 39, 35th Congress, 1st Session, House of Representatives. 1977 Reprint, Ye Galleon Press, Fairfield, Washington.

Brush, Stephen B.
1976 Introduction, Symposium on "Cultural Adaptations to Mountain Ecosystems." Human Ecology 4:125-133.

Bryan, Alan L.
1980 The Stemmed Point Tradition: An Early Technological Tradition in Western North America. In Anthropological Papers in Memory of Earl H. Swanson, Jr., edited by Lucille B. Harten, et al., pp. 77-107. Special Publication of the Idaho Museum of Natural History, Pocatello.

1963 An archaeological survey of northern Puget Sound. Occasional Papers of the Idaho State Museum No. 11. Pocatello, Idaho.

Bryson, Reid A., and Thomas J. Murray
1977 Climates of Hunger. The University of Wisconsin Press, Madison.

Bryson, Reid A., and Christine Padoch
1981 On the Climates of History. In Climate and History, edited by Robert I. Rotberg and Theodore K. Rabb, pp. 3-17. Princeton University Press, Princeton, New Jersey.

Butler, B. Robert
1978 A Guide to Understanding Idaho Archaeology: The Upper Snake and Salmon River Country (third edition). A Special Publication of the Idaho Museum of Natural History, Pocatello.

Butzer, Karl W.
1982 Archaeology as Human Ecology. Cambridge University Press, Cambridge.

1971 Environment and Archaeology. Second edition. Aldine Publishing Company, Chicago.

Byrd, Robert (editor)
1972 Lake Chelan in the 1890s. Robert Byrd, Stehekin, WA.

Cain, H. T.
1950 Petroglyphs of Central Washington. University of Washington Press, Seattle.

Caldwell, Warren W.
1954 An Archaeological Survey of the Okanogan and Similkameen Valleys of British Columbia. Anthropology in British Columbia No. 4:10-25. Victoria.

Carlson, Roy L.
1983 The Far West. In Early Man in the New World, edited by Richard Shutler, Jr., pp. 73-108. Sage Publications, Beverly Hills.

1982 Prehistory of the Northwest Coast. In Indian Art Traditions of the Northwest Coast, edited by Roy L. Carlson, pp. 13-32. Simon Fraser University Press, Burnaby, British Columbia.

Chance, David H., and Jennifer V. Chance
1982 Kettle Falls: 1971/1974. University of Idaho Anthropological Research Manuscript Series No. 69, Laboratory of Anthropology, University of Idaho, Moscow.

Chartkoff, Joseph L.
1983 A Rock Feature Complex from Northwestern California. American Antiquity 48(4):745-760.

Chatters, James C.
1982 Prehistoric Settlement and Land Use in the Dry Columbia Basin. Northwest Anthropological Research Notes 16(2):125-147.

Cleveland, Gregroy C.
1974 Initial Archaeological Reconnaissance, Lake Wenatchee State Park Expansion. Report submitted to the Washington State Parks and Recreation Commission. Ms. on file, Washington Archaeological Research Center, Pullman.

Cleveland, Gregory C., et al.
1977 Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village Near Burbank, Franklin County, Washington. Project Report Number 46. Washington Archaeological Research Center, Pullman.

Coleman, E. T.
1869 Mountaineering on the Pacific in 1868. Harpers New Monthly Magazine 39:793-817.

Collier, Donald, A. E. Hudson, and Arlo Ford
1942 Archaeology of the Upper Columbia Region. University of Washington Publications in Anthropology, Vol. 9, No. 1, Seattle.

Collins, June M.
1980 Report on the Use of the Skagit River, Including Village Locations, by the Upper Skagit Indians. In Cultural Resource Overview and Sample Survey of the Skagit Wild and Scenic River, vol. 2, by Astrida R. Blukis-Onat, Lee A. Bennett, and Jan L. Hollenbeck, pp. 1-17. Institute of Cooperative Research, Seattle.

1974 Valley of the Spirits. University of Washington Press, Seattle.

Connolly, Thomas J. and Paul W. Baxter
1983 The Problem with Probability: Alternative Methods for Forest Survey. Tebiwa 20:22-34.

Cundy, Harold J.
1938 Petroglyphs of North Central Washington. Washington State Historical Society, Tacoma.

Cybulski, Jerome S., Donald E. Howes, James C. Haggarty, and Morley Eldridge
1981 An Early Human Skeleton from South-Central British Columbia: Dating and Bioarchaeological Inference. Canadian Journal of Archaeology 5:49-60.

Dancey, William S.
1975 The Wood Box Spring Site (45KT209): A Preliminary Report. Office of Public Archaeology Reports in Archaeology 1, Seattle, Washington.

1973 Prehistoric Land Use and Settlement Pattern in the Priest Rapids Area, Washington. Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington, Seattle.

Darsie, Richard F., and James D. Keyser (editors)
1985 Archaeological Inventory and Predictive Modeling in the Pacific Northwest. Studies in Cultural Resource Management, No. 6. US Department of Agriculture, Forest Service, Pacific Northwest Region, Portland, Oregon.

Daugherty, Richard D.
1965 An Archaeological Survey of Mount Rainier National Park. Laboratory of Anthropology, Washington State University, Pullman. Manuscript submitted to the US National Park Service.

1962 The Intermontane Western Tradition. American Antiquity, 28(2):144-150.

1956 Archaeology of the Lind Coulee Site, Washington. Proceedings: American Philosophical Society 100(3):223-278.

deLaguna, Frederica
1958 Geological Confirmation of Native Traditions, Yakutat, Alaska. American Antiquity 23(4):434.

Dillehay, Tom D.
1984 A Late Ice-Age Settlement in Southern Chile. Scientific American, 106-117.

Dobyns, Henry F.
1983 Their Number Become Thinned. The University of Tennessee Press, Knoxville.

Driver, Jonathan C.
1985 Prehistoric Hunting Strategies in the Crowsnest Pass, Alberta. Canadian Journal of Archaeology 9(2):109-129.

Duff, Wilson
1964 The Indian History of British Columbia. Anthropology in British Columbia, Memoir No. 5. Provincial Museum of British Columbia, Victoria.

Eller, Terry K.
1980 A Report of the Archaeological Survey of the Oroville Pit Site, PS-U-309, and Stockpile Site, SP-U-23133, Okanogan County, Washington. Washington Archaeological Research Center Project Report No. 103, Washington State University, Pullman.

Eller, Terry K., Robert R. Mierendorf, and Stan Gough
1981 A Cultural Resources Survey and Site Testing Along the Bonneville Power Administration's Proposed Chief Joseph Dam-East Omak-Tonasket and Grand Coulee-Keller Transmission Lines, Douglas, Ferry, and Okanogan Counties, Washington. Eastern Washington University Reports in Archaeology and History 100-4, Cheney.

Elmendorf, William W.
1965 Linguistic and Geographic Relations in the Northern Plateau Area. Southwestern Journal of Anthropology 21:63-78.

Fagan, John L.
1974 Altithermal Occupation of Spring Sites in the Northern Great Basin. University of Oregon Anthropological Papers No. 6, University of Oregon Press, Eugene.

Fedele, F. G.
1984 Toward a Human Ecology of Mountains. Current Anthropology 25(5):688-691.

1978 Man in the Italian Alps: A Study of the Pleistocene and Post-Glacial Evidence. In Views of the Past: Essays in Old World Prehistory and Paleoanthropology, edited by Leslie G. Freeman, pp. 317-55. The Hague, Moutan.

Fladmark, Knut R.
1985 Glass and Ice, The Archaeology of Mt. Edziza. Department of Archaeology, Simon Fraser University, Publication Number 14, Burnaby, British Columbia.

1983 Times and Places: Environmental Correlates of Mid- to Late-Wisconsinan Human Population Expansion in North America. In Early Man in the New World, edited by Richard Shutler, Jr., pp. 13-41. Sage Publications, Beverly Hills.

1982 An Introduction to the Prehistory of British Columbia. Canadian Journal of Archaeology 6:95-156.

1979 Routes: Alternative Migration Corridors for Early Man in North America. American Antiquity 44(1):55-69.

Flannery, Kent V.
1976 Linear Stream Patterns and Riverside Settlement Rules. In The Early Mesoamerican Village, edited by Kent V. Flannery, pp. 173-180. Academic Press, New York.

Flenniken, J. Jeffrey
1978 Further Technological Analyses of the Lithic Artifacts from the Miller Site, 45FR5. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), a Late Prehistoric Village Near Burbank, Washington, edited by Gregory C. Cleveland, pp. 81-132. Washington Archaeological Research Center, Washington State University, Project Report Number 72.

Fredlund, Dale and William LaCombe
1971 Alpine Archaeology in the Bitterroot Mountains of Montana. Ms. on file, Department of Anthropology, University of Montana, Missoula.

Frison, George C.
1983 The Western Plains and Mountain Region. In Early Man in the New World, edited by Richard Shutler, Jr., pp. 109-124. Sage Publications, Beverly Hills.

1978 Prehistoric Hunters of the High Plains. Academic Press, Inc., New York.

Fryxell, Roald
1965 Mazama and Glacier Peak Volcanic Ash Layers: Relative Layers. Science 147:1288-1290.

Fryxell, Roald (in cooperation with Richard D. Daugherty)
1963 Late Glacial and Post Glacial Geological and Archaeological Chronology of the Columbia Plateau, Washington. Laboratory of Anthropology, Report of Investigations No. 23, Washington State University, Pullman.

Fryxell, Roald, Tadeusz Bielicki, Richard D. Daugherty, Carl E. Gustafson, Henry T. Irwin, and Bennie C. Keel
1968 A Human Skeleton from Sediments of Mid-Pinedale Age in Southeastern Washington. American Antiquity 33(4):511-514.

Galm, Jerry R., and Glenn D. Hartman
1979 Additional Note on Stone Piling in the Pacific Northwest. Northwest Anthropological Research Notes 13(1):9-11.

Galm, Jerry R., and Ruth A. Masten (editors)
1985 Avey's Orchard: Archaeological Investigation of a Late Prehistoric Columbia River Community. Archaeological and Historical Services, Eastern Washington University Reports in Archaeology and History 100-42. Cheney.

Garnett, Alice
1937 Insolation and Relief--Their Bearing on the Human Geography of Alpine Regions. The Institute of British Geographers, Publications Nos. 4 and 5. London.

Gibbs, George
1877 Tribes of Western Washington and Northwestern Oregon. US Geographical and Geological Survey of the Rocky Mountain Region. Contributions to North American Ethnology 1:157-241.

Grabert, Garland F.
1983 Ferndale in Prehistory: Archaeological Investigations in the Lower and Middle Nooksack Valley. Occasional Paper 19, Center for Pacific Northwest Studies, Western Washington University, Bellingham.

1979 Pebble Tools and Time Factoring. Canadian Journal of Archaeology 3:165-176.

1975 An Archaeological Reconnaissance of the Newhalem Vicinity, Washington. Department of Sociology/Anthropology, Western Washington State College, Bellingham.

1968 North-central Washington Prehistory: A Final Report on Salvage Archaeology in the Wells Reservoir--Part 1. Department of Anthropology, University of Washington Reports in Archaeology 1.

Grabert, Garland F. and E. Richard Chesmore, Jr.
1979 Archaeological Investigations at 45WH81, Newhalem, Washington. Reports in Archaeology No. 10, Department of Anthropology, Western Washington University, Bellingham.

Grabert, Garland F. and D. J. Pint
1978 An Archaeological Reconnaissance and Cultural Resource Inventory of the North Cascades National Recreation Area. Reports in Archaeology No. 5, Department of Anthropology, Western Washington University, Bellingham.

Greengo, Robert E.
1983 The Location of Archaeological Places in the Puget Lowlands. In Prehistoric Places on the Southern Northwest Coast, edited by Robert E. Greengo, pp. 77-83. Thomas Burke Memorial Washington State Museum, University of Washington, Seattle.

Greengo, Robert E. (editor)
1983 Prehistoric Places on the Southern Northwest Coast. Thomas Burke Memorial Washington State Museum, University of Washington, Seattle.

Griswold, Gillett
1970 Aboriginal Patterns of Trade between the Columbia Basin and the Northern Plains. Archaeology in Montana 11(2-3):1-96.

Gruhn, Ruth
1965 Two Early Radiocarbon Dates from the Lower Levels of Wilson Butte Cave. Tebiwa 8(2):57.

1961 The Archaeology of Wilson Butte Cave, South-Central Idaho. Occasional Papers of the Idaho State College Museum No. 6, Pocatello.

Guillet, David
1984 On a Cultural Ecology of Mountains: Reply to Malengreav and Messerschmidt. Current Anthropology 25(4):535-536.

1983 Toward a Cultural Ecology of Mountains: The Central Andes and the Himalayas Compared. Current Anthropology 24(5):561-574.

Gunkel, Alexander
1961 A Comparative Cultural Analysis of Four Archaeological Sites in the Rocky Reach Reservoir Region, Washington. Theses in Anthropology 1, Washington State University, Pullman.

Gunther, Erna
1973 Ethnobotany of Western Washington, revised edition. University of Washington Press, Seattle.

Gustafson, Carl E.
1972 Faunal Remains from the Marmes Rockshelter and Related Archaeological Sites in the Columbia Basin. Unpublished Ph.D. dissertation, Department of Zoology, Washington State University.

Gustafson, Carl E., Delbert Gilbow, and Richard D. Daugherty
1979 The Manis Mastadon Site: Early Man on the Olympia Peninsula. Canadian Journal of Archaeology 3:157-164.

Haeberlin, Hermann, and Erna Gunther
1930 The Indians of Puget Sound. University of Washington Publications in Anthropology, Vol. IV, No. 1. Seattle..

Hamilton, Annette
1982 The Unity of Hunting-Gathering Societies: Reflections on Economic Forms and Resource Management. In Resource Managers: North American and Australian Hunter-Gatherers, edited by N. M. Williams and E. S. Hunn, pp. 229-247. AAAS Selected Symposium 67, Westview Press Inc., Boulder, Colorado.

Hassan, Fekri
1981 Demographic Anthropology. Academic Press, New York.

Hayden, Brian
1981 Research and Development in the Stone Age: Technological Transitions among Hunter-Gatherers. Current Anthropology 22:519-548.

Hayden, Brian, Morley Eldridge, Anne Eldridge, and Aubrey Cannon
1985 Complex Hunter-Gatherers in Interior British Columbia. In Prehistoric Hunter Gatherers, edited by T. Douglas Price and James A. Brown, pp. 181-199. Academic Press, New York.

Heizer, Robert F.
1978 Trade and Trails. In Handbook of North American Indians, vol. 8, California, edited by Robert F. Heizer, pp. 690-693. Smithsonian Institution, US Government Printing Office, Washington, DC.

Hewes, Gordon W.
1973 Indian Fisheries Productivity in Precontact Times in the Pacific Salmon Area. Northwest Anthropological Research Notes 7:133-155.

Hill, Beth, and Ray Hill
1974 Indian Petroglyphs of the Pacific Northwest. Hancock House Publishers Ltd., Saanichton.

Hollenbeck, Jan L. and Susan L. Carter
1986 A Cultural Resources Overview: Prehistory and Ethnography, Wenatchee National Forest. Ms. on file, US Department of Agriculture, Forest Service, Pacific Northwest Region.

Holley, Gerald A. and Ann Ramenofsky
1979 A Cultural Resources Survey of Selected Areas of the Mt. Baker-Snoqualmie National Forest. Reconnaissance Report No. 30, Office of Public Archaeology, Institute for Environmental Studies, University of Washington, Seattle.

House, John H., and James W. Smith
1975 Experiments in Replication of Fire-cracked Rock. In The Cache River Archeological Project, assembled by Michael D. Schiffer and John H. House, pp. 75-80. Arkansas Archeological Survey, Publications in Archeology, Research Series No. 8.

Hunn, Eugene S.
1981 On the Relative Contribution of Men and Women to Subsistence among Hunter-Gatherers of the Columbia Plateau: A Comparison with Ethnographic Atlas Summaries. Journal of Ethnobiology 1(1):124-134.

Husted, Wilfred H.
1974 Prehistoric Occupation of the Alpine Zone in the Rocky Mountains. In Arctic and Alpine Environments, edited by Jack D. Ives and Roger G. Barry, pp. 857-872, Muethen and Co., Ltd., London.

1969 Bighorn Canyon Archaeology. Smithsonian Institution River Basin Surveys, Publications in Salvage Archeology No. 12.

Irving, Washington
1976 Astoria, or Anecdotes of an Enterprise beyond the Rocky Mountains, edited by Richard Dilworth Rust. University of Nebraska Press, Lincoln.

Irwin, Ann M. and Ula Moody
1978 The Lind Coulee Site (45GR97). Project Report No. 56, Washington Archaeological Research Center, Washington State University, Pullman.

Jermann, Jerry V.
1981 Surface Collection and Analysis of Spatial Pattern: An Archaeological Example from the Lower Columbia River Valley. In Plowzone Archaeology: Contributions to Theory and Technique, edited by Michael J. O'Brien and Dennis E. Lewarch, pp. 71-118. Vanderbilt University, Publications in Anthropology No. 27, Nashville, Tennessee.

Jones, Chris
1976 Climbing in North America. Published for the American Alpine Association, University of California Press, Berkeley.

Jones, George T.
1984 Prehistoric Land Use in the Steens Mountain Area, Southeastern Oregon. Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington.

Kaiser, V. G.
1961 Historical Land Use and Erosion in the Palouse--A Reappraisal. Northwest Science 35(4):139-153.

Kelly, Robert L.
1983 Hunter-Gatherer Mobility Strategies. Journal of Anthropological Research 39(3):277-306.

Kidd, Robert S.
1964 A Synthesis of Western Washington Prehistory from the Perspective of Three Occupation Sites. Unpublished Masters thesis, Department of Anthropology, University of Washington.

King, Thomas F., Patricia P. Hickman, and Gary Berg
1977 Anthropology in Historic Preservation. Academic Press, New York.

Klement, Otto
1935 Early Skagit Recollections. In Stehekin: Glimpses of the Past, compiled by Carol M. Stone, pp. 2-10. Long House Printcrafters and Publishers; Friday Harbor, Washington. 1983.

Konlande, J. E., and J. R. K. Robson
1972 The Nutritive Value of Cooked Camas as Consumed by Flathead Indians. Ecology of Food and Nutrition 1:193-195.

Krantz, Grover S.
1979 Oldest Human Remains from the Marmes Site. Northwest Anthropological Research Notes 13(2):159-174.

Kroeber, A. L.
1939 Cultural and Natural Areas of Native North America. University of California Publications in American Archaeology and Ethnology 38:1-242. University of California Press, Berkeley.

Larson, Lynn
1978 Master Site File for Archaeological Sites 45SK102, 106, 107, and 108. Washington Archaeological Research Center, Pullman.

Lenihan, Daniel J., Toni L. Carrell, Stephan Fosberg, Larry Murphy, Sandra L. Rayl, and John A. Ware
1981 The Final Report of the National Reservoir Inundation Study, volumes I and II. United States Department of the Interior, National Park Service, Southwest Cultural Resources Center, Santa Fe, New Mexico.

Leonhardy, Frank C.
1970 Artifact Assemblages and Archaeological Units at Granite Point Locality 1 (45WT41), Southeastern Washington. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Lewarch, Dennis E.
1978 An Archaeological Assessment of Chester Morse Lake and Masonry Dam Pool. Office of Public Archaeology, Institute for Environmental Studies, University of Washington Reconnaissance Report No. 15.

Lewis, Henry T.
1982 Fire Technology and Resource Management in Aboriginal North America and Australia. In Resource Managers: North American and Australian Hunter-Gatherers, edited by N. M. Williams and E. S. Hunn, pp. 45-67. AAAS Selected Symposium 67. Westview Press, Inc., Boulder, Colorado.

Linsley, D. C.
1932 Pioneering in the Cascade Country. Civil Engineering 2(6):339-344. New York.

Lobdell, John E.
1974 The Combined Use of Varied Geologic Features in Bison Procurement: An Early Middle Period Example from South-Central Wyoming. In Applied Geology and Archaeology: The Holocene History of Wyoming, edited by Michael Wilson, pp. 19-21. Geological Survey of Wyoming, Report of Investigations No. 10, Laramie.

Loendorf, Lawrence L. and Joan L. Brownell
1980 The Bad Pass Trail. Archaeology in Montana 21(3):11-101.

Lothson, Gordon A.
1982 Final Report of Phase II and Phase III Archaeological Testing of the Rock Island Reservoir, Wenatchee, Washington. Laboratory of Archaeology and History, Project Report No. 13, Washington State University, Pullman.

Louis, William A., Jr.
1985 On the Concepts of "Significance" and "Site": Implications for Inventorying Archaeological Resources. In Archaeological Inventory and Predictive Modeling in the Pacific Northwest. Studies in Cultural Resource Management No. 6, edited by Richard F. Darsie and James D. Keyser, pp. 31-46. USDA Forest Service, Pacific Northwest Region, Portland.

1976 Quarter Sections and Forests: An Example of Probability Sampling in the Northeastern Woodlands. American Antiquity 41(3):364-372.

Lyman, R. Lee
1985 On the Concepts of "Significance" and "Site": Implications for Inventorying Archaeological Resources. In Archaeological Inventory and Predictive Modelling in the Pacific Northwest. Studies in Cultural Resource Management No. 6, edited by Richard F. Darsie and James D. Keyser, pp. 31-46. USDA Forest Service, Pacific Northwest Region, Portland.

1978 Cultural Resource Overview, Chelan, Okanogan, and Douglas Counties. Washington Archaeological Society, Occasional Paper 6.

Majors, Harry M. (editor)
1984 First Crossing of the Picket Range 1859. Northwest Discovery (5):22.

Malouf, Carling I.
1980 On the Trail of the Indian. Archaeology in Montana 21(3):1-9.

1962 Stone Piles. Archaeology in Montana 3(4):1-5.

1956 The Montana Western Region. Research Studies of the State College of Washington, Vol 24, No. 1:45-52.

Martin, Paul S. and Herbert E. Wright, Jr. (editors)
1967 Pleistocene Extinctions: The Search for a Cause. Yale University Press, New Haven, Connecticut.

Marvin, Susan H.
1985 Surveying in Westside Forested Environments: Problems and Potentials. In Archaeological Inventory and Predictive Modelling in the Pacific Northwest, edited by Richard F. Darsie and James D. Keyser, pp. 49-56. Studies in Cultural Resource Management No. 6, Pacific Northwest Region, US Forest Service, Portland.

Matson, R. G.
1983 Intensification and the Development of Cultural Complexity: The Northwest Coast Versus the Northeast Coast. In The Evolution of Maritime Cultures on the Northeast and Northwest Coasts of America, edited by Ronald J. Nash, pp. 125-148. Publication No. 11, Department of Archaeology, Simon Fraser University, Burnaby, B.C.

1981 Prehistoric Subsistence Patterns in the Fraser Delta: The Evidence from Glenrose Cannery. In Fragments of the Past: British Columbia Archaeology in the 1970's, edited by K. Fladmark. B.C. Studies, Special Issue 48:64-85.

1976 (editor) The Glenrose Cannery Site. Archaeological Survey of Canada, Mercury Series, Paper 52. National Museums of Canada.

Matthews, W. H.
1979 Late Quaternary Environmental History Affecting Human Habitation of the Pacific Northwest. Canadian Journal of Archaeology 3:145-156.

Mattson, John Lyle
1971 A Contribution to Skagit Prehistory. Unpublished M.A. thesis, Department of Anthropology, University of Washington, Seattle.

McClure, Richard H., Jr.
1979 Dating Petroglyphs and Pictographs in Washington. Paper presented at the 32nd Annual Northwest Anthropological Conference, Eugene, Oregon.

1978 An Archaeological Survey of Petroglyph and Pictograph Sites in the State of Washington. The Evergreen State College, Archaeological Reports of the Investigations No. 1.

McDowell, Patricia F.
1984 Geomorphic Setting of Archaeological Sites in Southern Willamette Valley, Oregon. In Geoarchaeology in the Northwest: Recent Applications and Contributions, edited by Judith A. Willig. Tebiwa 21:35-44.

McGimsey, Charles R. and Hester A. Davis (editors)
1977 The Management of Archaeological Resources. The Arlie House Report. Special Publication of the Society for American Archaeology.

Mermel, T. W. (editor)
1958 Register of Dams in the United States. McGraw-Hill, New York.

Messerschmidt, Donald A.
1976 Ecological Change and Adaptation Among the Gurungs of the Nepal Himalaya. Human Ecology 4(2):167-185.

Mierendorf, Robert R.
1986 Environment and Land Use in the Calispell and Pend Oreille River Valleys. In Calispell Valley Archaeological Project, edited by Alston V. Thoms and Greg C. Burtchard, pp. 59-108, Contributions in Resource Management No. 10. Center for Northwest Anthropology, Washington State University, Pullman.

1984a Landforms, Sediments, and Archaeological Deposits along Libby Reservoir. In Cultural Resources Investigations for Libby Reservoir, Lincoln County, Northwest Montana, edited by Alston V. Thoms, vol. I, pp. 107-136. Center for Northwest Anthropology, Project Report No. 2, Washington State University, Pullman.

1984b Late-Pleistocene and Early-Holocene Fluvial Processes and Their Effects on Human Use of the Riverine Landscape. In Geoarchaeology in the Northwest: Recent Applications and Contributions, edited by Judith A. Willig. Tebiwa 21:15-25.

1983a Fluvial Processes and Prehistoric Settlement Patterns Along the Rocky Reach of the Columbia River. In Cultural Resources of the Rocky Reach of the Columbia River, vol. II, edited by Randall F. Schalk and Robert R. Mierendorf, pp. 633-647. Project Report No. 1, Center for Northwest Anthropology, Washington State University, Pullman.

1983b Significance of Archaeological Sites. In Cultural Resources of the Rocky Reach of the Columbia River, vol. II, edited by Randall F. Schalk and Robert R. Mierendorf, pp. 649-663. Project Report No. 1, Center for Northwest Anthropology, Washington State University, Pullman.

1983c Assessment of Erosive Effects of a Two-Foot Pool Raise on Cultural Resources Around Lake Pateros. Results of a study submitted to the Colville Confederated Tribes, Nespelem, Washington.

1981 Geologic and Cultural Interpretation of Stratigraphy at the Miller Site, 45FR5, Franklin County, Washington. Unpublished MA thesis, Department of Anthropology, Washington State University, Pullman.

Mierendorf, Robert R., and Sheila J. Bobalik
1983 Description of the Sites Tested. In Cultural Resources of the Rocky Reach of the Columbia River, vol. II, edited by Randall F. Schalk and Robert R. Mierendorf, pp. 473-601. Project Report No. 1, Center for Northwest Anthropology, Washington State University, Pullman.

Mierendorf, Robert R., and Jim Thomson
1986 An Assessment of the Effects of Endowment Commission Projects to Archaeological Remains in the Ross Lake National Recreation Area. Ms. on file, Pacific Northwest Region, National Park Service, US Department of the Interior, Seattle.

Miller, Susan J. and Wakefield Dort, Jr.
1978 Early Man at Owl Cave: Current Investigations at the Wasden Site, Eastern Snake River Plain, Idaho. In Early Man in America, edited by Alan L. Bryan, pp. 128-139. Occasional Papers No. 1, Department of Anthropology, University of Alberta, Canada.

Moran, Emilio F.
1982 Human Adaptability to High Altitudes. In Human Adaptability, edited by Emilio F. Moran, pp. 141-171. Westview Press, Boulder, CO.

Moratto, Michael J.
1981 An Archeological Research Design for Yosemite National Park, California. Publications in Anthropology No. 19, Western Archeoloigcal and Conservation Center, National Park Service, Tucson, Arizona.

Munford, J. Kenneth
1979 Newcomers in a New Land. In Atlas of the Pacific Northwest, Sixth Edition, edited by Richard M. Highsmith, Jr. and A. Jon Kimerling. Oregon State University Press, Corvallis.

Murdock, George P.
1968 The Current Status of the World's Hunting and Gathering Peoples. In Man the Hunter, edited by Richard B. Lee and Irven Devore, pp. 13-20. Aldine Publishing Company, Chicago.

Murray, Keith A.
1965 Building a Wagon Road Through the Northern Cascade Mountains. Pacific Northwest Quarterly 56(2):49-56.

Nash, Roderick
1982 Wilderness and the American Mind, (Third edition). Yale University Press, New Haven, Connecticut.

Nelson, Charles M.
1973 Prehistoric Culture Change in the Intermontane Plateau of Western North America. In The Explanation of Culture Change: Models in Prehistory, edited by C. Renfrew, pp. 371-390. London: Gerald Duckworth & Company.

1969 The Sunset Creek Site (45KT28). Report of Investigations, No. 47, Laboratory of Anthropology, Washington State University, Pullman.

Nelson, Charles M., and David G. Rice
1969 Archaeological Survey and Test, Asotin Dam Reservoir Area, Southeastern Washington. Reports of Investigations, No. 46. Laboratory of Anthropology, Pullman.

Netboy, Anthony
1980 The Columbia River Salmon and Steelhead Trout, Their Fight for Survival. University of Washington Press, Seattle.

Nicholson, B. A.
1985 The Kain Cache Site (DILW12): A Functional Explanation of a Boulder Structure on the Northern Plains/Parkland Interface. Canadian Journal of Archaeology 9(2):173-181.

Northam, Ray M.
1979 Population and Settlement. In Atlas of the Pacific Northwest, Sixth Edition, edited by Richard M. Highsmith, Jr. and A. Jon Kimerling, pp. 19-25. Oregon State University Press, Corvallis.

Norton, Helen H.
1979 The Association Between Anthropogenic Prairies and Important Food Plants in Western Washington. Northwest Anthropological Research Notes 13(2):175-200.

Norton, H. H., R. Boyd, and E. S. Hunn
1983 The Klickitat Trail of South-Central Washington: A Reconstruction of Seasonally Used Subsistence Sites. In Prehistoric Places on the Southern Northwest Coast, edited by R. E. Greengo, pp. 121-152. Thomas Burke Memorial Washington State Museum, Seattle.

Norton, H. H., E. S. Hunn, C. S. Martinsen, and P. B. Keely
1984 Vegetable Food Products of the Foraging Economies of the Pacific Northwest. Ecology of Food and Nutrition 14(3):219-228.

O'Connell, James F.
1975 The Prehistory of Surprise Valley. Ballena Press Anthropological Papers No. 4. Ramona, California.

Osborn, Alan J.
1983 Ecological Aspects of Equestrian Adaptations in Aboriginal North America. American Anthropologist 85(3):563-591.

Osborne, Douglas
1967 Archaeological Tests in the Lower Grand Coulee, Washington. Occasional Papers of the Idaho State College Museum, No. 20. Pocatello, Idaho.

1957 Excavations in the McNary Reservoir Basin Near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Papers, No. 8. US Government Printing Office, Washington, D.C.

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

Osborne, Douglas, Warren W. Caldwell, and Robert H. Crabtree
1956 The Problem of Northwest Coastal-Interior Relationships as Seen from Seattle. American Antiquity 12(2):117-128.

Pawson, I. G. and C. Jest
1978 The High-Altitude Areas of the World and Their Cultures. In The Biology of High-Altitude Peoples, edited by P. T. Baker, pp. 17-45. Cambridge University Press, London.

Peters, Ed (editor)
1982 Mountaineering: The Freedom of the Hills. Fourth Edition. The Mountaineers, Seattle.

Phebus, George E.
1978 The Smithsonian Institution 1934 Bonneville Reservoir Salvage Archaeology Project. Northwest Anthropological Research Notes 12(2):113-177.

Pierce, Henry H.
1883 Expedition from Fort Colville to Puget Sound, Washington Territory, by Way of Lake Chelan and Skagit River. US Government Printing Office, Washington, D.C. Reprint by Ye Galleon Press, Fairfield, Washington. 1983.

Pitzer, Paul C.
1978 Building the Skagit. The Galley Press, Portland.

Pokotylo, David L.
1978 Lithic Technology and Settlement Patterns in Upper Hat Creek Valley, B.C. Unpublished Ph.D. dissertation, Department of Anthropology and Sociology, University of British Columbia.

Pokotylo, David L. and Patricia D. Froese
1983 Archaeological Evidence for Prehistoric Root Gathering on the Southern Interior Plateau of British Columbia: A Case Study from Upper Hat Creek Valley. Canadian Journal of Archaeology 7(2):127-157.

Pomeroy, J. A.
1976 Stone Fish Traps of the Bella Bella Region. In, Current Research Reports, edited by Roy L. Carlson, pp. 165-173. Department of Archaeology, Simon Fraser University, Publication No. 3, Burnaby, British Columbia.

Price, Larry W.
1981 Mountains and Man. University of California Press, Berkeley.

Price, T. Douglas, and James A. Brown (editors)
1985 Prehistoric Hunter-Gatherers. Academic Press, New York.

Ray, Verne F.
1942 Culture Element Distributions: XXII Plateau. Anthropological Records 8(2):99-262.

1939 Cultural Relations in the Plateau of Northwestern America. Publications of the Frederick Webb Hodge Anniversary Publication Fund, vol. III:1-154. (Reprinted in 1964).

1933 The Sanpoil and Nespelem: Salishan Peoples of Northeast Washington. University of Washington, Publications in Anthropology, No. 5. Seattle. Reprinted by Human Relations Area Files, New Haven, Connecticut 1954.

Reagan, Albert B.
1934 Various Uses of Plants By West Coast Indians. The Washington Historical Quarterly, Vol. XXV, No. 2:133-137.

Reagan, Michael J.
1985 Stratified Inventory Sample System: An Intuitive Sample Design. In Archaeological Inventory and Predictive Modelling in the Pacific Northwest, edited by Richard F. Darsie and James D. Keyser, pp. 57-64. Studies in Cultural Resource Management No. 6, Pacific Northwest Region, US Forest Service, Portland.

Redmann, R. E.
1982 Production and Diversity in Contemporary Grasslands. In Paleoecology of Beringia, edited by David M. Hopkins and others, pp. 223-239. Academic Press, New York.

Reeves, B. O. K.
1975 Early Holocene (ca. 8,000-5,500 B.C.) Prehistoric Land/Resource Utilization Patterns in Waterton Lakes National Park, Alberta. Arctic and Alpine Research 7(3):237-248.

1973 The Concept of an Altithermal Cultural Hiatus in Northern Plains Prehistory. American Anthropologist 75:1221-1253.

Reeves, B. O. K., and J. F. Dormaar
1972 A Partial Holocene Pedological and Archaeological Record from the Southern Alberta Rocky Mountains. Arctic and Alpine Research 4(4):325-336.

Reher, Charles A. and George C. Frison
1980 The Vore Site, 48CK302, A Stratified Buffalo Jump in the Wyoming Black Hills. Plains Anthropologist Memoir 16.

Reinhard, Johan
1983 High Altitude Archaeology and Andean Mountain Gods. The American Alpine Journal 25(57):54-67.

Relander, Click
1965 Tokens, Tales, and Tepees. The Mountaineer 58(4):21-26.

Rhodes, Robert E. and Stephen I. Thompson
1975 Adaptive Strategies in Alpine Environments: Beyond Ecological Particularism. American Ethnologist 2:535-551.

Rice, David G.
1972 The Windust Phase in Lower Snake River Region Prehistory. Washington State University, Laboratory of Anthropology Reports of Investigations No. 50.

1969 Archaeological Reconnaissance, South-Central Cascades, Washington. Occasional Paper No. 2, Washington Archaeological Society, Seattle.

1965 Archaeological Test Excavations in Fryingpan Rockshelter, Mount Rainier National Park. Report of Investigations No. 33, Laboratory of Anthropology, Pullman, Washington.

Rice, Harvey S.

n.d.a An Archaeological Survey of the Proposed Roland Point Road and Recreational Development in the Ross Lake National Recreation Area. Ms. on file, National Park Service, Pacific Northwest Region, Seattle.

n.d.b The Ross High Dam Archaeological Survey. Ms. on file, National Park Service, Pacific Northwest Region, Seattle.

n.d.c An Archaeological Survey of the Stehekin Valley Road in the Lake Chelan National Recreation Area and North Cascades National Park. Report submitted to the Washington State Highway Commission. Ms. on file, Washington Archaeological Research Center, Washington State University, Pullman.

n.d.d Aboriginal Rock Features on White Mountain. Ms. on file, Washington Archaeological Research Center, Washington State University, Pullman.

1975 Preservation of Archaeological Resources. In Washington Environmental Atlas, Second Edition, pp. 55-57. Seattle District, US Army Corps of Engineers.

Ritzenthaler, Robert E.

1978 Southwestern Chippewa. In Handbook of North American Indians, Vol. 15, Northeast, edited by Bruce G. Trigger, pp. 743-759. Smithsonian Institution, Washington, D.C.

Rosenberg, Robert L.

1964 Origins of the Peoples of Washington and British Columbia: A Comparative Study of Ethnic, Racial, and Religious Groups from 1870 to 1961. Unpublished Masters thesis, Department of Geography, University of Washington, Seattle.

Ross, Alexander

1956 The Fur Hunters of the Far West. Edited by Kenneth A. Spaulding, University of Oklahoma Press, Norman.

1849 Adventures of the First Settlers on the Columbia River. Reprinted by Readex Microprint Corporation, 1966.

Rusk, C. E.

1924 Tales of a Western Mountaineer. Published by the Mountaineers, Seattle, in 1978.

Salo, Lawr V.

1985 Introduction to Analytic Units: Chronological Ordering, Site Types, and Biases. In Summary of Results of Chief Joseph Dam Cultural Resources Project, edited by S. K. Campbell. Office of Publica Archaeology, Institute for Environmental Studies, University of Washington, Seattle.

Sappington, R. Lee

1984 Procurement without Quarry Production: Examples from Southwestern Idaho. In Prehistoric Quarries and Lithic Production, edited by Jonathon E. Ericson and Barbara A. Purdy, pp. 23-34, Cambridge.

Schalk, Randall F.

1984a Prehistoric Land Use in the Montane Coniferous Forest in Environment, Archaeology, and Land Use Patterns in the Middle Kootenai River Valley. In Cultural Resources Investigations for Libby Reservoir, Lincoln County, Northwest Montana, edited by Alston V. Thoms, vol. 1, pp. 37-47. Center for Northwest Anthropology, Project Report No. 2, Washington State University, Pullman.

1984b The Columbia Plateau Salmon Fisheries: Archaeological Evidence for Intensification. Paper presented at the Forty-ninth Annual Meeting of the Society for American Archaeology, Portland.

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

n.d. The Montana Soupstone: Experiments on the Effects of Thermo Stress on Quartzite Cobbles. Ms. on file, Office of Public Archaeology, University of Washington, Seattle.

1981 Land Use and Organizational Complexity Among Foragers of Northwestern North America. In Affluent Foragers, edited by Shuzo Koyama and David H. Thomas, pp. 53-75. Senri Ethnological Studies 9. National Museum of Ethnology, Senri. Osaka, Japan.

1978a Some Observations on Migratory Fish in the Plateau. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington, edited by Gregory C. Cleveland, pp. 61-80. Project Report No. 72, Washington Archaeological Research Center, Pullman.

1978b Foragers of the Northwest Coast of North America: The Ecology of Aboriginal Land Use Systems. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

1977 "The Structure of an Anadromous Fish Resource." In For Theory Building in Archaeology, edited by Lewis R. Binford, lpp. 207-249. Academic Press, New York.

Schalk, Randall F. and Gregory C. Cleveland
1983 A Chronological Perspective on Hunter-Gatherer Land Use Strategies in the Columbia Plateau. In Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, Near Lyons Ferry, Washington, edited by Randall F. Schalk, pp. 11-56. Laboratory of Archaeology and History Project Report No. 8, Washington State University, Pullman.

Schalk, Randall F., and Robert R. Mierendorf
1984 The Montana Coniferous Forest Ecosystem of Northwest Montana and Vicinity. In Volume I: Environment, Archaeology, and Land Use Patterns in the Middle Kootenai River Valley, edited by Alston V. Thoms, pp. 17-36. Center for Northwest Anthropology, Project Report No. 2, Cultural Resources Investigations for Libby Reservoir, Lincoln County, Northwest Montana. Washington State University, Pullman.

Schroedl, Gerald F.
1973 The Archaeological Occurrence of Bison in the Southern Plateau. Laboratory of Anthropology Reports of Investigations No. 51, Washington State University, Pullman.

Shepard, Anna D.
1954 Ceramics for the Archaeologist. Publication 609, Carnegie Institution of Washington, Washington, D.C.

Sheppard, John C., Peter Wigand, and Meyer Rubin
1984 The Marmes Site Revisited: Dating and Stratigraphy. In Geoarchaeology in the Northwest: Recent Applications and Contributions, edited by Judith A. Willig, pp. 45-49. Tebiwa 21.

Shutler, Richard, Jr.
1983 Introduction. In. Early Man in the New World, edited by Richard Shutler, Jr., pp. 11-12. Sage Publications, Beverly Hills.

Skolnik, Arthur M.
n.d. Archaeology and History. Technical Report 4. In Copper Creek Environmental Assessment, Technical Reports Part II. Prepared by the Conservation Company for City of Seattle, Department of Lighting.

Smith, Harlan I.
1910 Archaeology of the Yakima Valley. Anthropological Papers of the American Museum of Natural History, Vol VI, Part I.

Smith, Harlan I., and Gerald Fowke
1901 Cairns of British Columbia and Washington. Memoir of the American Museum of Natural History, Vol. II, Part II. AMS Press, Inc., New York, 1975.

Smith, Marian W.
1950 The Nooksack, the Chilliwack, and the Middle Fraser. Pacific Northwest Quarterly 41:330-341.

Smith, William C.
1977 Archaeological Explorations in the Columbia Basin. A Report on the Mesa Project. Central Washington Archaeological Survey, Department of Anthropology, Central Washington University, Ellensburg.

Smith, William C. and David H. Stratton
1976 A Cultural Resource Survey of the Wapato Point Area, Chelan County, Washington. National Heritage, Inc. Ms. on file, Washington Archaeological Research Center, Pullman.

Snyder, Sally
1980 Aboriginal Settlements in the Skagit Drainage System. In Cultural Resource Overview and Sample Survey of the Skagit Wild and Scenic River, vol. 2, by Astrida R. Blukis-Onat, Lee A. Bennett, and Jan L. Hollenbeck, pp. 18-39. Institute of Cooperative Research, Seattle.

Soffer, Arnon
1982 Mountain Geography--A New Approach. Mountain Research and Development 2(4):391-398.

Speth, John D., and Katherine A. Spielmann
1983 Energy Source, Protein Metabolism, and Hunter-Gatherer Subsistence Strategies. Journal of Anthropological Archaeology 2:1-31.

Sprague, Roderick
1967 Aboriginal Burial Practices in the Plateau Region of North America. Ph.D. dissertation,, University of Arizona, University Microfilms, Ann Arbor, Michigan.

Stevens, Isaac I.
1855 Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean. House of Representatives, 36th Congress, 1st Session. Ex. Doc. No. 56, Volume XII, Book I. Thomas H. Ford, Printer 1860.

Stevenson, Marc G.
1985 The Formation of Artifact Assemblages at Workshop/Habitation Sites: Models from Peace Point in Northern Alaska. American Antiquity 50(1):63-81.

Stewart, Hilary
1977 Indian Fishing. The University of Washington Press, Seattle.

Stocking, George W., Jr.
1968 The Dark-Skinned Savage: The Image of Primitive Man in Evolutionary Anthropology. In Race, Culture, and Evolution, pp. 110-132. The Free Press, New York.

Suttles, Wayne
1968 Coping with Abundance: Subsistence on the Northwest Coast. In Man the Hunter, edited by Irven DeVore and Richard B. Lee, pp. 56-68. Aldine Publishing Co., New York.

Swanson, Earl H., Jr.
1962 The Emergence of Plateau Culture. Occasional Papers of the Idaho State College Museum, No. 8. Pocatello.

1959 Archaeological Survey of the Methow Valley, Washington. Tebiwa 2(1):72-87.

1956 Archaeological Studies of the Vantage Region of the Columbia Plateau, Northwestern America. Ph.D. dissertation, Department of Anthropology, University of Washington, Seattle.

Swanson, Earl H., Jr. and Alan L. Bryan
1960 Carved Stone Objects from the Columbia Plateau. Tebiwa 3(1 and 2): 39-40.

Swanton, John R.
1952 The Indian Tribes of North America. Smithsonian Institution Bureau of American Ethnology, Bulletin 145. Smithsonian Institution Press, Washington, D.C. Fifth reprint 1979.

Talmage, Valerie, and Olga Chesler
1977 The Importance of Small, Surface, and Disturbed Sites as Sources of Significant Archaeological Data. Cultural Resource Management Studies, Office of Archaeology and Historic Preservation, National Park Service, US Department of the Interior, Washington, D.C.

Teit, James A.
1930 The Salishan Tribes of the Western Plateaus. In 45th Annual Report of the Bureau of American Ethnology, 1928-29, pp. 23-396. US Government Printing Office, Washington, DC.

Testart, Alain
1982 The Significance of Food Storage Among Hunter-Gatherers: Residence Patterns, Population Densities, and Social Inequalities. Current Anthropology 23(5):523-537.

Thomas, R. Brooke
1979 Effects of Change on High Mountain Human Adaptive Patterns. In High Altitude Geoecology, edited by Patrick J. Webber, pp. 139-188. American Association for the Advancement of Science Selected Symposium 12. Washington, D.C.

Thompson, Erwin N.
1970 North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area History Basic Data. Office of History and Historic Architecture, Eastern Service Center. US Department of the Interior, National Park Service.

Thoms, Alston V.
1984 The General Nature and Distribution of Cultural Resources. In Volume I: Environment, Archaeology, and Land Use Patterns in the Middle Kootenai River Valley, edited by Alston V. Thoms, pp. 69-105. Center for Northwest Anthropology, Washington State University, Pullman, Project Report No. 2, Cultural Resources Investigations for Libby Reservoir, Northwest Montana. Submitted to Seattle District, US Army Corps of Engineers under Contract No. DACW67-81-C-0100 and DACW67-83-M-0522.

1979 Survey Error: A Result of Intensive Archaeological Surveys. In Scholars as Contractors, US Department of the Interior, Heritage Conservation and Recreation Service Publication No. 14, Washington, D.C.

Thoms, Alston V. (editor)
1983 Archaeological Investigations in Upper McNary Reservoir: 1981-1982. Laboratory of Archaeology and History, Washington State University, Project Report No. 15.

Thoms, Alston V., and Greg C. Burtchard
1986 Environment and Land Use in the Calispell and Pend Oreille River Valleys. In Calispell Valley Archaeological Project, edited by Alston V. Thoms and Greg C. Burtchard, pp. 59-108, Contributions in Resource Management No. 10. Center for Northwest Anthropology, Washington State University, Pullman.

Thoms, Alston V., and Robert R. Mierendorf
1984 Archaeological Assessment. In A Pilot Study of the Culture Resources at the Proposed Usk Newsprint Mill Site, assembled by Alston V. Thoms, pp. 40-67. Ms. submitted to RUST International Corporation, Portland, by the Center for Northwest Anthropology, Washington State University, Pullman.

Thoms, Alston V., Randall F. Schalk, and Robert R. Mierendorf
1984 Cultural Resources Protection Plan for the Libby Reservoir, Northwest Montana. Report submitted to the US Army Corps of Engineers, Seattle District. Center for Northwest Anthropology, Washington State University, Pullman.

Thwaites, Reuben G. (editor)
1959 Original Journals of the Lewis and Clark Expedition, 1804-1806. Antiquarian Press Ltd., New York.

Turner, Nancy J.
1978 Food Plants of British Columbia Indians, Part 2. Interior Peoples British Columbia Provincial Museum Handbook No. 36, Victoria.

1975 Food Plants of British Columbia Indians, part 1/Coastal Peoples. British Columbia Provincial Museum, Handbook No. 34, Victoria, British Columbia.

US Department of the Interior
1984 Request for Proposal. An Archaeological and Ethnographic Overview and Research Design for the North Cascades National Park Complex, RFP-9000-84-30. National Park Service, Pacific Northwest Region, Seattle, Washington.

1980 Resource Protection Planning Process. Heritage Conservation and Recreation Service Publication 50.

1977 How to Complete National Register Forms. National Register of Historic Places, Office of Archaeology and Historic Preservation, National Park Service Publication 171. Washington, D.C.

Victor, Earl
1935 Some Effects of Cultivation upon Stream History and upon the Topography of the Palouse Region. Northwest Science 9(3):18-19.

Wagner, Philip
1960 The Human Use of the Earth. The Free Press, New York.

Warren, Claude, Alan L. Bryan, and Donald R. Tuohy
1963 The Goldendale Site and Its Place in Plateau Prehistory. Tebiwa 6(1):1-21.

Walker, Deward E., Jr.
1967 Mutual Cross-Utilization of Economic Resources in the Plateau: An Example of Aboriginal Nez Perce Fishing Practices. Laboratory of Anthropology, Report of Investigations, No. 41, Washington State University, Pullman.

Walker, Jeffery B.
1978 "Fire-Cracked Rock:" Replication and Implications. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington, edited by Gregory C. Cleveland, pp. 134-145. Project Report No. 72, Washington Archaeological Research Center, Washington State University, Pullman.

Watanabe, Hitoshi
1968 Subsistence and Ecology of Northern Good Gatherers with Special Reference to the Ainu. In Man the Hunter, edited by Richard B. Lee and Irven DeVore, pp. 69-77. Aldine Publishing Company, Chicago.

Wildesen, Leslie E.
1982 The Farthest Frontier of All: A Cultural Resource of the River of No Return Wilderness, Idaho. US Department of Agriculture, Forest Service, Intermountain Region, Cultural Resource Report No. 8, Ogden, Utah.

Willey, Gordon R. and Jeremy A. Sabloff
1974 A History of American Archaeology. W. H. Freeman and Company, San Francisco, CA.

Williams, Nancy M. and Eugene S. Hunn (editors)
1982 Resource Managers: North American and Australian Hunter-Gatherers. American Association for the Advancement of Science, Selected Symposium 67. Westview Press, Inc., Boulder, CO.

Wolf, Eric R.
1982 THe Fur Trade. In Europe and the People Without History, pp. 159-194. University of California Press, Berkeley.

Wright, Gary A.
1984 People of the High Country, vol. 7. American University Studies, Series XI, Anthropology/Sociology. Peter Lang, New York.

Wright, Gary A., Susan Bender, and Stuart Reeve
1980 High Country Adaptations. Plains Anthropologist 25(89):181-197.

Wright, M. J., and J. H. Williams
1981 Glub Glub: Experimental Archaeology in a Fresh Water Reservoir in Southwestern British Columbia. Paper presented at the Annual Meeting of the Canadian Archaeological Association, Edmonton, Canada.

Zelinsky, Wilbur
1973 The Cultural Geography of the United States. Prentice Hall, Englewood Cliffs, New Jersey.

APPENDIX A

INVENTORY OF ARCHAEOLOGICAL SITES

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INVENTORY OF ARCHAEOLOGICAL SITES

The site inventory that follows is listed in the same order as the itemization shown in Table 5-1. Those that have been assigned a Smithsonian number have been recorded on a statewide site form on file at the Washington Archaeological Research Center in Pullman. The first two digits of this number, 45, means that the site is in the state of Washington; the two letters that follow indicate the county, either Whatcom, Skagit, or Chelan; and the remaining digits show the number assigned to each site within the county.

The description provided for each site is a brief summary of information derived from the site form, in some cases from technical archaeological contract reports, and in most cases field notes recorded during field examination of the site. In a few cases, more detailed information about the site is provided if the data is new and undocumented elsewhere. In other cases, minimal descriptive information is given because many of the sites were previously unknown and I did not have time to adequately examine the site.

Field notes for the sites were recorded during four separate visits to the park, covering about 30 working days. The visits were in October of 1984, June and August of 1985, and April of 1986. The Park Service (US Department of Interior 1984) requested that I visit, photograph, and describe only known sites within the park complex. In fulfilling this obligation, I recorded a number of sites previously unknown while traveling to the previously recorded sites. In some cases (sites nos. 6 and 23), I went out of my way to examine areas that seemed to be likely locations for archaeological sites and found them. In other cases, I searched for sites and either did not find them or found problematical evidence for their existence. Detailed information on all sites, whether previously known, new or potential, is contained in my field notes which are on file with the Park Service.

Thorough examination of known sites was done by intensively surveying the ground surface and any exposures of mineral soil such as are seen in riverbanks, backdirt of burrowing rodents, tree tip-ups, road beds, and other disturbed areas. All artifacts (chipped or groundstone tools, chipped stone debitage, burned rocks, and burned animals bones) were marked using wire flags. Bedrock was examined for rock art and trees for blaze marks or evidence or bark stripping. A sketch map was made of the flagged distribution relative to local cultural and natural landmarks, the artifacts were described, and the site photographed as conditions permitted.

As in other wet, heavily forested mountain environments, finding artifacts and sites can be a problem. Site boundaries are more often controlled by the density of vegetation growth, the amount of downed timber, and disturbance processes that expose mineral soil and less so by the patterning of survey transects. This generalization, however, is less applicable to above-ground surface features. As an archaeological survey method, the flagging-mapping-describing procedure outlined above was

Table 5-1. Inventory of Known Archaeological Sites Within the Park Complex by Type, Elevation, and Zone.

Field Number	Site Location/Name	Site Number	Site Type and Possible Function	Elevation m	(ft)	Zone
1	Goodell Creek	45WH63	Lithic scatter--?	152	(500)	2
2	Goodell Creek	45WH64	Lithic scatter--?	146	(480)	2
3	Hozomeen Campground	45WH79	Lithic scatter--hunting	488	(1,600)	3
4	Big Beaver Creek	45WH80	Lithic scatter--hunting	488	(1,600)	3
5	Newhalem Creek	45WH81	Lithic scatter--food processing	146	(480)	2
6	Little Beaver Creek	45WH220	Lithic scatter--stone working or hunting	503	(1,650)	3
7	Skagit River	45SK102	Lithic scatter--food processing	117	(385)	2
8	Bacon Creek	45SK106	Lithic scatter--food processing	107	(350)	2
9	Damnation Creek	45SK107	Lithic scatter--food processing	122	(400)	2
10	Damnation Creek	45SK108	Lithic scatter--food processing	122	(400)	2
11	Skagit River	45SK171	Hearth--food cooking	122	(400)	2
12	Purple Point	45CH65	Lithic scatter--?	334	(1,095)	3
13	Stehekin Pictograph	45CH66	Pictograph--ceremonial	335	(1,100)	4
14	Hazard Creek	45CH67	Pits--earth ovens?	335	(1,100)	3
15	Courtney Ranch	45CH68	Courtney artifact collection	396	(1,300)	2
16	High Bridge G.S.	45CH69	Lithic scatter--hunting	489	(1,600)	3
17	High Bridge Campground	45CH219	Lithic scatter--hunting	500	(1,640)	3
18	Bridge Creek	45CH220	Lithic scatter--hunting	640	(2,100)	3
19	Cascade Pass	45CH221	Lithic scatter--hunting	1,646	(5,400)	5
20	Cascade Pass		Talus pits--hunting	1,677	(5,500)	5
21	Rock Cairn in Rockshelter		Rock cairn--?	1,585	(5,200)	5
22	Lower Sahale Arm		Talus pits--hunting/storage?	1,451	(4,760)	5
23	N. Fk. Bridge Cr. Cmpg.		Lithic scatter--hunting	780	(2,560)	3
24	Goode Lookout Trail		Lithic scatter--hunting	658	(2,160)	3
25	High Bridge Cmpg. Turnoff		Lithic scatter--hunting	500	(1,640)	3
26	Buckner Orchard		Lithic scatter--hunting	350	(1,150)	2
27	High Lake Chelan Site		Lithic scatter, midden, rock features--habitation	332	(1,090)	2
28	Fourmile Creek		Rock cairns--storage	341	(1,120)	3

relatively time-consuming. Generally, a relatively small, even low density, lithic scatter covering an area 40 x 20 m required four to eight hours (one person) to complete.

The age of most of the sites described below is unknown. Most are probably prehistoric (before about A.D. 1800), but some could be later.

1. 45WH63. This site is located between the bridge that crosses the Skagit River at Newhalem and the mouth of Goodell Creek. It is bounded on the south by the Skagit River and is reported to extend north of SR-20 into the area of the Department of Transportation facility. The site was recorded by Grabert in 1975 on the basis of scattered pieces of burned rocks, chipped stone debris, and four tools. Almost all of these remains were found along the eroding bank of the Skagit River in an area about 12 x 5 m. Field inspection of this site in October of 1984 on both sites of SR-20 failed to reveal cultural remains except for a few widely scattered burned rocks. The site area has been disturbed by land clearing and contouring, road construction, building construction, and river erosion.

2. 45WH64. This site is located west of Goodell Creek and along the north bank of the Skagit River. The landform is densly vegetated with closed canopy forest and brushy understory. The site was recorded by Grabert in 1975 on the basis of chipped stone debris, a serpentine adz, a cobble tool, and a flake tool. These were exposed along a 40 m length of sandy Skagit River bank near campsites 23, 25 and 26 of Goodell Creek Campground. This lithic scatter was still clearly visible in October of 1984. In addition, intermittent but very localized scatters of burned rocks or cobble flakes were observed along the Skagit River bank from Campsite 22 to the runoff gully about 20 m east of Campsite 11. The site thus extends much farther to the east and closer to the mouth of Goodell Creek than previously thought. The area has been disturbed by logging, campground construction, construction of the raft-launching area, and possibly by railroad construction.

3. 45WH79. The site is located along the edge of and under the high pool level of Ross Lake directly west of the area known as Winnebago Flats. The site was recorded and tested in 1977 and is reported in Grabert and Pint (1978). A high density of chipped stone remains, including cores and notched and leaf-shaped points, were found. A controlled collection of artifacts was made from the surface and from two test pits dug into the site. The site was visited in October of 1984 and again in April of 1986. During drawdown of Ross Lake, cultural remains are scattered along a low but prominent erosional terrace that is directly east of and parallels the channel of Howlett Creek. Prior to reservoir construction, the entire site area and beyond was heavily forested and the artifacts are now scattered between the sawn tree stumps. A low to high density of chipped stone debris is scattered across the site, with the highest densities along the western edge of the low river terrace. A controlled surface collection of selected artifacts (Mierendorf and Thomson 1986) was made in April of 1986 along about 250 m of the river terrace. These consisted of:

Figure A-1. Site #2 (45CH64), facing southwest, elevation: 146 m. Artifacts are scattered on the sandy Skagit River bar in the foreground and along the flood plain bank in the center right. This general type of artifact exposure is typical of other sites eroding along the banks of the Skagit River between Newhalem and the mouth of Bacon Creek.

Figure A-2. Site #3 (45WH79), facing east, elevation of Ross Lake in foreground is 488 m, Hozomeen Mountain in upper right is 2,460 m. The site is located under the reservoir and along its edge in the vicinity of the recreational vehicles. The moderately elevated forested terrain behind the RV's is an expanse of Zone 3 as described in this report.

Figure A-3. Site #3 (45WH79), facing north, elevation of Ross Lake is 488 m. A small portion of this large site is exposed along the reservoir margin to the left of the recreational vehicles, while most of the site is under water to the left of the photo. Mountains in the background are in British Columbia.

7 complete or fragmented points, including leaf-shaped, stemmed, corner-notched, and side-notched types
4 bifacially flaked nondiagnostic tools
3 flaked knives or knife fragments
3 flakes (raw material samples)
1 pyramidal microcore
1 end-battered river cobble tool

No features are known to occur at the site. High density scatters of chipped stone debris occur north and south of the collection area mapped in detail in Grabert and Pint (1978). The site has been disturbed by road construction, borrowing of sand and gravel, campground and boat launch facility construction, logging and clearing, and shoreline erosion and deposition along Ross Lake. However, portions of the site appear uneroded and relatively intact.

4. 45WH80. This site is located between the trail bridge that crosses Big Beaver Creek and the campground. It is on the north side of Big Beaver Creek, along the edge or or under the high pool level of Ross Lake. The site was recorded by Pint in 1977 on the basis of a single, triangular-shaped, corner-notched point and the nearby presence of two possible housepit depressions. These were test excavated, but no artifacts or other evidence for cultural origin was found. Examination of the area in October of 1984 revealed no chipped stone debris or artifacts. Burned rocks scattered across the area could be from burning that accompanied vegetation clearing prior to impoundment of the reservoir. It is possible that the site is below the high pool level of Ross Lake. The two large depressions may be the remains of river flood channels that have become filled at the upper and lower ends, or they may be flood scour features that form in strong eddy currents. In either case, their cultural significance remains problematical. The site apparently has been disturbed by vegetation clearing (before that time it was covered by dense forest) and by erosion caused by the operation of Ross Lake.

5. 45WH81. The site is located west of the mouth of Newhalem Creek, along the south bank of the Skagit River, both upstream and downstream of the bridge. The site was recorded by Pint in 1977 based on the presence of chipped stone debris and burned rocks. Subsequent testing showed that cultural remains were confined to the eroded Skagit River banks and floodplain and the adjacent but slightly higher terrace. During examination of the site in October of 1984, scattered areas of burned rocks could be found eroding from the Skagit River banks both upstream and downstream of the bridge. Two dense concentrations of burned rocks were seen eroding from the riverbank a short distance downstream of the bridge. The site is covered by dense forest and undergrowth. Portions of the site appear to have been disturbed by construction of the bridge, roads and the campground, and by Skagit River erosion.

6. 45WH220. The site was recorded during a brief visit in October of 1984. The site is located on the rocky point of land that stands above the high pool level of Ross Lake, along the west lake shore and north of the now inundated channel of Little Beaver Creek. The site was recognized by the

Figure A-4. Site #6 (45WH220), facing west, elevation of Ross Lake is 488 m; elevation of bedrock knob is about 503 m. The site is a low density scatter of chipped stone debris on the bedrock knob along the width of the photograph. Little Beaver Creek valley at extreme left and in the background.

presence of nearly two dozen chipped stone flakes of a dark gray to greenish, locally-derived chert. One edge-modified flake and a fragment of burned, split mammal bone were found. All artifacts were found within the Little Beaver Creek campground overlooking Ross Lake. The site is presently covered by relatively open forest and shrubs. The site may have been slightly disturbed by campground development.

7. 45SK102. The site is located along the southwest bank of the Skagit River near Rivermile 87. The site was recorded by Larson in 1978 based on the presence of burned rocks and chipped stone flakes. These artifacts were exposed along the eroded bank of the Skagit River. The site area is covered by dense forest and brush. At least a portion of the site has been apparently disturbed by river erosion. Because the site requires boat access, it was not examined in October of 1984.

8. 45SK106. This site is located along the northwest bank of the Skagit River about 3/8 miles upstream of the mouth of Bacon Creek. The site was recorded by Larson in 1978 based on the presence of burned rocks, chipped stone debris, and recognition of two buried occupation layers. Two separate attempts were made to locate the site in October of 1984. More than a half mile of Skagit River bank was examined. The locational information provided on the site form should have been adequate, but no cultural remains could be found. Bank erosion was ongoing at the time the site was recorded so that it is possible that it has been removed by river erosion. Except for a nearby clearing, the site vicinity is heavily forested and has a dense understory.

9. 45SK107, and 10. 45SK108. Both sites are located along the north bank of the Skagit River within a few hundred meters west of the mouth of Damnation Creek. These sites were recorded by Larson in 1978 based on the presence of burned rocks, chipped stone debris and charcoal. Both sites were considered to be heavily disturbed by riverbank erosion. The vicinity of the sites is densely forested and has a brushy understory. Close examination of the riverbank failed to reveal any evidence of these sites. The locational information provided in the site forms should have been adequate to find them. Rapid erosion of the sites by the Skagit River, as noted in the site forms, may have resulted in their complete removal.

11. 45SK171. The site is located along the northwest bank of the Skagit River about 1/2 mile downstream from the mouth of Damnation Creek and across from the upstream end of an island gravel bar in the Skagit River channel. The site was found and recorded in October of 1984 during the search for sites 45SK107 and 45SK108.

The site was exposed along the nearly vertical side of a 6.4 m high riverbank. This bank is the edge of a nearly flat-topped terrace that is being rapidly eroded by the Skagit River. The site surface supports a dense forest with thick brushy understory. No artifacts were found on the terrace surface. Exposed in the eroding bank, 1.2-1.5 m below the ground surface, were two thin charcoal-rich black stains containing burned rocks and a few

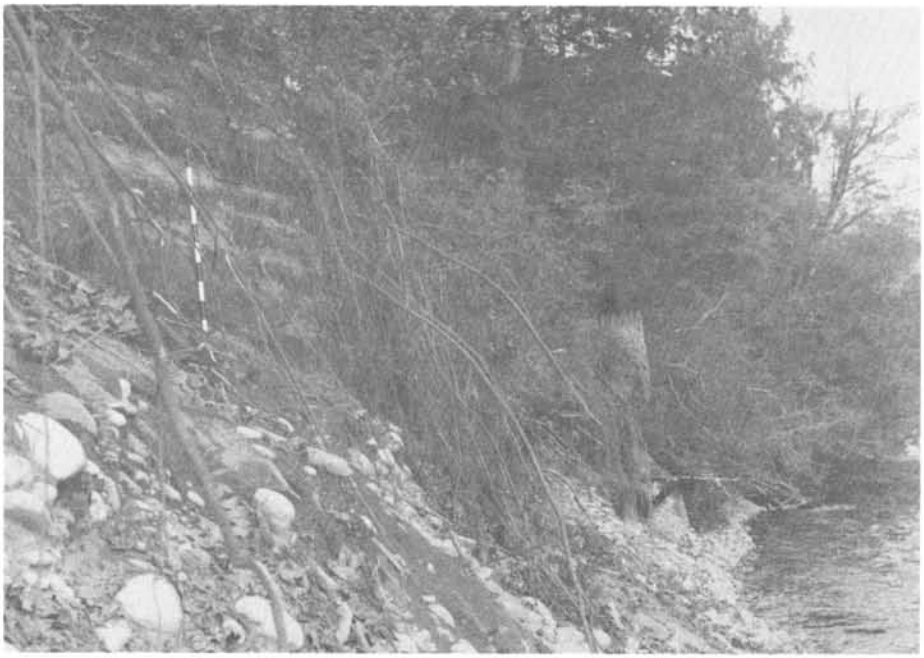

Figure A-5. Site #11 (45WH171), facing north, elevation: 122 m. Skagit River in lower right. Buried hearth, 475 years old, shows as black stain left of the top of the meter stick.

Figure A-6. Close-up of hearth shown in Figure A-5.

cobble cortex flakes. These two stains were bedded between sandy river deposits and could be traced for a distance of 40 m along the eroding bank.

Within the lower (1.5 m below surface) stain was found a saucer-shaped hearth about 2.3 m long and 10-20 cm thick. It contained charcoal chunks, a small concentration of burned rocks, and a black mudstone flake struck from a river-rolled cobble. The presence of the hearth feature was reported to Jim Thomson of the Park Service's regional office in Seattle. Because it appeared to be eroding rapidly, the entire remaining feature matrix was removed (by Jim Thomson and Jane Evans) and sent to Washington State University for analysis. The results of the analysis are given below.

The total weight of the hearth matrix and its contents was 1034.3 g. The analysis began with water flotation that separated the sample into a heavier and lighter fraction. The dry weight of the flotted fraction was 15.1 g. Using a low power magnifier, this organic fraction was sorted into:

charcoal	12.3 g
seeds	0.1 g
modern rootlets, mica particles, miscellaneous	2.7 g
subtotal	15.1 g

The charcoal and seed fraction was submitted to Dr. Steven J. Gill for botanical identification. Results of his analysis are as follows:

5 uncarbonized *Sambucus* seeds, most and probably all *Sambucus racemosa* (red elderberry)
47 carbonized *Sambucus* seeds, most and probably all *Sambucus racemosa* (red elderberry)
2 cedar (probably *Thuja plicata*) branchlet fragments

Red elderberry was an important food plant for almost all of the native peoples living on the west side of the Cascades. As far as I know, the berries were generally cooked or otherwise treated before eating. There is some evidence that they may be mildly toxic when fresh. The carbonized seeds and the context of recovery strongly indicate that the elderberries were utilized by the people occupying the site, most likely for food. It is not possible to draw any conclusions concerning the two cedar fragments. The preservation in this sample was very good.

The nonorganic, heavier fraction of the hearth sample was wet sieved through 2 mm, 1 mm, 0.5 mm, and 0.125 mm screens. These subsamples were dried and the fraction larger than 0.5 mm was sorted and found to contain:

small burned rock "heat spalls"	21.8 g
large burned rock fragments	178.6 g
charcoal chunks	11.4 g
burned bone fragments and unidentifiable stone debris	0.2 g
sand, silt, with smaller than 0.5 mm bone pieces and charcoal	807.2 g
subtotal	1019.2 g
total sample size	1034.3 g

The burned bone fragments were examined by Deborah Olson for identification and were found to contain:

1 salmon (Salmonidae) tooth
1 fish spine or rib fragment
Numerous unidentifiable burned mammal bone fragments

Charcoal collected from the hearth matrix was submitted to the Radiocarbon Dating Laboratory at Washington State University. It was dated to 475 ± 65 B.P. (WSU 3137).

12. 45CH65. The site is located on the northeast shore of Lake Chelan a short distance north of the Stehekin boat landing. It was recorded by Pint in 1977 from information provided by local informants. The site was recognized by the presence of chipped stone debris and stone circles. The high pool level of Lake Chelan covers the site for most of the year. Examination of the lake edge in early June and again in August of 1985 revealed no evidence of cultural remains. The site may be disturbed by artifact collecting, by boat landing development, and by reservoir-related erosion.

13. 45CH66. This is the well-known Stehekin Pictograph site. It is located along the southwest shore of Lake Chelan and is labeled on the Stehekin, Washington 7.5' USGS topographic map as "Painted Rocks." It was probably the first recognized prehistoric site within the park complex boundaries. It consisted of stylized human-like and animal figures, including mountain sheep, painted with red pigment. Some of the figures have been inundated by the artificial level of Lake Chelan, while those above water have been badly vandalized with commercial paint or impact from small arms discharge.

14. 45CH67. The site is located on the northeast shore of Lake Chelan along the northern part of the small alluvial fan formed at the mouth of Hazard Creek. This fan is labeled "Adams Point" on Stehekin, Washington 7.5' USGS topographic map. The site was recorded by H. S. Rice based on informant information, but the site was not described. The site was examined in June of 1985 and August 1986 and was found to contain four well-formed ground surface depressions, two large and dense burned rock concentrations, and a very low density scatter of chipped stone debris. The site area supports an open stand of pine and Douglas fir. It is presently being eroded by the high pool level of Lake Chelan. One of the depressions and the two burned rock features are presently exposed in the erosional bank along the lake edge.

15. 45CH68. The site is located on the Ray Courtney Ranch, which is just beyond Rivermile 8 on the north side of the Stehekin River valley adjacent to the Stehekin River road. The site was recorded by H. S. Rice on the basis of four artifacts collected by the Courtney's from their land. These include a carved soapstone effigy, a carved and polished stone club, and two groundstone pestles. In June of 1985, Estella and Cliff Courtney granted permission to examine the flat clearing between their cabins and the Stehekin River road. No cultural remains were found.

Figure A-7. Site #14 (45CH67), facing west, elevation: 335 m. Depression No. 1 in foreground. Lake Chelan is in the background.

Figure A-8. Site #14, facing north. Depression No. 2 shows in the foreground, No. 1 shows in the upper middle portion of the photograph.

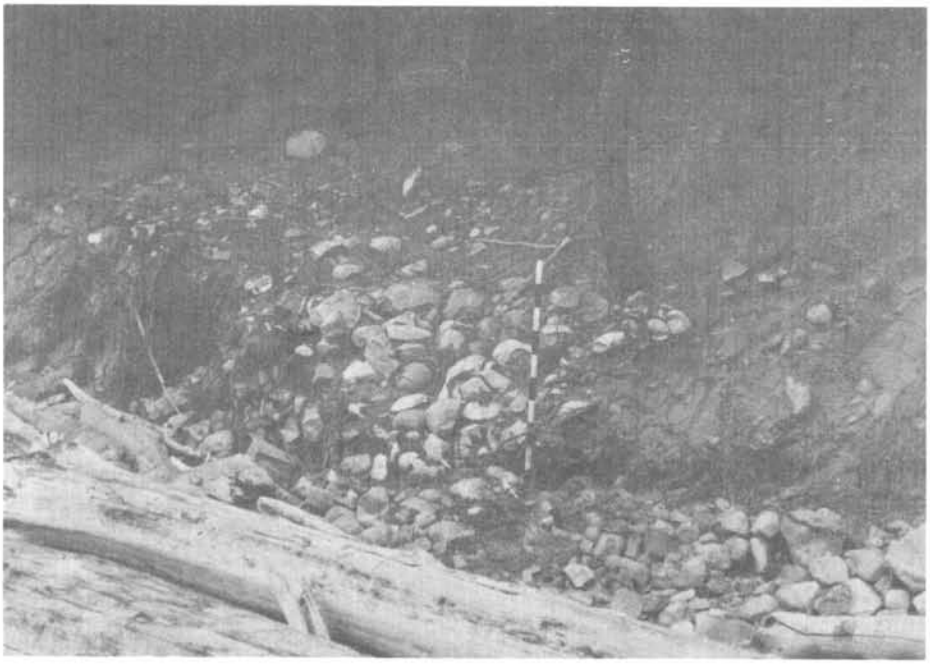

Figure A-9. Site #14, facing northeast. Immediately to left of meter stick is a large burned rock feature eroding from the high pool level of Lake Chelan.

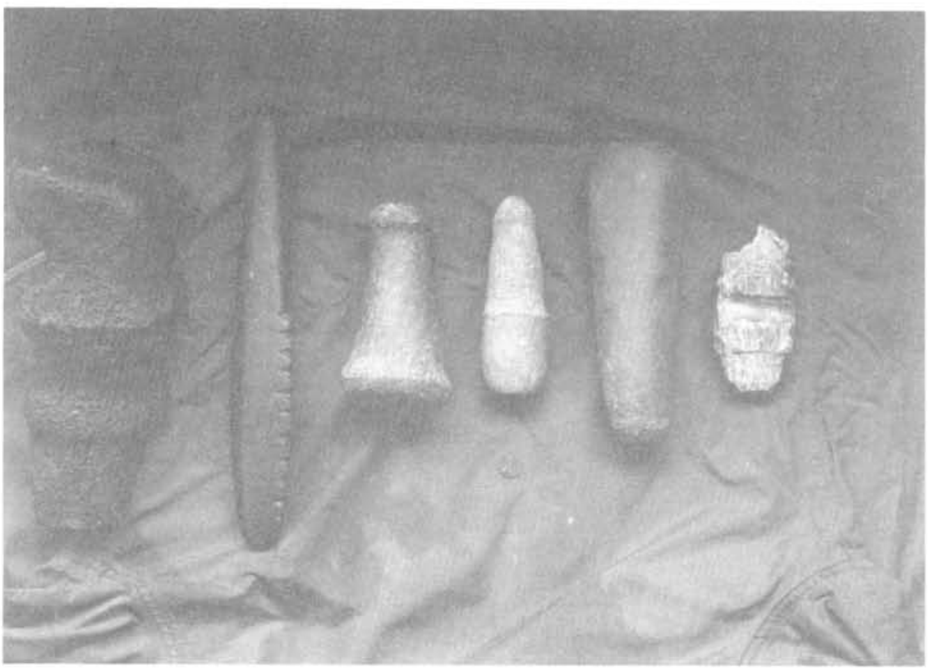

Figure A-10. Artifacts collected from the Courtney Ranch (Site #15, 45CH68). Scale is provided by a penny in the lower middle of photo. The notched club (2nd from left) and carved figurine (far right) are most similar to artifacts that occur near the Fraser River delta.

16. <u>45CH69</u>. This site is located on the north site of the Stehekin River on the flat benchland in the vicinity of the High Bridge Guard Station. It was recorded in 1977 by Pint and was mentioned in an earlier report by H. S. Rice. Recognition of the site was based on the presence of a moderate density of chipped stone debris scattered on the ground surface between the guard station and the road. Examination of the site in June of 1985 showed that surface artifacts were scattered over a much larger area than had been described, including both sides of the road, in the corral, near the trailhead between the barn and the shed, and on the next higher terrace level behind the barn. Four chipped stone artifacts were collected from the site: a biface, a core, a point tip, and a knife. The site area is covered by open forest with relatively little undergrowth. It has been disturbed by road construction and development of the guard station facilities.

17. <u>45CH219</u>. The site is located on the west side of the Stehekin River, about 200 m west of the High Bridge Guard Station. It was recorded by Pint in 1977 based on the presence of chipped stone debris found scattered on the ground within the Park Service's High Bridge Campground. The area is a flat rocky bench that supports an open forest with brushy understory. Examination of the site in June of 1985 showed that artifacts were scattered throughout the area encompasses by the shelter, picnic table, picnic area, and road loop. This area is much larger than the small scatter outlined on the 1977 site form. The site has been disturbed by road construction and campground development.

18. <u>45CH220</u>. The site is located on the east side of Bridge Creek, within and on either side of the Stehekin River road. The site was recorded by Pint in 1977 based on the presence of chipped stone debris scattered on either side of the road bed just before it drops to the bridge over Bridge Creek upstream of its junction with the Stehekin River. Examination of the site in June of 1985 showed the scatter of artifacts to extend from just north of the head of the Pacific Crest Trail to the terrace edge elevated above the bridge. This encompasses an area much larger than that mapped on the 1977 site form. The site area supports an open forest with some brushy understory. The site has been disturbed by road construction and turn-outs.

19. <u>45CH221</u>. The site is located on the restricted flats along the narrow ridge crest at the top of Cascade Pass. It was recorded by Pint in 1977 on the basis of informant information and the presence of a very low density of chipped stone debris. Examination of the site in August of 1985 showed a very low density scatter of chipped stone pieces within the trail and near the rest area. Vegetation at the pass consists of small clusters of alpine trees and alpine tundra ground cover. The site has been disturbed by trail construction, camping, and possibly by revegetation and stabilization efforts.

20. This site is located on a steep talus slope 50-100 m north of Cascade Pass. The site was recorded in August of 1985 based on the presence of eight clearly defined pits formed in the talus. The pits are clearly of cultural origin and were made by piling talus boulder blocks along the sides of the

Figure A-11. Site #19 (45CH221), facing north, elevation: 1,646 m. Site is in vicinity of trail and rest area in middle foreground. Part of Site #20 is at the top of the talus slope, shown by the black arrow.

Figure A-12. Site #20, facing east, elevation 1,168 m. Large pit to left of meter stick is hollowed out of boulder blocks forming talus.

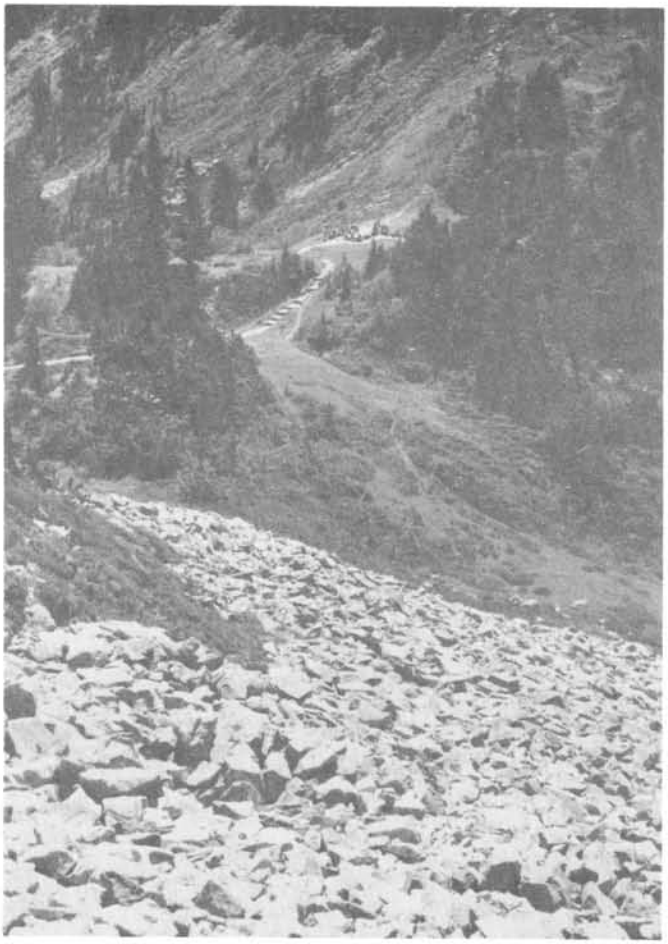

Figure A-13. Sites #19 and #20, facing south. Lowermost talus pit shows in foreground with clear view to Cascade Pass in the distance.

Figure A-14. General setting of Cascade Pass (in the lower left) showing trail system. Mt. Sahale at upper right is 2,569 m.

pits, which vary from deep to shallow. Thin lichens are the only vegetation growing on the talus rocks. The pits have been disturbed by boulders falling into them from the uphill side.

21. This site is located about 500 m east of Cascade Pass and about 50 m upslope (north) of the present trail approaching Cascade Pass from the east. The site was recorded in August of 1985 based on the presence of a large rockshelter containing a prominent, one-meter high rock cairn. The cairn was made by piling rocks that cover the rockshelter floor. The rockshelter has formed at the top of a bouldery talus slope, at the base of a high bedrock wall. The rockshelter is most visible from the west when descending the trail east of Cascade Pass. The rockshelter and cairn rocks are covered with lichens and mosses. The site appears undisturbed.

22. The site is located on the part of the Sahale Arm that is well below the elevation of Cascade Pass. It is about 400 m southeast of the Park Service's backcountry ranger tent camp, which is located adjacent to the Cascade Pass trail. The site was recorded in August of 1985 based on the presence of two pits hollowed out of the top of a narrow rock outcrop. The outcrop is about 50 m long and is aligned along the southern margin of the narrow ridge crest that drops to Pelton Creek. The pits are about 2 m in diameter and a meter deep. The pit rocks are covered with mosses and lichens. The area supports a closed-canopy dense forest with little understory. The site appears undisturbed.

23. This site is located on the point of land formed by the junction of the North Fork Bridge Creek with Bridge Creek. The site was recorded in August of 1985 based on the presence of a low density scatter of chipped stone debris found on the ground surface within the Park Service's North Fork Campground. The artifact scatter extended from the open bedrock bench south of the trail junction to the trail approaching the campground outhouse. The area supports an open forest with a scattered brushy understory. The site has been disturbed by campground and trail development and use.

24. This site is located west of the road bridge that crosses Bridge Creek upstream of its junction with the Stehekin River. The site was recorded in June of 1985 based on the presence of a moderate density of chipped stone debris found scattered along the edge of the Stehekin River road. The artifacts were scattered for less than 10 m along the western edge of the road bed. The scatter is located about 15 m south of Goode Mountain Lookout trailhead. The site area is forested and brushy. The site has been disturbed by road construction.

25. The site is located just west of the Stehekin River at the junction of the Stehekin River road with the access road to the High Bridge Campground. This site is about 50 m south of Site 17. It was recorded in June of 1985 based on the presence of a moderate density of chipped stone debris found scattered along about 30 m of the roadbed between its junction with the Stehekin River road and the campground. The site area supports an open

Figure A-15. Site #21, facing northeast, elevation: 1,585 m. Rockshelter is visible in middle of photo; trail to Cascade Pass is in foreground.

Figure A-16. Chipped stone debris collected from Site #25. Stone materials consisted of obsidian, quartzite, black mudstone, black basalt, and various colored cherts.

forest with dense brushy understory. The site has been disturbed by road construction.

26. The site is located adjacent to Buckner Orchard on the east side of the Stehekin River. The site was recorded in August of 1985 based on the presence of two pieces of chipped stone debris found on the edge of a low sandy terrace in the horse pasture west of the western end of the orchard. The site area apparently has been disturbed by clearing, cultivation, and trampling by stock.

27. The site is located near the northeast shore of Lake Chelan and is inundated during the high pool level. During winter and spring drawdown of the lake level, the site is exposed on a flat river terrace dissected by the braided channels of the Little Boulder Creek. The site was recorded in June of 1985 based on the presence of a high density scatter of burned rocks, chipped stone debris and tools, pieces of burned mammal bones, dark organic-rich midden-like stains, and circular and linear rock features. It is one of the largest known sites in the park and covers an area measuring thousands of square meters. The site area is unvegetated and portions have been disturbed by clearing, reservoir-related erosion, wind erosion, and artifact collection.

28. This site is located along the northeast shore of Lake Chelan on the alluvial fan that has formed at the mouth of Fourmile Creek. The site was recorded in June of 1985 based on the presence of five prominent rock cairns. These are located a short distance west of the mouth of Fourmile Creek on the first flat bench about 6 m above and immediately west of the brushy bottomland adjacent to the creek channel. The cairns are about 70-90 cm high and more than 1 m in diameter at the base. They were made by piling small boulders that litter the fan surface. The cairn rocks are covered with heavy lichen growth. The cairns are grouped in a relatively restricted area that supports an open stand of trees with a shrubby groundcover. The site appears undisturbed.

Figure A-17. Site #27, facing southeast, elevation: 332 m. Site is exposed in drawdown zone of Lake Chelan in vicinity of black arrow. Little Boulder Creek flows past the site.

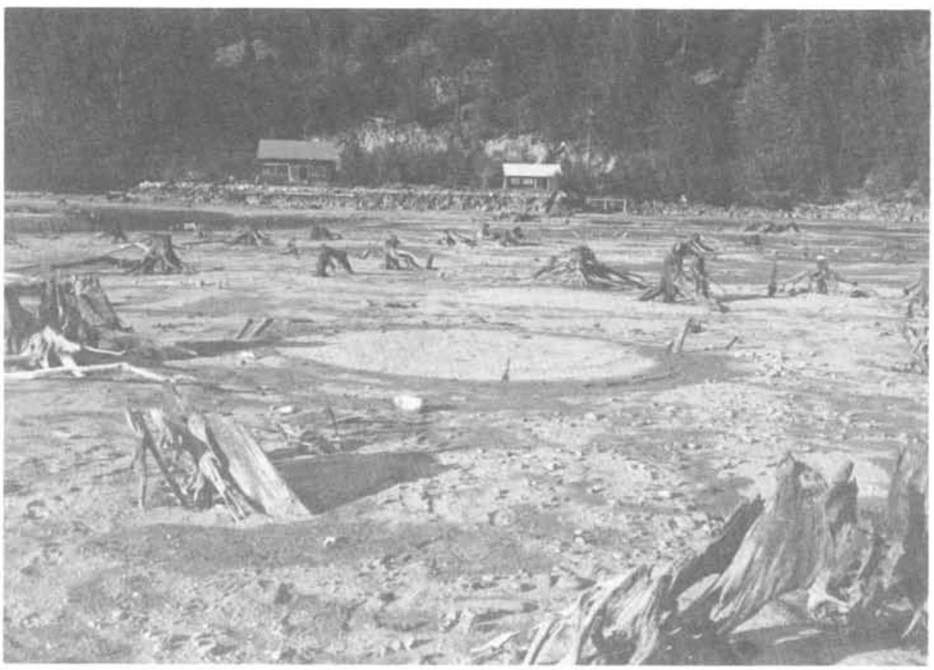

Figure A-18. Site #27, facing north. Burned rocks and other archaeological remains are scattered in the foreground. An unidentified circular feature shows in the middle distance.

Figure A-19. Site #27, facing west. Close-up of archaeological debris scattered across site surface. Exposure of tree roots gives some measure of amount of surface erosion at this location.

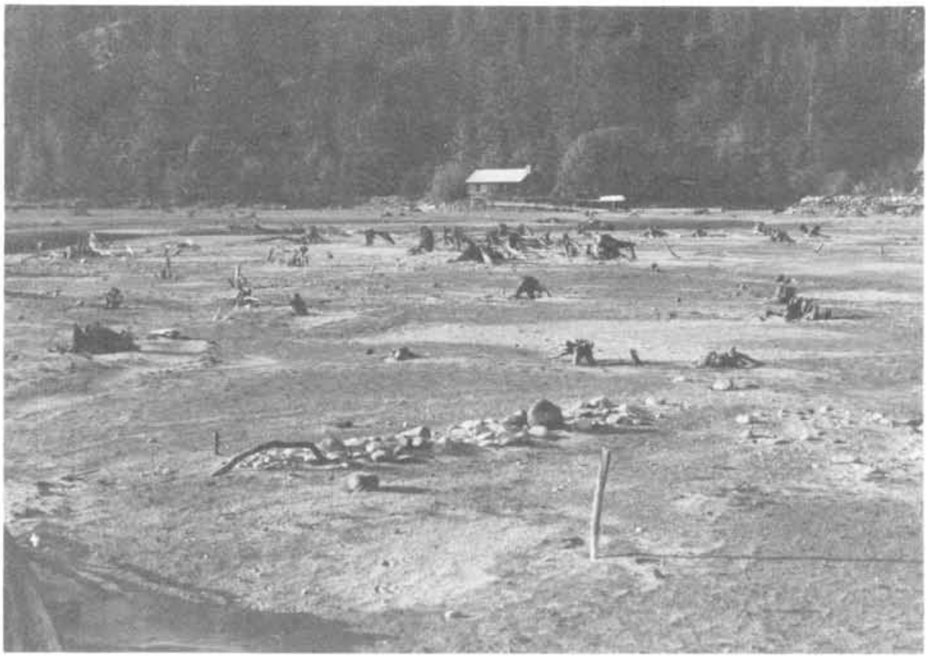

Figure A-20. Site #27, facing north. Rock alignment in foreground, with archaeological debris scatters visible in foreground and background.

APPENDIX B

ANNOTATED BIBLIOGRAPHY OF ARCHAEOLOGY AND NATURAL HISTORY TOPICS RELATED TO PREHISTORY OF THE PARK COMPLEX

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Buechner, Helmut K.
1953 Some Biotic Changes in the State of Washington During 1853-1953. Research Studies of the State College of Washington 21. Pullman.

A review and listing of native plant, mammal, bird, and fish species for Washington; includes lists of introduced species. The main portion of the article discusses the effects of European land use on native biota.

Clague, John J.
1981 Late Quaternary Geology and Geochronology of British Columbia, Part 2: Summary and Discussion of Radiocarbon-Dated Quaternary History. Geological Survey of Canada, Paper 80-35.

A summary review of the glacial, late glacial, and post-glacial history of British Columbia, uses extensive compilation of radiocarbon dates and published literature to discuss the timing of glacier advances, retreats, sea level changes, climatic changes, and volcanic eruptions.

Denton, George H. and Wibjorn Karlen
1973 Holocene Climatic Variations--Their Pattern and Possible Cause. Quaternary Research 3:155-205.

A review of worldwide evidence for climatic changes during the last 10,000 or so years. Uses mostly evidence from fluctuations in mountain glaciers. Discusses the timing of climatic cycles and their causes.

Fladmark, Knut R.
1982 An Introduction to the Prehistory of British Columbia. Canadian Journal of Archeology 6:95-156.

A detailed review of the archaeology and prehistory for British Columbia. Discusses early, middle, and late time periods for the coast and the interior. Includes a general summary and many references.

Hamilton, Annette
1982 The Unity of Hunting-Gathering Societies: Reflections on Economic Forms and Resource Management. In Resource Managers: North American and Australian Hunter-Gatherers, edited by Nancy M. Williams and Eugene S. Hunn, pp. 229-247. American Association for the Advancement of Science, selected Symposium 67, Westview Press, Boulder, CO.

A critical look at different anthropological views of hunter-gatherers. Discusses the use and control of natural resources by foraging economies.

Heusser, Calvin J.
1985 Quaternary Pollen Records from the Pacific Northwest Coast: Aleutians to the Oregon-California Boundary. In Pollen Records of Late-Quaternary North American Sediments, edited by A. V. Bryant, Jr., and R. G. Holloway, pp. 141-165.

A review of the results of pollen cores taken from the Pacific Coast. Reconstructs the vegetation history of the area during earlier glacial periods and since the end of the last one.

Kirk, Ruth with Richard D. Daugherty
1978 Exploring Washington Archaeology. University of Washington Press. Seattle.

A nontechnical treatment of selected aspects of archaeology in the state of Washington. Has numerous photographs of archaeological excavations and artifacts.

Matthewes, W. H.
1979 Late Quaternary Environmental History Affecting Human Habitation of the Pacific Northwest. Canadian Journal of Archaeology 3:145-156.

A general reconstruction of the late-glacial environment for the Pacific Northwest. Changing climates and conditions affecting resources and terrain used by early prehistoric people are discussed.

Mehringer, P. J., Jr.
1985 Late-Quaternary Pollen Records from the Interior Pacific Northwest and Northern Great Basin of the United States. In Pollen Records of Late-Quaternary North American Sediments, edited by V. A. Bryant, Jr., and R. G. Holloway, pp. 167-189. American Association of Stratigraphic Palynologists, Dallas, TX.

A review of pollen evidence for environmental changes for the interior Northwest and Great Basin over the last 12,000 years. Changes in vegetation distributions are discussed and compared with climatic change.

Norton, H. H., E. S. Hunn, C. S. Martinsen, and P. B. Keely
1984 Vegetable Food Products of the Foraging Economies of the Pacific Northwest. Ecology of Food and Nutrition 14(3):219-228.

Examines the nutritional value of prehistoric Native American plant foods and compares them to some modern equivalents. Discusses the role of various plant foods in traditional Northwest Indian subsistence.

Porter, Steven C. (editor)
1983 Late-Quaternary Environments of the United States, vol. 1, The Late-Pleistocene. University of Minnesota Press, Minneapolis.

A compilation of review articles discussing various aspects of the natural history of the Pleistocene for the United States. Replaces the out-of-date The Quaternary of the United States published in 1965.

Price, Larry W.
1981 Mountains and Man. University of California Press, Berkeley.

A well-referenced collection of published information about mountain environments from around the world. Generally covers most aspects of the natural history of high mountains, including human land use.

Price, T. Douglas and James A. Brown (editors)
1985 Prehistoric Hunter-Gatherers. Academic Press, New York.

A compilation of papers that deal with various aspects of hunter-gatherers from a prehistoric viewpoint. Includes articles that cover interior and coastal portions of the Pacific Northwest.

Rhoades, Robert E. and Stephen I. Thompson
1975 Adaptive Strategies in Alpine Environments: Beyond Ecological Particularism. American Ethnologist 2:535-551.

Discusses the anthropology of mountain areas as distinctive landscapes and looks generally at the various adaptive strategies of mountain-dwelling people.

Turner, Nancy J.
1978 Food Plants of British Columbia Indians. Part 2, Interior Peoples. British Columbia Provincial Museum Handbook No. 36, Victoria.

1975 Food Plants of British Columbia Indians, part 1/Coastal Peoples. British Columbia Provincial Museum, Handbook No. 34, Victoria, British Columbia.

Both are well-illustrated handbooks covering the preparation and use of various Native American plant foods, both interior and coastal. Many of these plants are found within the Park Complex.

Turner, Nancy J., Randy Bouchard, and Dorothy I. Kennedy
1980 Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washington. British Columbia Provincial Museum, Occasional Paper Series No. 21, Victoria.

A detailed study of Native American plant use for parts of Washington and British Columbia.

Wright, Gary A.
1984 People of the High Country, vol. 7. American University Studies, Series XI, Anthropology/Sociology. Peter Lang, New York.

Results of years of study of archaeological sites in Grand Teton National Park and adjacent lowlands. Examines prehistoric use of high mountain resources and adaptive strategies.

Wright, H. E., Jr. (editor)
1983 Late-Quaternary Environments of the United States, vol. 2, The Holocene. University of Minnesota Press, Minneapolis.

A companion volume to Porter (1983). Summarizes results of a wide range of natural history studies in the United States covering about the last 10,000 years.

Wolf, Eric R.
1982 The Fur Trade. In Europe and the People Without History, pp. 159-194. University of California Press, Berkeley.

An anthropological and economic analysis of the European fur trade in North America. Takes a close look at the many economic, political, and social effects to Native American populations.