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AN ABSTRACT OF THE THESIS OF

CONSTANCE J. BURKE for the degree of MASTER OF SCIENCE

in GEOGRAPHY (PHYSICAL GEOGRAPHY) presented on December 5, 1979

Title: HISTORIC FIRES IN THE CENTRAL WESTERN CASCADES, OREGON

Abstract approved: ______________________
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The history of fire between 1850 and 1977 in a portion of the Willamette National Forest in the central Western Cascades of Oregon was documented using historical sources. Three types of records were available: (1) records and writings not primarily concerned with fire but yielding information about fire in context with human activities, (2) descriptive accounts of fires prior to 1910, and (3) statistical reports generated by the U.S. Forest Service from 1910 to the present. Corresponding to each type of record, this study was divided into three time periods: pre-1850, 1850-1909, and 1910-1977.

Information about the pre-1850 period was drawn from reconstructions of aboriginal forest use by anthropologists, archaeologists, and enthnographers. Although four groups of aboriginal people inhabited areas within or adjacent to the study area, evidence is lacking for intentional Indian burning in the central Western Cascades. Unintentional burning from untended or abandoned campfires is probable. Coupled with naturally occurring lightning-caused fires, these fires

were ample ignition to maintain an age class of 125 years or older in the forests of the central Western Cascades.

Information about fires occurring between 1850 and 1909 came from a variety of historic sources. All chronicled fires were attributed to man. Many man-caused fires were related to specific human activities, including road building, sheep grazing, and camping. As human use increased, the numbers of fires increased. Conflicts in use occurred because of the threat of fire. Some activities, such as mining and railroading, were not causes of fire in the central Western Cascades. Lightning was not regarded as a cause of forest fires until after 1900.

Fire records for the period from 1910 to 1977 were generated by the U.S. Forest Service. These records exist in various forms including fire maps, summary tables, and individual fire reports. Almost 60 percent of all recorded fires from 1910 to 1977 were lightning caused. While lightning ignited more fires, they were usually small and occurred in mid-summer. Man-caused fires although fewer, were larger and occurred throughout the fire season. An increase in the number of fires is paralleled by an increase in forest use.

Two maps were constructed to illustrate the spatial distribution of man-caused and lightning-caused fires. Lightning-caused fires appear to be unevenly distributed over the landscape. Three areas exhibit a low incidence of lightning-caused fires. Lightning fires occur at higher elevations, where fuel accumulations are less, and tend to remain small. Man-caused fires exhibit a definite pattern corresponding with land-use. These fires tend to follow major transportation routes which are generally at lower elevations. Man-caused fires, ignited at lower elevations, have more chance to spread and become large fires.

ACKNOWLEDGMENTS

Many people have contributed to the completion of this study. I am especially grateful to Dr. Frederick J. Swanson for initiating the project, contributing financial support, and providing intellectual stimulation. Without his unending patience and understanding, and his ability to keep me fired-up I would have burnt out long ago. I thank Dr. Robert E. Frenkel for his enthusiastic encouragement and scholarly advice throughout my entire graduate career. I appreciate and respect both of them for allowing me the freedom and independence to design and implement the research in my own way. Dr. Jim Sedell was instrumental in starting me down the Pike, and Drs. Jerry Franklin and Dick Waring provided initial financial support. I am also indebted to all of the members of Research Work Unit 1653, Forestry Sciences Laboratory, Corvallis, Oregon, especially Dr. Logan Norris, for additional financial support and Ms. Jeanne Vial and Ms. Betty Arnold for logistical support. Thanks for making me a part of the team. Drs. Mary Lee Nolan and William Chilcote served as enthusiastic members of my committee. All of these people were especially supportive and provided ongoing inspiration.

Without the help of the following people, this thesis could not have been completed. Many individuals provided access to hard-to-reach data; of these I am especially thankful to Ms. Betty Hooker, Willamette National Forest Headquarters, and Mr. Pat Kelly, Regional Office, U.S. Forest Service (Region 6). Alfred Brown, Forest Science Department, Oregon State University, my computer ombudsman, facilitated organization of the data. The maps and figures were prepared by Donna Batch, Nick Chase, and Doug Krauss, Cartographic Services, Geography Department, Oregon State University. Lee Ann Fairchild, Patty Wickliff, and Tawny Blinn deciphered and typed the manuscript. Thanks to all.

Numerous friends in Corvallis helped and supported me in various ways: special thanks to Torrey Parenzin, Ann Werner, Linda Donaldson and George Lienkaemper. The Brookes family, especially Martha, contributed to my mental health and physical well-being. Thanks for making me a member of your family. And finally, Bill, thank you for making the past year worth living and the completion of this thesis a reality.

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I. INTRODUCTION

Fire has long been recognized as playing an important role in many forest ecosystems. In temperate forest ecosystems fire influences species composition and distribution, initiates succession, controls the pattern and scale of the vegetation mosaic and governs ecological processes by regulating fuel accumulation. Fire is also important in maintaining wildlife habitats, reducing forest insects and parasites, and influencing ecosystem stability and diversity. Since fire affects all of the interdependent components of an ecosystem, the knowledge of the natural fire regime is paramount to understanding the entire system (Kozlowski and Ahlgren 1974; Heinselman 1978).

Because of its importance, the occurrence, effects, behavior, and history of fire have been extensively studied. Interest in fire now includes (1) understanding the effects of fire suppression, (2) reestablishing natural fire regimes, and (3) preserving the natural ecological role of fire in designated wilderness areas. Many of the initial studies focused on fire suppression in ecosystems where fire burns frequently. In such areas fire protection over the last 50 years or more has caused unnatural fuel accumulations and invasions of tree species in once open stands. Suppression of fire has threatened the giant sequoia forests of Sequoia-Kings Canyon and has eliminated valuable wildlife habitats in Yellowstone National Park (Kilgore 1970; Houston 1973). These initial studies enabled Heinselman (1978) to deliniate six different fire regimes each characterized by the fire type and intensity, the fire size, and the fire frequency. Ecosystems with little natural fire, or with very long interval crown fires have received little attention. Current interest has focused on preserving the natural ecological role of fire in national and state parks, natural areas, and scientific reserves especially where fire occurs with at least moderate frequency. These studies have concentrated on restoration of the natural fire regime to maintain ecosystems designated as wilderness (Hartesveldt 1964; Habeck 1970; Heinselman 1970, 1973, 1978; Houston 1973; Taylor 1973; Tande 1977; Hemstrom 1979; and Kilgore and Taylor 1979).

But wilderness and natural areas make up a small fraction of forested ecosystems. Most forests are managed for timber production not wilderness. In 1977, 14 million acres of forest land in the U.S. were classified as wilderness whereas 500 million acres were considered commercial forest (Hendee et al. 1978; Clawson 1979). Many of these commercial forests, especially the dense coniferous forests of the Pacific Northwest, are characterized by large-scale, very long-interval crown fires. Fire return times of 150 to over 500 years are not uncommon (Franklin et al. nd). Fire studies in the Cascade Ranges of Oregon and Washington are lacking. According to Heinselman (1978), "detailed fire-history work is still needed in this region, especially for westside ecosystems."

Realizing the need for such studies, Hemstrom (1979) investigated the disturbance history of Mt. Rainier National Park. Wildfire has dominated the forest history of the park. Like other specially managed forest ecosystems, fire will need to be included in a management plan if the park is to be maintained in a natural state. But what about the ecological role of fire in commercially managed forests?

In the central Western Cascades of Oregon, the location of this study, we are moving from a landscape totally dominated by nature to one partially modified by man. Within the next 60 years, the forests will have been completely converted from a mosaic determined by patterns of wildfire to one determined by patterns of logging and effective fire suppression and prescribed burning.

Since man and fire are integral and interrelated components of this forested ecosystem, the purpose of this investigation was to determine what effects man has had on altering the natural fire regime of a Douglas-fir forest. This study covers the temporal interface between a nature-dominated landscape and a man-dominated landscape.

When reconstructing the fire history of a forested ecosystem, there are as many methods as time spans to study. One time span is that of recorded history (Wein and Moore 1979). Jacobs (1978) believed that by looking at the past use of natural resources we gain a window to a clearer image of the past and a unique perspective on generally accepted historical and ecological concepts. Following this premise I chose to examine the recent fire history and related human activities of the central Western Cascades, using historical records. The primary objective of this study was to determine the occurrence, location, date, and cause of forest fires from presettlement to the present. Three aspects of this primary objective were considered, specifically to (1) determine the extent of forest burning by aboriginal man, (2) document the activities of Euro-American man as related to fire, and (3) define and analyze the temporal and spatial differences between lightning-caused and man-caused fires in the central Western Cascades.

II. METHODS

The numerous approaches to studying fire history each have distinctive advantages and limitations (Wein and Moore 1979). I chose to study the fire history of the central Western Cascades from a cultural perspective. Although Euro-American man has been in the forests of the Pacific Northwest less than 200 years, his impact has been profound. Aboriginal man's role is considered too, but from a modern day viewpoint. To understand the relationship between human and fire history, I used documented evidence, seeking records generated at the time of an event as well as later interpretations of events. Three kinds of records were available: (1) descriptive accounts of fires prior to 1910, (2) statistical reports generated by the U.S. Forest Service from 1910 to the present, and (3) records not primarily concerned with fire but yielding information about fire in context with human activities. When adding man to a study of an ecosystem process such as fire, a clearer image of the past comes into focus, allowing a unique perspective on generally accepted historical beliefs (Jacobs 1978). Just as historians are becoming aware of the need to study the history of the land as well as its people, ecologists are recognizing man in their studies of ecosystems.

The historic method was used to provide a synthesis of recorded fire history. This complex process involves the search for sources of information, critical evaluation of both, and the synthesis, analysis, and exposition of the results of the research (Garraghan 1957, 33). Because of the interdisciplinary approach of this project and the diverse source material, an expanded definition of the historic method follows.

Historical documentation draws on the primary historical sources; those records and writings produced at the time of the events themselves. When trying to document an event which occurred in the past, the most accurate information is usually found in the original record. Primary sources such as field notes and journals, diaries and letters, unpublished manuscripts and reports, and other archival materials allow the researcher to make judgments about the events without interpretation by anyone other than originator of the document. Because of their diverse and often obscure nature, primary sources are not found through ordinary literature searches. To locate original source material, it is necessary to know something about the event, who might have kept a record of it, and why. To paraphrase Philip Brooks (1969), a person must carry knowledge with him in order to bring knowledge back.

Secondary sources provide general dicussion of the topic and interpretation of other researchers (Daniels, 1972). Secondary sources include books, periodical articles, symposia contributions, and pamphlets. These works, usually based on primary source material, present the author's perspective. Use of secondary sources requires an evaluation of the depth and completeness of the research undertaken to produce the source. Secondary sources are the most numerous, providing more general information than is usually necessary. More importantly, secondary sources direct the researcher to primary sources. Garraghan (1957, 139) suggests that one "work first on primary material, then on secondary." But he goes on to say, "In actual research primary and secondary sources will not be generally found sorted out neatly in distinct groups, but mingled together... the student must utilize the sources in order in which they occur" (Garraghan 1957, 139).

Research aids, consisting of indexes, abstracts, bibliographies, and catalogs, lead to both primary and secondary sources, but do not yield specific details. Generally, these bibliographic aids lead to secondary sources which, in turn, lead to primary sources. An important component of historical research can circumvent this process. Communication with an authority in the field quickly guides the research and shortens the steps to key source materials.

In outlining the steps required to document historic fires in the central Western Cascades, I divided my research effort into two stages, each corresponding with a summer's research season. The first research stage consisted of becoming familiar with the subject, contacting University and U.S. Forest Service personnel, and locating bibliographic aids, secondary sources, and a few primary sources. The initial step in this stage was to decide on possible subject headings for use in search of archived materials. Using the Library of Congress Subject Headings list (U.S. Library of Congress 1975), I chose a number of possible subject classifications dealing with forests, forestry, and Oregon history.[1/] It was necessary to remain flexible when adding or deleting subject headings because as knowledge of the subject matter increased,

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[1/] The value of checking this list prior to using the card catalog is that time is not wasted on subject headings which do not exist. Also, additional classifications or subject headings phrased differently may provide more information.

so did the number of subject headings--even though many were dropped. Armed with a list of subjects known to be in the main card catalog of the William Jasper Kerr Library at Oregon State University, the processes of locating suitable secondary sources began.

Bibliographic aids important to the study include the Oregon Historical Quarterly Index, North American Forest and Conservation History: A Bibliography, and North American Forest History: A Guide to Archives and Manuscripts in the United States and Canada. Although not as pertinent, Dissertation Abstracts, Forestry Abstracts, Cumulative Index to Government Publication, and the Annotated Lists of Publications of the Pacific Northwest and Range Experiment Station provided more leads to secondary and primary sources.

The Oregon State University card catalog revealed a large number of excellent secondary sources dealing with both fire ecology and Oregon history. Sources such as the "Annual Proceedings of the Tall Timbers Fire Ecology Conferences" and "Fire in the Northern Environment: A Symposium" provided information concerning current attitudes about fire, the direction of fire research, and previously completed fire histories. Johansen and Gates (1967), Empire on the Columbia: A History of the Pacific Northwest, provided insight into who, when, and why potential record keepers came to Oregon. Additionally, each useful book or article contained numerous references to additional sources of information.

At this point, the second step of the preliminary research stage began. Tracking down each citation, skimming or reading it, when and if it was located, deciding if the information was germane, and garnering new citations from the bibliography consumed approximately six weeks. It is important here to note the value of negative information. Many titles appear, on first glance, to be pertinent but on detailed examination do not yield useful information. Each new citation was noted, even though it may have appeared useless at the time. This saved much back-tracking as my knowledge of the subject matter increased. It has been estimated that, when documenting an historical event, over 75 percent of the researcher's time is spent doing negative research (Bert Fireman, Curator, Arizona Historical Foundation, personal communication, 1978). As the study evolved, different subject headings and subsequent literature searches were undertaken.

Leads which directed me to primary sources developed during this preliminary stage. The path to a primary source usually involves numerous steps guided by a good memory for details, careful note-taking, cooperative people, and luck.

The second research stage involved the location of primary sources and followed many paths. The primary sources used in this study can be divided into three categories (1) groups of documents or papers generated by the records of an organization such as the U.S. Forest Service, (2) collections of special historical manuscripts acquired by repositories such as the pioneer diary collection within Special Collections at the University of Oregon Library; and, (3) private collections, family archives, and oral histories and interviews (Brooks 1969). In locating a primary source, a different approach was required for each category.

Primary source documents are usually unique and therefore rare.

The record of an event is seldom complete when a researcher sets out to study it. Not only are some things never recorded, many documents once created are haphazardly or systematically destroyed. Records, diaries, and letters may be accidentally lost due to floods, fires, moves, or other causes, or they may be intentionally destroyed in the process of records management. Often, records may be located, but access to them is barred by restrictions on their use. The reasons for limitations on access and use are varied, but may include fragility of the document, family restrictions, security classifications, or one of nine exemptions outlined in the Freedom of Information Act of 1966.

In reconstructing the occurrence of fires in the central Western Cascades of Oregon, the most useful records have been those of the U.S. Forest Service. Documents generated by this agency belong in the first category, records created, used, and stored by the organization which produced them. As an example of the process undertaken to track down these records, I will trace the steps I took to locate Forest Service records pertaining to fire, including individual fire reports, summary fire reports, and miscellaneous information in the form of maps, tables, and narrative descriptions of fires in the region.

Federal agencies generate and store tremendous quantities of records.[2/] Since each agency has its own methods of compiling, filing, organizing, and storing information, it was necessary to become familiar with the structure of the U.S. Forest Service before attempting to

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[2/] In 1978, the General Services Administration will store 14.6 million cubic feet of federal records (G.S.A., 1977).

locate the records generated by it. Pertinent information was found at each of the three levels of the management of the Forest Service and at the regional headquarters of the research arm.

At each level, the studies, perspectives, and purposes are quite different. As this research carried me from the lowest management level in the pyramid, the individual ranger district, to the supervisor's office, and finally mid-way in the hierarchy to the regional office; the records became less resource oriented and more administration centered. Information at the administrative level is compact and usually in summary form. Regional statistics replace descriptions of individual events.

To get background information on the individual ranger districts, I began my search at the Supervisors Office of the Willamette National Forest. Analogous to using secondary sources prior to locating primary materials, the Supervisors Office provided a general source for the cultural and management history of the entire area. Cultural resource inventories, photographs, maps, and summarized district histories yielded excellent information. Primary source material in the form of individual fire reports was also located at the Willamette National Forest Headquarters. The Fire Management office at this level has retained records from 1949 to the present for all statistical fires in the seven ranger districts which make up the Willamette National

Forest.[3/] Histories of individual ranger districts provided detailed information about specific events important in reconstructing the history of the area. The resolution of data at this level was quite good; many descriptive accounts existed either as formal reports, informal memoranda, maps, or ranger's memoirs. The rangers and their co-workers also provided additional information and contacts with long-time residents of their districts.

Information in the Pacific Northwest Regional Office (Region 6) centered on the policies of fire prevention and suppression, fuels management, and fire weather forecasting. Generally, historical information about Region 6 existed in brief summaries, although some primary source material was located at this level. Fire atlases containing summarized fire data from 1919 to 1939 as well as fire maps for individual forests from 1908 to 1938 provided an excellent account of reported fires for those time periods. Interestingly, these atlases were thought to be in the Seattle Federal Records Center, as I was told when I first inquired about fire reports. On looking for them in Seattle, I discovered they had been returned to the regional office ten

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[3/]As defined by the U.S. Forest Service "A statistical wildfire is a fire that burns uncontrolled in vegetative or associated flammable material, and either requires suppression action to protect natural resources or values associated with natural resources, or is destructive to natural resources. A fire report will be prepared for each statistical wildfire..." (U.S. Forest Service Handbook, Individual Fire Report Handbook Form 5100-29). The Individual Fire Report form 5100-29, was first used in 1949 and has undergone revision every ten years. Before 1949, numerous methods existed for recording fires but none were considered satisfactory until the initiation of the Individual Fire Report Form. Inconsistent record keeping with various forms has made locating the information difficult.

years previously. A thorough search of the office produced the folio-sized atlases.[4/]

An attempt to track down fire reports for the years 1940 to 1948 proved unsuccessful. A telephone search to other regions as well as letters and a personal visit to the National Archive and Records Service (NARS) in Washington, D.C., produced negative results. Records were kept, but their fate is unknown (Linda Donoghue, Research Forester, North Central Forest Experiment Station, U.S. Forest Service, personal communication, 1978).

Historical records of federal agencies in the Pacific Northwest are located at the Seattle Federal Records Center, a regional branch of the National Archives and Records Service. Unlike a library, a federal archive is a repository for records considered permanently valuable by each agency of the Federal Government. The Forest Service was the first federal agency to instigate a system of records management (Pinkett 1959). In this system, material is classified by subject and given a file designation (which corresponds to a retention schedule). When local need for the material no longer exists, the records are boxed and

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[4/] The existence of these fire atlases is somewhat remarkable. Current Forest Service policy dictates periodic "house cleaning" and disposal or disposition of records unless classed as "P," those with permanent retention value. According to the Filing System Handbook, fire reports are kept for three years at the originating office, retained for 10 years at a Federal Records Center, and then destroyed (U.S. Forest Service Handbook 6209.11-Filing System Handbook).

sent to a records center. Depending on how they were originally filed, most records have a retention time of 3 to 25 years. Because of the enormous cost of preserving and storing paper, very few records have permanent retention value.

This system proved to be too efficient for me! Upon interviewing a retired Forest Service employee, once very active in fire history and fire weather research at the Pacific Northwest Forest and Range Experiment Station, I learned that he had deposited 21 cubic feet of fire-related records at the Seattle Federal Records Center. He felt strongly about the need to preserve records which might have future historical value. A visit to the records center revealed that these fire records had been destroyed on schedule and recycled for reuse as the inner cores of toilet paper and paper towel rolls.

Fortunately, not all my research ended so dramatically and the search for more information continued. The Forest Service was just one of several federal agencies which kept records of their activities in the central Western Cascades. The files of the Bureau of Land Management and the U.S. Geological Survey also provided very useful information. State and county agencies were checked as were the Oregon State Archives and the Oregon Historical Society. The state library and two other university libraries (each with specialized manuscript collections) provided excellent primary source materials. Local museums and libraries, private organizations, companies, and families all yielded additional information. The variety of methods used to locate pertinent information almost equals the number of sources found. Each record group or individual document requires a separate path; rarely does the identical procedure work for different source materials.

Mentioned last only to add emphasis, this type of research deals with people, thus the interpersonal aspect cannot be ignored. A co-operative archivist, a ranger who happens to be a history buff, a tireless reference librarian are key ingredients in successful historical research.

III. PHYSICAL OVERVIEW OF THE CENTRAL WESTERN CASCADES

Study Area Location

Located in the central Western Cascade Mountains of Oregon, the study area is bounded by 44°11' and 44°33'N latitude and 121°50' and 122°33'W longitude. The 2378 km^2 area comprises 25 complete and fractional townships: T, 13, 14, 15, 16, 17, S and R; 4, 5, 6, 7, 7 1/2, 8, E, Willamette Meridian in Linn and Lane Counties. The area is bounded by the South Santiam River on the north, by the approximate division between the Western and High Cascades on the east, by the McKenzie River on the south, and by the current National Forest boundary on the west (Figure 1).

The area includes major portions of Sweet Home, McKenzie Bridge and Blue River Ranger Districts in the Willamette National Forest. Also included in the area are small parcels of state and privately owned land.

Geology and Topography

The geologic history of the Cascade Range has been studied by numerous investigators (Peck 1960, Peck, et al. 1964). The Cascade Range in Oregon contains two physiographic provinces, formed by sequences of volcanic activity of Cenozoic age. The older sequence, the Western Cascades, consists of warped, folded, and partially altered late Eocene to late Miocene lava flows and pyroclastic rocks which form the maturely dissected western slope of the range. The High Cascades are

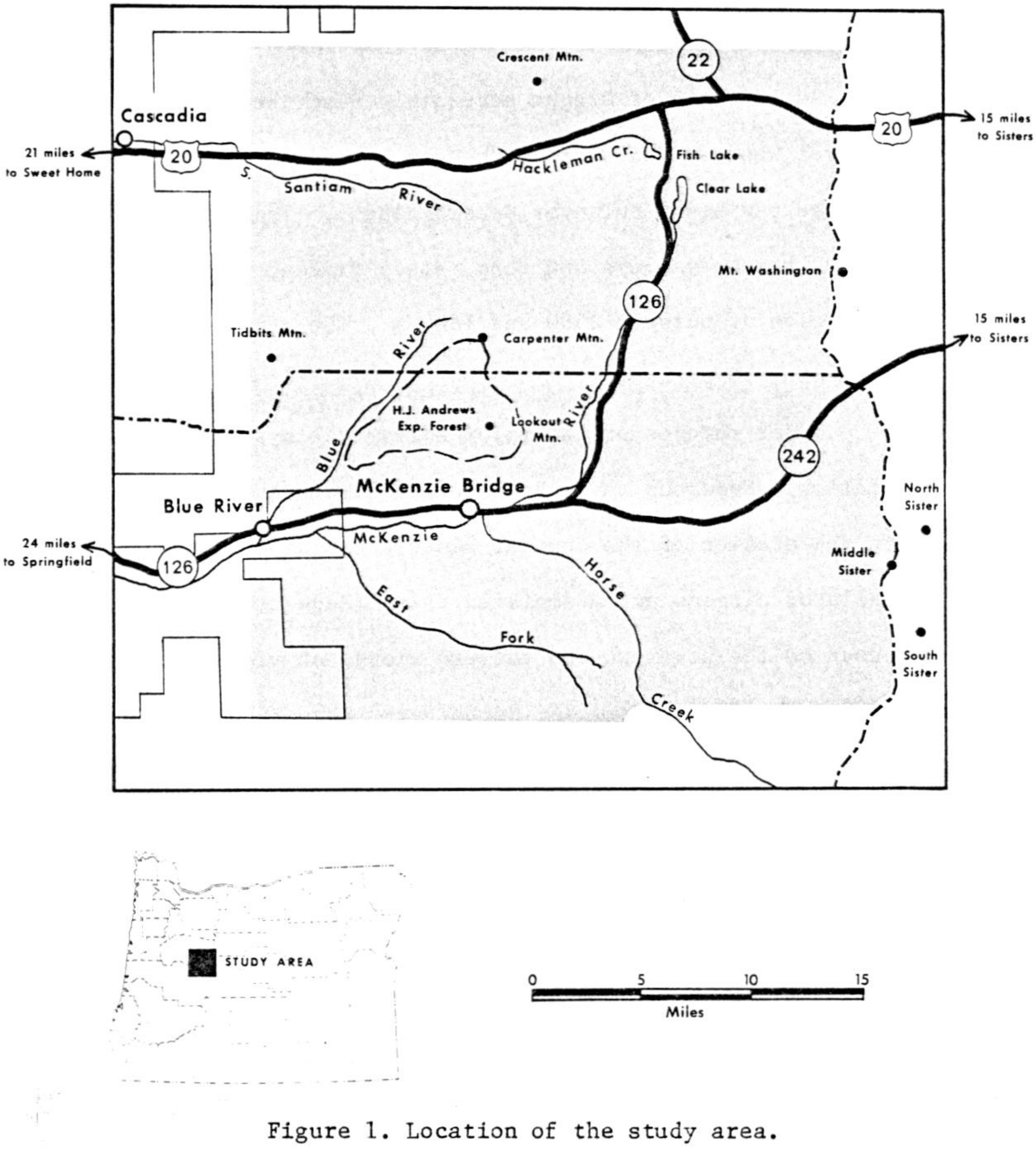

Figure 1. Location of the study area.

comprised of Pliocene to recent andesite and basalt flows, cinder cones, and stratovolcanoes forming the crest and much of the undissected eastern slope.

An 1863 map of Oregon accurately describes the topography of the central Western Cascades as "heavily timbered ridges separated by immense ravines" (Surveyor General 1863). This area is characterized by narrow stream valleys and long, steep ridges, which rise to a uniform elevation of between 1500 and 1800 m. The slopes are steep, commonly exceeding 70 percent.

Upper reaches of the major stream valleys show evidence of glaciation. Numerous small Pleistocene glaciers were an important factor in the erosion of the central Western Cascades, producing steep headwalls of cirques and associated tarns (Peck et al. 1964). The features occur on the northern and eastern slopes of ridges, at elevations above 1600 m, on Three Pyramids, North Peak, Echo Mountain, Cone Peak, Browder Ridge, and Lowder Mountain within the study area (Hickman 1968).

Another notable physiographic feature described by Hickman (1968) is the "valley-in-valley" effect in the valleys of Blue River, Tidbits Creek, Canyon Creek, and Squaw Creek. In these areas the high mountainsides are uniformly gentle with a break in the slope to steeper, lower slopes. This break in slope is thought to correspond with a contact between two rock formations of differing resistance, and results in increased stream gradients and incised valleys.

Topography affects the behavior of fire (Brown and Davis 1973, 184-189, 196). The steeper the slope, the faster the rate of spread, other environmental factors remaining unchanged. The entire area of the central Western Cascades is mountainous with deeply incised stream channels, high ridges and steep slopes--terrain capable of carrying a rapidly moving fire. Combined with other environmental variables such as wind, relative humidity, and fuel conditions, topography can have an even greater effect.

In rugged terrain, local convective upslope and downslope winds are generated by intense solar heating and nighttime inversions. These winds are prominent in the summer, when fire susceptibility is high due to lower fuel moisture and high fuel availability. Relative elevation and aspect, two other factors which influence fuel moisture and fuel type, also cause variations in fire behavior. Fuels on a south-facing slope may be dry enough to burn furiously whereas similar fuels on a north slope may be too moist to carry fire. Elevation and aspect effect the distribution of vegetation and thereby the pattern of fire on the landscape. Notable in the central Western Cascades are grass prairies on south-facing slopes, huckleberry fields at high elevations and low elevation meadows with a long history of human use.

Several physiographic features may act as fire breaks in the central Western Cascades. Although limited in extent, debris and snow avalanche tracks, lava flows, and riparian zones associated with lakes, ponds, and marshes may function as natural barriers to the spread of ground and surface fires. Ground fires, which consume organic material beneath the surface litter and low vegetation would be essentially stopped or rerouted by sizeable rocky outcrops and very wet areas.

Climate

The maritime climate of the central Western Cascades is characterized by cool, wet winters and warm, dry summers. Within the Cascade Range, local climate is affected by elevation--precipitation and snowfall increase and temperatures decrease with increasing elevation. Long-term data exist for U.S. Weather Bureau stations wtihin the study area at Cascadia State Park (elevation 258 m), formerly Cascadia Ranger Station, and McKenzie Ranger Station (elevation 419 m). Records from these stations indicate a mean annual temperature of 10.5°C for Cascadia (1922-1977) and 10.0°C for McKenzie (1918-1977). A mean minimum in January of 2.0°C and 2.9°C and a mean maximum in July of 28.3°C and 29.3°C has been recorded for Cascadia and McKenzie weather stations, respectively. At Cascadia extremes of 40.0°C and -16.9°C have been recorded, while McKenzie has recorded temperature extremes of 42.6°C and -20.6°C. Extremes in temperatures are usually moderated by air masses moving across the region which have been over the Pacific Ocean. In winter, these moisture-laden air masses are responsible for the abundant precipitation.

Average annual precipitation for Cascadia (1909-1977) was 1605 mm, and at McKenzie Bridge (1918-1977) it was 1777 mm (U.S. Dept. of Commerce 1931, 1973, 1974-1977). Precipitation has a marked seasonal distribution with 72 percent occurring between November and March and only 7 percent between June and September.[5/] Snowfall records for the area are incomplete. At Cascadia (1911-1950) the average annual snowfall was 394 mm, while at McKenzie Bridge (1922 to 1947) it was 685 mm. Recent snowfall measurements have been recorded by the Soil Conservation Service at Santiam Junction and Hogg Pass, both at much higher elevations than either Cascadia or McKenzie Bridge. At Santiam Junction (elevation 1157 m) the average annual snowfall from 1941 to 1977 was 4048 mm, and at Hogg Pass (elevation 1412 m) the average snowfall from 1938 to 1977 was 9174 mm.

The Pacific Ocean exerts tremendous influence on the climate of the region. However, there are times when the region's normally marine-type climate is interrupted by invasion of a continental air mass or by subsidence of an upper air trough. During these periods, weather conditions develop which contribute to the ignition and spread of a fire. The composite or integration of weather elements which affect fire behavior is known as the fire climate of a region (Schroeder and Buck 1970). These conditions vary regionally. In the Pacific Northwest, the fire climate has two major components: strong, easterly winds, and lightning associated storms. In contrast to fire climate, the term fire weather is associated with the regional occurrence of strong east winds. These winds increase the possibility of ignition by dessicating

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[5/] Unpublished data from the H. J. Andrews Experimental Forest on file at Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oregon.

fuels and fanning small fires into conflagrations. Lightning storms may also occur during periods of fire weather. The combination of these components produces periods of critical fire weather.

Two synoptic weather types are responsible for fire weather conditions. The Pacific High with post-frontal or east winds is responsible for more than 75 percent of the high fire danger periods whereas the Northwest Canadian High with post-frontal or east winds accounts for the remainder. Both patterns produce similar conditions, but occur at different times. The Pacific High pattern is most frequent in July while the Canadian High pattern tends to occur in August and September (Schroeder et al. 1964).

During periods exhibiting both weather patterns, a surface pressure differential develops. The surface pressures, along or just off of the coast, are lower than those inland, as a high pressure ridge settles over eastern Oregon. This pressure differential produces warm, dry, low-level east winds which push over and through the Cascade Mountains. A self-sustaining process, clear skys, and adiabatic warming coupled with warm surface temperatures push much of the air aloft. This air subsides, reaches the surface of eastern Oregon, and becomes extremely warm and dry. As it crosses the Cascades, the air is further warmed and becomes the hot, dry east winds associated with fire weather. In extreme cases, winds of over 130 km/hr have been measured. Usually during the peak period, afternoon temperatures will climb to over 38°C and relative humidities will drop to 15 to 20 percent and in extreme cases to less than 10 percent. The high fire danger period ends with the development of a short-wave trough aloft and the associated surface frontal system. Surface winds ahead of the front surface winds return to an onshore direction and the maritime climate returns (Cramer 1957, Schroeder et al. 1964, Schroeder and Buck 1970).

Topographic winds, especially prominent during warm, dry periods produce local conditions of critical fire weather. True convective winds are associated with cumulus cloud development, thunderstorm activity, and lightning-caused fires. These powerful winds can blow a small fire out of control. Summer thunderstorms are an extremely important element in the fire climate of the central Western Cascades. Although lightning storms occur on the average of only 7 days a year, they generate 60 percent of the fires within the central Western Cascades (Morris 1934, Cramer 1955, 1965; U.S. Forest Service Summary Fire Reports 1917-1939, U.S. Forest Service Individual Fire Reports 1949-1977).

Vegetation

Forested Communities[6/]

Forest vegetation of the central western Cascades has been divided into two major zones based on the climax tree species (Dyrness et al. 1974). Distribution of these zones is determined by temperature and moisture regimes which vary with elevation.

[6/] Scientific names follow Franklin and Dyrness 1973.

The Tsuga heterophylla Zone lies approximately within the elevational belt between 300 to 1050 meters. Dyrness, et al. (1974), recognized eleven climax or near climax associations and three seral communities within the Tsuga heterophylla zone. The potential climax species is western hemlock (Tsuga heterophylla), although truly climax communities are rare (Franklin and Dyrness 1973). The major seral tree species, Douglas-fir (Pseudotsuga menziesii) forms extensive, dense stands, some of which have remained undisturbed by fire for 400 to 850 years. Usually though, western hemlock begins to invade as Douglas-fir mortality opens up the stand at age 100 and 150 years. The major understory species range from swordfern (Polystichum munitum) and oxalis (Oxalis oregana) on wet sites to oceanspray (Holodiscus discolor) and salal (Gaultheria shallon) on dry sites. Understory species such as Pacific rhododendron (Rhododendron macrophyllum) and Oregon grape (Berberis nervosa) occur on more modal sites.

The Abies amabilis Zone occurs in the central Western Cascades at elevations between 1050 and 1550 meters (Franklin and Dyrness 1973). Within this zone seven climax and two seral associations have been recognized (Dyrness et al. 1974). Although Pacific silver fir (Abies amabilis) is the dominant climax species, Douglas-fir and noble fir (Abies procera) are far more abundant as seral species. Within this zone the major understory species are widespread. However, "preferential" species, with restricted distributions along a gradient from wet to dry, have been identified. The wettest habitats in the zone are occupied by devilsclub (Oplopanax horridum), modal sites by western coolwort (Tiarella unifoliata) and cutleaf goldthread (Coptis lachiniata), and drier environments by beargrass (Xerophyllum tenax) (Dyrness et al. 1974).

These zones are based on topo-edaphic climax dominants, species capable of reproducing without a major stand-level disturbance under prevailing climate conditions. In the central Western Cascades, forests dominated by a single seral species, Douglas-fir, cover 85 percent of the land (Hickman 1976). Able to regenerate and grow rapidly in relatively open areas, Douglas-fir is established in abundance after disturbances such as fire and logging. Old-growth Douglas-fir forests in this region were established after one or more catastrophic fires 400 to 500 years ago. Pockets of even older stands, 700 to 800 years old, demonstrate this species ability to persist for long periods of time. The more abundant, mature or "second-growth" forests, also products of wildfires, have resulted from many smaller fires, not necessarily catastrophic conflagrations, between 100 and 200 years ago.[7/] Repeated burns, fires occurring in the same locality within a few decades, complicate the picture making the boundaries between age classes confusing and often difficult to decipher.

[7/] Unpublished data from the H. J. Andrews Experimental Forest, on file at Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oregon.

Non-Forested Communities[8/]

Several vegetational units, closely associated with frequently occurring physiographic features, make up a number of non-forested communities in the central Western Cascades. These units consist of species groups which are often associated with certain landforms. Hickman (1968, 1976) has described twelve non-forested communities for the peaks and ridges of the central Western Cascades. Those specialized communities, which may be maintained by fire or act as fire breaks, are briefly discussed here. Including wet or boggy meadows, mesic meadows, dry meadows or grassy prairies, and huckleberry fields; these communities commonly intergrade depending on topography, moisture status, and season. Historical records show that human activity in these areas has been frequent. The following examples of each type are not substantiated by reference stands or type localities, but contain many characteristic vegetative associations.

Gently sloping areas of ground water discharge, commonly bordering larger bog areas, typify wet meadows such as those at Tombstone Prairie and Lava Lake. Both open areas have constant moisture supplies. Tombstone Prairie is the headwaters of Hackleman Creek which flows eastward into Fish Lake. Similar to Hickman's _Veratrum viride/Valeriana sitchensis/Senecio triangularis_ Wet Meadow Associes, Tombstone Prairie, also contains "a wide assortment of asters and fleabanes" (A. G.

[8/]Names of non-forested community types follow Hickman 1976.

Campbell personal communication, 1978). The Salix/Alnus bordered meadow at Lava Lake is the destination of a number of small streams, most of which sink before reaching the lower end of the "lake." This large, heterogenous area contains many streambank species such as cow parsnip (Heracleum lanatum), starry solomonplume (Smilacina stellata), arrowleaf groundsel (Senecio triangularis), and, around the edges of the meadow, black cottonwood (Populus trichocarpa). The old-growth Douglas-fir along the west and southwest border of the meadow exhibit numerous fire scars. At the turn of the century, both areas were described as favorite camping places which provided wild hay and good pasturage for stock for hunting and fishing parties. Indian Prairie and Lost Prairie "are the result of very small fires mainly in the underbrush, only a few trees burned" (Plummer 1903, 130).

Mesic meadows, such as Lost Prairie and Fish Lake, have an adequate water supply until mid-summer when they begin to dry out. "Fish Lake is a pleasure resort for fisherman and camping parties. It is dry in the fall, the bed of the lake supporting a good growth of wild hay" (Plummer 1903, 131). This meadow type corresponds with Hickman's Rubus parviflorus/Pteridium aquilinum Meadow Associes about which he states "this associes has likely expanded to grazing at the ends of grass-dominated meadows such as the Bromus/Rudbeckia Associes" (Hickman 1976, 151) Fish Lake and Lost Prairie, at lower elevations than Hickman's examples, are dominated by Carex spp., Poa pratensis and Potentilla glandulosa.

Usually at higher elevations than the two previously described examples, dry meadows or grassy prairies have been important components in the human land use history of the central Western Cascades. Sheep and cattle were brought from the Willamette Valley and Eastern Oregon to these areas in search of summer pasture. Commonly located along ridge crests and a south-facing slopes, the grassy prairie or dry meadow type is often a combination of the Bromus carinatus/Rudbeckia occidentalis Meadow Associes and the Gilia aggregata/Polygonum douglasii/Eriogonum nudum Lithosolic Meadow Association (Hickman 1976). Including some of the forage grasses once prominent, but probably reduced due to grazing, this type is currently dominated by grass species of less forage value. Browder Ridge has abundant dry meadows and minor areas of mesic communities. This area is high, its soils are light, loamy, and dry. Plummer (1903) described the area as "high, rough, and mountainous, with open summits which have been thoroughly sheeped. In July, 1901, there were 2000 sheep on Browder Ridge." Similar dry meadows include areas found on Cone Peak and Echo Mountain. Although these areas are no longer grazed, the effects of grazing on the vegetation can still be observed.

Huckleberry (Vaccinium membranaceum) fields "once common in burned over areas, are less obvious today as old burns become reforested and new burns become increasingly rare" (Minore 1972). Huckleberries were an important component in the diet of Indians who visited the central Western Cascades and a recreational resource used by Euro-Americans. Only Indian Ridge and Huckleberry Lake have been historically significant as huckleberry gathering sites within the study area (Henn 1975).

Within the time frame of this study no widespread catastrophic conflagrations have occurred, but given an ignition source the three essential elements are there: topography, weather, and fuels. The central Western Cascades are characterized by mountainous topography with rugged steep slopes, a climate which includes low summer precipitation and humidity, a history of fire weather and associated east winds, and a combination of vegetation types especially susceptible to fire if the other conditions are present. One source of ignition, lightning, has been briefly discussed; its effects on the fire regime of the central Western Cascades will be described in Chapter Five. Fire caused by man constitutes the other major ignition source. Man-caused fires are a function of certain human activities. The following chapter briefly describes the cultural history of the central Western Cascades in relation to fire-related activities.

IV. CULTURAL OVERVIEW OF THE CENTRAL WESTERN CASCADES

Introduction

Human use of the central Western Cascades is a function of the total physical environment and the abundance and distribution of natural resources. Through time, the use of these resources has changed as the perception of them have changed. The forests, now a tremendously valuable resource, were once regarded as an impediment to travel and were intentionally burned by early settlers. Today such management would be unthinkable. Huckleberry fields, so important to the native peoples of the area, were kept open by burning. Today, due to fire exclusion and supression and the emphasis on timber management, this resource is disappearing. To better understand man's impact on the forest fire regime of the central Western Cascades, the following cultural overview describes those human activities, some of which have already been alluded to, significant to the fire history of the area. This narrative focuses on those fire-related activities which might have played a decisive role in altering the natural cycles of fire in a forested ecosystem. It is not intended to be a complete social history.

Prehistory - Aboriginal Burning of the Forests

Assessing the impact of aboriginal peoples on the forest is difficult since no written records exist. We must depend on reconstructions of aboriginal life from anthropologists, ethnographers, and archaeologists. Many fire histories, if viewed in a cultural context, disregard aboriginal burning, preferring to focus on the Euro-American influence on landscape change. There are some notable exceptions. Stewart (1956, 1963) emphasizes the use of fire by aboriginal peoples and the barriers to understanding the role of ancient fires by modern scientists. Reynolds (1959) attributes the age structure of east-side Sierra Nevada *Pinus ponderosa* forests to aboriginal burning. Documenting the role of man-related burning on Alaskan boreal forests, Lutz (1959) cites seven uses of fire by aboriginal man. Kilgore and Taylor (1979) studied the fire history of a sequoia-mixed conifer forest in the Sierra Nevada and concluded that Indian burning augmented lightning-caused fires prior to contact with Euro-American people.

Ethnographic and historic evidence indicates that four groups of aboriginal people inhabited areas within or adjacent to the central Western Cascades at the time of the first Euro-American contact. Living in villages or bands, the Molala, Kalapuya, Tenino, and Northern Paiute lacked specific territorial or tribal boundaries. The area each group occupied varied through time and space in response to pressures for resources, competition with other aboriginal peoples and contact with Euro-American settlers. Although evidence of extensive aboriginal settlements in the area is lacking, these four groups are known to have utilized the central Western Cascades for hunting, fishing, gathering fruits and berries, and camping (Beckham 1977; Minor and Pecor 1977).

Preliminary archaeological surveys in the central Western Cascades indicate a correlation between aboriginal sites and elevation. The sites occur from the foothills to the highest peaks ranging from 274 m to 1828 m in elevation (Grayson 1975). Although the majority of the sites occur at the lower end of this range, the tendency for greater intensity of use at an individual site increases with increasing elevation. The most intensively used sites occur above 1200 m. "Upland sites in the Cascades occur in two distinct topographic situations, either along the crests of ridges, or on the benches and ridge noses above small valleys or lakes" (Minor and Pecor 1977, 165-166).

Historic maps are criss-crossed with trails indicating aboriginal use. The original cadastral surveys remark on numerous Indian trails which many of the first surveyors used. Modern trails as well as major highways follow Indian travel routes. These trails followed the ridge crests and avoided the valley bottoms. Trade routes were generated by Indians traveling across the Cascades and many lesser trails were maintained during the summer season when the area was visited primarily for its resources.

According to Minor and Pecor (1977), the Molala were an upland people, living along the western slope of the Cascades. It is thought that the distribution of this small band ranged from the upper Rogue River in the south to the Clackamas River and Mt. Hood in the north.

> The Molala wintered at sites located along streams in the lower elevations, usually west of the Cascade divided, and at other times of the year they exploited the higher elevations for roots, berries, and large game animals. Fishing also provided an important aspect of their subsistence pattern (Minor and Pecor 1977, 81).

The Kalapuya, an aboriginal population usually associated with the Willamette Valley, consisted of a number of linguistic groups including the Santiam, Luckiamute, Yamhill, and Yoncalla. Although the Kalapuya "seemed to have confined their subsistence activities to the valley floor, expeditions were undertaken into the uplands of the Cascades during the summer to hunt large game and gather berries" (Minor and Pecor 1977, 78).

The Tenino lived east of the Cascades from the Columbia River south to the lower reaches of the Deschutes and John Day Rivers. While fishing and hunting provided the majority of their diet, gathering fruits and berries yielded supplemental food. In mid-summer the Tenino participated in a second-fruits ceremony whereafter the band divided, part remaining in the summer village to continue salmon fishing and the remainder going up into the mountains to hunt and gather berries. "The Tenino were known to have employed the surround hunting technique, with the animals being driven into a natural enclosure" (Minor and Pecor 1977). Fruits and berries, especially serviceberry, huckleberry, chokecherry, and strawberry were collected during these treks into the Cascades. According to Suphan (1974) the Tenino visited the Metolius River for fishing and ventured to Black Butte for roots, berries, and nuts.

The Northern Paiute occupied an extensive portion of the Great Basin, including most of southeastern Oregon. The most northwesterly band was located immediately south and southeast of the Molala and Tenino. The Great Basin environment provided little in the way of natural resources, forcing the Northern Paiute to travel far distances to obtain food. According to Suphan (1974), the Northern Paiute established summer camps along the eastern margin of the Cascades and ventured to the Mt. Jefferson—Ollalie Butte region to pick berries and hunt game.

Attempts to reconstruct the aboriginal use of fire in the central Western Cascades using ethnohistorical data have been marginal due to the decimation of native populations by disease prior to the arrival of scientific observers. It is difficult to ascertain the habits of a culture when so little of the population existed. Of the groups previously described only the Kalapuya have been intensively studied. The first material collected by an anthropologist on Willamette Valley Indians contains translated texts describing events and conditions of Santiam Kalapuya life. Like native peoples the world over, the Santiam Kalapuya employed a slow match to maintain fire. This practice was described by a native informant and translated by Melville Jacobs:

> Long ago when some of the people went to the mountains to hunt, they carried fire with them. They put a (hardwood) burning coal in, they put it inside some little rotten wood, (1) and they put the fire in mussel shells, in between the mussel shells. They took two mussel shells, they put it (the burning coal) between the mussel shells, they closed the shells together. And then they wrapped it (all) in fire ashes. (2) That is how they did when they carried fire along when they went hunting. That was when they lacked matches. That is how they did so they say (Jacobs 1945, 32).

Since fire was precious, something which needed to be carried from place to place, the likelihood of willfully extinguishing a campfire was slight. According to Stewart (1956), aboriginal man would preserve a campfire by putting on a big log and banking the fire in hopes of finding it upon his return. Rarely were aboriginal people careful with campfires, but instead allowed them to ignite the landscape. Seldom, if ever, were they concerned with the need to protect vegetation from fire (Stewart 1956, 118).

The Kalapuya are known to have intentionally burned the grasslands of the Willamette Valley each fall (Johannessen et al. 1971; Towle 1974). Although the reasons are not always clear, maintaining an open landscape, concentrating large game in unburned areas, and facilitating grasshopper and acorn gathering are benefits usually attributed to aboriginal burning in the Valley. Although they burned the grasslands of the Willamette Valley, it is doubtful if they willfully set fire to the forests for the same reasons.

Jacobs (1945), Mackey (1974), Suphan (1974), and Beckham (1977) describe the methods used by the Kalapuya, Tenino and Molala to capture game. These include snares, pits, and nets but do not mention fire. The rugged terrain of the central Western Cascades would have precluded the use of fire as a hunting tool as well. Clearing the land for agricultural purposes, often used by sedentary native peoples, would not have been used by the hunter-gathers who seasonally visited the central Western Cascades. Clearing the land by fire to maintain trails and travel routes and improve visual access also seems unlikely. Archaeological evidence indicates that a majority of the trails were "likely to occur along ridge crests above the narrow rugged valleys with overgrown creek bottoms" (Minor and Pecor 1977, 166). Thus, the need to clear a path would have been minimal, and to keep it clear would have been almost impossible due to the rapid regeneration of understory species. This is substantiated by an entry in an early government report which describes Indian trails as "small trails leading over a succession of high, steep ridges, running nearly at right angles to our course, and covered with forests of pine and fir, and a dense undergrowth of brush wood and fern" (Talbot 1849, 109). Andrew McClure, one of the first Americans to cross the central Western Cascades and leave a journal describing his trip noted:

> (We) travelled about six miles and struck an Indian Trail. This trail runs nearly parallel with the range...after following it some three miles it became so dim that we could not follow it. The pine and fir timber on the side of the mountain and the alder in the bottom we found to be an impassable barrier (McClure 1853).

Nowhere are fire-maintained trails mentioned.

Berry picking, an important subsistence activity of the four aboriginal groups utilizing the central Western Cascades, took place from mid-summer to early autumn. Huckleberry fields prominent at higher elevations in the central Western Cascades were favorite camping localities for small bands of Indians. Ollalie, a Chinook word for huckleberry (Thomas 1970), references two favorite camping sites, Ollalie Butte and Ollalie Meadows, located just south of the study area. Huckleberry Meadows and Indian Ridge, both within the study area, are known aboriginal huckleberry hunting grounds. The Indian Ridge site, in the southwest portion of the area studied, was utilized by Indians from the Warm Springs Reservation[9] each fall into the 1920's for collecting huckleberries and hunting deer (Henn 1975).

Although some thought has been given to the idea that Indians intentionally burned huckleberry fields, I think it is unlikely. According to current research, Vaccinium membranaceum, the thin leaf huckleberry, returns in only three to five years following a fire (Don Minore, personal communication 1978). With such a long return time, as compared to the annual return of grasses, it is doubtful that aboriginal man systematically destroyed this resource. More likely, escaped campfires from nearby campsites initiated sufficient fires to maintain huckleberry fields over the short and long terms.

The aboriginal use of fire in the forests of the central Western Cascades was probably limited to campfires. It is doubtful that large tracts of forest were burned purposely as were the grasslands of the Willamette Valley. Unintentional burning by escaped campfires is probable though. Four Indian groups utilized the central Western Cascades from mid to late summer, a time when susceptibility to fire is highest. Their campsites were located along ridge crests in conjunction with trails, along with benches above lakes or streams and in close proximity to berry fields. Campfires were undoubtedly left burning and could have easily ignited nearby vegetation. Depending on the condition of the fuels and the weather, these campfires were ample ignition for

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[9] The Warm Springs Reservation was created by treaty in 1855. Native peoples from many tribes and bands throughout the state were removed from their homelands, placed on this reservation, and became collectively known as Warm Springs Indians.

forest fires in the central Western Cascades contributing to the mosaic of age classes older than 125 years.

Euro-American History - Activities and Attitudes

With the coming of Euro-American man into the forests of the central Western Cascades, the fire regime changed. White man's attitudes about nature, the landscape, and the role of fire were far different from those of the Indian. This newcomer was well aware of the usefulness and destructiveness of fire. As his use of the forest resources changed, his attitude about fire changed and he altered the forest fire regime of the region accordingly. The following capsule version of the Euro-American history of the central Western Cascades traces the history of land use as an introduction to the fire history of the study area.

Expansion into the Forest: Discovery, Exploration, and Early Settlement

Euro-American history in the central Western Cascades roughly parallels that of the Willamette Valley, a focal point of expansion in the Pacific Northwest. As demand for furs increased in eastern markets, the margin of the western frontier expanded until reaching the Pacific Ocean. In the early 1800's, the Willamette Valley was explored by British, Canadian, and American fur trappers. Between 1807 and 1846, American and British diplomats argued their national claims over control of the land beyond the Rockies, while Canadian merchants of the Northwest Company and later the Hudson's Bay Company effectively exploited the region's fur trade. American interest, sparked by the Lewis and Clark expedition of 1804, waned for ten years after the war of 1812. Then in 1824, American trappers once again began active fur trading west of the Rockies, bringing with them a new method for the industry. Fundamental differences between British and American trading practices ultimately solved the question of Oregon's status. The Hudson's Bay Company, a commercial corporation with the special privileges and powers of a monopoly, adopted long-range policies for development of fur trade and controlled the region by building forts discouraging unrestricted settlement. American fur trade, primarily an individual effort, lacked organization and long range planning. Extremely competitive and exploitive, American trappers came and left, paving the way for widespread colonization, settlement, and eventual American sovereignty over the region (Jacobs 1938, Johansen and Gates 1967).

These differences in the way the resource was used affected Indians in the area. The British trade system utilized the Indians as trappers, establishing trading posts which enabled them to exchange valuable furs for a less-than-equitable amount of manufactured goods. The British system encouraged and even protected the Indians and their life style. The American system did not allow for Indians, viewing them as competition. Missionaries tried, with limited success, to convert and change the Indians from hunter-gathers to farmers. This change in life style, coupled with epidemics in the 1830's reduced the aboriginal population of the Willamette Valley to less than one-fourth that of pre-contact time (Scott 1928, Berreman 1937, Kroeber 1939, Cook 1955). Those who survived were eventually removed to reservations. The native population and the Euro-American one barely touched in time, and although both groups used the central Western Cascades, no serious conflicts have been recorded. Instead, American and British trappers took advantage of the network of Indian trails, occasionally venturing up the stream valleys in search of beaver.

In time, fashions changed, the beaver population diminished, and British influence in the region waned. By the 1840's the fur trade was over. A few mountain men decided to remain in the Oregon Country, as did a handful of missionaries. All together the population of Euro-Americans in 1835 may have numbered thirty-five. In the fall of 1843, there were 1200 and by 1850 more than 13,000 people had settled in Oregon (Clark 1927, Black 1942).

By the mid 1830's the Oregon Territory had become known as a promised land. Word spread that beyond the Rockies there was a land where grass was never ending, water was abundant, timber was available for cabins, and all free to men with the courage to take it (Galbraith and Anderson 1971). Newspapers in eastern towns published glowing reports of the region. In 1844, the the Ohio Statesman published a letter from Peter H. Burnett, a pioneer leader in Oregon, stating that "sheep have lambs twice a year in some of the territory. The reason is they are always fat and get their growth much sooner" (Lomax 1928, 127). Statements like these promoted the idea of fertile pastures, green hills, and a mild climate. It was a land open to the people, and the people came: immigrants, soldiers, businessmen, and fortune seekers. The Oregon Territory was settled by people anxious to achieve the American dream.

Getting to Oregon was not an easy matter. Early maps show the central Western Cascades as unexplored, rough, mountainous, and without trails (Bureau of Topographical Engineers 1859; Surveyor General's Office 1863). Indian guides were nonexistent, their populations decimated by disease and their remaining numbers greatly feared by the pioneers. Most settlers crossed the Cascades via the Barlow Road or followed the Oregon Trail down the Columbia Gorge, both inhospitable routes. Each route terminated at the northern end of the Willamette Valley. At this point the newly arrived settlers had to choose either to head north to the lesser developed Puget Sound region or south to the popularized Willamette Valley. To increase settlement in the Oregon Territory, the U.S. Congress enacted the Donation Land Law of 1850 which granted each white male citizen, eighteen years and over, 320 acres of land if he settled in Oregon prior to December 1, 1851; if he married, his wife could own the same amount of land in her own right. From 1851 to 1855 each white male citizen was granted 160 acres as was his wife (O'Callaghan 1960; Head 1971). These large land grants pushed settlement southward in search of free, open land.

According to Towle (1974), the pioneer farmer preferred to occupy the transition zone between woodland and prairie, needing the grassland for farming and grazing and the woodland for timber. As this land became scarce, settlers were forced to claim less desirable land.

Small, scattered pockets of open land in the foothills and valley bottoms of the Coast and Cascade Ranges soon attracted settlement. After large-scale importations of sheep and cattle from California in 1845, stock in Willamette Valley multiplied rapidly, competing for farm land (Oliphant 1948). Although many men left the Willamette Valley after the 1849 discovery of gold in California, those ranchers who remained benefitted by exporting meat and other products back to California at the expense of grain farmers who suffered for lack of land (Lomax 1928; Bowen 1978). Soon the human and animal population of the Willamette Valley and the surrounding smaller settlements increased to the point that additional range land had to be found. The river valleys of the South Santiam, Calapooyia, and McKenzie proved to be excellent for grazing and were well occupied by the mid 1850's (Surveyor General 1868; U.S. Forest Service n.d.c). By the late 1850's and early 1860's, the wheat farmers pushed the sheepmen and cattlemen over the Cascades into central and eastern Oregon (Minto 1902; Oliphant 1933; Wentworth 1948, 208).

Activities Within The Forest: Transporation, Exploitation, and Expansion

Desiring easy access to more and better pasture as well as a safer and faster route for settlers, business interests in the Willamette Valley promoted expeditions into the central Western Cascades in search of a suitable mountain pass. In 1859, Andrew Wiley and two companions forged their way across the mountains. This route, which later became the South Santiam Highway, followed old Indian trails, the South Santiam

River, and numerous creeks and stream valleys until finally reaching the Deschutes River. Encouraged by this discovery, a second successful trip convinced businessmen in the Willamette Valley to promote construction of a wagon road. In 1864, the Willamette Valley and Cascade Mountain Wagon-Road filed its articles of incorporation. Two years later, the Act of July 5, 1866 (14 Stat. 89) granted the company 800,000 acres of land in odd-numbered sections along the route from Albany to the eastern boundary of the state. This was the largest land-grant ever given to a wagon road company in the United States (Amundson 1928).

The potential for another successful toll road as well as the need to supply the newly discovered gold fields in Idaho, prompted the Felix Scott party of Eugene to try another route across the Cascades. Following the McKenzie River into the mountains, up the steep slopes, and on the lava beds, this route later became the McKenzie Highway. In the fall of 1860, some 700 to 900 cattle and oxen along with many wagon loads of supplies crossed the summit and headed for Idaho. This adventure prompted the formation of the McKenzie Fork Wagon Road Company. Apparently unsuccessful, a year later another company, the MacKenzie River Waggon Road Company [sic] filed its articles of incorporation and still later, in 1865, a third group, the McKenzie Valley and DesSchutes Wagon Road Company [sic] proposed a similar route (Sawyer 1932).

With the successful opening of two major passes, travel increased through the Cascades. Initially, interest focused on what lay on either side of the mountains, but in time the abundant resources within the region became attractive. Spurred by gold discoveries in California, Idaho, and southern Oregon, prospectors in the central Western Cascades soon were scouring creek bottoms and rock outcrops in search of gold. Gold was discovered in the early 1860's but not productively mined until the 1880's (Burch 1942). Realizing the potential for improved economic development, the State Board of Agriculture under Legislative direction published a document praising Oregon's resources (State of Oregon 1888).

Contained in this report, The Resources of the State of Oregon: A Book of Statistical Information Treating Upon Oregon as a Whole and by Counties; It being an Appéndix to the Annual Report for 1887 to the Govenor, is the following description of mining in Blue River District:

> ...The quartz veins of this region lie mainly at a good height, the more important ones being found upon the summit of Gold hill, six miles by trial from Davis' ranch at the junction of Blue river with the McKenzie. The principal locations are the Eureka, the Treasure, Key West, etc. The veins are large, the second named attaining a thickness of 12 feet. The rock is easy to excavate, and as the pyrites, which occurred in abundance, have also decomposed at the surface; milling would be easy and cheap, there being only "free gold" to save. There has been little work done upon these ledges beyond the perfunctory task work necessary to hold possession of them, if the Eureka be expected, which of probably a hundred locations has advanced the most. The owners have prospected their apparently valuable ledge with industry and zeal. Nature has provided well for the efficient working of this and neighboring mines in that water power and mining timber are both very abundant, the latter of the best quality, and the various ledges are easily accessible by tunnel at great depths. In all perhaps 100 miners are interested in working or prospecting the quartz lodes of the Blue river district, and the number is increasing. Placer ground is being worked to some extent upon the lower course of the Blue river, yield wages to miners and affording the very best evidence of richness of quartz veins, which have furnished the float gold.

Publicity such as this attracted attention to the central Western Cascades. Although when compared to other states, Oregon was not an important producer of metals, four major mining districts developed in the Oregon Cascades: North Santiam and Quartzville to the north, Blue River, within the study area, and the Bohemia, south of the study area.

At about the same time gold was discovered in the central Western Cascades, farming interests and increased human population in the Willamette Valley forced more sheep and cattle ranchers into the mountains for summer pasturage. Once the central Western Cascades were opened, driveways developed for herding sheep and cattle across the mountains into eastern Oregon. Some grazers chose to graze their animals, especially sheep, in the open prairies and grass balds in the Cascades. Miners depended on the sheep herders for fresh supplies. "Until 1870, all products of the expanding cattle and sheep industry were utilized locally. Mining operations were extensive and thousands of miners throughout the Northwest required meat and other products" (Galbraith and Anderson 1971, 8). One flock of 700 sheep never arrived at its destination in Idaho, having been consumed by the miners in the Cascades (Carman, Heath and Minto 1892).

As areas of free grazing land lessened, conflicts intensified between stockmen and farmers. Eventually the farmers of the Willamette Valley occupied most of the land. By 1880, the number of cattle and sheep east of the Cascades was considerably larger than west of the mountains (Oliphant 1948). Stockmen in central Oregon utilized the central Western Cascades for summer pasturage. According to a 1923 Range Appraisal Report, all sheep grazed on the Santiam Forest were shipped from various points in Central Oregon. The grazing examiners stated: "The demand for sheep range from the east side of the Cascades is far in excess of the carrying capacity of the forest. The dependent territory for all the cattle permitted lies west of the forest in the Willamette Valley. No qualified applicant for cattle range from the west side has however been refused a permit" (Ingram and Horton 1923). By 1948, most grazing was curtailed. A more detailed examination of sheep grazing in the central Western Cascades and the relationship of fire to grazing follows in the next chapter.

Conflicts Within The Forest: Utilization, Conservation and Management

The decade of 1880's saw Oregon experience economic and social changes of revoluntionary consequences. Realization of the economic importance of the region's resources brought big business to Oregon's doorstep. As demand for these resources grew, correspondingly higher values were placed on them. Developments in transportation, communication, manufacturing, and marketing were reflected in a regional economy interlocked with the rest of the nation. Oregon was no longer thought of as the wild frontier. The rapid building of railroads, the spread of farming, the change from country towns to city civilization produced occupational conflicts. These conflicts occurred on many levels: cattlemen versus sheepmen, stockmen versus farmers, businessmen versus conservationists. As demand for land increased, these men became more conscious of their individual rights and ambitions. Yet as resources began to dwindle, these same men consented to government regulation of resource use to prevent monopoly and waste. This was especially true for forested lands.

With the coming of the transcontinental railroad, large corporations bought up or were granted tremendous quantities of timberland made available by the federal government. Much of this land, originally intended for settlers, was in fact falling into the hands of the soon-to-be timber barons (Bureau of Corporations 1914). Unable to stop this exploitation, the government often seemed to encourage it. Legislation intended to aid in the disposal of generous railroad and wagon road grant lands, as well as state school lands, usually favored only the speculator (Robbins 1974). During the late 1880's prior to vigorous Federal surveillance of western land acquisition, timberland was commonly obtained from the public domain through fradulent claims and political maneuvers (Erickson 1965). For example, the Willamette Valley and Cascade Mountain Wagon Road Company, a company with little capital and even less intention of building a road, instead desired the 800,000 acres which came with the grant (Amundsen 1928). Although laws at the time stipulated the land be sold to actual settlers, this was easily circumvented (Erickson 1965, 17; Puter 1972, 22-32).

Similar problems regarding state school lands, prompted the Oregon State Legislature to review and rewrite its land laws many times in the period between 1850 and 1905. The results were usually the same. The land was sold as quickly as possible. This attitude was dangerous. Large amounts of Douglas-fir in western Washington and Oregon were purchased from the government at $1.25 an acre and were later sold for $100 to $200 (Bureau of Corporations 1914, 1:4). Thus speculators, not settlers, bought the land. Frederick Weyerhaeuser and other far-sighted lumbermen were quick to realize the value of the land was not in the soil but in the thick stands of Douglas-fir.

Although a conservation movement was afoot, by the time the federal government passed the Forest Reserve Act of 1891, almost four-fifths of the nation's standing timber was in private ownership (Bureau of Corporations 1914, I:3). In western Oregon and Washington, speculators, lumbermen, and railroad companies controlled more than two-thirds of the private timberlands. Ownership of the land was in the hands of a few (Erickson 1965). A federal study in 1910 found that nationally only 64 owners controlled 334 billion board feet of timber, or about 54 percent. The largest share of Oregon's forest, some 70.5 billion board feet, was controlled by Southern Pacific Railroad (Bureau of Corporations 1914, 2:5). But interest in these lands was beginning to come from other directions. Across the country, people were becoming increasingly alarmed over the status of the Nation's resources, as well as the growing power of trusts and monopolies.

The conservation movement began with a concern for forested lands and their associated watersheds. Shortly after the Civil War, and perhaps influenced by George Perkins Marsh's, Man and Nature, an 1864 monograph warning of environmental deterioration and unethical land use, a variety of people became interested in preserving and perpetuating wilderness (Rakestraw 1955; Petulla 1977, 221-222). Equating forests with wilderness, scientists were alarmed over the loss of forested lands and the degradation of watersheds. While recreational and aesthetic groups desired unique scenic beauty as a source for spiritual renewal away from civilization, businessmen and professional foresters worried about profits, the nation's economy and corruption of the public land laws. Even in Oregon where the prevailing attitude viewed the forest resource as limitless, conservationsists were becoming alarmed.

In 1889, John B. Waldo, a member of the Oregon State Legislature, introduced a memorial to Congress praying "to set aside and forever reserve, for the use herein specified, all that portion of the Cascade Range throughout the State, extending twelve miles on each side, substantially, of the summit of the range" (Waldo 1898, 101). Stressing esthetic value, sustained water flow, and preservation of wildlife, the memorial passed the House but failed in the Senate "because of opposition from sheepmen in the state, afraid of losing their summer range" (Rakestraw 1958, 371). Although the State of Oregon balked, the federal government did move in the direction of conservation preventing further sales of public lands. In 1891 the U.S. Congress authorized the creation of Forest Reserves, and two years later, President Grover Cleveland set aside the Cascade Forest Reserve, one of the first withdrawals of the public domain (MacDaniels 1941; Dana 1956; Robbins 1974). The Cascade Forest Reserve ran practically the entire length of the Cascade Range in Oregon from T.2 N to T.38 S., Willamette Meridian. Most land withdrawals were made in what was perceived as wilderness. No detailed information about them existed at the time (MacDaniels 1941).

When the Forest Reserve Act of 1891 created forest reserves, it did not provide the means to protect, regulate, or manage them. The original legislation was intended to revise a series of land laws, not create nationally-owned forests. The Forest Reserve Act was appended to the bill in such a way that Congress approved it without knowledge of its content (Steen 1976, 27).[10/] Shortly after passage, a storm began to brew and continued to rage on for fourteen years as to who would manage the reserves. Initially, the General Land Office within the Department of the Interior was charged with administering what few regulations there were; whereas the Department of Agriculture foresters in the recently created Bureau of Forestry were to scientifically examine the forests, making only technical decisions. Numerous surveys and reports were completed by both organizations often with conflicting ideas and opinions.

[10/] "The Act of March 3, 1891 (26 Stat. 1095) repealed the Timber Culture Act of 1878 and the Preemption Act of 1841; put a stop to auction sales of public land except isolated tracts and abandoned military and other reservations...and empowered the President to set aside as forest reserves public lands covered with timber or undergrowth, whether of commercial value or not. The last provision (Sec. 24) was added by the conference committee and is often referred to as the Forest Reserve Act" (Dana 1956, 387).

The 1897 Sundry Civil Appropriations Act of June 4 (30 Stat. 11, 34), renamed the Organic Act of 1897, specified the purposes of the forest reserves; established and provided for their protection and administration (Steen 1976, 317).

Away from Washington, D.C., the battles were notably different. Unlike Easterners who viewed forest reserves as good for the nation, Westerners felt threatened by the withdrawal of their land. Concern was not for who should manage the land but who should use it. Here the debate over federal control of the public domain met much resistance.

Opposition to the creation of Forest Reserves came from many camps. Were the forests to be reserved from use or for use (Rakestraw 1958, 371)? In the central Western Cascades, a conflict arose between sheepmen and conservationists. There was no uniform opinion as to the advisability of opening the reserves to grazing. Traditionally able to use the central Western Cascades as summer pasture, men such as John Minto reacted strongly to the proposed restrictions. Just as adamantly, preservationists such as John Muir opposed any use of the forest reserves by sheepmen.

Muir's opposition to sheep grazing reflected his experiences in California where he witnessed the "comprehensive destruction caused by sheepmen." He wrote that "incredible numbers of sheep are driven to the mountain pastures every summer, their course ever marked by desolation." Just as strongly he spoke of the destruction of native plant life, the over grazing and trampling causing deterioration of the watershed and the practice of "light-burning" the setting of surface fires" to improve the pasture and facilitate the movements of the flocks" (Muir 1916, I:221-222, II:97-98). Muir's views were shared by a variety of people: the Oregon Alpine Club (predecessor to the Mazamas); huckleberry pickers, the largest group of forest users; water boards and the chambers of commerce of cities in the Willamette Valley (dependent upon whose water supply came from streams issuing from the Cascades, and cattlemen (Colville 1898, 48; Rakestraw 1958, 373).

Realizing the enormity of the conflict, the government, at the request of the Secretary of the Interior, appointed a commission from the National Academy of Sciences to examine western forests and recommend a forest policy. The commission toured Oregon and Washington, accompanied by Muir who influenced a report recommending regulated mining and lumbering, but excluded grazing (National Academy of Science 1897). John Minto strongly disagreed, basing his arguments on scientific rationale versus what he felt were biased observations (Carmen, Heath, and Minto 1892, Minto 1897). The Department of Interior, faced with contradictory assertions, realized the need for an impartial investigation and requested that a Department of Agriculture botanist, Frederick Colville, conduct an examination of the problem. His report was well received, being sympathetic to sheepmen, but realistic of the need for regulation of all forest uses (Colville 1898; Rakestraw 1958).

Colville's report, Forest Growth and Sheep Grazing in the Cascade Mountains of Oregon, not only set the stage for a national grazing policy, his successful method of local investigation by a trained investigator was followed from that time on (Colville 1898, Rakestraw 1958, 381). Investigations, studies, and surveys of the forest reserves were forthcoming. Henry Gannett and a number of assistants from the U.S. Geological Survey, inventoried and mapped the reserves providing high quality, basic information still in use today. Concurrently, Gifford Pinchot, then Chief of the Division of Forestry, examined the needs of the forest reserves from an administrative viewpoint, proposing a structure which eventually the Department of Agriculture followed (Pinchot 1947).

In 1905, the forest reserves were transferred from the Department of the Interior to the Department of Agriculture, the Bureau of Forestry was renamed the United States Forest Service, and two years later the forest reserves were renamed national forests.

The following year, the administration of the national forests was decentralized into six districts.[11/] On July 1, 1908, the Cascade Forest Reserve which had extended from the Columbia River almost to the California border was divided into four National Forests. One of the four, Cascade National Forest, consisted of the area between the Santiam River and the Middle Fork of the Willamette River. In 1911, the Cascade National Forest was extended south to include the entire upper Middle Fork of the Willamette drainage, but at the same time the northern portion of the Cascade and the southern portion of the Oregon National Forest (today, the Mount Hood National Forest) were combined to form the Santiam National Forest. The Santiam National Forest was divided into two Ranger districts, the Detroit and Cascadia Districts. The Cascade National Forest was divided into the McKenzie Ranger District, the West Boundary District, and the Oakridge District. In 1931, the Santiam National Forest was transferred to the Cascade National Forest and in

[11/] Today there are 10 subdivisions called regions.

1933 the name was changed to, and remains, the Willamette National Forest. Land transfers and boundary adjustments continued to accomodate the changing management needs of the Forest. In 1956, the Blue River Ranger District was formed from a division of the McKenzie and in 1962 the headquarters of the Cascadia Ranger District were moved and the name changed to the Sweet Home Ranger District (MacDaniels 1941).

The change in administration and the formation of the Forest Service coincided with an increased need for fire protection in the National Forests. The decade 1900 to 1910 was marked by increasingly destructive forest fires (Holbrook 1943).

> By mid-September, 1910, the Northwest's most destructive fire season to that date had come to a close. In the four states (Oregon, Washington, Idaho, and Montana), more than 7000 fires had burned over an area of 3,336,750 acres and destroyed 7,408,645 board feet of timber (Morgan 1964, 120).

In 1911, Congress approved passage of the Weeks Law which provided a system of cooperative state and federal forest fire protection (Dana 1956, Morgan 1964, Steen 1976).

The Forest Service had a custodial, rather than managerial role, the first forty years it was active in the central Western Cascades whereby fire prevention and suppression constituted the primary function of the ranger. A lookout at Crescent Mountain was built as early as 1914. Two more followed in 1915 at Carpenter Mountain and Tidbits Mountain. Fire trails and fire breaks were built as well. As a part of the plan for fire prevention, roughly 1500 acres were planted in the Seven Mile Burn area, long a trouble spot for repeated fires. Browder Ridge was replanted as well (Jess 1965).

Although the newly organized Forest Service realized the need for protection of forests from fire, the need for a better understanding of fire effects was also recognized (Schiff 1962). One of Gifford Pinchot's first research efforts, as the new chief, was to study the history of fire (Pinchot 1899, 98). Interest in fire stemmed not only from its destructive nature but also from the benefits of prescribed burning. As early as 1912, the Forest Service experimented with the use of fire as a management tool (Steen 1976, 135-136).

The Forest Service prided itself in its scientific approach to forestry. Coupled with this new approach was a new method of record keeping. The Forest Service was the first government agency to use vertical files, develop a system of subject classification and inaugerate a plan for systematic disposal or retention of records (Pinkett 1959, 421). Now fires became a matter of public record.

Fire protection work increased nationally and locally. In expanding the 1911 Weeks Law, the Clarke-McNary Act of 1924 provided for cooperative forestry practices between federal, state, and private timber owners. The act authorized a system of forest fire prevention and suppression for timbered and cut-over lands. Protecting logged-off lands was important because the high risk of fire in these areas prevented privately-financed reforestation. By 1928, standards were set for control of fire by the day following discovery. Discovery of fire in an area as rugged as the central Western Cascades required the construction of many more lookouts.

In the 1930's the Civilian Conservation Corps (CCC) played an important role in fire protection by constructing roads and trails, clearing brush, laying telephone lines, building new lookout towers, and combating fires. The Eugene district of the CCC had nearly 20 camps with 200 men each, located in or near the study area (CCC 1938; Eugene Register Guard March 7, 1965). Very active throughout the forests of the Cascades, the CCC built roads up Canyon Creek and Tombstone Pass as well as felled snags and built fire breaks in the Seven Mile Burn (Jess 1965). In 1938, Robert Fechner, Director of the Corps said:

> The Civilian Conservation Corps was largely responsible for holding forest fire losses in Oregon, during the 1937 calendar year, to a new low record for acres of forested lands burned over...even though there were a greater number of fires for the year (CCC 1938).

After the Tillamook Burn of 1933 in the Coast Ranges of Oregon, forest fire research increased. The Forest Service, in cooperation with the U.S. Weather Bureau, began to analyze various daily and seasonal climatic factors to establish zones of relative fire hazard. Most studies concentrated on solving immediate problems of fire protection agencies. Initial research work focused on flammability of forest fuels, accurate fire weather forecasts, fire behavior, and fire control planning. Fire protection and control continued to demand increasing attention. The publication of forest classification inventory maps emphasized the magnitude of the fire problem showing large tracts of burned over areas and nonproductive cut-over lands (Cowlin 1973).

Fire studies took on added importance when protecting the Nation's lumber supply became a matter of national defense. During World War II, the Japanese sent incendiary ballons to coastal North America via the jet stream. The plan was to cause mass confusion and panic by igniting extensive forest fires. Due to the strict silence enforced by the United States government, the Japanese were unable to obtain any information about their attacks, and sensing failure stopped sending the balloons. But the balloon threat had been real (Webber 1975). Another war related effort was the organization of the Cooperative Forest Fire Campaign, which educated the public about the importance of preventative forest fire measures. An important contribution of this campaign was the Smokey Bear symbol (Davis 1951).

In the 1940's and 1950's the Forest Service adapted to the new age of technological change and economic growth. Research took on added emphasis. In 1946, a system of research centers was established, each with a specialized function and a geographic territory. In 1948, the Blue River Experimental Forest, renamed the H. J. Andrews Experimental Forest in 1953, was formally established in the central Western Cascades. One aspect of research in the H. J. Andrews has been how to effectively log trees, assure rapid regeneration of a new forest, and maintain the quality of the soil and water resources. A related experiment involved broadcast burning of slash following a total clearcut (Rothacher n.d.). With the increase in logging activity in the central Western Cascades since the early 1950's, interest relative to fire has focused on reforestation after fire, management of slash fuels, and improved timber harvest techniques to reduce other fire hazards (Erickson 1965; U.S. Forest Service 1966; U.S. Forest Service 1967; Brown and Davis 1973).

Since the 1940's fire fighting techniques have become quite sophisticated. Smoke-jumping first begun in the 1930's, became an important component in forest fire control by the 1950's. Today when a fire is spotted, a smoke-jumper can be on the scene in 40 minutes (U.S. Forest Service 1969). More and more reliance has been placed on aerial detection, replacing lookouts, as a means of detecting forest fires. Fire prevention, fire suppression, and fire control have reached an advanced level of development. The numerous methods and sophisticated techniques now available to fire control agencies are beyond the scope of this paper. It should be remembered, however, that although fire suppression and fire control have reached a level that most fires can either be prevented or put out, critical weather conditions and available fuels will continue to be present such that an existing fire could turn into a conflagration (Brown and Davis 1973).

This cultural overview has focused on the numerous activities traditionally associated with man's use of fire. Some activities, while prominent causes of fire in other regions, were not relevant to the cultural development of the study area, and therefore were not included in this discussion.[12] Integrating the knowledge of man's past activities with the knowledge of past fires will establish a better understanding of the historic fire regime of the central Western Cascades.

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[12] Railroading, for example, has been traditionally listed as a major cause of man-caused fires. Although many were planned, no railroad lines were ever completed through the study area. The most notable attempt was made in the late 1880's when T. Egenton Hogg built a section of track high in the Cascades near today's Hogg Rock (Drawson 1966; Bell 1968).

V. HISTORIC FIRES IN THE CENTRAL WESTERN CASCADES, 1850 TO 1977

Introduction

The historic record of fire in the central Western Cascades is divided into two time periods, an early period from 1850 to 1909, and a later period from 1910 to 1977. This arbitrary division reflects the changing availability and types of source materials which parallel increasing human activity in the area.

Information for the early years was drawn from newspaper accounts, early timber surveys, government reports, and legal documents. These sources, although intermittent in occurrence and usually general in content, offer valuable initial insights into the patterns of fire in the central Western Cascades.

Source material for the later years was drawn from U.S. Forest Service files. Since its inception, the Forest Service has been extremely aware of the need to keep accurate records of forest fires. Although the methods of detecting and reporting fires have varied in the last sixty years, the available records reveal the pattern of man-caused fires and delineate differences in occurrence between man-caused and lightning-caused fires.

Historic Fires, 1850-1909

"Diligent inquiry was made to fix the date and causes of the fires, an undertaking beset with difficulty, for those persons who have the most reliable information are the ones involved in the causes, and they, therefore, have the best reasons for strict silence" (Plummer 1903, 88). Although published in 1903, this statement remains true today. Reconstructing the natural landscape from historical sources is a difficult job at best, but investigating past events where blame is involved becomes a formidable task. Conflicting reports are common. No one wanted to take the blame, prefering to pass it on, usually to an adversary.

Information about fires occurring between 1850 and 1910 comes from a variety of sources. When pieced together, these apparently unrelated records present a pattern of man-caused fire in the central Western Cascades. Interestingly, lightning was never mentioned as a cause. Most scientists prior to 1900 were trained in the east where lightning-caused fires make up a small percentage of all fires (Dana 1956, 134-136; Wein and Moore 1977, 1979). When writing about the reasons for fires in the Western Cascades, a prominent scientist, Frederick Colville (1898, 32-33) stated that, "for a long time little credence was given to forest fires started by lightning, but the possibility does exist and the subject is one worthy of further investigation." Apparently he had changed his mind after he observed a tree struck by lightning.

The following chronology examines man-caused fires in the area prior to 1910 focusing on the circumstances of the fire (if known) and the events surrounding the fire. Interwoven throughout are the prevailing attitudes about forest fires. Often the only record available is not from direct observation, but from later reconnaissance.

Complementary evidence, though, establishes a pattern. Where man traveled he left a trail of fire.

In 1850, the Seventh Federal Census listed just about 12,000 Americans residing in Oregon. Most of these people settled in the northern Willamette Valley. Oregon's first newspapers, the Oregon Spectator and the Oregonian, were published in Oregon City and Portland, respectively. These newspapers concentrated on home-town news and reports from the United States.

Since no record keeping agencies existed at that time, newspapers were searched for references to fire. As Morris (1934, 322) noted

> ...in the newspapers from 1849 to 1866, even though the coverage of local events was more and more complete, no references are found indicating great forest fires in Oregon and Washington covering several hundred thousand acres each. Every fall, however, fires occured in many different localities so that the air was heavy with smoke.

During this time fires in the forests were considered common. Oregon's forests were viewed as barriers to transportation and settlement, not as valued resources. Many fires probably went unnoticed and unreported due to limited access and a lack of interest. Since fires were not considered unusual, only a few brought mention, usually because of the irritating smoke which drifted into the Willamette Valley. For example, a small news item in the Oregonian of August 1, 1857 stated:

> Heavy fires have been sweeping through the woods during the week, on the Columbia river near the Cowlitz. The smoke is so thick along the river, that objects can be seen but a short distance. These fires occur every summer along the Columbia and sometimes it is so thick as to greatly impede navigation, steam, and other boats having had to lay by until it had cleared away. In the mountains the first were often very heavy during the summer months, being set by the Indians

> so as to burn the old grass and brush, that green feed may be secured for their horses which grows very luxuriant after the first fall rains.

The first part of this statement concerned with smoke is verified by another newspaper account. The September 1, 1857 issue of the Oregon Statesman reported: "The timber in the mountains and in some portions of the valley, (some between this place and Portland) is on fire and has been burning for several weeks. A dense smoke, resembling a thick fog, has settled over the country."

The Oregonian's statement placing blame on the Indians is probably somewhat biased. By the late 1850's very few Indians were left in the Willamette Valley and surrounding countryside. Bowen (1978, 59) stated:

> One of the more popular topics of frontier scholarship has been the interaction of pioneer and native inhabitants. Notwithstanding the attention paid to them by local historians, the Indians of the Willamette Valley and lower Columbia were of little direct consequence to American settlement during the 1840's. Altogether they probably numbered fewer than five hundred at the time of the first federal census (1850).

Each year the native population diminished considerably (Beckham 1977). But extreme prejudice and fear made it easy to use the Indian as a scapegoat. In actuality, most of the Indians that had lived in the Willamette, Umpqua, and Rogue River valleys were removed to reservations in 1856 as a reaction to the Rogue River Indian Wars of 1853 (Beckman 1977, 147). "Journals document that Indian burning was all but a thing of the past in most areas by 1850..." (Bowen 1978, 61). But fires continued to burn.

Despite the lack of written record during this early period, several references to fire in the central Western Cascades were found.

Escaping mention in the newspapers, the Canyon Creek fire of 1856 is described by the superintendent of the Willamette Valley and Cascade Mountain Wagon Road Company. In describing the construction of the road, Jason Wheeler stated:

> From Canon [sic] Creek coming up easterly up the Santiam was a very rough country, by reasons of side hills and creek bottoms. It had been heavily timbered along there, but the timber had taken fire and burnt, leaving logs lying in every direction across the line of the road, lying along it and across. I think that is what is usually called the big burn. From all appearances the timber had been burnt probably ten years before we made the road. We made the road through there in 1866.
>
> This big burn was about 10 miles long along the line of the road. We cut out these logs and moved them, sometimes in the bottom; sometimes on the hillside (McNamee 1888, 122).

This description as well as those which follow come from the reports of two investigations of the Willamette Valley and Cascade Mountain Wagon Road Company. These investigations were undertaken after residents in eastern Oregon, dependent upon the road, became extremely dissatisfied with the initial construction and later maintenance of the wagon road. Equally serious were the accusations of withdrawing the land from settlement. Having been granted more than 800,000 acres of land, the W.V. and C.M. Wagon Road Company was holding onto the land for speculation instead of selling it to settlers. This angered the residents of the Willamette Valley as well as eastern Oregon (Amundsen 1928; O'Callaghan 1960). Complaints were lodged against the company. Once these complaints reached the Secretary of Interior, an investigation was quickly ordered.

In 1881, W. F. Prosser, a special agent of the General Land Office, presented a report outlining his investigation including written affidavits of citizens involved in the petition against the company. No action was taken until 1888 when J. B. McNamee of the Department of Interior and G. C. Wharton of the General Land office examined all of the federally supported roads in Oregon. McNamee's report on the Willamette Valley and Cascade Mountain Wagon Road Company provides an excellent description of the road from 1866 to 1873. Although both reports focus on problems associated with road construction and ownership of the odd-numbered sections along the right-of-way, descriptions of the terrain and timber provide a early glimpse of the natural landscape.

These reports include narrative descriptions, transcripts of testimony and personal affidavits. The following excerpt from Jason Wheeler's statement provides an early view of Seven Mile Hill:

> Starting up the hill called Seven Mile Hill, graded about one-half mile, cut out the timber and graded one-half mile. Here we came to a bench-like ground; so we didn't have to grade, but had to cut timber out. Not a great deal of grading from there for about a mile, but heavy timber all the way. We had to cut out and remove timber. I wouldn't say just how much we moved; there wasn't much down because the timber was green, but I should think we moved forty logs between where we started up from the river to the steepest part of Seven Mile Hill, say about a mile-nearly so. This estimate includes the standing trees we cut down, but there was underbrush besides that we cut. Then we struck the steepest part of Seven Mile Hill; we graded up that hill, I suppose, over a mile; pretty heavy grade. It required a great deal of hard work to make it. After that we struck comparatively level ground, a little sidling.
>
> From there most of the way it had to be graded a little way-perhaps 100 yards-then flat again. The timber had to be

> removed all the way through. The whole mountain was covered then with green timber, except about one-half mile or a mile just at the top, which was dead timber (McNamee 1888, 124).

In cross examination, Wheeler answered questions, adding to his description of the area.

> Q. What was the first timber east of Sweet Home?
>
> A. Just east of Sweet Home there is a belt about a mile wide; some timber up Wiley Hill. Coming down the hill there is considerable timber for a mile. At Deer Creek the timber sets in very thick for a distance of 4 miles to the burn this side of Canyon Creek. From Canyon Creek to Soda Fork is mostly dead timber, and for 1 mile farther east. Then comes heavy green timber for 3 miles to foot of Seven-Mile Hill. Up the hill was all green timber, with very thick undergrowth. From Seven-Mile Hill to Cache Creek is 22 miles; over half of it was timbered.
>
> Q. What time was the fire on "Seven-Mile Hill" that burnt the bridges?
>
> A. There was one in 1870; Cedar bridge was burnt, a little creek east of there about a mile and a small one below that about a mile (McNamee 1888, 131).

This reference to a fire that 'burnt the bridge' seemed somewhat unusual but further exploration into the testimony surprisingly reinforced other references to similar events. In J. W. Gilliland's testimony he stated: "...I should regard a bridge across this river (the Santiam) as superfluous and a bridge constructed there would be burnt away nearly every year or two" (Prosser 1881, 37). John A. Crawford's affidavit also remarks on the similar fate of bridges:

> He (Mr. Prosser) said that it (the road) would be better for one or two more bridges. In answer to this last remark I told Mr. Prosser that they had been put at places alluded to by him, but that mountain fires had burned them out, and stopped travel... (Prosser 1881, 26).

Additional descriptions of the road, the timber and the terrain were provided by A. B. Webdell, a stock rancher from central Oregon who stated that in 1869:

> The timber along the Santiam, nearly the entire distance was called burnt timber. It was very large fir timber, and was cut just so a wagon could pass through. "Seven Mile Hill" was graded in places, timber moved, trees cut out of the way, so as to barely admit of the passage of a wagon. The timber on "Seven-Mile Hill" in most places would be considered a very heavy forest (McNamee 1888, 132).

Questions asked of Webdell during cross examination were answered as follows:

> Q. What is the character of the forest as to underbrush?
>
> A. Thick fir-brush generally, excepting of the burn, big burn on Sand Mountain; some yew.
>
> Q. Through the bottoms is not the character of the country what you would call thickly timbered with heavy timbers?
>
> A. In some places it is. It is thickly timbered, what I would call heavy timber, from Deer Creek, from where the road strikes Deer Creek, up to what is called Canyon Creek; then there is another thick, heavy belt of timber sets in at Elk Creek, extends on up to the Mountain House, or a little above there, Deer Creek is below Canyon Creek about 3 1/2 miles.
>
> Q. What is the extent of the big barn [sic] you speak of below Seven-Mile Hill?
>
> A. I think about 14 miles.
>
> Q. Is the timber swept off clean, or how is it?
>
> A. No sir; the timber was all burnt and charred, the timber killed a great many left standing, the underbrush was killed. The first time I went through there there was scarcely any (McNamee 1888, 134).

More information about early forest fires comes from the original cadastral surveys. Land had to be surveyed and legally described before it could be settled and owned. The Ordinance of 1785 made the survey of public domain a prerequisite to settlement, and called for the rectangular system of cadastral survey. Using this system the land is plotted into townships, each approximately six miles to a side. Each township is further subdivided into 36 one-mile square sections each containing 640 acres (BLM 1977). Lacking the sophisticated equipment used today, a surveyor and his assistants walked section lines with a rod and a chain, setting corner posts and making notes until the entire township was surveyed. The surveyor was responsible for a drawing or map known as a plat, and a written description of the field work (BLM 1968). Prior to the turn of the century, surveyor's plats and fieldnotes were extremely detailed.

> From the beginning the surveyor was required to note all mines, salt springs, salt licks, water courses, mountains, and other remarkable or permanent things over or near which the lines passed as well as the quality of the land and its potential for farming, mining, or lumbering had to be noted (BLM nd).

This list of items was expanded until, by 1847, full-scale geological surveys were being made in conjunction with public land surveys. It was natural that the surveyor was usually the first natural history-oriented man to give detailed attention to a new area (BLM nd). The richness of the information is illustrated by Figures 2 and 3, examples of a plat and a page of fieldnotes for T. 14 S., R. 4 E. surveyed in 1895.

Congress recognized the surveying system in 1910 at a time when the government was forming land-management agencies. As a part of the formation of these new agencies, new methods of record keeping were

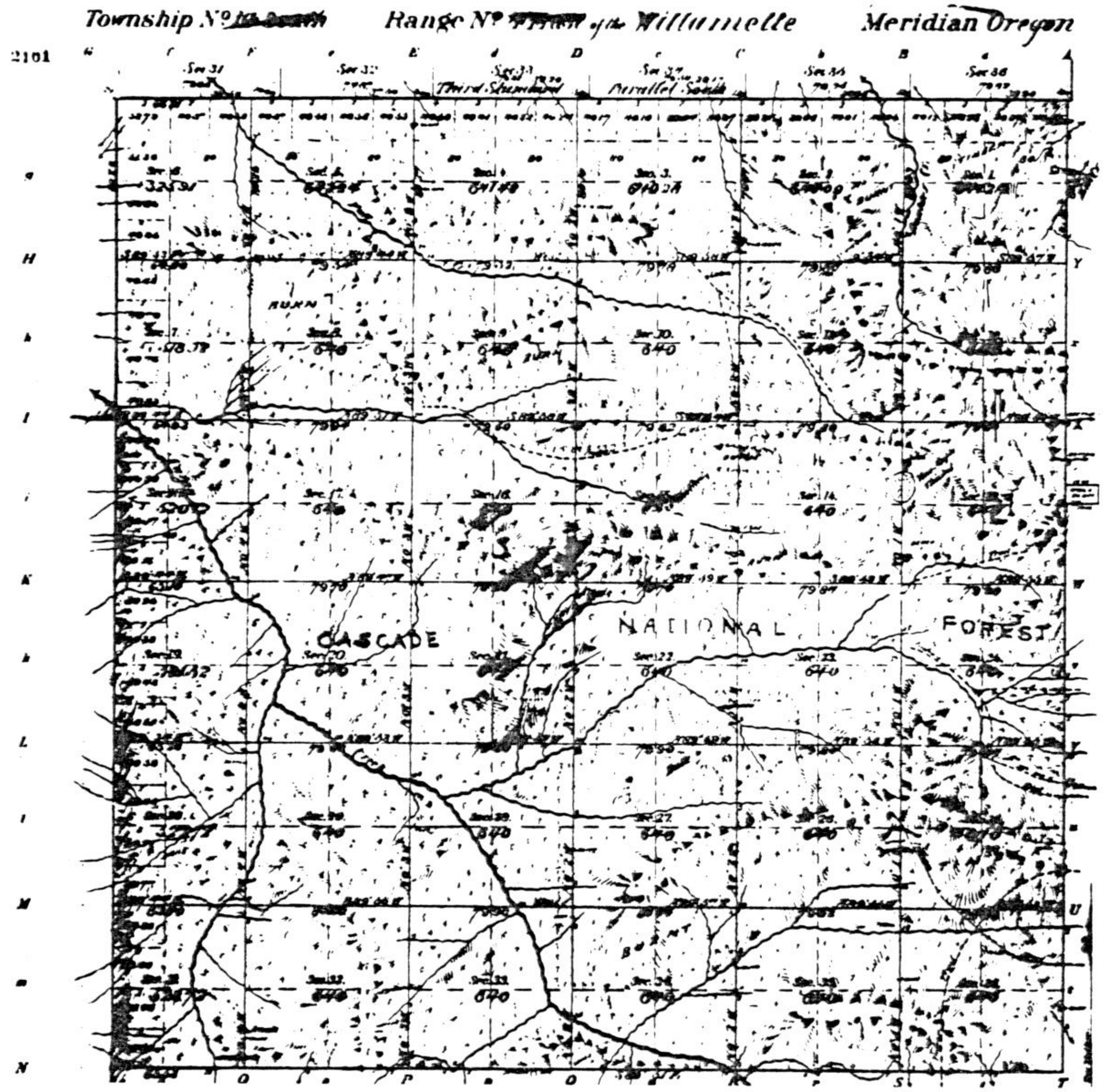

Figure 2. Original cadastral survey plat for T. 14 S., R. 4 E. Note "BURNT TIMBER" in sections 1, 2, 25, 26, and 34; "BURN" in sections 8, 9, and 14.

19

Subdivisions of T.14.S. R4E W.M.

Chains Thence I run

N 89°55' W on a true line bet secs

26 and 35.

Descend from ... through burn.

39.92 A point 200 ft below S ce cor

Set a fir post 3 ft long 4 ins sq

24 ins in the ground for 1/4 S ce cor

marked 1/4 S on N face from which

A fir 24 ins diam bears N40°E 69 lks

dist marked 1/4 S. B.T.

a fir 24 ins diam bears S25°W 28 lks

dist marked 1/4. S. B.T.

Descend 200 ft to

55.00 Brook 5 lks wide flows S.W.

Ascend 50 ft to

66.50 Top of small spur slope S.W.

Descend 100 ft to

79.17 Brook 4 lks wide flows S30°W

79.92 Cor of secs 26.27.34 and 35

Land mountainous

Soil 3rd and 4th rates.

Timber fir partially destroyed by fire.

Mountainous land 79.92 chs.

Figure 3. Corresponding page of cadastral survey fieldnotes for T. 14 S., R. 4 E., describing a section line between sections 26 and 35.

developed. At the same time, many of the older, self-taught surveyors working under a contract system retired and were replaced by a new breed of surveyor, formally trained and employed directly by the government. The fieldnotes and plats lost their descriptive, natural history quality when replaced by the up-dated, standardized forms.

Of the 24 complete and fractional townships surveyed in the study area, 11 were surveyed prior to 1900 in this old style of surveying. The amount of detail is remarkable and especially useful to my study were the areas marked "BURN" or "BURNT TIMBER." Using these 11 plots and the corresponding fieldnotes, I plotted the burned and unburned section lines.[13/] Of 248.5 miles walked by a surveyor, 40.25 miles or 21 percent had been recently burned before 1900 (Figure 4). Although not originally intended as such, this method is comparable to the line-intercept method of vegetation analysis as described by Mueller-Dombois and Elleberg (1974) and others.

Cadastral surveys were not the only surveys undertaken prior to 1900. Interest in the potential lumber market or the possibility of publicly owned forest reserves prompted a number of forest inventories. For the Tenth Census of the United States, Charles S. Sargent prepared the Report on the Forests of North America, which "was the first truly comprehensive picture of forest resources in the country" (Dana 1956,

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[13/] Copies of all of the original plats and accompanying fieldnotes for the study area are on file at the Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, Corvallis, Oregon.

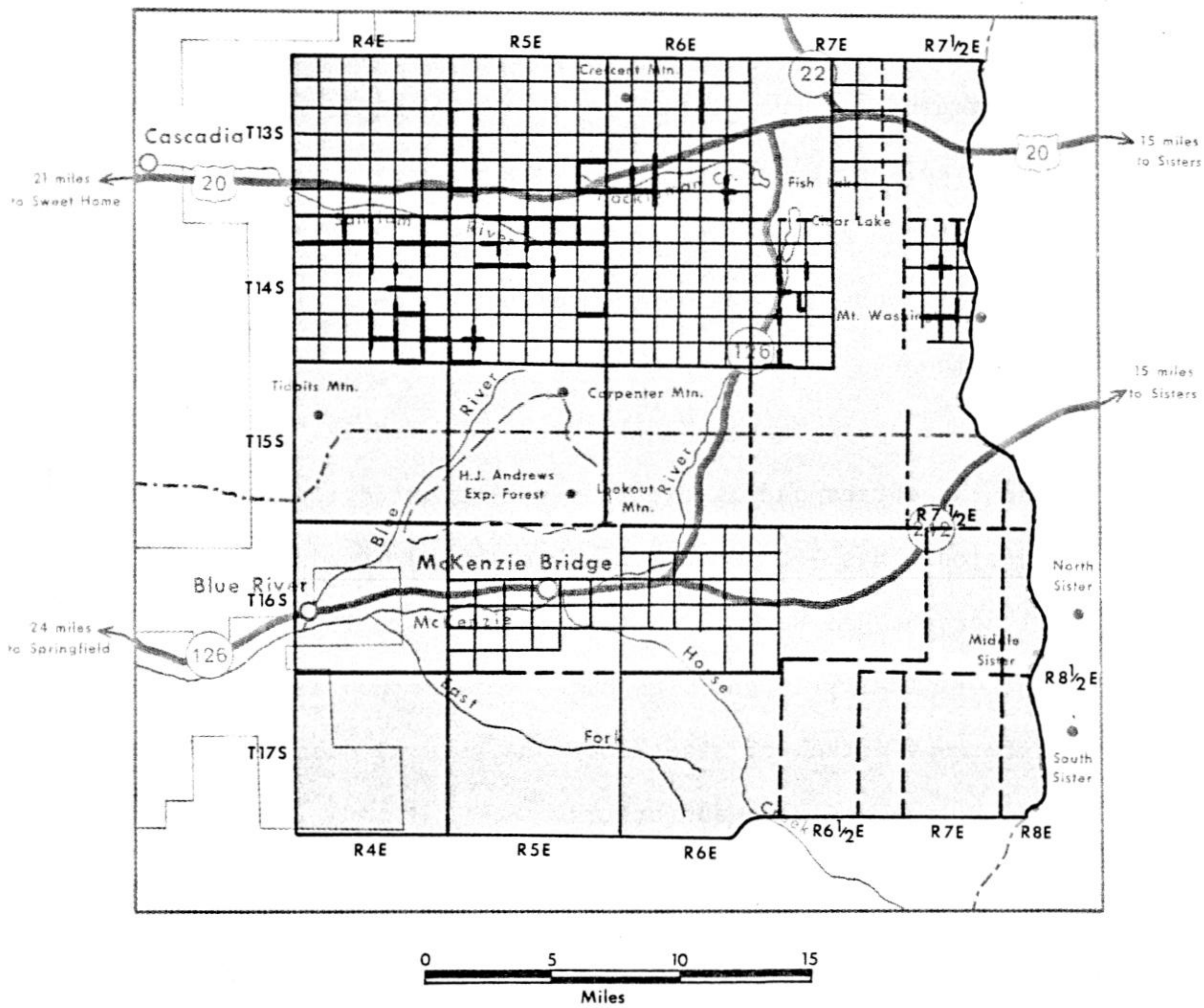

Figure 4. Cadastral survey status of study area. Complete and fractional townships surveyed prior to 1900 are shown divided into sections. Thin section lines represent unburned land. Thick section lines represent "burned" areas identified on plots or in fieldnotes. Dashed lines are unsurveyed approximations of section lines or township boundaries (Source: Bureau of Land Management, Portland, OR).

90). Sargent, obviously concerned about the condition of the nation's forest, stated:

> The extent of the loss which the country sustains every year from injury to woodlands by fire is enormous... The largest number of these fires of any one class was traced to farmers clearing land and allowing their brush fires to escape into the forest. The carelessness of hunters in leaving fires to burn in abandoned camps, next to farmers, was the cause of the greatest injury...while the intentional burning of herbage in the forest to improve pasturage often caused serious destruction of timber.
>
> The damage inflicted upon the permanency of the forests of the country by browsing animals is only surpassed by the injury which they receive from fire. The pasturage of the forest is not only enormously expensive in the destruction of young plants and seeds, but this habit induces the burning over every year of great tracts of woodland, which would otherwise be permitted to grow up naturally, in order to hasten the early growth of spring herbage....All undergrowth and seedlings are swept away, however, and not infrequently fires thus started destroy valuable bodies of timber. This is especially true also in the coniferous forest of the Pacific region (Sargent 1884, 491-493).

Comparing the regional effects of fire, he noted:

> The forests of the north Pacific coast offer an exception to the law, otherwise general, for this context at least, that a change of forest crop follows a forest fire. The fir forests of western Washington territory and Oregon when destroyed by fire are quickly replaced by a vigorous growth of the same species...(Sargent 1884, 491).

Sargent's report outlined, state by state, the condition of the forest resources, including among other factors, how many acres were burned during the census year and the ways in which the forests had burned both in the past and during the census year. Consistent with the thinking of that time, lightning was not mentioned as a cause of forest fires. His report gives us an insight to man-caused fires in Oregon prior to 1910, especially when coupled with William Bowen's (1978) work on migration and settlement patterns in the Willamette Valley.

Bowen analyzed Oregon's pioneer population by place of origin and concluded that almost half (43 percent) of the population came from Missouri, Illinois, Ohio, Indiana, and Tennessee.

> Missouri's overriding importance among the western states is underscored by the fact that 38 percent of all normal families (551) and 43 percent of all migrating individuals (2,865) passed through this single state. Illinois and Iowa ran a distant second and third. In the Missouri-derived population, the most prominent contributing states were Kentucky, Indiana, and Illinois, followed by Tennessee, Ohio, and Virginia (Bowen 1978, 29).

Stating that "Information, its acquisition, dissemination, and use is central to the development of motives and is a prerequisite to any decision to migrate," Bowen (1978) believed word-of-mouth communication was by far the best and most trusted source of knowledge. One implication of this type of communication is that information was restricted to families, clans, and communities who tended to migrate as units. Once in Oregon, they isolated themselves from other groups. Ideas and attitudes carried from home-states were reinforced once on the frontier. Consequently, settler's beliefs about the value of forests as a natural resource and attitudes about fire did not change as their environment changed.

An excerpt from Sargent's report exemplifies these beliefs and attitudes. Corresponding with a resident of Tennessee, Sargent noted:

> The practice of burning timber-land, said to have been of Indian origin, has been continued by the white settlers. The native grasses do not die down when killed by frost; they simply die standing, and the young grass in the spring has to

> push through the old tuft which is often 6 or 8 inches high. The fires are set in the timber and old fields to burn these tufts, that stock may graze four or six weeks earlier than if old herbage had been left upon the ground....The practice kills, too, the young trees, so that some of the most valuable timber that the land is suitable to produce is unable to stand. The state law makes it a misdemeanor with heavy penalty for anyone to set fire to and burn a neighbor's land, but the difficulty of detection and conviction in such cases makes this law non-effective (Sargent 1884, 545).

During the 1880 census year 985,430 acres of woodland were destroyed by fire in Tennessee. In reviewing other states, Sargent noted that during the census year 556,647 acres were burned in Kentucky, 783,646 acres in Missouri, 74,114 acres in Ohio, 90,427 acres in Indiana, and 48,691 acres in Illinois. With reference to Oregon, Sargent (1884, 577) stated: "forest fires are increasing in frequency, especially west of the summit of the Cascade Mountains. During the census year, however, only 132,320 acres of woodland were reported destroyed by fire..." For the most part, the largest number of fires were set by farmers carelessly clearing land for farming and grazing and by hunters' and loggers' campfires.

Sargent's work, a preliminary forest inventory, focused on regional statistics. Using these figures, he predicted that within his life-time many of the nation's important forest trees would be gone. As the American public became aware of its dwindling resources, pressure was exerted on the government to inventory what remained. Realizing the need for more detailed information, the federal government commissioned various agencies and individuals to survey the nation's natural resources and make recommendations for future management.

In 1897 Henry Gannett, a geographer for the U.S. Geological Survey was ordered to examine all of the forest reserves established by President Grover Cleveland. A number of field assistants were assigned to assist him; the instructions to each differing slightly owing to differences in the conditions encountered. F. G. Plummer surveyed the forest conditions in the central portion of the Cascade Range Forest Reserve. Many aspects of the forest reserves were touched on, including a section on "Burns". In his introduction, Plummer stated:

> Probably 90 percent of the entire area examined has at some remote period suffered from fires, of which a trace still remains. The areas here classified as burns are those on which the fires are of comparatively recent occurrence and on which restocking has not reached a size which can be called merchantable timber (Plummer 1903, 88).

Plummer's 1901 land classification map included areas of burned timber (Figure 5).

Accompanying the map is a narrative description of each township. In his description of T.13 S., R 5 and 6 E., the area known as Seven Mile Hill, Plummer (1903, 130) noted:

> The burns in the southern half of the township occurred in 1867 and were very severe. Several smaller fires have since destroyed this restocking, that in 1896 being the most destructive. About 25 percent of the total area is burned, the big burns being 'clear burns,' excepting in a few small area where standing snags would indicate the former forest was a thick stand of the alpine species. Probably the date was that of the destructive fires of 1867.

Of T 14 S., R.5 E. he noted:

> About 35 per cent of the total area is burned. The burn in sections 13 and 24 is very old and was an Indian hunting ground. The burn in section 12 and part of section 13 occurred in 1896. That in sections 1,2,3, and 4 occurred in 1885, and again in 1897.

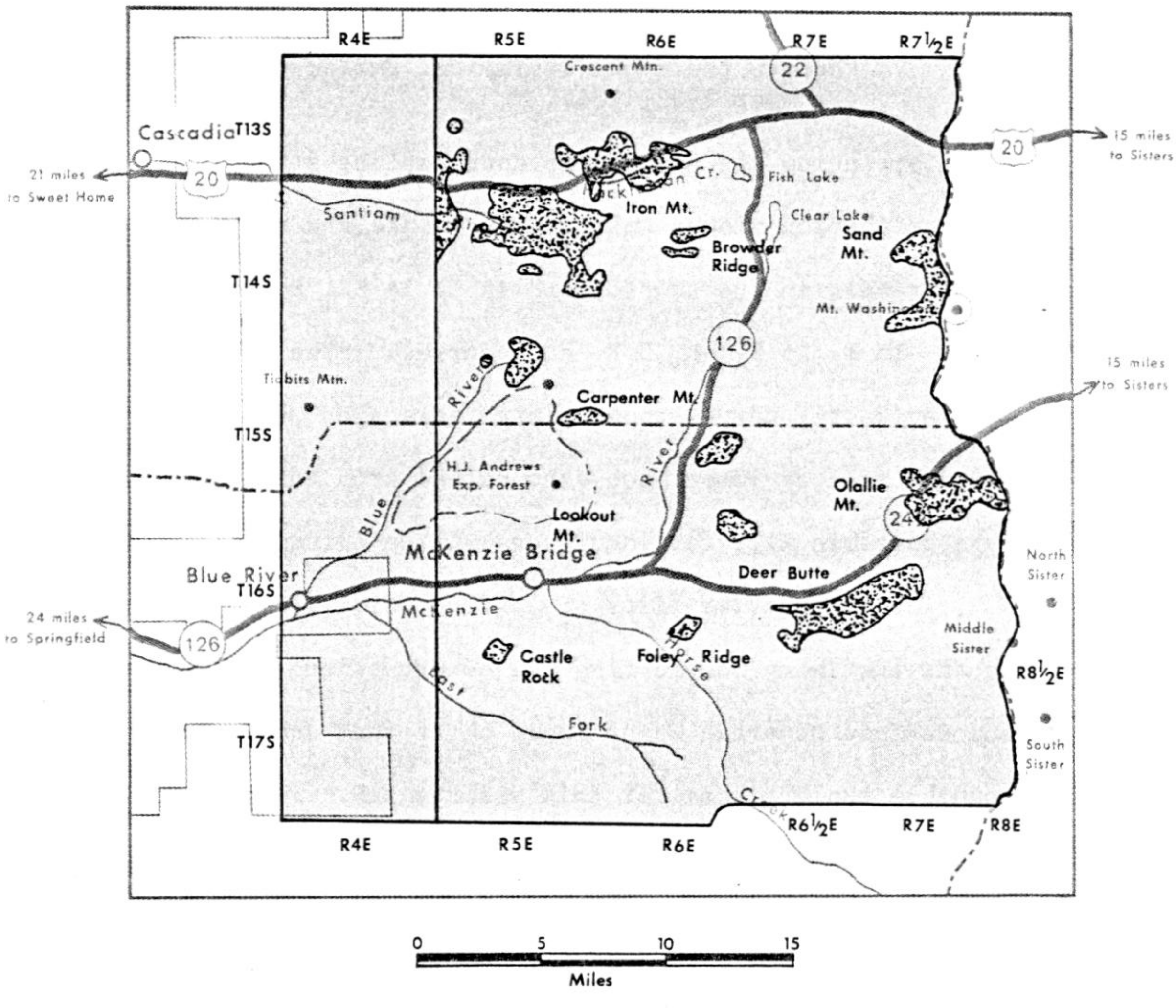

Figure 5. Area of "burnt timber" identified in 1901 by F. G. Plummer (1903) in the Cascade Range Forest Reserve east of R.4 E.

> The heavy timber in section 5 is old growth but not first class, being sometimes limby and windshaken. The proportion of poor timber being about 10 percent. Although the timbered areas were saved from the big burn, the trunk's were scorched to a height of 20 feet or more showing that the fire ran through the under-brush, but failed to ignite the timber (Plummer 1903, 134).

Continuing his systematic appraisal he stated: "A very old burn occurred on the slopes west of Clear Lake and the old burned stumps still remain in the new forest" in T. 14 S., R. 7 E., (Plummer 1903, 135). In T. 16 S., R. 5 E. he observed: "The lightly forested areas were evidently burned about sixty years ago. In Section 18, about 200,000 feet of lumber has been culled from the standing forest and cut by a portable mill for local consumption (Plummer 1903, 140).

The destructive fires of 1867 noted by Plummer were not mentioned in the testimony documenting the construction of the Willamette Valley and Cascade Mountain Wagon Road, built that same year. There are two possible explanations for this discrepancy. Plummer might have been off by 10 years or so, confusing the 1856 Canyon Creek fire with the 1867 fire. This is doubtful though because his field methods included interviews with local residents to verify his observations and Canyon Creek is 15 miles to the west of Seven Mile Hill. More likely, fires did occur in 1867 and were possibly associated with construction of the road. During the early days of roadbuilding, fire was a common tool for timber removal. According to Frederick Colville (1898, 30):

> A second great source of fires in the Cascades was the early road building across the mountains to connect eastern with western Oregon. A broad band of fires usually accompanied such an enterprise. At that time the amount of destruction thus caused was not appreciated, because most of those

> who were connected with the building of these roads were from the Eastern States, where timber was abundant and where the first prerequisite of agricultural progress was to burn off timber in order to clear the land for farming purposes. The details of an interesting method of felling large trees of Douglas spruce (Pseudotsuga mucronata)[14/] were learned from some of the old inhabitants. The trees are large, commonly 6 feet in diameter at maturity, and to cut them was too expensive and difficult a task. The method of felling the tree was to bore a hole with a long auger diagonally downward to the heart of the tree and to bore another similar hole diagonally upward from the base of the tree, connected with the first. A live coal was then dropped into the hole, and the draft through the two auger holes causing the wood to take fire, a roaring conflagration followed which burned away a large portion of the tree trunk. It was seldom that an axe had to be used to fell the tree, as the fire almost always ate away a sufficient portion of the trunk to cause it to fall.

Additional limited evidence for fires in 1867 was found in the Oregonian (Morris 1934). Why these fires were not mentioned by those men involved in road construction is probably due to the fact that in 1867 when the fire occurred, forest fires were readily accepted as a road building tool, but by 1880 and 1888 when the testimony was given, the public had become aware of the peril of forest fires. On trial for fraudulent road construction, undoubtedly no one wanted to implicate himself in destruction of part of the soon-to-be Cascade Range Forest Reserve as well.

Destruction of the nation's forests had become a popular topic. Coincidental with the increased economic and political growth, the resource preservation movement also grew in strength. Embarking on a theme dating back to the early 1800's John Muir "embodied and spread abroad the idea that the wilderness mirrors divinity, nourishes

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[14/] Pseudotsuga mucronata is a synonym, nonvalid scientific name for Douglas-fir (Pseudotsuga menziesii) (Hitchcock and Cronquist 1973, 63).

humanity, and vivifies the spirit" (Petulla 1977, 231). Muir despised sheep, referring to them as "hoofed locusts" (Muir 1894, 116). Based on his experience in California he attacked the sheep industry's use of the Cascade Forest Reserve. Controversy and confrontation waged (Rakestraw 1958). Sheep grazing in the central Western Cascades had been a major force in opening the two passes through the Cascades providing the opportunity to establish stock driveways and use the forests for summer pasture. Caught in the crossfire between the preservationists and the sheepmen, the U.S. Department of Interior, at that time responsible for administering the forest reserves, requested the Department of Agriculture to inspect and report upon sheep grazing in the Cascade Mountains. Frederick Colville examined and reported upon the problems.

Colville's report traced the histories of sheep grazing and fire in the Cascades. He interviewed local residents and sheep herders to ascertain their attitudes about each subject:

> With the sheepmen themselves, we talked very frankly, and as a result of these conversations it may be stated, without betraying any confidences and without citing individual cases, as unquestionably true that in the early days of sheep grazing in the Cascades there was a widespread belief among the sheepmen that burning off the forest was of positive benefit to the sheep-grazing industry, and that many herders undoubtedly did systematically burn over areas in the forest, either where the density of the timber had prevented the growth of suitable grazing plants, or where they had already grazed and were about to remove to another camp, or when they were leaving the forest at the end of the season. How general this practice was it is impossible to say.
>
> It is clear that, at the present time, most sheep herders and packers are extremely careful not to allow their camp fires to spread and not to set fires intentionally (Colville 1898, 34).

He continued:

> The necessity of forest fires to the summer grazing industry has undoubtedly been over-estimated both by the general public and frequently by stockmen themselves. A fire on an occupied range is objectionable, because it both burns up the forage and menaces the sheep herder's camp, and often the sheep themselves. Cases are known in which the whole camp, outfit and provisions have been burned by the accidental spreading of a fire while a herder was away from camp with his sheep, and other cases are known in which sheep have narrowly missed being caught and burned up in a forest fire. Besides this a single fire in the black-pine belt, for example, is followed after a few years by such a growth of sapling among fallen logs as to make it exceedingly difficult to drive a band of sheep through. If the logs are charred, the wool of the sheep becomes blackened by the charcoal dust to such an extent as to decrease the value of the wool often a cent a pound. Furthermore, as already stated under the head of the effect of fires in the upper portion of the yellow-pine belt, a fire is often followed by a dense growth of underbrush, which in itself prevents a growth of forage and makes traveling across such an area almost impossible.
>
> Against these statements, however, may be set the indisputable fact that a large amount of the grazing in the Cascades is upon old burns and that had these fires never occurred the available grazing area would have been reduced by precisely that amount (Colville 1898, 35).

In a section describing types of grazing available, he stated:

> The burns in the west slope forests are very destructive to timber if they occur at a dry season when the deep litter feeds the flames and everything burns readily. By the second year they are usually covered with a dense growth of weeds and browse, often interspersed with tall grasses. Within a few years, however, on account of the humidity of the climate, they grow up with underbrush soon developing, if they are not again burned, a growth of sapling; but if repeatedly burned, supporting only a dense growth of underbrush (Colville 1898, 20).
>
> One phase of the forest fire evil in the Cascades must still be mentioned, the slowness of reforestation in certain areas. On several of the old burns there was evidence that many years had elapsed since the fire that destroyed the trees had done their work, and upon inquiry it was found that a surprisingly long period had intervened. It was stated, for

> example, that the burn on the upper west slope of the Santiam-Prineville road occured earlier than thirty years ago. This burn is now grown to snowbrush (*Ceanothus velutinus*) and other shrubs, and no evidences of reforestation are in sight. Some portions of the great burn on the south slope of Mount Hood, we were informed, are more than forty years old and at present they bear only scattered saplings. It is clear that in many such areas, where the conditions are naturally unfavorable to the growth of trees, reforestation must be extremely slow, and that a hundred years is not too low an estimate for the period that elapse before a young forest covering of even moderate density will return (Colville 1898, 36).

Colville also obtained a reliable estimate of the number of sheep grazed in the reserve. His method was "to take an actual census on the ground" (Colville 1898, 16). In 1897, he determined that 188,360 sheep ranged on the Cascade Reserve, contained in 86 bands with an average of 2190 sheep per band (Colville 1898, 16). Concurrently the General Land Office within the Department of the Interior required all sheep owners to apply for permits to pasture, stating the number of sheep and their location on the range.

In 1905 when the administration of the forest reserves transferred to the Forest Service, grazing allotments were established to protect the range from overuse (Figure 6). A similar permit procedure was followed except a fee was charged. The permits recorded that during the early 1900's, 20,000 sheep in bands averaging 2200 grazed in the study area. Remarkably close to Colville's earlier census, these figures indicate that grazing activity in the central Western Cascades was at its peak during the period of the 1880's to the 1920's and diminished over the next two decades (Table 1).

Sheep grazing was not the only human activity in the central Western Cascades, and certainly not the only one responsible for forest

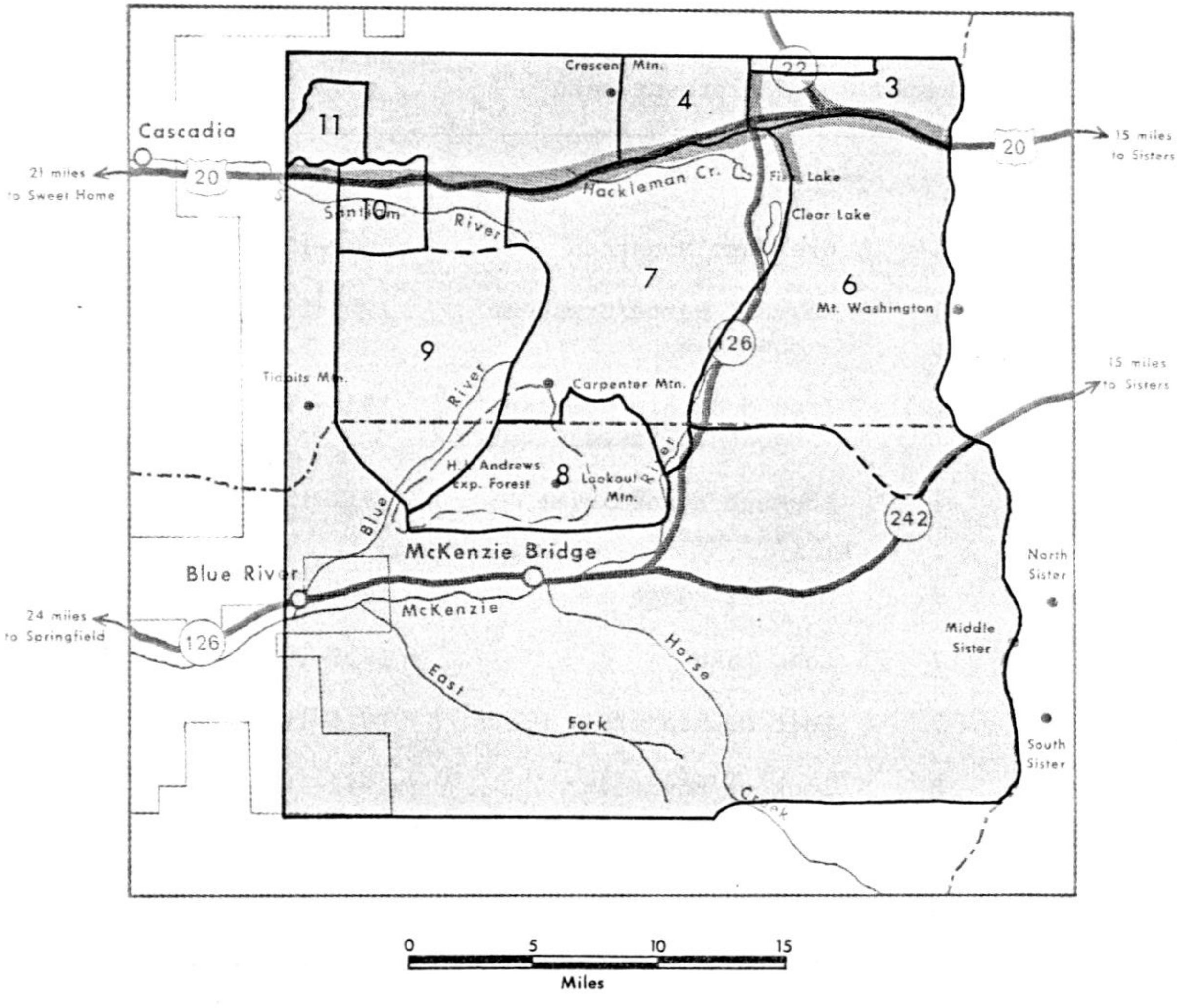

Figure 6. Grazing allotments in the central Western Cascades, c.1920. Lightly stippled area superimposed along Highway 20, shows the approximate stock driveway through the central Western Cascades. (Source: U.S. Forest Service 1923; 1946-1950). See Table 1 for grazing allotment descriptions.

Table 1. Grazing Allotments within the Study Area.

Map number	Allotment name	Dates of active grazing	Animals grazed* (average no./yr)
SHEEP ALLOTMENTS			
4	Crescent Mountain	1909-1920	1413
4	Maxwell Butte/Crescent Mountain	1923-1934	1200
4	Iron Mountain/Crescent Mountain/Maxwell Butte	1924-1943	1662
6	Lookout Mountain/Mt. Washington	1912-1938	2445
7	Browder Ridge	1908-1945	1678
7	Lost Lake	1908-1914	6843
7	Wolf Mountain/Big Marsh	1915-1925	1123
8	Lookout Mountain	1912-1922	1500
9	Soap Grass/Two Girls	1912-1948	2426
CATTLE ALLOTMENTS			
3	Lava Lake	1967-1977	75
10	Hyatt-Gordon	1912-1977	51

*Data compiled from sheep and cattle use permits at the Willamette National Forest Headquarters, Eugene, Oregon.

fires. In a report on the Bitterroot Forest Reserve similar to Plummer's on the Cascade Forest Reserve, Leiberg stated that blame for modern fires may be placed on prospectors who "roamed over the countryside in the summer, when the forest litter is dry and ready to burn," in search of new discoveries or legendary lost mines (1900, 385-90). Discovery of gold in the Blue River area in 1860 brought this new breed of men to the central Western Cascades. In describing the mining activity in the Cascade Forest Reserve, Plummer (1903, 76) concluded: "It is probable that every township in the mountainous region has been visited by prospectors." Most of the activity centered in the Blue River area.

According to Callaghan and Buddington (1938) the "history and production of the Blue River district is largely that of the Lucky Boy mine." Discovered in 1887, the Lucky Boy mine continued operation until 1913. During its most productive period, 1900-1913, the mine produced nearly $159,000 almost all in gold, although total production, including years prior to 1900, may have been greater by $50,000 to $100,000 (Callaghan and Buddington, 1938). The Lucky Boy consisted of 14 patented claims and a 40-stamp mill on the east side of Quartz Creek. By 1938, the mill was in ruins and today (1978) the site is barely recognizeable. Although the largest, the Lucky Boy was not the only mine in the area. Twenty other mines were once in operation in the Blue River mining district (Table 2).

This increase in human activity late in the 1880's increased the potential for man-caused forest fires. A distinction is made between mining and prospecting, especially regarding fire. In the central

Table 2. Historic Mining Claims Located within the Study Area (Source: Parks and Swartley 1916; Callaghan and Buddington 1938).

Name of mine or claim	Location	Comments
Cinderella	T.15 S. R.4 E. sec. 28	Stamp mill
Durango	T.15 S. R.4 E. sec. 28	Near summit of Gold Hill
Evening	T.15 S. R.4 E. sec. 32	East peak of Gold Hill
Morning	T.15 S. R.4 E. sec. 32	South slope of Gold Hill
Great Eastern	T.15 S. R.4 E. sec. 28	Northeast of Cinderella
Great Northern	T.15 S. R.4 E. sec. 28	4-stamp mill, aerial tram line, small buildings
Great Western	T.16 S. R.4 E. sec. 10 & 11	East fork of Quartz Creek
Higgins	T.15 S. R.4 E. sec. 29	2-stamp mill, cabin
Lucky Boy	T.15 S. R.4 E. sec. 32 & 33 T.16 S. R.4 E. sec. 4 & 5	Group of 14 claims. 40-stamp mill, crusher power plant on the McKenzie River with transmission lines, 10 vanners, 5 ore tanks, aerial trams, mining equipment, various office and personnel buildings
Lucky Girl	T.16 S. R.4 E. sec. 4	7 claims
Merger	T.15 S. R.4 E. sec. 32	
Poorman	T.15 S. R.4 E. sec. 31 & 32	2-stamp mill
Red Buck	T.15 S. R.4 E. sec. 29	

Table 2, continued.

Name of mine or claim	Location	Comments
Rialto (Blue Bird)	T.15 S. R.4 E. sec. 28 & 33	12 claims, near head of the North Fork of Quartz Creek, cabin, mill house, water tank and mill
Rowena	T.15 S. R.4 E. sec. 28 & 33	8 claims east of Rialto
Sochwich	T.15 S. R.4 E. sec. 29	
Tate	T.15 S. R.4 E. sec. 28	In valley of Tate Creek
Treadwell	T.15 S. R.4 E. (on line between sec. 21 & 28)	
Treasure	T.15 S. R.4 E. sec. 32	Offices, boarding house, bunkhouse, 12 stamp mills
Uncle Sam	T.16 S. R.4 E. sec. 6	Large mill house
Union	T.16 S. R.4 E. sec. 6	

Western Cascades, mining was localized, whereas prospecting occurred throughout the area. Prospectors often used fire to clear the land for exploratory purposes (Lutz 1959, 33). Miners were extremely careful of fire since most of a mine was supported by wood. Although occurring somewhat later, only one large fire can be traced to mining. In 1911, the buildings of the Great Northern mine in the Blue River district were destroyed by fire which spread to the nearby forests. A report in the August 29 issue of the Oregonian stated ..." a serious fire is raging there (at the mine site) in green timber at the head of the Calapooia River in the Santiam Forest Reserve..." Although no cause was officially reported malicious intent was inferred. Incendiarism, while quite common, was not the major source of forest fires; "carelessness" was more often listed as the cause of fires. When people began using the forested lands more for their enjoyment and less for their livelihood, fires due to carelessness and neglect became more prevalent.

As Oregon's population grew, more people sought the mountainous countryside for recreation and relaxation. Into the woods went picnickers, campers, berry pickers and hunters. Traveling up both the Santiam and McKenzie River roads, tourists found favorite camping and picnicking spots. Along the Santiam, Tombstone Prairie, Lost Prairie, Fish Lake, and Lava Lake attracted many visitors. Hot springs located up the McKenzie River, especially Foley Springs and Belknap Springs, became favorite health resorts for the settlers of the Willamette Valley (U.S. Forest Service n.d.b; Ruralite 1967; MacArthur 1974, 279).

Berry picking was another important recreational activity. Concerned that regulation of the Cascade Forest Reserve would mean restricting this use, Colville (1898, 48) stated:

> In this connection (restricted use) one of Oregon's peculiar institutions should not be lost sight of. This is the practice common to the ranchers and townspeople who live near the Cascade Range of resorting to the mountains in summer to pick huckleberries. There are areas in the mountains which, from late August to October, produce annually an enormous amount of wild huckleberries (chiefly the kind known to botanists as <u>Vaccinium membranaceum</u>), and the present inhabitants, following an aboriginal custom of the Indians, go into the mountains, usually a whole family together, often driving 100 miles, and camp out for a few weeks, hunting, fishing, and picking huckleberries.

Colville (1898, 31) also noted that:

> Repeatedly camp fires were seen which had been left by these people (travelers) and which under suitable conditions might have caused disastrous forest fires.
>
> It is clear that a very large majority of the fires in the Cascades forests are due to carelessness rather than maliciousness...Camping parties, particularly those made up of young and inexperienced people from towns, are a fertile source of forest fires. These parties commonly go into the woods for a summer outing, often making the chief object of the pleasure the hunting and fishing afforded by the region. Some of these parties are made up of young men who go into the woods for the special purpose of hunting, but who have little experience in woodcraft and no knowledge of the proper method of handling a camp fire.

H. D. Langille (1903, 40) responsible for the reconnaissance of the northern portion of the Cascade forests summarized the reasons for fires in the forest reserves prior to 1900 when he noted:

> Doubtless many fires were set by sheepmen to increase the acreage of range land, and hunters, fishermen, travelers, campers, and others thoughtlessly left their fires to spread, or deliberately set them to destroy hornet nests or obstructions in roads, trails, or the forest. The sentiment has not been awakened to an appreciation of the value of the forests, and they were looked upon as nobody's for which no one was responsible.

This unconcerned attitude persisted. According to Morgan (1978) public, individual, and corporate apathy toward fire, strengthened by the myth of the inexhaustibility of the forests, met little challenge until disasterous fires during the first decade of the 1900's destroyed countless acres of forested land throughout the Pacific Northwest. Morris (1934, 333) concluded that in 1902 numerous land-clearing and campers' fires were burning in all parts of the region during late August and early September. Strong east winds drove the "harmless" fires over the countryside. News items in the Oregonian about the fires went from almost nothing on September 7, to column after column after September 12.

Reporting on the fires in the mountains east of Eugene, the Oregonian (September 14, 1902, 2/4)[15/] noted:

> Smoke from the numerous forest fires continues to thicken in the Valley...Everything is in semi-darkness, and in the houses and stores it is almost dark enough to light lamps in the middle of the day.

Listing the various areas in danger, the article continued:

> Above the ferry on the McKenzie, at one point in the stage road, it is considered dangerous for teams to travel the road. The fire has crossed the river and is burning on both sides, and there is great danger of trees falling across the road. (Oregonian, September 14, 1902, 2/4).

The next day the Oregonian (September 15, 1902, 12/2) declared:

> The Eugene Guard has advices to the effect that forest fires have been numerous along the McKenzie and that some logs and a log check have been destroyed. Above the McKenzie bridge a whole mountainside is ablaze, and fires are reported above Belknap Springs and near the headwaters of the South Fork.

[15/] For the reader's convenience, I am including the page/column numbers with each newspaper citation.

Reports continued to come from many parts of the state. A headline in the Oregonian of September 16, 1902, 1/4, proclaimed, "Big Loss in Santiam" and the article which followed stated:

> Millions and millions of feet of good timber has been destroyed in the Santiam country, and the fire is still raging with nothing to stop it but a rain...The timber destroyed is supposed to belong principally to the Northern Pacific Company and the Willamette Valley and Cascade Military Road Company.

Reporting the observations of a group of witnesses, four men hunting deer 20 miles south of Quartzville, the article continued:

> They saw the first smoke ascending from the canyons the first having been started simultaneously in two different places. Nothing but smoke appeared until Thursday night, when a strong wind sprang up from the East. The fire then swept up the mountain side in a most terrifying manner. The forest was thick and the trees were large. The fire had been set in the bottom of a canyon which formed a sort of furnace for the fire...Trees were falling everywhere, and rocks weighing many tons were loosened from their beds in the hillside and sent crashing down into the gulch hundreds of feet below (Oregonian, September 16, 1902, 10/4).

These few newspaper articles, which focused on the central Western Cascades, sample the many reports about the 1902 forest fire in the Pacific Northwest. The Oregonian also published editorial comments about the need for fire control. Taken from the Walla Walla Union (Washington), the following excerpts from an article entitled "Burning Gold," infer a changing attitude about forest fires:

> Reports from Southwestern Oregon, from Southern Oregon, in Siskiyou and Klamath Counties, from Central Oregon, in Grant and other counties, and from various portions of Western Washington, British Columbia, and Idaho stressed that, if anything, more than the usual amount of fine timber is being destroyed by forest fires this season...Generally speaking it (fire) is only combatted when it begins to endanger individual property--Government property is permitted to burn away unchecked. This, of course, is only natural.

> But the moral is that action is imperative somewhat to save the splendid areas of marketable timber which annually go as a sacrifice to the forest Vulcan of the West. Representatives of the people will not be content to stand idly by 10, 20, or 30 years from now and watch the smoke of pine and fire ascend into heavy--it will be the burning gold then...Cannot these forest fires be prevented?
>
> Would the Government be warranted in establishing a system of forest ranging in the best timbered districts of the West? Would it not be profitable in the end if an apparent extravagance in protecting the open Government timber were indulged now?...The greatest country is the country which conserves its resources, permitting nothing to be wasted. The Government should conserve the forest resource of the West.... (Oregonian, September 9, 1902, 6/5).

Although many advocated complete federal responsibility for fire prevention and control, others felt government protection would profit the private sector at public expense.

The public had become extremely distrustful of big business and with good reason. The movement of the lumber industry from the east to the west had progressed with amazing speed. In the 1870's when the Lake states dominated lumber production, three-fourths of the standing timber was publically owned, including most of what was referred to as the public domain in the Pacific Northwest. Within twenty years, large corporations such as Northern Pacific Railroad, Weyerhaeuser and Southern Pacific Railroad, had moved into the Northwest and had easily obtained control of more than two-thirds of the once publicly owned timber land (Bureau of Corporations 1914).

While these large corporations professed some interest in fire control, most lumbermen "believed fires were inevitable and thought logging rapidly and wastefully and then abandoning the cutover land was justified" (Steen 1976, 174). This attitude about fire followed the industry as it moved from the East to the Lake states and is mirrored by Sargent (1884) when he observed that in Michigan destructive fires generally originated in the neighborhood of the logger's camps, the timber prospectors were responsible for many fires, and that as a rule fires followed, not preceded the lumberman. Sargent stated:

> The reason is obvious, the logger in his operations leaves the resinous tops, branches, and chips of the pine trees scattered far and wide; then by the following midsummer become dry as tinder, and afford abundant material to feed a fire started by a careless hunter, log-cutter, or farmer clearing land near the forest (Sargent 1884, 550).

Finally, when the lumbermen had logged their way to the Pacific Ocean, they realized that the nation's forests were not inexhaustible. Suddenly there was a new awareness of the destructive nature of past logging practices, the need for fire control, and the possibility of managed forests to ensure adequate future supply. No longer could they "cut out and get out" (Morgan 1964, 91). The lumber industry, faced with the need for better fire control, uncertainties in the tax situation, and falling lumber prices, turned to the government for help.

The government's initial efforts at forest protection failed because it faced similar problems: inadequate funds for an inordinate responsibility. In Oregon, the State legislature passed a bill which provided for protection districts, but the governor vetoed it stating such a law would put the burden on the taxpayers and not the timber-owners. Frustrated by the failure of the government to implement a forest fire law and devastated not only by the 1902 fire, but by another series of fires in 1904, timber companies such as Weyerhaeuser increased the patrol of their own lands. Now private lands were protected but public forests burned. In time, a State Board of Forestry was established, fire wardens were employed and stricter laws enacted (Rakestraw 1955; Dana 1956; Morgan 1964; Steen 1976).

Gradually the private patrols joined together to form protective associations which, in turn, cooperated with the newly formed state forestry agency. According to Morgan (1978, 176) "The earliest formalized cooperative patrol agreement came in 1905 when the Booth-Kelley Lumber Company, then the largest timber owner in Oregon's heavily forested Lane County, joined Weyerhaeuser Timber Company, C. and J. K. Wentworth of Chicago and the Southern Pacific Railroad Company to provide protection through the county and also along the McKenzie River."

In time, the organization became known as the Eastern Lane County Fire Patrol Association. Similar fire control problems faced other forested counties. Banding together, the timber owners in Linn County formed the Linn County Fire Patrol Association (Eastern Lane County Fire Patrol Association; Linn County Fire Patrol Association).

At first these protective associations were only marginally effective. Continued carelessness with logging and fire and the lack of funds for the state forestry system, coupled with the "crazy-quilt" pattern of federal, state, and private timberlands made effective forest protection difficult (Figure 7).

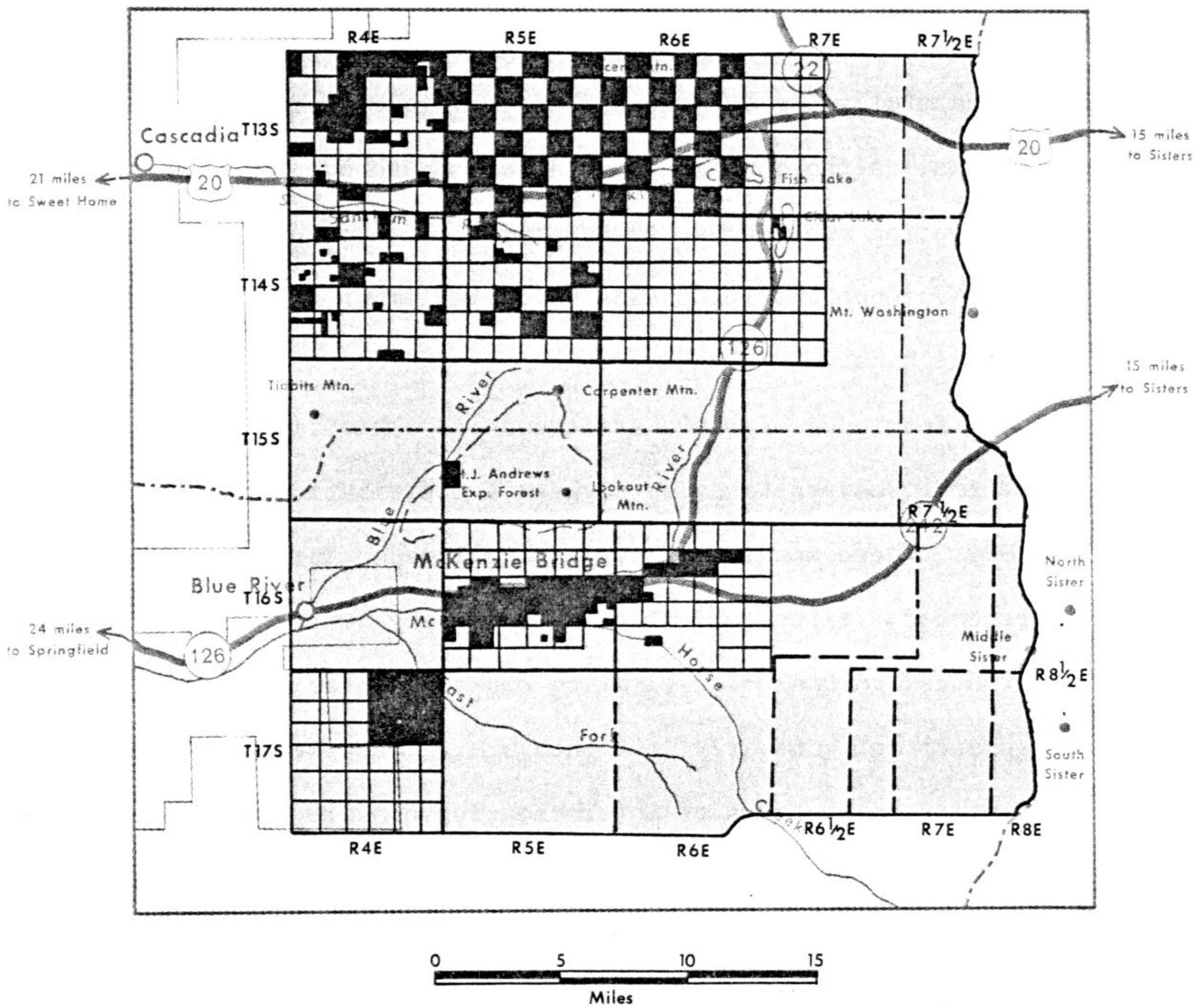

Figure 7. Private land in the central Western Cascades, c.1920. (Source: U.S. Forest Service 1919.)

When logged off, this private land posed a threat to the surrounding timber because of the quantity of slash and brush. Logging practices during the early 1900's made it financially impossible to totally or carefully log an area and no techniques were used to hasten reforestation. Although slash removal and brush burning were standard fire protection procedures, these practices were seldom followed (Graves 1910). Once cleared of its valuable timber, the land was abandoned and a fire hazard developed.

Knowledge of man's attitudes and activities in the forests of the central Western Cascades suggest a distribution of fire from 1850 to 1909. Where man traveled, fire followed. Yet only certain fires were recorded. Fires thought to be extremely destructive, fires which produced volumes of irritating smoke or fires caused by a segment of society not generally well-thought-of were the only ones receiving mention. A pattern of interpretation of fire causes emerges which not only includes these biases but which excludes a major cause of forest fires in the study area. Since lightning was not considered to be a cause of forest fires until the turn of the century, unknowing witnesses often blamed Indians for lightning-caused fires. Thus an entire aspect of the fire history of the central Western Cascades is missing from the early record or obscured by ignorance or bias. Although the pattern of man-caused fires changes little in the next sixty years, the added dimension of lightning-caused fires brings into focus a clearer picture of the recent fire history of the central Western Cascades.

Historic Fires, 1910-1977

Source material for the years 1910-1977 was drawn from the U.S. Forest Service files. The first fire reports originated only five years after formation of the organization. The period from 1910 to 1940 represents the initial attempts of the Forest Service to record fires. Various methods were used: annual fire reports on tabular folio-sized forms, annual fire maps by individual forest, summary tables for ten year periods, and summary fire maps by decade. Information about fires occurring between 1931 to 1939 or 1931 to 1940 came from summary fire maps showing the location and size of fires for those time periods, but not broken down by individual year.

The methods for recording fires changed each decade and were often different for each forest. Fire records for 1940 to 1948 are missing for the central Western Cascades. Many thoughts arise as to why these records could not be found.

In my queries about this lack of record, several possibilities were mentioned. Most often cited was the impact of World War II. During the war, manpower was limited and record keeping was probably a low priority duty. Even if records were kept, they might have been considered sensitive and therefore classified. Knowledge of our National Forests, amount of timber available, and area burned, as well as the number of men fighting fires and therefore unavailable for military duty, are other probable reasons for possible classification of these records. (During my past experience in historical investigation, I found many roadblocks to information about events during this decade.)

In 1949, the Forest Service introduced the Individual Fire Report Form 5100-29. A revised edition of this form is still in use today. The fire record since 1949 is more accurate and consistent.

Using these records, I determined the location, date, cause, and size of 1624 fires occuring in the central Western Cascades between 1910 and 1977. The diverse reporting forms and numerous fires required developing a computerized data storage system. Specific information about each fire was abstracted from the source, coded, and keypunched onto a computer card. Appendix A is a listing on microfiche sorted by location (township, range, section, and quarter-section) and by date (year, month, and day).

The exact date for most of the fires is known, listed as year, month, and day. Exceptions are noted such as fires occurring during the 1930 to 1940 decade when only summary maps were abstracted. The size class refers to the size of the fire:

A = $<$0.25 acres	D = 100-299
B = 0.25-10	E = 300-999
C = 10-99	F = 1000+

Fire causes are listed as lightning (L), man (M), or unknown (U). Man-caused fires are further categorized as:

1 = lumbering

2 = mining

3 = cooking/camping

4 = grazing

5 = road building

6 = settlement

7 = miscellaneous

The miscellaneous category consists primarily of smokers, berry pickers, or incendiary fires.

These sub-causes are a combination of the many general categories found on fire report forms. They reflect the most common resource uses in the central Western Cascades. A study of the fire report forms themselves revealed much about the recent history of man's activities in the forest. Since 1910, when the Forest Service began tabulating fire data, the fire report form has been changed every decade to accomodate for changes in land-use and management. For example, the 1930 fire report form for Region 6 required listing travel time to a fire in one of three categories: on foot, on horseback, or by auto. Today's form allows for aerial reconnaissance and helicopter support. Similarly, although unusual causes such as moonshiners were listed on the early forms, in 1920 there were only fifteen causes and today there are over thirty (Linda Donoghue, personal communication, July 14, 1978). Using the computer sorted listings, I mapped the location of each lightning-caused and man-caused fire, including the year of the fire, the size class, and if man-caused, the subcause. These maps (Appendices B and C) provide a visual representation of the distribution of reported fires in the central Western Cascades for a 60 year period.

Although 1624 fires were reported--they are just that, reported fires. As Wein and Moore (1977, 1979) found, during the early days, in this case prior to 1949, it was very unlikely that all fires were reported especially class A fires. The National Forests were understaffed. This is certainly true of the central Western Cascades as indicated by this statement:

> Early records on fire control work show that this work was quite limited owing to the lack of funds and shortage of personnel. One ranger or guard had a large area to patrol--sometimes hundreds of thousands of acres (Willamette National Forest 1938).

Lightning storms with many ground strikes probably ignited many unrecorded spot fires. Fire detection and suppression were usually emphasized after a large fire and slacked off during uneventful years.

Because information supplied on each fire report form or map changed through time, I chose to use only location, date, size, and cause. Although this decision was made prior to publication of Wein and Moore's study of fire history using historical records, I concur with and list the possibilities for error using fire report forms. Most errors result from:

1. People with varying amounts of time and interest who compile the fire statistics.
2. Understaffing
3. Limited information due to limited technology.
4. Recopying and summarizing the data.
5. Possible exaggeration of the time required to detect a fire and the difficulty in fighting a fire to help justify more equipment and fire fighters (Wein and Moore 1977, 286-287).

With these limitations in mind, the following data analysis portrays patterns and relative importance of fire occurrence rather than absolute values.

The annual number of fires from 1910 to 1977 has fluctuated from 1 to almost 100, with a mean of 28 fires per year. Of the 1624 reported fires, 53 percent were lightning-caused, 45 percent were man-caused and 2 percent were of unknown origin (Table 3). After 1918, the number of fires of unknown cause decreased because of an increase in fire detection by the Forest Service and the fire protection associations.

Eighty-one percent of the total number of fires were class A fires (less than 0.25 ac), 14 percent were class B fires (0.25 to 10 ac), 4 percent were class C fires (10 to 99 ac) and 1 percent were class D, E, or F (100 ac or more). Lightning was responsible for most small fires--54 percent and 60 percent of the class A and class B fires were caused by lightning respectively. Man-caused fires make up 57 percent of class C fires and 73 percent of class D, E, or F fires (Table 4). Whereas lightning ignites more fires, they are usually small; man is responsible for fewer but larger fires. To determine the reasons for the differences between lightning-caused and man-caused fires, it was necessary to evaluate and compare spatial and temporal distributions of fire or both ignition types.

A number of problems limit interpretation of the record of lightning-caused fires. First, the record is not uniform. Because access and fire suppression have increased progressively from 1910 to 1977, the record of lightning-caused fires has changed through this period.

Table 3. Annual Number of Fires by Cause from 1910 to 1977.

Year	Lightning	Man	Unknown	Total
1910*	-	-	3	3
1911*	-	1	4	5
1912*	3	1	1	5
1913*	1	0	-	1
1914*	10	1	4	15
1915*	7	4	3	14
1916*	1	1	3	5
1917*	4	19	2	25
1918*	8	10	5	23
1919*	29	16	-	45
1920*	24	2	-	26
1921*	12	7	-	19
1922*	2	15	-	17
1923	2	6	-	8
1924	37	22	-	59
1925	3	14	-	17
1926	1	14	-	15
1927	25	17	-	42
1928	4	20	-	24
1929	46	31	-	77
1930	51	19	-	70
1931-1939	47	107	-	154
1940-1948	reports missing			
1949	17	14	-	31
1950	7	7	1	15
1951	0	4	-	4
1952	34	16	-	50
1953	25	3	-	28
1954*	0	2	-	2
1955	10	5	-	15
1956	28	5	-	33
1957	0	8	-	8
1958	18	3	1	22
1959	reports missing			
1960	10	3	-	13
1961	46	9	-	55
1962	0	15	-	15
1963	2	3	-	5
1964	1	7	-	8
1965	10	21	-	31
1966	24	15	-	39

Table 3, continued.

Year	Lightning	Man	Unknown	Total
1966	24	15	-	39
1967	84	12	3	99
1968	15	12	-	27
1969	0	27	-	27
1970	70	27	2	99
1971	20	17	-	38
1972	28	30	-	58
1973	11	34	-	45
1974	19	54	-	73
1975	17	20	-	37
1976	6	20	-	26
1977	45	8	-	53
Grand Totals	864	728	32	1624

*1910-1922 Reports for Cascadia Ranger District only; 1954 Reports for Sweet Home only.

Table 4. Number of Fires by Class and Cause from 1910 to 1977* (percentage of fires by class in parentheses).

Class (acres)	Total number of fires by class	Lightning	Man	Unknown
A (<0.25)	1319	706 (54%)	596 (45%)	17 (1%)
B (0.25-10)	224	134 (60%)	83 (37%)	7 (3%)
C (10-99)	66	20 (30%)	38 (57%)	8 (12%)
D,E,F (100+)	15	4 (27%)	11 (73%)	-

*59 year record; 1940-1948; 1959 fire reports missing.

Better reporting of fires has had a similar effect on the record of lightning-caused fires. Second, during the almost 70 years of recorded fire data, the climate has varied (Blasing and Fritts 1976). Climatic variations affect potential thunder and lightning storms and fuel flammability. Finally, the variation in the annual number of lightning-caused fires is great, because a few lightning storms dominate the record of a decade or more. In 1967 and 1970, for example, 84 and 70 fires were ignited by lightning, respectively. During the 1967 fire season, 45 lightning-caused fires occurred between August 10 and August 12, and 26 lightning-caused fires occurred on August 28. Under these conditions, small lightning-caused fires have the potential of becoming larger because fire suppression crews are unable to control or contain each fire.

The first two factors, a non-uniform record due to (1) varying effectiveness of fire suppression and fire reporting and (2) variable climate, affect forest fires regardless of cause. Man-caused fires are affected by these factors in much the same way as lightning fires. When considering man-caused fires though, further complications arise. Human use has increased steadily through time. Logging and road building since the mid-1950's have opened areas once accessible only with great difficulty. Not only are more people using the forest, improved access has led to a change in the types of forest user. As industrial activities increased, so did recreational uses (U.S. Forest Service 1971). More man-caused fires are attributed to cooking/camping than any other cause. Whether or not these cooking/camping fires are actually due to recreational users is difficult to discern. Similar to the old prejudice against sheep herders, campers are often blamed for many fires not associated with recreational activities.

Recognizing these limitations, I examined the data by month, class, cause, and subcause. Eighty percent of the lightning-caused fires occurred in July and August whereas no lightning-caused fires were reported in April or after October. Man-caused fires exhibited a broader distribution throughout the fire season (Tables 5 and 6). Fifty-four percent of all man-caused fires were due to cooking/camping fires and 14 percent were due to lumbering. These activities also extended later into the year, during periods of possible acute fire weather (Table 7).

Just as complex as the distribution of fire through time, is the geographic distribution of fire. With the aid of the computer-sorted data, I mapped the location of each lightning-caused and man-caused fire, noting the size and the year; in the case of man-caused fires, I also noted the subcause (Appendices B and C). The obvious lack of information in T. 17 S., R. 4 E. is due to extensive private ownership resulting in a sparse record for that township. In general, lightning-caused fires appear unevenly distributed, whereas man-caused exhibit definite patterns.

Prentice (1977) noted that many factors contribute to the non-uniform areal distribution of lightning strikes in a particular region. Some are obvious, such as the presence of relatively tall objects (e.g., isolated trees); other factors such as elevation and topography are less

Table 5. Number of Lightning-Caused Fires by Class and Month from 1910-1977* (percentage of fires by class in parentheses).

Class (acres)	May	June	July	Aug.	Sept.	Oct.	Total
A (<.25)	11 (2%)	40 (6%)	184 (28%)	361 (54%)	65 (10%)	9 (<1%)	670 (82%)
B (.25-10)	1 (<1%)	3 (2%)	21 (17%)	75 (60%)	20 (16%)	6 (5%)	126 (15%)
C (10-99)	-	1 (6%)	2 (13%)	13 (81%)	-	-	16 (2%)
D (100-299)	-	-	-	2 -	-	-	2 } (.5%)
E+F (300-4999)	-	-	-	2 -	-	-	2 }
Totals	12	44	207	453	85	15	816
% of lightning fires by month	1.5	5.4	25.4	55.5	10.4	1.8	
% of total fires by month	0.8	3.0	14.0	31.5	6.0	1.0	56%

*1931-1939 fires not listed by month; 1940-1948, 1959 no data; fires of unknown origin represent less than 2 percent of the sample and were not included.

Table 6. Number of Man-Caused Fires by Class and Month from 1910-1977* (percentage of fires by class in parentheses).

Class (acres)	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
A (<.25)	6 (<1%)	16 (2%)	44 (9%)	127 (25%)	175 (35%)	121 (24%)	18 (6%)	-	1 (<1%)	508 (81%)
B (.25-10)	3 (4)	3 (4%)	5 (7%)	12 (16%)	19 (25%)	17 (22%)	13 (17%)	3 (4%)	1 (<1%)	76 (12%)
C (10-99)	-	-	2 (8%)	6 (23%)	3 (12%)	7 (8%)	2 (8%)	6 (23%)	-	26 (4%)
D (100-299)	-	-	-	1	2	2	1	-	-	6 } 2%
E+F (300-4999)	-	-	-	-	3	2	-	-	-	5 }
Totals	9	19	51	146	202	149	34	9	2	621
% of man	1.4	3.0	8.2	23.5	32.5	23.9	5.5	1.4	.03	
% of total	0.6	1.3	3.5	10.0	14.0	10.0	2.4	0.6	.14	42.5%

*1931-1939 fires not listed by month; 1940-1948, 1959 no data; fires of unknown origin represent less than 2 percent of the sample and were not included.

Table 7. Percentages of Total Man-Caused Fires by Subcause and Month, from 1910-1977.

Subcause	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1 (lumbering)	1	1	-	1.5	2.5	4.5	3.5	1	-	14
2 (mining)	-	-	-	-	-	-	-	-	-	-
3 (cooking/camping)	T*	T	4	15	20	13	2	-	T	54
4 (grazing)	-	-	-	-	-	2	-	-	-	2
5 (roadbuilding)	-	-	-	T	-	-	-	-	-	T
6 (settlement)	T	-	-	2	T	T	-	-	-	3
7 (miscellaneous)	T	1	-	6	11	8	T	-	T	27

* = $<$0.5 percent

evident, for example, the effect of channelling vertical air streams through valleys.

Many observational biases influence the data for the geographic distribution of fires. Lightning-caused fires occurred throughout the study area, often in areas of poor accessibility. Many small lightning-caused fires, especially those which were extinguished by the accompanying rain, probably went unnoticed and unreported. In the rugged terrain of the central Western Cascades lightning fires on ridge tops were probably reported more often than those on mid-slopes or valley bottoms, not because ridge tops were struck more often but because they were observed more readily. The distribution of lightning strikes may differ from that of lightning-caused fires. Not all lightning strikes result in fires. A lightning strike in a valley bottom or on a north-facing slope may have less potential of starting a fire than on a ridge top because of differences in fuel moisture.

At first examination, lightning-caused fires appear to be unevenly distributed, but closer inspection reveals areas of low fire density. Three areas, Gordon Meadows/Soapgrass Mountain, Quentin Creek/Carpenter Mountain, and Scott Creek/Knobs Sheep Camp, seem to have low incidence of lightning-caused fire. A number of possible explanations are offered for this observation. In an area as rugged as the central Western Cascades, topography and elevation may be important factors in the distribution of lightning-caused fires.

Morris (1934) mapped the movement of lightning storms through Washington and Oregon at a regional scale. He noted that on any given national forest the number of lightning fires per acre at low elevations (600 to 1200 m) was as great as the number per acre at high elevations (1800 to 2400 m), if an equal number of lightning storms occurred over the two areas. Thus, frequency of lightning fires was proportional to surface area, not elevation.

For the Rocky Mountain region, Viemeister (1972) concluded that lightning ignited twice as many fires per unit area at elevations between 2,000 and 2,300 m than between 700 and 1,000 m. He also noted that if a mountain peak protruded into clouds, the charge would be dissipated resulting in fewer ground flashes. In some areas, depending on the prevailing air currents, thunderstorms followed valleys and lightning struck at the sides of mountains.

Prentice (1977, 490) commented on a similar observation made by R. H. Golde, stating:

> In valleys running roughly in the same direction [as the movement of a thunderstorm] transmission lines at the bottom of the valley were struck more frequently than lines running along the tops of the hills. Where valleys are at right angles to the direction of cloud movement, lines on the tops of the hills received more flashes than those in the valleys.

Whether or not topography is responsible for the apparent heterogeneous pattern within the area studied is difficult to discern. To evaluate the effect of elevation and terrain on lightning-caused fires would require a study area much larger than this; one large enough to sample the entire path of a storm as it tracked through the Cascades.

Another possibility for these areas of low lightning fire occurrence might be a lack of fuels. Each of the three areas which appear as "holes," lacking lightning-caused fires, have been burned and reburned within 30 years prior to 1910, the start of the mapped record. Although each area differs in topography and elevation, each has a similar land use history. Records indicate that within each area sheep were grazed. Sheep grazing reduced the amount of fine fuels and the possible fires accompanying this activity would have certainly reduced the medium to coarse fuels. Since records exist for lightning-caused fires and not lightning strikes, strikes in these areas may have gone unreported due to a lack of flammable material which would preclude a fire.

The distribution of man-caused fires from 1910 to 1977 produced an obvious pattern. Most of these fires occurred along major transportation routes: the Santiam Highway, the McKenzie Highway, and the Clear Lake Cutoff. The majority of the fires were concentrated in the McKenzie Valley, and the Lava Lake/Fish Lake/Clear Lake corridor.

During the period from 1850 to 1909, most of the human activity and therefore most of the fires were concentrated along the Santiam travel corridor and were travel related. In the last 60 years many more man-caused fires have occurred in the McKenzie Valley. Although also used as a travel route, the McKenzie Valley has been a preferred area for settlement and recreation. The Lava Lake/Fish Lake/Clear Lake area has had a long history of human use. Fish Lake was one of the most used and developed stops on the old wagon road. Around the turn of the century, Fish Lake and Lava Lake were heavily grazed by sheep and cattle. Fish Lake continues to be grazed by cattle today. This natural junction has been and continues to be a convenient stopping place, a favorite camping spot and therefore an area of numerous man-caused fires.

Many man-caused fires attributed to camping and berrypicking were also located in the southeastern portion of the study area, an area long used for recreational activities. Since the early 1960's the number of fires at higher elevations has increased due to increased recreational activity in undeveloped areas. Similar to the distribution of man-caused fires from 1850 to 1909, the location of man's activities determined the distribution of man-caused fires during the 1910 to 1977 period.

VI. SUMMARY AND CONCLUSIONS

Paralleling a common concern of geographers, man's role in altering the landscape, this study focused on man's alteration of the natural fire regime of a coniferous ecosystem. Using the historic method to trace the land-use history of the central Western Cascades of Oregon, the patterns and distribution of man-caused and lightning-caused fires were determined.

The study of historic (1850 to 1977) fires in the central Western Cascades begins at the interface between a fire regime dominated by nature and one dominated by modern man. Prior to Euro-American man's settlement of the Pacific Northwest, four groups of aboriginal people inhabited areas within or adjacent to the study area. Little evidence was found to substantiate intentional Indian burning in the forests of the central Western Cascades. Although one group, the Kalapuya, are known to have burned the grasslands of the Willamette Valley, it is doubtful they willfully set fire to the Cascade forests. As hunter-gatherers, none of the four groups used fire as a method of hunting nor did they use fire to clear the land for agricultural purposes. Archaeological evidence indicates that the majority of trails occurred along ridge crests, thus the need to clear and maintain paths by burning would have been minimal. Intentional burning of huckleberry fields is also unlikely, although unintentional burning from escaped campfires is probable. Depending on the condition of the fuels, untended or abandoned campfires coupled with naturally occurring lightning fires were ample ignition to maintain an age class of 125 years or older in the forests of the central Western Cascades.

With the coming of Euro-American man into the forests of the central Western Cascades, the fire regime changed. Viewing the forests as barriers to transportation, settlement, and progress, early settlers used fire as a tool to clear land, build roads, and improve grazing. As access improved so did forest use. An increase in use corresponded with an increase in the numbers of fires. Although many fires were willfully or maliciously set, most were due to carelessness.

Lumbermen, railroadmen, and businessmen followed the early settlers, sheep grazers, and miners into the forests of the central Western Cascades. This next group viewed the forests as limitless, undeveloped tracts of land to be used possessively. Interest focused on the thick stands of Douglas-fir, not on the value of the land. An attitude of "cut-out and get-out" prevailed. Extreme carelessness with fire was common. Although a conservation movement worked to halt these practices, by the 1890's four-fifths of the nation's standing timber was privately owned. In general, the period from 1850 to 1909 was characterized by exploration, expansion and exploitation of the natural resources of the central Western Cascades. Little thought was given to recording, controlling, or preventing forest fires. Interestingly the historic record from 1850 to 1909 chronicles only one dimension of the fire history of the study area--man-caused fires.

Because fires were not considered unusual during this 60 year period, only certain ones were recorded. Fires of unexplained origins or in inaccessible areas were usually blamed on Indians, even though few of any Indians lived in the area after 1860. Lightning was not regarded a cause of forest fires until after 1900.

The fire record from 1910 to 1977 reveals that almost 60 percent of all fires were caused by lightning. While lightning ignited the most fires, these were usually small and occurred primarily in July and August. Differences in the annual number of lightning-caused fires are best explained by the differences in the duration and amount of rainfall prior to, and during, the storm. Rain usually accompanies lightning storms, extinguishing fires or retarding their spread. In the central Western Cascades, however, potential fuels are at their peak of flammability during mid to late summer when conditions of low humidity, light precipitation, and numerous lightning storms coincide.

Man-caused fires for this period were fewer, larger, and exhibited a broader distribution throughout the fire season. Since the mid-1960's there has been an increase in the number of man-caused fires. This increase is due to increased access, more industrial use, more recreational use, and better reporting.

Lightning-caused fires are distributed unevenly over the landscape. Three areas exhibit low incidence of lightning-caused fires. These "holes" may be due to a biased record, differences in topography and elevation and therefore fewer strikes, or the lack of available fuels due to fires occurring during the previous period, 1850 to 1909.

Man-caused fires from 1910 to 1977 exhibit an obvious pattern, similar to that for man-caused fires between 1850 and 1909. Most fires for both periods occurred along major travel routes. Although the location and type of activities changed, generally where man travelled and later settled, fire followed.

In comparison with man-caused fires, lightning-caused fires, although unevenly distributed, occur more frequently at higher elevations. Man-caused fires tend to follow the major travel routes which are generally at lower elevations. Lightning-caused fires if ignited at higher elevations have less tendency to spread due to a lack of fuels, and therefore remain relatively small. Man-caused fires, ignited at lower elevations, where fuel availability is greater, have more chance to spread and become large fires.

This study represents the transition between a landscape dominated by nature and one modified by man. Concerned with the human history as it affects the fire history of the central Western Cascades, this study emphasizes only one aspect of the fire regime of this ecosystem. To completely understand the fire regime of such an ecosystem, studies need to be undertaken which reach further into the past. Although the natural coniferous forests of the Pacific slope will soon be gone, the tree-ring record of their history will remain for decades before it is lost to decay.

Using tree-ring analysis in combination with aerial photography to determine stand ages, dating fire scars on fire-resistant trees, and examining bog sediments for evidence of charcoal will allow us to look into the past history of fire. With the cultural influences peeled away, we will be able to incorporate all of these methods and further our knowledge of the fire regime of the central Western Cascades.

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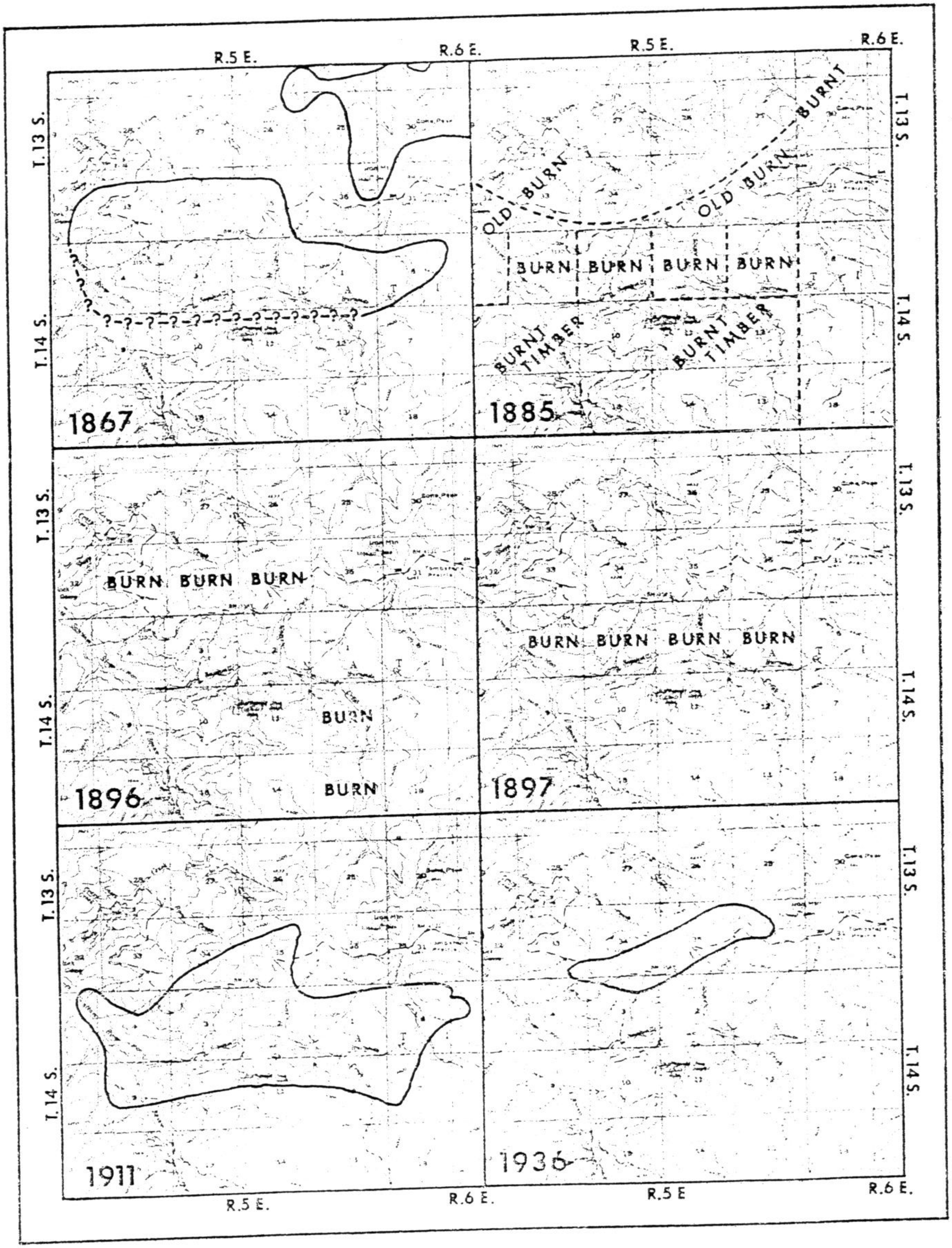
Glenn - Sevenmile Ck area
by Connie Burke
Fred



Reconstruction of Major Fires in the
Sevenmile Area, 1850 - 1977