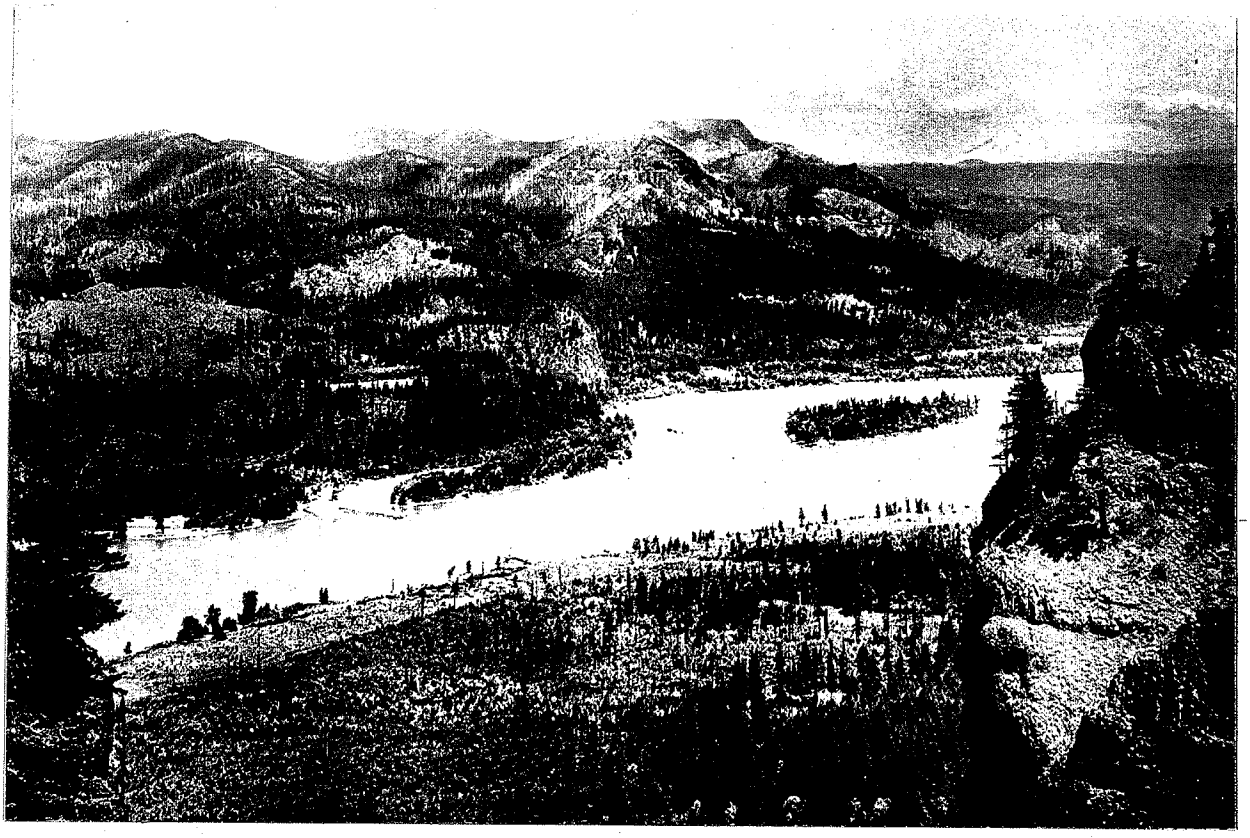
Historical Overview of Columbia Gorge Forestlands: Dynamics and Fragmentation, 1792-1996



Williams 1912

By Bob Zybach
NW Maps Co.
Corvallis, Oregon

May, 1996

Report cover: **St Peter's Dome view of Washington, 1914**

Variations of forest cover patterns nearly one hundred years ago are apparent in this pre-1912 photograph of the Columbia Gorge. The view is from 2,300 ft. elevation, west of St. Peter's Dome and south of Dodson, looking northeast toward the Washington side of the Columbia. Compare this picture with the 1867 view of fire patterns in the Gorge (Fig. 3) and the c.1920 view of logging on the Gorge (Fig. 15). A careful examination of these types of evidence is also useful for interpreting even earlier periods of time, such as existed during the Columbia River Gorge explorations of Lewis and Clark in 1805 and 1806.

TABLE OF CONTENTS

Illustrations

Tables

Maps

HISTORICAL OVERVIEW OF COLUMBIA GORGE FORESTLANDS: DYNAMICS AND FRAGMENTATION, 1792-1996

I. INTRODUCTION.

At 2:00 in the afternoon of October 21, 1792, Lieutenant Wilham Robert Broughton, commander of the Chatham and next in authority to Captain George Vancouver of the British Expedition of 1792 to the North Pacific, entered the Columbia River and quickly became grounded on a great bank of sand. With the arrival of high tide the ship became free and commander and crew proceeded upstream, accomplishing the first historical exploration of the Columbia River between its bay and its exit from the Cascade Mountains, a distance of over 120 miles.

By the time he reached the Sandy River (which he named Baring River), Broughton had mapped and named Mt. St. Helens, Mt. Hood, Young's River, Tongue Point, Pillar Rock, Warrior Rock, Mt. Coffin, and Oak Point. These names are still in use today, over 200 years later. The Baring River, however, was another matter. Not only did its name quickly disappear, but the stream Broughton described bears little resemblance to the Sandy River of today. Rather, it was more like the Toutle River of 1981, a river so greatly clogged with volcanic ash, sand and dead trees that it affected the flow and appearance of the Columbia itself. The Sandy River that Broughton described, as verified by the Lewis and Clark expedition 13 years later, was a river impacted by a major eruption of an active volcano. Just as the Toutle had been affected by the eruption of Mt. St. Helens in 1980, the Sandy was similarly affected by one or more eruptions of Mt. Hood sometime around 1790.

Broughton had entered a land of great rivers, giant volcanoes, massive landslides, eternal snows and glaciers, some of the world's most powerful riverine currents, and heavy, unrelenting winds. A land that had been occupied by others before him for 11,000 or more years.

During the past several millennia, the forests of that portion of the Cascade Range bisected by the Columbia River–the area barely entered and described by Lieutenant Wilham Broughton and first revealed to the outside world through the published Journal of Captain George Vancouver–have consistently been among the most dynamic and fragmented lands of the Pacific Northwest. These qualities have been apparent through history and are the direct result of at least four major factors: the size and presence of active volcanoes, the size and force of the Columbia River, the size and activities of local human populations, and a warm, moist, Mediterranean climate with seasonal dry winds from the east. The combination of these factors has directly influenced the locations and structures of plant and animal populations in local forests by directly affecting local weather patterns, by causing and modifying the

effects of catastrophic events, and by the resulting uses of land and resources by local peoples for a wide variety of purposes.

Purpose and Objectives of the Report

The purpose of this paper is to provide an historical overview of the dynamics and fragmentation of forestlands adjacent to the Columbia River along the slopes of the Cascade Range of Oregon and Washington during the last 200 years. The primary focus of the report will be on current and historical patterns of northern spotted owl *(Strix occidentalis caurina)* habitat within the study area, as defined by Washington State and federal documents (Washington Forest Practices Board Supplemental EIS on Forest Practice Rule Proposals, hereafter "WFPB 1996" and U.S. Fish and Wildlife Service Draft Environmental Alternative Analysis for a 4(d) Rule for the Conservation of the Spotted Owl on Non-Federal Lands, hereafter "USFWS 1995"). The principal objective is to provide a basis for better understanding the role of these forests in providing a possible link (or "demographic interchange") between spotted owl populations of the two states, particularly as that link may have functioned during historical time.

This report makes extensive use of quotations from original sources. Except for bracketed explanatory material, the quotations are provided as they appear in the original journal or other source documents including any misspellings or grammatical errors.

Sources of Information

This report is based on historical records, government maps and surveys, photographs, scientific literature, and federal resource planning documents. Particular use is made of the 1805-1806 journals of Lewis and Clark (Thwaites 1959), the 1902 USGS report on the forests of the Oregon Cascades (Langille 1902), the pre-1912 photographs of John H. Williams (Williams 1912), John Eliot Allen's tour guide of the Columbia River Gorge (Allen 1984), and various 1986-1996 federal and state reports on the northern spotted owl (USDA 1986, Thomas, and others 1990, WFPB 1996, USFWS 1995).

Arrangement of Report

This report is arranged in six parts. The first part is this introductory commentary on the themes, time, place, and arrangement of the overview. Part two is an examination of local catastrophic event history, and how that has affected vegetation patterns in the study area. Part three is an examination of local forest dynamics of a more general nature. Although these processes are less spectacular than volcanic eruptions, catastrophic fires or gargantuan landslides, over time they may affect forest conditions and vegetation patterns to a very similar (or even greater)

degree. Part four considers human influences on local wildlife habitat patterns and populations during the past 200 years, and shows how these effects compare to other dynamics over time. Part five is an examination of current definitions of "spotted owl habitat" and compares these descriptions with actual forest conditions in the study area through time. Part six discusses the findings of the first five chapters and lists the major conclusions derived from this analysis.

Definition and Scale of Fragmentation

The period of time considered in this overview is 1792-1996, beginning with the first exploration of the Columbia River by Broughton and continuing to the present day. The principal geographical focus of the report is the forests of the Cascade Mountains region where they intersect with the Columbia River. The primary biological focus is on areas that have been described as "northern spotted owl habitat", particularly habitat that has been designated as "nesting, roosting, and foraging" (NRF) habitat.

This overview uses historical documentation to identify and describe primary and secondary causes of "fragmentation" in the forested lands to the north and south of the Columbia River in the Columbia Gorge area of the Cascade Mountains. Forest fragmentation is defined as vertical and/or horizontal vegetation patterns within the forest ecosystem. The minimum scale used for this report is 80 acres; that is, each fragment of potential spotted owl habitat (and/or other "forest types") must be at least 80 acres in size in order to be mapped or further analyzed. The combination of contiguous 80-acre types (sometimes totaling stands thousands of acres in size) in graphic and tabular formats provides the historical landscape-scale patterns that are the principal focus of this overview.

Historical documentation, including first hand accounts, maps, photographs, and scientific literature, was used to identify and measure the processes involved in creating vegetation patterns in the study area. These are identical to the processes responsible for fragmentation. Examples of these types of documentation are included with this overview and form the primary basis for the discussion and conclusions of this paper.

For the period 1792 to 1842, climate, volcanic eruptions and Indian burning were the primary shapers of the forest environment, with floods and landslides providing additional definition. Wind, insects, disease, lightning, and other factors were also undoubtedly important in shaping local vegetation patterns, but little documentation regarding these factors for this time period exists.

From 1843 to 1910, forest fires, grazing, logging, insects, agriculture, urban development, and railroad construction altered Columbia Gorge forestlands significantly. During this period, California condors, grizzly bears and mountain sheep

were eliminated from the environment, and numerous domestic plants and animals were introduced.

From 1911 to 1972, the simultaneous evolution of national forest management policies (including fire suppression and forest nursery development) and the automobile industry led to a prolonged, and complementary, era of dam construction, road building, fire fighting, timber harvesting and plantation reforestation. The increased focus on forestry and the decreased dependency on animals for transportation led directly to the afforestation and reforestation of large areas of previously nonforested or sparsely forested lands. These processes resulted from the reduced burning and grazing pressures on young seedlings and saplings (a result of fewer domestic animals in the environment), and from the creation of national, industrial, and state forest tree nurseries for the sole purposes of reforestation and afforestation of regional lands. The advent of log trucks, cable systems and power saws in the 1930's led to increased efficiencies in salvage and clearcut logging operations, as well as further improvement in fire fighting capabilities.

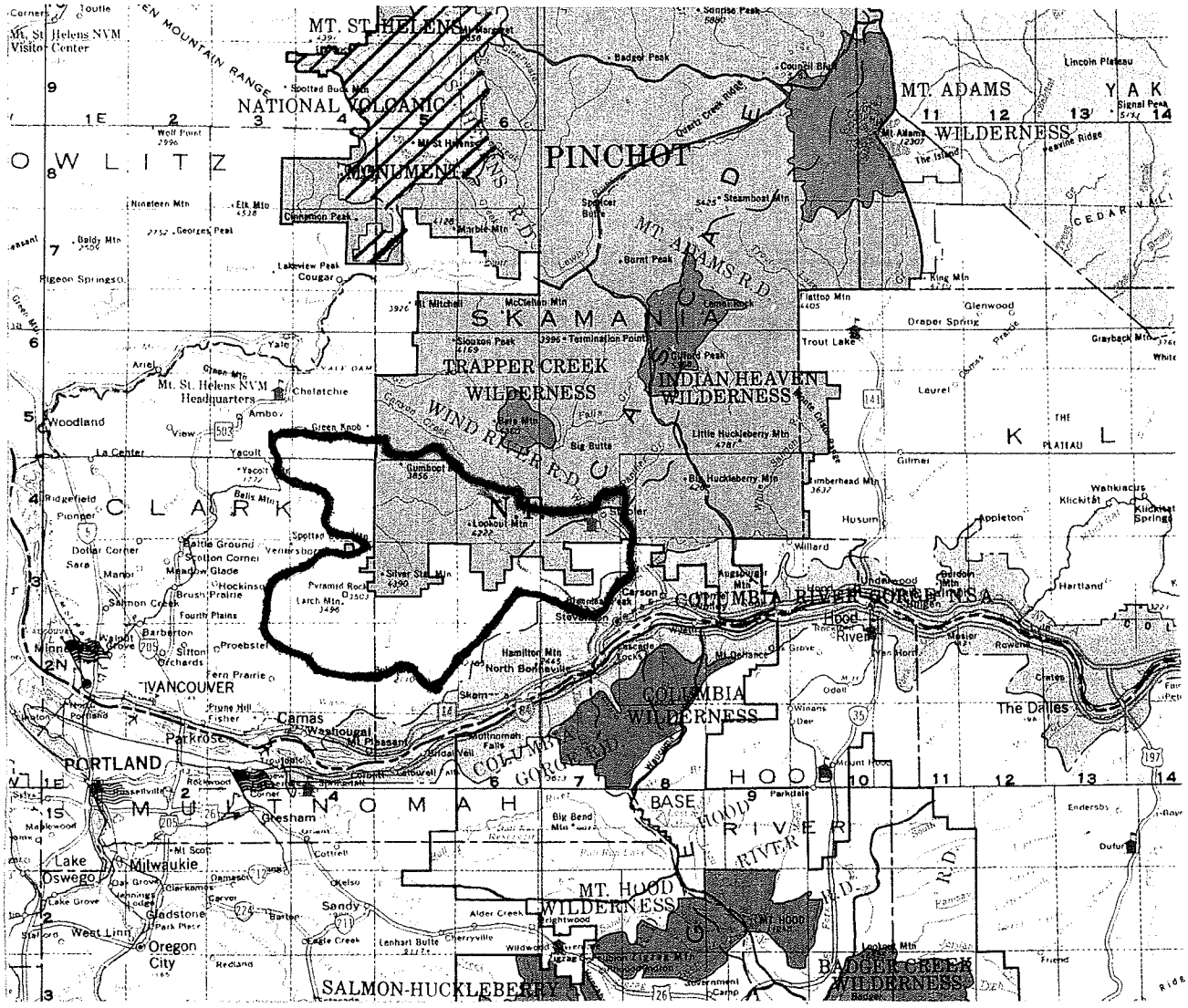
Description of Study Area Boundaries

The study area of this report is defined as the lands within the area bounded by Mt. St. Helens and Mt. Adams to the north, the town of The Dalles to the east, the southern slope of Mr. Hood to the south, and Oregon City to the west.

The maps on the following three pages depict the geographic boundaries of this overview and provide the basic land ownership, land use, and forest type patterns that are considered. Each map is further described at the top of each page.

Map I 1996 Columbia Gorge Forestlands Study Area

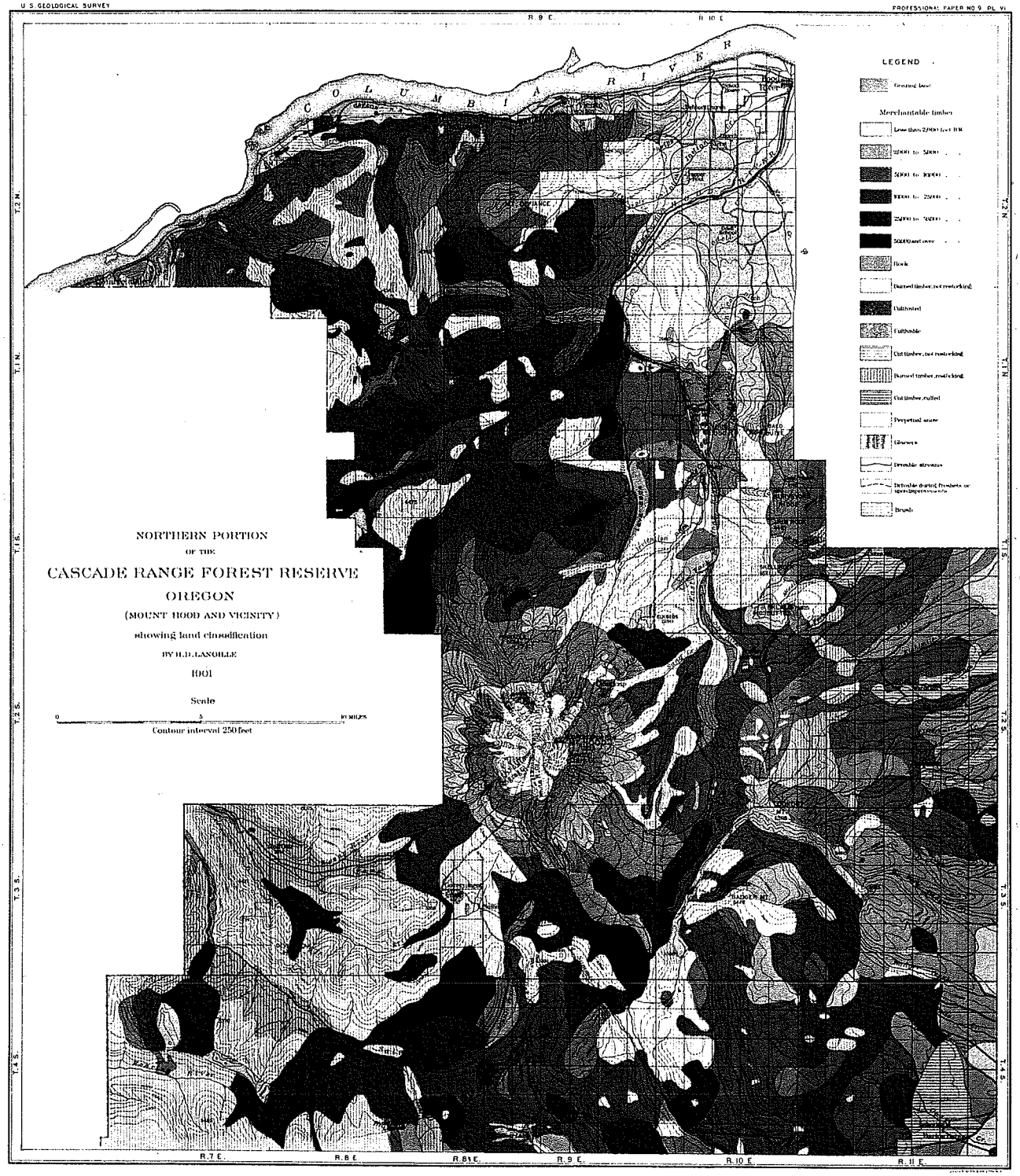
This map displays the portion of the Cascades that will be considered in this report and places that area in context with the following maps. Highlighted areas display the great amount of federal ownership and urban development in the general study area, forming a pattern in stark contrast to the fragmentation of the following map. Whereas the vegetation patterns of the area's forests are highly variable as illustrated in Map 2, the ownership and land use patterns are not. Note the National Forest Wilderness Areas are shaded with dark green. The approximate boundary of the 1902 Yacolt Burn was transferred from the Yacolt Burn State Forest Map (DNR 1991).



USDA Forest Service 1988 / Washington State DNR 1991

Map 2 Pre-1902 USDI Mount Hood Forest Patterns

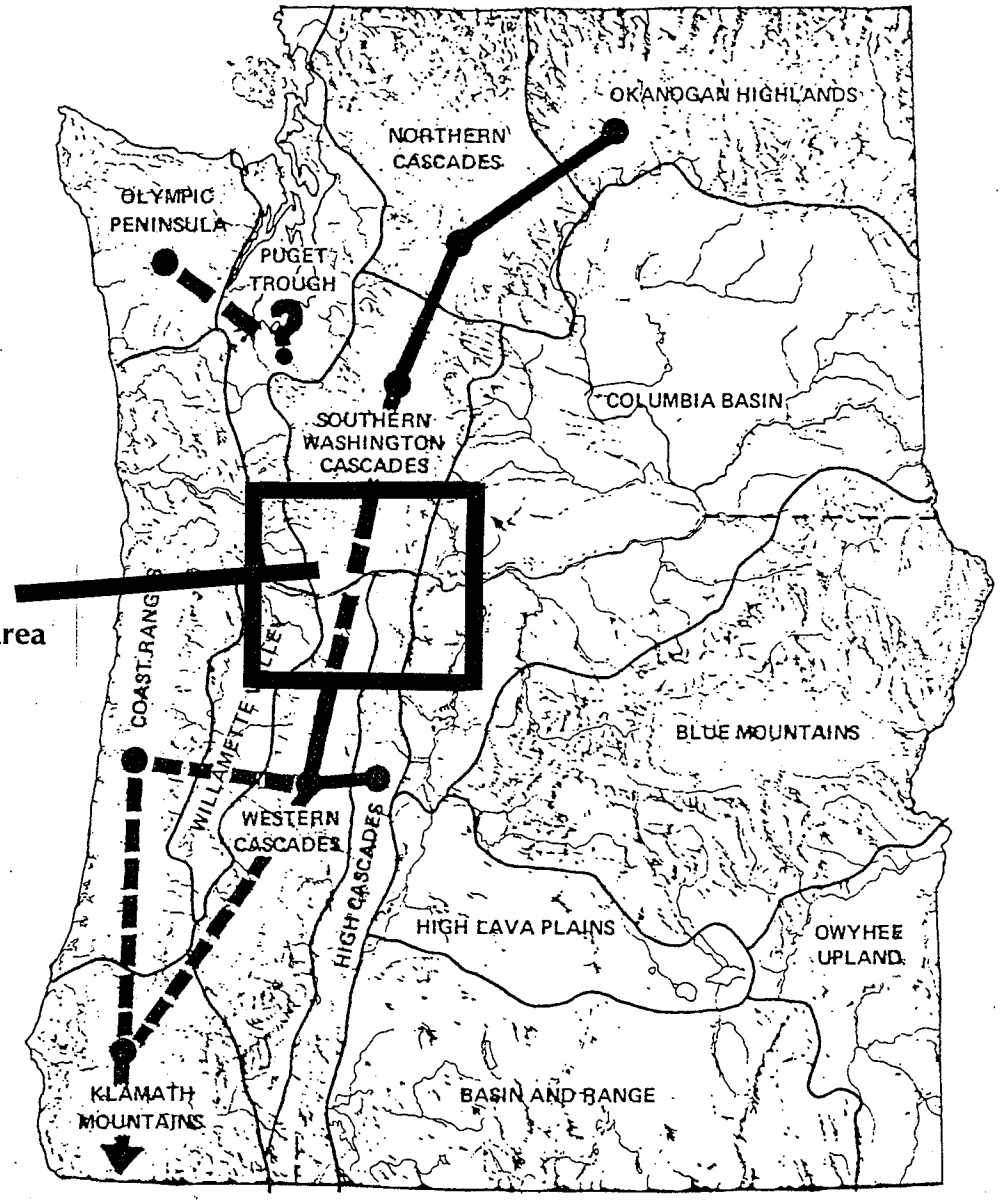
This map displays the portion of the Oregon Cascades that will be most thoroughly considered in this report. It was constructed by the U.S. Geological Survey between 1899 and 1901 and first published in 1902 (U.S.D.I. 1902). The map displays the great amount of forest fragmentation that existed in the southern area of the study at the turn of the century and provides an excellent basis for interpreting local landscape photographs of that era (see Figures 9 through 12, and 14 in this report as examples). The map is further analyzed in Part V of this report.



USDI 1902

Map 3 1986 USDA Spotted Owl "Interchange" Barriers

This map displays the general geographic focus of the overview, an area that depicts the Columbia River distribution of northern spotted owls "Where the Degree of Genetic Interchange is Unknown" (USDA 1986:3-11). This area can be described as the forestlands of the southern-most Cascade Mountains of Washington and the northern-most Cascade Mountains of Oregon that center on the Columbia River Gorge.



olumbia Gorge
orestlands Study Area

Physiographic and geological provinces of Oregon and Washington
(from Franklin and Dyrness, 1973)

Figure 3-3. Distribution of Northern Spotted Owls by Physiographic Province. Solid Lines Denote Lack of Barriers to Genetic Interchange, Dashed Lines Denote Where the Degree of Genetic Interchange is Unknown.

USDA 1986

II. CATASTROPHIC EVENTS HISTORY.

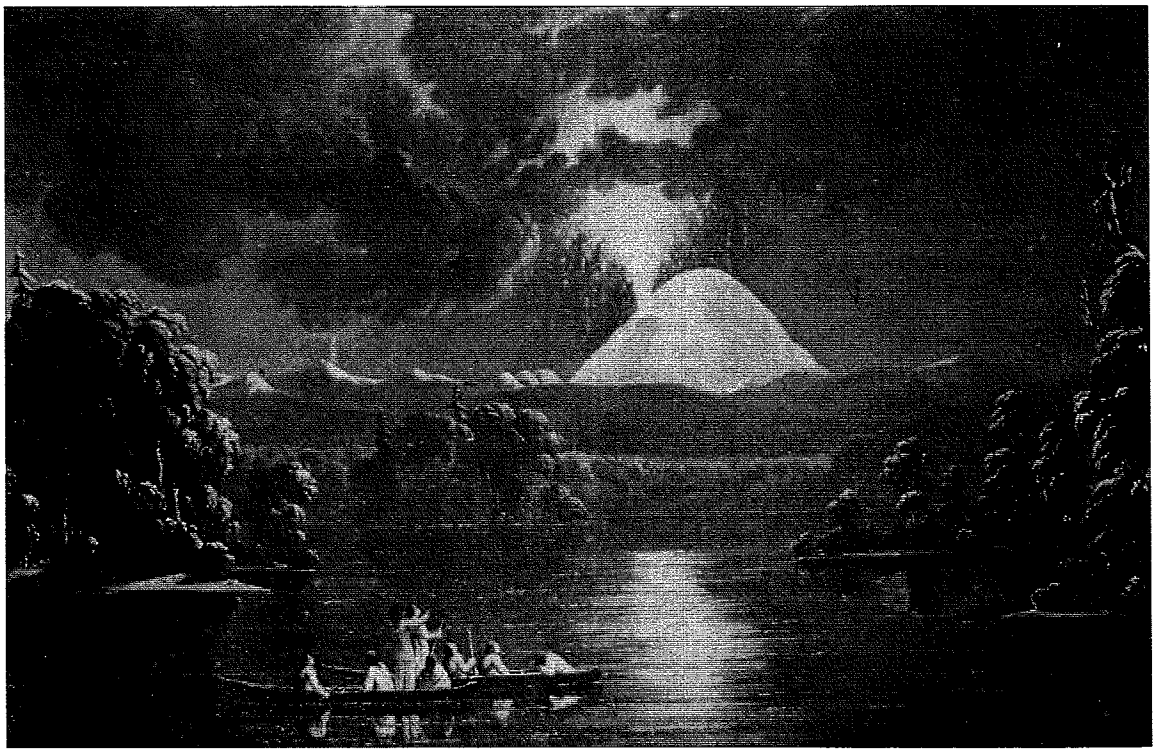
The most spectacular and immediate causes of change in forest vegetation are the result of catastrophic events. Such occurrences are usually defined in terms of loss of human life, loss of human property values, or by radical changes in local or regional populations of plants and animals. For the purposes of this paper, the latter definition will be used, particularly as it applies to horizontal and vertical patterns of vegetation.

In the Pacific Northwest, catastrophic events have typically taken place in a matter of a few hours or days and have dramatically affected populations of tens of thousands of acres of plants and animals at a time. Examples of such events include large scale floods, holocaustic forest fires, hurricane-scale windstorms, massive landslides, regional earthquakes, major volcanic eruptions, and tidal waves. During historical times, the most notable events to affect the forests of the Columbia Gorge area include the eruptions of Mt. St. Helens and Mt. Hood, the Yacolt Fires of 1902 and 1910, and windstorms.

1. Volcanic Eruptions.

The forests of the Columbia Gorge region of the Cascades can be roughly defined as being bounded by the treeless heights of Mt. St. Helens to the northwest, by Mt. Adams to the northeast, and by Mt. Hood to the south. Both St. Helens and Hood have erupted repeatedly during historical times (Fig. I), and Mt. Adams, though generally dormant for the past several thousand years, is also considered to be active and capable of large scale events at any given future time.

The 1980 eruption of Mt. St. Helens lasted a day, decimated about 230 square miles of forests and lakes, caused the largest landslide in reported history, and filled the Toutle River with ash. Yet this eruption was only 1/10th of the size of a similar event that occurred 3500 years ago, and much smaller than two eruptions that occurred about 500 years ago. The huge lava dome that characterized the mountain from the time of its naming in 1792 until its eruption in 1980 was entirely formed as the result of an immense lava flow that occurred about 400 years ago. Even the smaller eruptions of 1800-1857 have been credited with starting forest fires in the Toutle and Lewis River basins that covered tens of thousands of acres. This history qualifies Mt. St. Helens as one of the most active of the twenty Cascades volcanoes, of which as many as eleven have erupted during the past 250 years (Harris 1990, pp. 105-109).



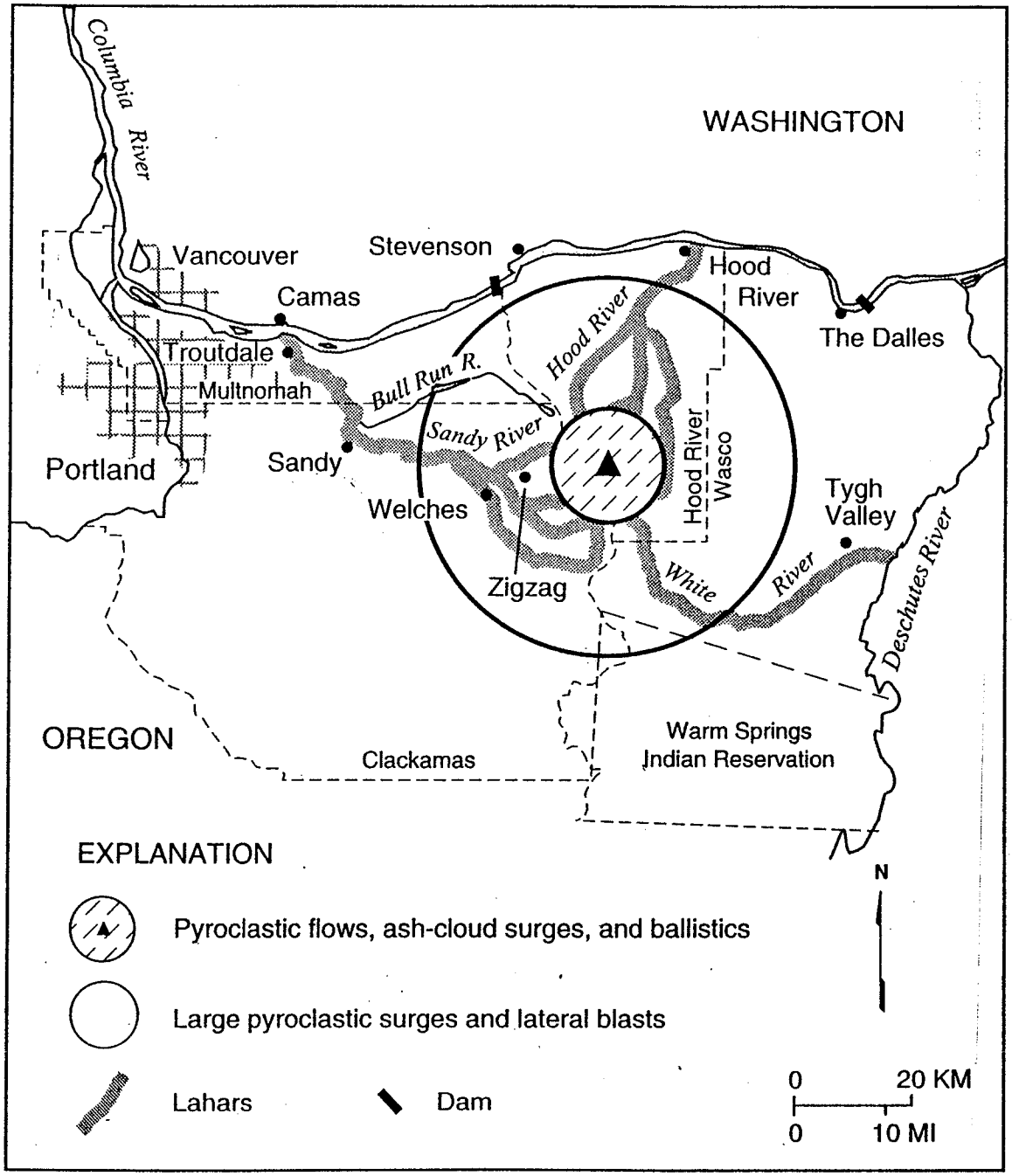
Painting by Paul Kane, c. 1847

Fig. 1 Volcanic Eruptions (Mt. St. Helens)

This picture, painted by Canadian artist Paul Kane, was based upon a sketch he made of the March 26, 1847 eruption he witnessed from the mouth of the Lewis River. This event was not as great as the events of 1842-1843, but accurately depicts the location of the vent and plume for the time period of 1831-1857 when numerous eruptions were noted by a large number of observers.

Map 4 Mount Hood Blast Zone

This map of the primary blast zone of Mount Hood was recently produced by the U.S. Geological Survey and is available as a web page on the internet. Notice the potential for "lahars" along the Sandy and Hood Rivers and compare these with Broughton's and Clark's descriptions of these rivers between 1792 and 1806. A lahar is an Indonesian term for mudflows that originate near the top of a volcano.



http://vulcan.wr.usgs.gov/Imgs/Gif/Hood/Maps/hood_hazards.gif

Mt. Hood is the tallest peak in Oregon and the second most climbed snowpeak in the world, following Japan's sacred volcano, Fujiyama. Although Hood has not been as active as St. Helens during historical times, its eruptions occur much closer to the Columbia Gorge and have the potential for greater impact upon the heavily populated communities of Portland and Vancouver as a result (Map 4).

The last documented eruption of Hood was reported in the August 20, 1859 Portland Weekly Oregonian, but the last major eruption probably occurred around 1790, with the possibility of another major eruption around 1800. Evidence for these events is provided by descriptions of the Sandy River at that time, which closely parallels effects on the Toutle River caused by the 1980 eruption of St. Helens. Vancouver described Broughton's findings at the mouth and immediately downstream of the Sandy (which he calls "Baring"), in his 1792 journals (Vancouver c.1920):

Tuesday, October 30, 1792

> They passed a small rocky opening that had a rock in its center about twelve feet above the surface of the water; on this were lodged several large trees that must have been left there by an unusually high tide. From hence a large river bore S. 5 E., which was afterwards seen to take a southwestwardly direction, and was named Baring River; between it and the shoal creek [immediately to the west of Sandy, along the southern shore of the Columbia] is another opening; and here that in which they had rested stretched to the E. N. E., and had several small rocks in it. . . The southern shore is low and woody and contracts the river by means of a low, sandy flat that extends from it, on which were lodged several large dead trees. . . "Having now passed the sand bank," says Mr. Broughton, "I landed for the purpose of taking our last bearings; a sandy point on the opposite shore bore S. 80 E., distant about two miles; this point terminating our view of the river, I named it after Captain Vancouver.
>
> * * *
>
> The breadth of the river there was a quarter of a mile; it afforded a good clear channel to the northern shore with soundings across from six to two fathoms, shoaling gradually to the bed of sand that stretches from the opposite side.
>
> * * *

> Little opportunity had been afforded, especially at their latter part of their journey up the river, to ascertain the depth of the channels; to supply this deficiency the two boats separated and sounded regularly all the way down. By this means a bank was found extending entirely across Baring's river to the rocky passage at the west end of Johnstone's [probably Government] Island; the greatest depth having been only three fathoms . . .

Wednesday, October 31, 1792

> Mr. Broughton departed early and off the village of their friendly old chief was joined by him and his tribe. Soundings were pretty regular until the party were abreast of some barren land, off which is an extensive bank. On this there were only three feet of water; this depth continued nearly to the east point of the islet, that was observed before to be covered with wild geese and obtained the name of Goose Island.

* * *

The "barren land" that Vancouver describes was about "five leagues" downstream from the Sandy River. William Clark's description of the area made almost exactly 13 years later, is remarkably similar to Broughton's. These similarities include the descriptions of geese (Clark was approaching from the east, rather than the west) and the impact the Sandy's discharges were having on the flow of the Columbia (Thwaites 1959).

Sunday, November 3, 1805

> (Clark) The Countrey has a handsome appearance in advance no mountains extensive bottoms. the water shallow for a great distance from shore. The fog continued thick untill 12 oClock, we coasted and halted at the mouth of a large [Sandy] river on the Lard. Side, this river throws out emence quantitys of sand and is verry shallow, the narrowest part 200 yards wide bold current, much resembling the river Plat, several Islands about 1 mile up and has a sand bar of 3 miles in extent imedeately in its mouth, dischargeing it[s] waters by 2 mouths, and crowding its corse sands so as to throw the Columbian waters on its No[r]thern banks, & confd. it to 1/2 mi. in width.

* * *

> at 3 miles I arrived at the entrance of [the Sandy] river which appeared to scatter over a Sand bar, the bottom of which I could See quit[e] across and did not appear to be 4 Inches deep in any part; I attempted to wade this Stream and to my astonishment found the bottom a quick Sand, and impassable. . . below quick Sand River the Countrey is low rich and thickly timbered on each Side of the river, the Islands open & some ponds river wide and emence numbers of fowls flying in every direction, Such as Swan, geese, Brants, Cranes, Stalks, white guls, comerants, & plevers &c. also great numbers of Sea Otter in the river.

On his return voyage up the Columbia the following year, Clark adds more detail to his earlier observations and Lewis describes the effect that Hood's eruption has had at the mouth of Hood River, on the eastern side of the Columbia Gorge (Thwaites 1959):

Tuesday April 1, 1806

> (Clark) This morning early we dispatched Sergt. Pryor, with two men in a small canoe up quick sand river with orders to proceed as far as he could and return this evening. .
>
> The information given by the indians to us last night respecting quick sand river was corroborated by sundry other indians who visited us in the course of this day. . . they inform us that quick sand river is not naviagable any distance in consequence of falls and rapids; and that no nation inhabit it. Sergt. Pryor returned in the evening and reported that he had assendd. the river six miles; that above the point which it divides itself into two chanels; it is about 300 yards wide tho' the chanel is not more than 50 yards, and only 6 feet deep. the other part of the river from 2 to 4 inches water, the bead of the river is formed entirely of quick sand; its banks are low and at present overflown. the water is turbid and current rapid. . .

Monday April 14, 1806

> (Lewis). . . at 9 A.M. the wind arrose and continued hard all day but not so violent as to prevent our proceeding. we kept close along the N. shore all day. the river from the

> rapids as high as the commencement of the narrows is from 1/2 to 3/4 of a mile in width, and possesses scarcely any current. the bed is principally rock except at the entrance of Labuish's [Hood] river which heads in Mount hood and like the quicksand river brings down from thence vast bodies of sand.

The recent eruption of Mt. St. Helens was claimed to have instantly eliminated about 25,000 acres of spotted owl habitat "known to contain a high density of spotted owls" (USDA 1986, p. B-43). It can be inferred from descriptions of the effects of Hood's eruption(s) between 1790 and 1805 that it (they) must have had a similar impact on local forest environments. According to current scientific findings regarding the 1800-era event (as in the case of Mt. St. Helens), this was not an isolated event:

> Nestled in the crater of Oregon's majestic Mount Hood volcano is Crater Rock, a prominent feature known to thousands of skiers, climbers, and tourists who journey each year to the famous Timberline Lodge located high on the volcano's south flank. Crater Rock stands about 100 m above the sloping crater floor and the warm fumaroles along its base emit sulfur gases and a faint steam plume that is sometimes visible from the lodge. What most visitors do not know, however, is that Crater Rock is a volcanic lava dome only 200 years old [i.e. circa 1793]. Lava domes are mounds that form when thick, pasty lava is erupted slowly and piles up over a volcanic vent. Crater Rock sits atop the vent and conduit through which molten rock traveled from deep below Mount Hood to the surface. During the past 2,000 years, growth and destruction of earlier lava domes at the site of Crater Rock produced hundreds of pyroclastic flows–these avalanches of hot volcanic rock, gas, and air move at hurricane speed–and have swept down the volcano's steep southwest flank as far as 11 km. The strikingly smooth, sloping surface on which the lodge and ski area are built, as well as the nearby community of Government Camp and highway crossing the Cascades, was created by these pyroclastic flows. (Brantley and Scott 1993)

2. **Winds.**

The Columbia Gorge is well known for its winds. These winds are caused in great part by its unique niche in the Cascade Range; a relatively narrow pass

between the dry deserts to the east and the maritime influence to the west. These powerfully driven air currents must pass between the highest peak in Oregon (11,000 feet) and the second highest peak in Washington (over 12,000 feet), and depending on their direction, either begin or end at sea level (0 feet). This circumstance, caused by the largest and most dynamic river to cross the Cascades – and at a point between two of its highest peaks – creates the largest and most dynamic air passage in the range. Hood River (on the eastern border of the Gorge), in fact, bills itself as the "wind surfing capital of the world," a designation based upon the predictability and force of local winds.

The incidental effects of winds can reach catastrophic proportions by two methods: the force of individual winds can blow down thousands of acres of timber at a time (Fig. 2), and the drying and spreading effects of more seasonal winds can create conditions that are ripe for the occurrence of uncontrollable forest fires (Figs. 3-10).

A well known example of the first type of wind is the Columbus Day Storm of October 12, 1962, which traveled from south to north nearly a 1000 miles, from northern California, through western Oregon and western Washington, to British Columbia. The storm, which took about 2 hours to pass most locations, was measured at 170 mph on the Oregon coast, over 115 mph in Portland, and blew down over 6 billion feet of timber in Oregon and nearly 5 billion feet in Washington (Lucia c.1963). Although this event only brushed the western edge of the Columbia Gorge, it is a good indicator of the types of wind that occur in this region.

The Christmas Day Storm of 1983, while more localized than the Columbus Day event, created similar types of damage (Fig. 2), and had a far greater effect within the study area boundaries. In addition to the approximately 6,000 acres of "old-growth" and mature timber blown down in the Bull Run watershed, it was estimated that 215 acres of spotted owl habitat was destroyed in "six spotted owl management areas in the southern Washington Cascades" (USDA 1986, p. B-43).

As in the case of volcanic eruptions, damaging winds in the Columbia Gorge forests are not recent or isolated phenomena. Lewis and Clark remarked repeatedly on the effects of wind as they approached and entered the Columbia Gorge area by canoe in both the fall (from the east) of 1805 and the spring (from the west) of 1806 (Thwaites 1959):

Sunday, October 27, 1805

> (Clark) Wind hard from the west all last night and this morning.

Monday, October 28, 1805

> (Clark) a windy morning . . . Wind from the West. . . . rained all evening & blew hard from the West . . . Bad place.

Tuesday, April 8, 1806

> (Clark) This morning about day light I heard a considerable roreing like wind at a distance and in the course of a short time wavs rose very high which appeared to come across the river and in the course of an hour became so high that we were obliged to unload the canoes, at 7 oClock A.M. the winds swelded and blew so hard and raised the waves so emensely high from the N.E. and tossed our canoes against the shore in such a manner as to render it necessary to haul them up on the bank. . . The wind continued violently hard all day, and threw our canoes with such force against the shore that one of them split before we could get it out

Sunday, April 13, 1806

> (Lewis) I departed and continued my rout with the four canoes along the S. side of the river the wind being too high to pass over to the entrance of Cruzatts river where I expected to have overtaken Capt. C. . . Capt C. informed me that the wind had detained him several hours a little above Cruzatt's river . . .

Monday, April 14, 1806

> (Lewis) at 9 A.M. the wind arrose and continued hard all day but not so violent as to prevent our proceeding. we kept close along the N. shore all day.

The "Cruzatt's River" referred to by Lewis is, not surprisingly, known today as Wind River. Of additional interest is the fact that heavy winds were observed as coming from both the west and the east, further indicating the channeling effect that the Gorge has on regional wind movements; whether moist western winds from the ocean, or drying "Chinook" winds from the east.

Photograph by John Foster, Spring, 1984

Fig. 2 1983 Bull Run Windfall

This picture of windfall in the Bull Run watershed was taken following the Christmas Day windstorm of 1983. Bull Run has been a protected reserve since 1892. Note the diameters of the damaged trees and the lack of large relict snags in the landscape.

3. Forest Fires.

As noted in the preceding section, a primary result of constant seasonal winds in the Gorge is the impact they have in fueling and spreading catastrophic wildfires. This effect is well described in a publication of the Washington State Department of Natural Resources (DNR) titled "The Yacolt Burn State Forest" (Washington DNR 1991):

> Usually, moist, cool air flows eastward from the coast, bringing rains that ensure lush forest growth in the Yacolt. When the wind reverses, the Columbia River Gorge acts like a giant chimney funnelling the arid east wind directly at the ridges and valleys of the Yacolt. The arid winds suck the last moisture from the dead wood and underbrush already dry from summer heat, turning the forests into tinder waiting to ignite. Pioneers called this hot east wind the Devil Wind because it often brought trouble in the form of a wildfire.

Although this quote regards the September 12, 1902 Yacolt Fire, which covered 238,000 acres (Map 1), killed 38 people and burned an estimated 12 billion board feet of timber, it describes a condition that has existed for thousands of years and has had a continual effect through historical times. Evidence that major stand replacement fires occurred in the Gorge area prior to 1902 is provided by an 1869 photograph of the Washington shore (Fig. 3), which clearly shows an overstory of (apparently) fire-killed snags, and by numerous first hand observations that preceded photography. For example, in 1848, Reverend George Atkinson, from his home in Oregon City, noted (Lockwood 1939):

Sunday, July 30, 1848

> The woods are on fire below and above us and we are enveloped in smoke. We have had no rain during the last six weeks. Probably there will yet be two months without rain. There is some danger from the fire, it is so dry. Much timber is destroyed. The heat and dust are very trying during the day but the nights are always cool and refreshing.

Sunday, August 12, 1848

> The fires in the woods render the atmosphere smoky & gloomy & unpleasant, but our afternoon breeze often clears the Heavens. . .

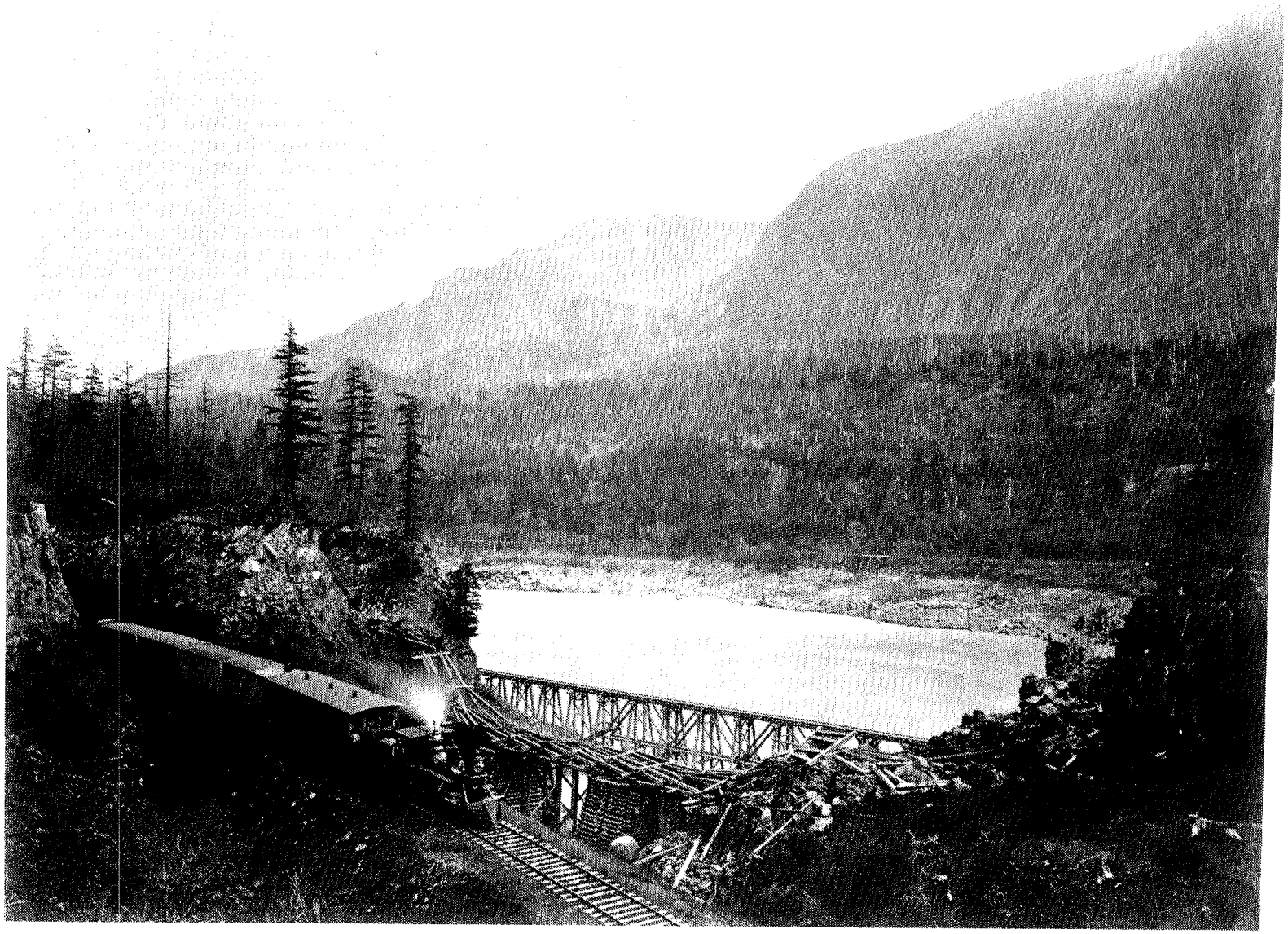
The impacts of forest fires, and particularly the Yacolt Burn on the Washington side of the Columbia Gorge, are shown in the photographs on the following pages. Impacts on the Oregon side were mapped between 1899 and 1901 (Map 2) and can be clearly seen in Fig. 10. In addition, these areas were summarized in the USDI report that contained Map 2 (Langille 1902):

> Forest fires within this area have been extensive and very destructive. As shown in the table of classification, the area burned is 85,731 acres, or 20.75 per cent of the total. These burns have taken place in all parts of the reserve, and are so distributed that their occurrence can not be attributed to any particular cause, but rather demonstrates the fact that wherever man goes fire follows.
>
> * * *
>
> Besides the areas shown on the map as burned, the restocked lands may also be considered as burns, since the timber was destroyed by fire, and the present growth is of little or no value as timber. Adding the restocked area of 20,153 acres to that of the burns, gives a total of 105,884 acres burned, or 25.63 per cent of the total area. . . .
>
> There are many wide tracts over which creeping fires have burned, killing a large percentage of the timber, but these have been considered as timber lands.

In sum, it can be demonstrated that because of geological formations and current environmental conditions, the forests of the Columbia Gorge area are highly dynamic. These formations and conditions set the stage for regular and predictable catastrophic events that affect tens of thousands of acres at a time, often taking place in just a few hours or days. During the past two hundred years, the most profound events have included volcanic eruptions, major windstorms, and holocaustic wildfires. The following eight historical photographs (Figs. 3-10) from the turn of the century depict the resultant landscape and vegetation patterns due to these events.

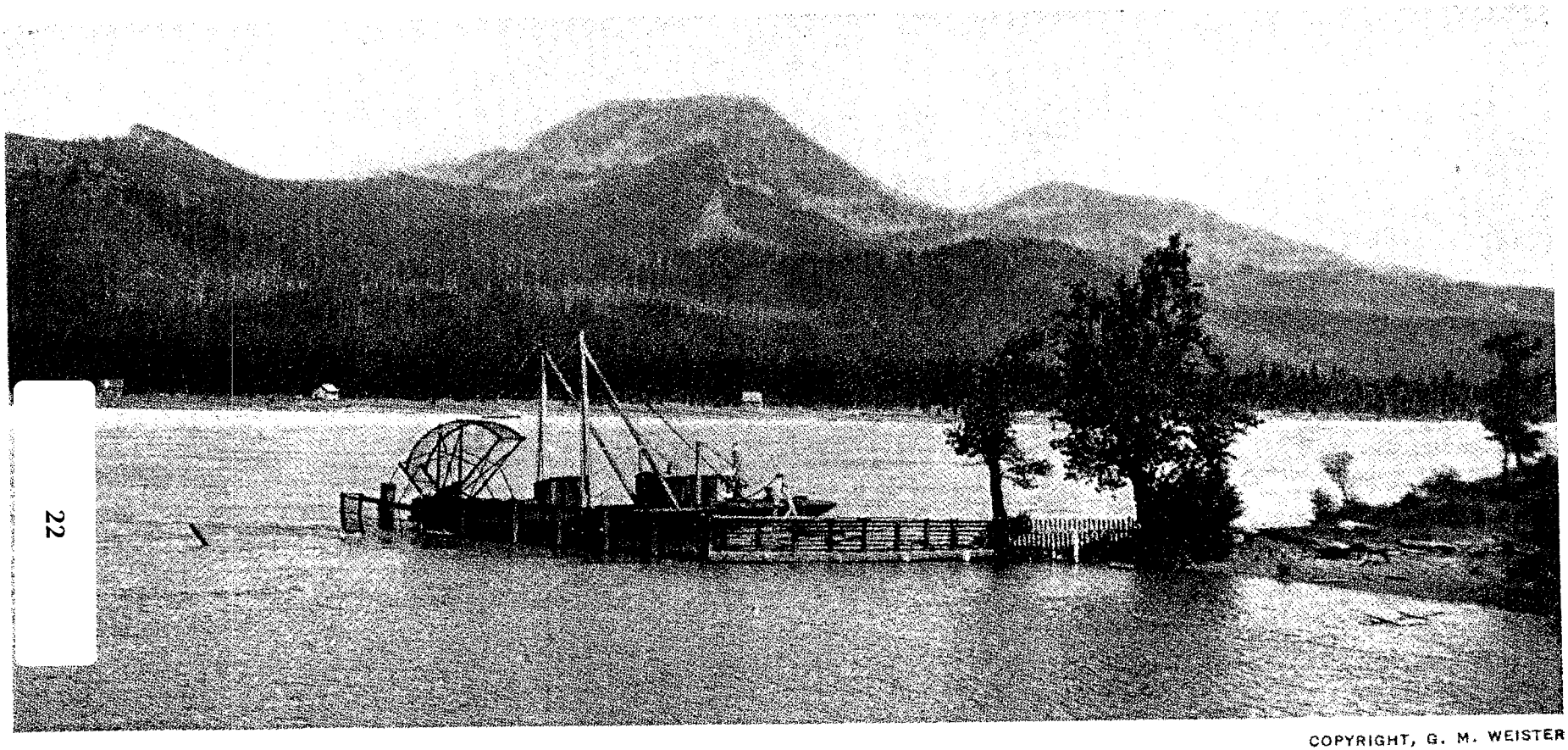
[Fig. 3 1869 Columbia Gorge Burn Patterns - following page]

San Francisco photographer, Carleton Emmons Watkins (1829-1916) made two trips along the Columbia River Gorge, once in 1869 and again in 1883. He took numerous photographs on both occasions and many of the original glass negatives from these trips are on file with the Oregon Historical Society in Portland. This photograph of the Washington side of the Gorge is filed with the 1867 negatives, but the existence of the locomotive may indicate the later 1883 journey. In either instance, the view precedes the 1902 Yacolt Fire by two or three decades and clearly shows evidence of an earlier fire. The young trees growing beneath the snags indicates the amount of time since the last fire swept the area, and also the general condition of the area by the time of the 1902 event. Local wildlife populations in this area during the past two centuries have had to contend with conditions that varied dramatically from time to time as a result of these fires. Primary conifer forest environments along the Columbia River during the past two centuries included numerous fires, extensive burns, clearcuts, decades of reforestation, and occasional developments of mature second growth.



Oregon Historical Society Photo (Preston, 1981)

Fig. 3 1867 Columbia Gorge Burn Patterns



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Fishwheel below the Cascades, with Table Mountain on north side of river.

Williams 1912

Fig. 4 Pre-1912 Table Mountain Yacolt Burn Patterns.

This view of Table Mountain clearly shows the effects of the 238,000-acre Yacolt Fire within a decade of its occurrence on September 12, 1902. It may also show effects of the Yacolt reburn in 1910. In 1929, the Dole Valley Fire added 153,000 acres to the area that had become known as the "Yacolt Burn."

Allen 1984

Fig. 5 c. 1920 Table Mountain Yacolt Burn Patterns

This view of Table Mountain, taken from a more easterly position than Fig. 4, clearly shows the beginning stages of reforestation that followed the 1902 (and perhaps 1910) Yacolt Fire. This photograph indicates wildlife habitat conditions for the preceding two decades, as well as for the next several decades, at least until the Yacolt Fire of November 8, 1952. For scale, note the fishwheel on the lower right.

W.L. Powell: OSU Archives Collection

Fig. 6 1914 Wind River Nursery Yacolt Burn Patterns

This photograph was taken by Oregon Agricultural College (now Oregon State University) forestry student William Lester Powell (1893-1978) on an OAC Forestry Club trip to the Wind River Nursery in 1914. Note the effects of the Yacolt Fire and the contiguous arrangement of snags indicating earlier forest conditions.

W.L. Powell: OSU Archives Collection

Fig. 7 1914 OAC Forestry Students at Wind River

This photograph of the OAC Forestry Club was taken at their camp site near the Wind River Nursery in 1914 (Fig. 6). Note the relative diameter of the snags resulting from the 1902 (and perhaps 1910) Yacolt Fire. These snags indicate the age of the trees were probably less than 100 years old at the time of the fire. This also indicates that the area was in a relatively young forested condition during the decades preceeding the burn.

W.L.Powell: OSU Archive Collection

Fig. 8 1914 Wind River Nursery Yacolt Burn Patterns

A third photograph from the 1914 OAC Forestry Club trip showing a more extensive area of landscape. Note the surviving seed trees and scattered older trees that were killed in the fire. Also note the contiguous canopy conditions that allowed the 1902 fire to travel over 30 miles in the first 36 hours of its existence.

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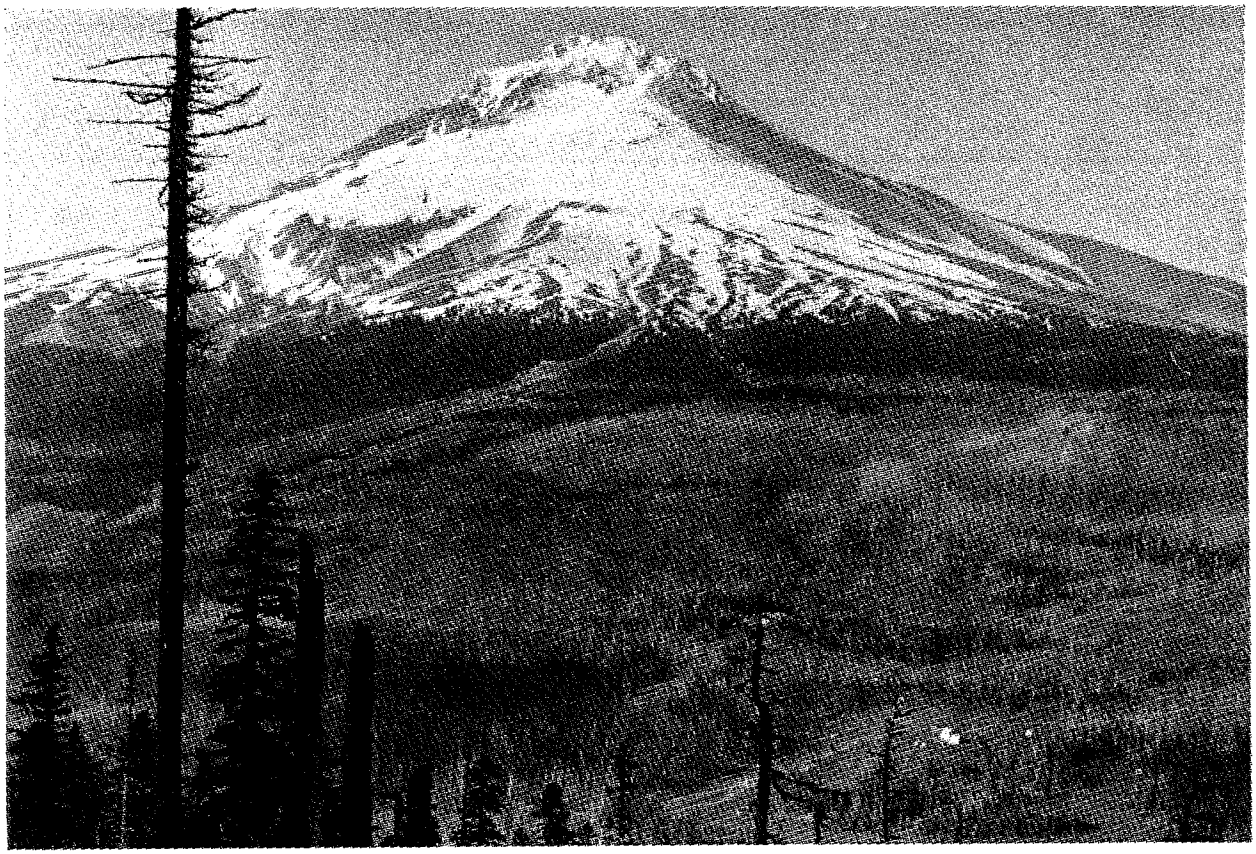
Mount Hood, seen from Larch Mountain, on the Columbia River. View looking southeast across the heavily forested ranges of the Cascades to the deep canyons below Ladd and Sandy glaciers.

Williams 1912

Fig. 9 Pre-1912 Mt. Hood Forest Patterns (North)

By comparison with the Washington side of the Columbia Gorge, the Oregon side remained well covered with commercial sized trees, as shown in this c. 1912 photograph taken from Larch Mountain to the northwest of Mount Hood. Also compare these patterns with those shown on Map 2 and with the logging patterns shown on Fig. 15.



South side of Mount Hood, seen from crag on Tom-Dick-and-Harry Ridge, five miles from the snow-line. A thousand feet below is the hotel called "Government Camp," with the Barlow road, the first across the Cascades. On left are Zigzag and Sand canyons, cut by streams from Zigzag glacier above.

Williams 1912

Fig. 10 Pre-1912 Mt. Hood Burn Patterns (South)

Although the north side of Mount Hood was well timbered at the turn of the century, this view of the south side is similar to habitat conditions in the Yacolt Burn area in Washington. The first recorded forest fire in this area was in 1845, during the initial trail clearing that eventually resulted in the Barlow Road segment of the Oregon Trail. This road is visible in the foreground. Compare the vertical pattern of this habitat type with the horizontal patterns shown on Map 2. Again, note the contiguous arrangement of the snags in the burn area.

III. GENERAL DYNAMICS: NONHUMAN DISTURBANCE PATTERNS.

In addition to spectacular catastrophic events, a number of more general dynamics also affect the forests of the Columbia Gorge area. Over time, the incremental and cumulative effects of these less noticeable actions can have results that are often more profound or pronounced than the events they trigger or help define. Some of these more general changes include climate conditions, insects or diseases, and landslides.

1. Climatic Variations.

The Columbia River is one of only two rivers that intersect the Cascade Range, the other being the Klamath River in southern Oregon. Because the Columbia is a major transportation route, however, the stark contrasts that exist between the eastern and western sides of the Cascades, and between the lower and higher elevations of the Cascade peaks, are probably better known and better recorded than in any other area of the Pacific Northwest. Because the change in elevations is so abrupt, rising from sea level to over 4000 feet in the Gorge and over 10,000 feet on nearby peaks, the changes in forest cover patterns are also probably more pronounced than in other areas of the Cascades.

The principal cause of these changes is well known: the sudden and extreme rise of the Cascades, which run on a parallel northwest course with the Pacific Ocean to the west, blocks the moist ocean currents on their western side. This creates an abundance of rain and snow that results in huge coniferous trees and forests on the west side of the Cascades, and dry currents to the east that result in scattered stands of pine and juniper. Because of this great change in elevation, the upper peaks of the Cascades have remained cloaked in snow throughout historical times.

The first historical record of these changes in forest conditions is contained in excerpts from the journal of William Clark as his expedition traveled down the Columbia River from its juncture with the Snake River in Idaho (Thwaites 1959):

Tuesday, October 15, 1805

> (Clark) no timber of any kind in Sight of the river, a fiew small willows excepted. . .

Thursday, October 17, 1805

> (Clark) I do not think at all improbable that those people make use of Dried fish as fuel, The number of dead Salmon

on the Shores & floating in the river is incrediable to say-and at this Season they have only to collect the fish Split them open and dry them on their Scaffolds on which they have great numbers, how far they have to raft their timber they make their scaffolds of I could not lern; but there is no timber of any sort except Small willow bushes in sight in any direction.

Sunday, October 20, 1805

(Clark) The Star Side is high rugid hills, the Lard. Side a low plain and not a tree to be Seen in any Direction except a fiew Small willow bushes which are scattered partially on the Sides of the bank.

Monday, October 21, 1805

(Clark) we could not cook brackfast before we embarked as usial for the want of wood or something to burn. . .

I saw some fiew small Pine on the tops of the high hills and bushes in the hollers. . . . we encamped and purchased a little wood to boil our Dogs & fish . . .obliged to purchase wood at a high rate.

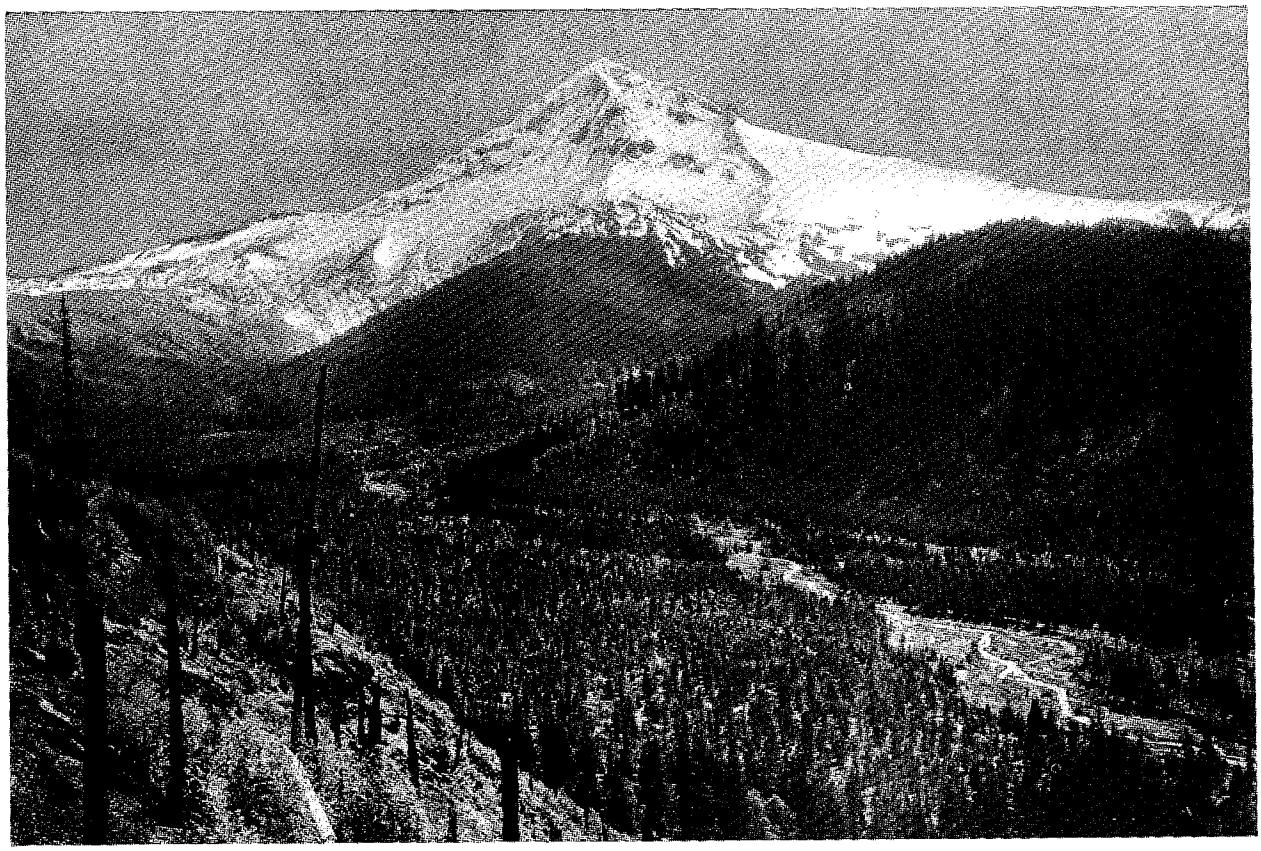
Elevational and east-west variations in forest cover patterns can be discerned on Map 2 and in Fig. 11, a view of Mount Hood from the east, and Fig. 12, a view of Mount Hood from the west. Additional comparisons can be made from the cover photograph, as well as Fig. 13.

Mount Hood from the hills south of The Dalles, showing the comparatively timberless country east of the Cascades. Compare this treeless region, as well as the profile of Mount Hood here shown, with the view from Larch Mountain.

Williams 1912

Fig. 11 Pre-1912 Mt. Hood Vegetation Patterns (East)

Compare this photograph with the view from Larch Mountain in the photograph in Fig. 9.



Mount Hood, seen from Sandy River canyon, six miles west of snow line. This important picture begins with Barrett Spur and Ladd glacier on the north sky line (left). On the northwest face of the peak is the main Sandy glacier, its end divided by a ridge into two parts. The forested "plowshare" projecting into the canyon is Yocum Ridge. South of it the south branch of the Sandy river flows down from a smaller glacier called the Little Sandy, or Reid. The broad bottom of this canyon and the scored cliffs on its sides show that it was formerly occupied by the glacier.

Williams 1912

Fig. 12 Pre-1912 Mt. Hood Vegetation Patterns (West)

Over time, glaciers have also had large impacts on high elevation forest cover in the study area. It would also be of interest to understand the effects of the 1790's eruption(s) on the structure and age of the trees in this photograph.

2. Insects and Diseases.

The effects of insects and diseases on the forests of the Columbia Gorge area were clearly described by Langille in 1902:

> Throughout the forest there is everywhere more or less timber which is dead or defective as a result of disease, old age, or overcrowding . . . The white pine has suffered a greater percentage of loss than any other species, and is rapidly disappearing from the forest. The cause of this is not apparent, but may be attributed to overcrowding by hardier species and the injury done by insects. The lodgepole pine is always a short-lived tree, which in time gives way to other species, and forms a dense litter. Mertens hemlock and lovely fir are most affected by wind shake, and in some places fully 60 percent of these species is defective from this cause. The percentage of dead white fir is also large. It does not resist fire, and the heartwood decays at an early age . . During the summer of 1894 the forests of the region were visited by great numbers of white butterflies, and as a result of this visitation a large percentage of white-bark pine on the north slope of Mount Hood was killed. Specimens of this insect were sent to the department of Entomology, which reported them to be *Neophasia menapia.* Polyporous is common on red fir and some other species when growing in moist places.

3. Floods and Landslides.

Although the Columbia River Gorge has been largely shaped by catastrophic floods and landslides, the magnitude of these types of events has been relatively minor over the past 200 years. The effects of the Bretz floods of 15,000 years to 12,800 years ago are still clearly visible along the walls of the Gorge and are responsible for the numerous waterfalls along the sheer cliffs on the Oregon side that were created during these events. The last catastrophic landslide occurred north of Bonneville about 700 years ago, temporarily ponding the entire Columbia and ultimately moving it a mile to the southward (Map 5 and Fig. 7). This event resulted in the movement of over ten miles of trees into the river, a result first noted by Lewis and Clark over 500 years later (Thwaites 1959):

Wednesday, October 30, 1805

> (Clark) passed a number of stumps at some distance in the water.

> This part of the river resembles a pond partly dreaned leaving many stumps bare both in & out of the water. . .

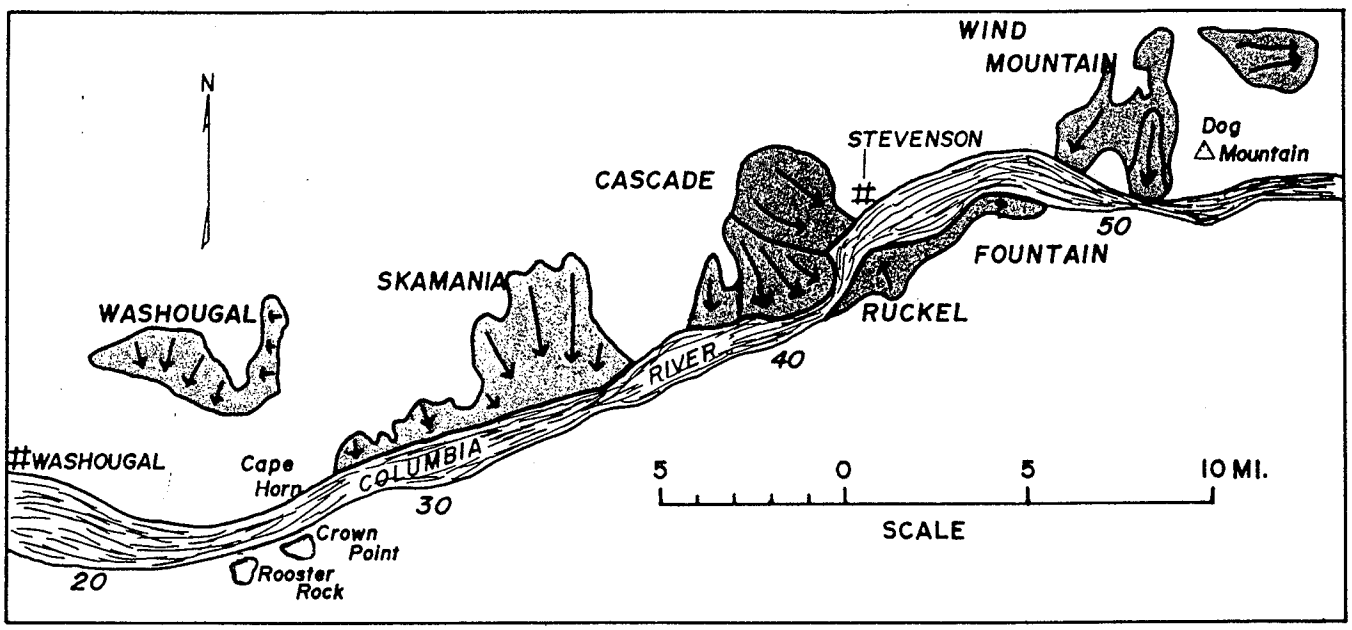
Monday, April 14, 1806

> (Lewis) the mountains through which the river passes nearly to the sepulchre rock [Memaloose Island], are high broken, rocky, partially covered with fir white cedar, and in many places exhibit very romantic seenes. . . throughout the whole course of this river from the rapids as high as the Chillukkittequaws, we find the trunks of many large pine trees s[t]anding erect as they grew at present in 30 feet water; they are much doated and none of them vegetating; at the lowest tide of the river many of these trees are in ten feet water. certain it is that those large pine trees never grew in that position, nor can I account for this phenomenon except it be that the passage of the river through the narrow pass at the rapids has been obstructed by the rocks which have fallen from the hills into that channel within the last 20 years; the appearance of the hills at that place justify this opinion, they appear constantly to be falling in, and the apparent state of the decayed trees would seem to fix the era of their decline about the time mentioned.

Because of the slow decay of the submerged trees and the active landslide activity in the area, Lewis was about five centuries off in his estimate of the slide's occurrence. Both his and Clark's other observations regarding this event are remarkably accurate. During historical times, landslide activity has been largely volcanic in origin or is otherwise restricted to a few identifiable portions of the Washington side of the Gorge (Map 5). Most of this later activity has taken place in the Wind Mountain area (Fig. 13).

Map 5 Columbia Gorge Landslide Patterns

Landslides north of the Columbia River are a dominant process in the study area. Interestingly, the slides to the west of Stevenson form the southern boundary of the 1902-1910 Yacolt fires.



Landslides cover an area of about 50 square miles within and near the Columbia River Gorge. The Cascade slide dammed the river about 1260 A.D., the remnants of the dam formed the Cascades of the Columbia before the building of Bonneville dam. Part of the Wind Mountain slide is moving today up to.45 feet per year.

Allen 1984

Wind Mountain intrusion (grano diorite), with Dog Mountain (Yakima Basalt) in background; separated by a fault and by a landslide area more than a mile wide and extending north three miles from the river. The 8-degree slope of its moving surface can be seen in the picture. (Ore. Dept. of Transp. photo)

Allen 1984

Fig. 13 Wind Mountain Landslide

Tree cover in the eastern portion of the study area depicted here is quite sparse, largely a result of geologic and climatic influences.

IV. HUMAN DISTURBANCE PATTERNS.

Because of its strategic position in providing easy canoe and boat access to much of the entire Pacific Northwest – including both eastern and western sides of the Cascades – and also because of the immense numbers of fish runs that exist along its course, the Columbia River region has long been one of the most heavily populated areas of the Cascade Range. Current proof of this condition is provided by the cities of Portland and Vancouver (Map 1). Early historical and late prehistoric evidence was provided in numerous journal entries by William Clark (Thwaites 1959):

Thursday April 3, 1806

> (Clark) I observe the wreck of 5 house remaining of a very large village, the houses of which had been built in the form of those we first saw at the long narrows of the Elute Nation with whome those people are connected. I endeavored to obtain from those people of the situation of their nation, if scattered or what had become of the nativs who must have peopled this great town. an old man who appeared of some note among them and father to my guide brought forward a woman who was badly marked with the Small Pox and made signs that they all died with the disorder which marked her face, and which she was verry near dieing with when a girl. from the age of this woman this Disruptive disorder I judge must have been about 28 or 30 years past, and about the time the Clatsops inform us that this disorder raged in their towns and distroyed their nation. . . they pay great attention to their aged severall men and women whom I observed in this village had arrived at a great age, and appeared helthy tho' blind.

The result of having large numbers of families in the area of the Columbia Gorge, particularly when coupled with the catastrophic events and other general disturbances described in the preceding pages, is further dynamic shaping and reshaping of the area's forests. People have lived along the Columbia River for at least 11,000 years, as evidenced by a number of local and regional archaeological findings. During all of that time they have set fires, built wooden structures and boats, hunted and fished. They have also practiced clearcut logging, fenced, plowed, and planted forest trees. Each of these activities has resulted in major changes to the forest patterns of the area, including wildlife habitat conditions and native plant and animal populations.

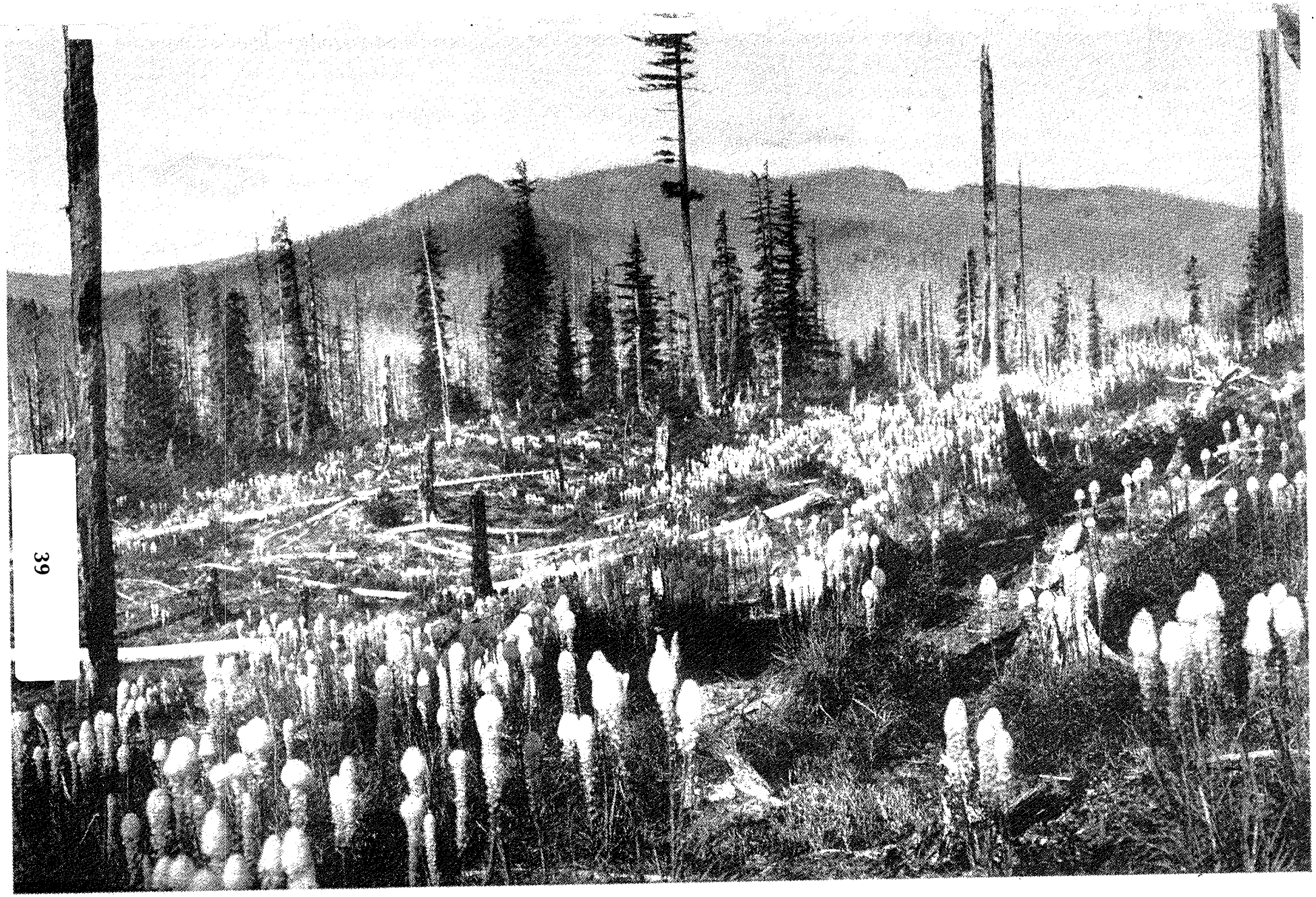
1. Prescribed Fire and Afforestation, 1792-1910.

Native Americans have used fire for thousands of years for an almost unlimited number of reasons: to heat, to cook, for hunting, to clear land, to fight enemies, as signals, for amusement, and so on. The fact that they did so is well documented in a wide number of sources, as well as being a matter of common sense. Because so many people lived and traveled along the Columbia Gorge area, it was only natural that hundreds of fires were set or maintained daily. These constant sources of ignition resulted in numerous purposeful or accidental fires in the adjacent forests. Sometimes the results were catastrophic, as described in Part 2 of this report. At other times, the result was more localized, as described by Meriwether Lewis (Thwaites 1959):

Wednesday, April 9, 1806

> (Lewis): . . . as we could not ascend the rapid by the North side of the river with our large canoes, we passed to the opposite side and entered the narrow channel which separates brant Island from the South shore . . . the fir has been lately injured by a fire near this place and many of them have discharged considerable quantities of rozin. we directed that Collins should hunt a few hours tomorrow morning and that Gibson and his crew should remain at this place untill we returned and employ themselves in collecting rozin which our canoes are now in want of.

Other results of setting fire to wooded areas, in addition to creating rosins that were useful for caulking canoes, were to clear meadows in which huckleberries, squaw grass, brackenfern, or other useful plants could be grown and harvested. On the Washington side of the Columbia Gorge, this process has been well documented and discussed by Minore (1972). On the Oregon side, numerous historical accounts and photographs exist that document these practices (Fig. 14). As fire suppression measures have been widely adopted in the Columbia Gorge area since the fires of 1902 and 1910, these once numerous habitat types have dwindled dramatically. For example, it has been estimated that the Twin Buttes huckleberry field, maintained at over 8,000 acres during historical times by Indian burning, had been reduced to 2,500 acres after only 40 years of fire suppression (Minore 1972, pp. 7-8). This result has been caused by the seeding and ultimate afforestation of these prehistoric fields by forest trees and shrubs; in the Twin Buttes case, at a rate of over 130 acres a year in a single field!



39

A "Burn" on the slopes of Mount Hood, overgrown with Squaw Grass. Such fire-swept areas are quickly covered with mountain flowers, of which this beautiful cream-colored plume is one of the most familiar. Its roots yield a fiber used by the Indians in making baskets.

Williams 1912

Fig. 14 Pre-1912 Mount Hood "Squaw" (or "Bear") Grass Meadow

2. Agriculture and Deforestation, 1826-1910.

Between 1840 and 1900, many of the forestlands and adjacent grassland prairies in the Columbia Gorge area had been converted to croplands and grazing lands. This process is well known and clearly documented on Map 2. Much of this process first began taking place in the Hood River area, and much of that land had been purposefully logged or burned and converted to orchard trees by the early 1900's. During this same period of time, California Condors, grizzly bears, timber wolves and mountain sheep became extinct in the Gorge. The prevalence of guns and rifles and concerns for livestock safety were two principal reasons for the local extirpation of these species.

3. Logging and Reforestation, 1826-1996.

Concerns about the impacts that logging, burning, and grazing were having on forests in the Columbia Gorge area became widespread in the late 1800s and early 1900's. Forest Reserves became established as early as 1892 in the Bull Run watershed of Mount Hood and quickly were expanded to include most of the Cascade Range in the United States. Fire suppression policies were enacted on both state and federal levels, grazing became severely restricted or eliminated in much of the new reserves, and a forest seedling nursery was established at Wind River (Fig. 6).

Although relatively little of the Gorge forestlands had been logged before 1900 (Map 2), this trend had been dramatically changed by 1920 (Fig. 15). About the same time, the planting of forest seedlings in unstocked burns and clearcuts came to be an accepted practice on both federal and private lands (Fig. 16). This further altered local wildlife habitat patterns and greatly accelerated the reduction in early seral stage plant and brush populations.

From 1911 to 1972, the simultaneous evolution of national forest management policies (including fire suppression and forest nursery development) and the automobile industry led to a prolonged and complementary era of road construction, fire fighting, and timber harvesting. The increased focus on forestry and the decreased dependency on animals for transportation led to the afforestation and reforestation of large areas of nonforested or sparsely forested lands. These processes resulted from the reduced burning and grazing pressures on young seedlings and saplings (a result of fewer domestic animals in the environment), and from the creation of national, industrial, and state forest tree nurseries for the sole purposes of reforestation and afforestation of regional lands. The advent of log trucks, cable systems and power saws in the 1930's led to increased efficiencies in salvage and clearcut logging operations, as well as improvements in fire-fighting capabilities.

Historical photograph (1920?) of the logged-off Gorge, with Crown Point in the upper right. Rooster Rock landslide block and fish cannery in the lower part of the picture. (Historical Society photo)

Allen 1984

Fig. 15 c. 1920 Columbia River Gorge Clearcutting Patterns

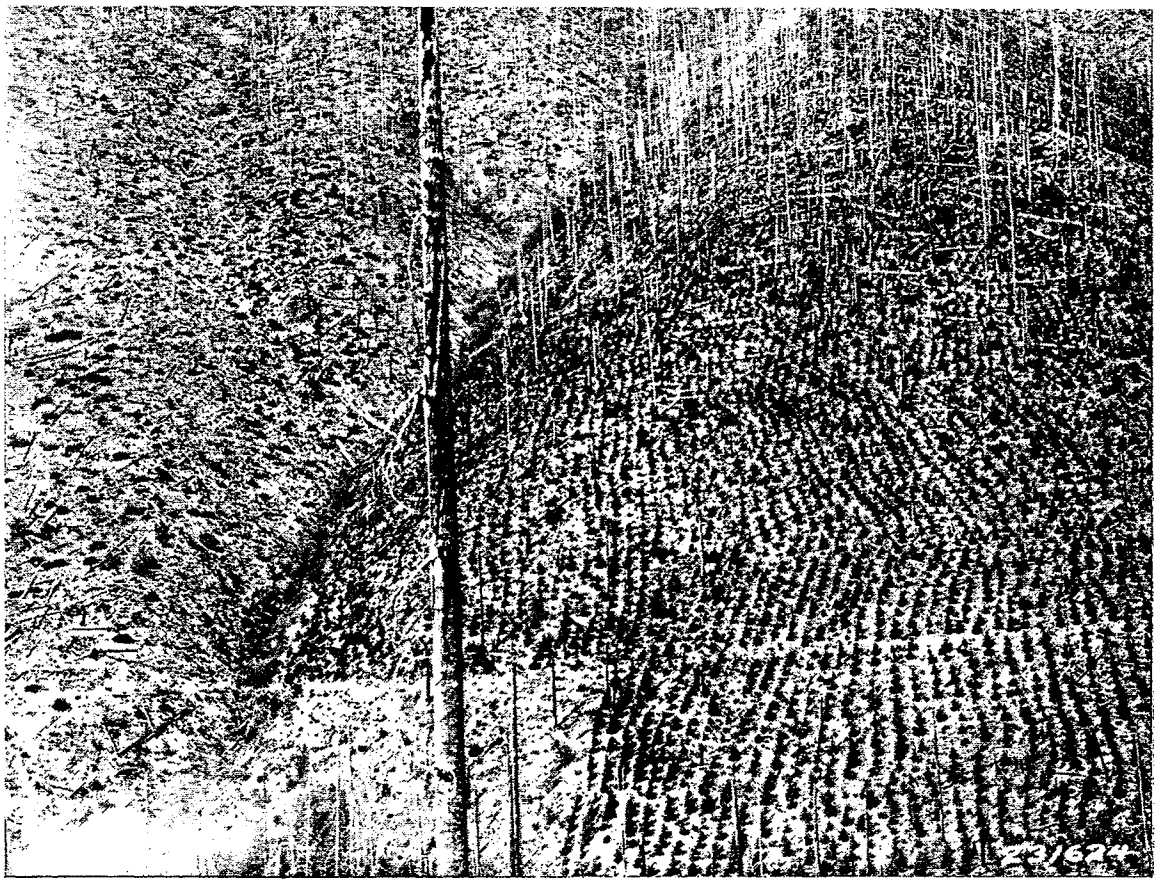


PLATE II-A. A steep sidehill on an old burn on Still Creek, Mt. Hood National Forest, planted 10 or 12 years previously, except for the area to the left.

USDA Forest Service 1944

Fig. 16 Early 1940's Mount Hood Forest Plantation Patterns.

4. Hunting, Fishing, Gathering, 1792-1996.

Although the elimination of such species as California Condors, grizzlies, timber wolves, and mountain sheep through hunting and trapping practices did not have a particularly noticeable impact upon Columbia Gorge wildlife habitat patterns, the change in hunting methods and seasonality of these practices did. In addition, the replacement of many of these animals in the environment by introduced and domestic species, such as horses, sheep, cattle, honeybees, and possums had additional effects.

Native American hunters, fishers, and gatherers were known to visit hunting, fishing, and gathering sites as soon as they became free of snow, or whenever plants became harvestable. This condition existed throughout the entire growing season for many plants, such as cedar, cattails, rushes, and brackenfern. These activities were accompanied by daily fires, including field burning, cooking, processing, and heating fires. The incremental and cumulative effects of these fires has already been discussed, as has their periodic escapements. Following the elimination of numerous iceage megafauna by Paleo-Indian hunters between 12,000 and 5,000 years ago, probably the greatest impacts to wildlife habitat caused by hunting and gathering during prehistoric times was the secondary effects caused by constant firewood gathering and broadcast burning. These effects remained throughout early historical times and well into the 20th century.

By contrast, early immigrant families had nearly unlimited access to metal traps, guns and gunpowder, and to technologies that were capable of seining the entire width of the Columbia River. The consequences of these actions led to a great reduction in beaver populations and other prized furbearing mammals, the extirpation of animals perceived as threats to safety or livestock, and the extirpation of animals that were limited in numbers or particularly susceptible to new hunting, fishing, and trapping technologies. Also, the enforcement of specific game seasons and the uses of fossil-fuel burning stoves led to a reduced need for firewood and year-round open fires for cooking.

V. SPOTTED OWL HABITAT: DISTRIBUTION PATTERNS.

Beginning in 1973, with the creation of an interagency committee named the Oregon Endangered Species Task Force, federal and state guidelines began to be developed for the management of northern spotted owls in forested environments. In 1977, the committee released its Interagency Spotted Owl Management Plan. In 1978, the Oregon-Washington Interagency Wildlife Committee was formed, replacing the earlier committee and adding Washington State to the planning process. By 1989, a more specific committee, the "Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl," had been formed. In May, 1990, this latter committee released its report, A Conservation Strategy for the Northern Spotted

Owl (Thomas and others, 1990). This process has continued to the present time. (USFWS 1995, WFPB 1996)

The principal results of these plans and political processes has been a sharp reduction in regional clearcut logging practices, a fundamental shift in management objectives for government-owned forest lands, and an increased focus on the preservation and management of "old-growth" Douglas-fir stands for aesthetic and biological objectives that exclude most logging options. These changes have been fueled and generally supported by an increased public concern regarding the maintenance and/or enhancement of northern spotted owl populations and the "mature forest" habitat conditions believed to achieve those results. This concern has resulted in more recent federal policies that have further reduced logging on federal lands, greatly increased the number of acres of Wilderness and other types of wildlife preserves, (see map 1) and developed additional formal plans for increasing the amount and extent of "spotted owl habitat" on private lands (WFPB 1996), as well as state and federal properties.

The fact that the committee-developed descriptions of habitat were considered critical to maintaining or enhancing populations of spotted owls is illustrated by the following 1992 exchange involving Jack Ward Thomas (Chairman of the 1989-1990 Interagency Scientific Committee) and a local mill representative at a public presentation held at the Western Forestry Center in Portland (Giesy 1993):

> Question: I would like to know how many owls there are at the present time.
>
> Dr. Thomas: Our estimate on the RFC [sic] is, I recall, was between 3,000-5,000 pairs. I don't know how many owls there are at the present time.
>
> Question: How many owls were there in 1940?
>
> Dr. Thomas: I don't know how many owls there were in 1940, however, if one uses the applicable theory, one would assume that there were considerably more than there are now.
>
> Question: How many in 1960?
>
> Dr. Thomas: I don't know how many there were in 1960.
>
> Question: 1970?

> Dr. Thomas: Let's not play this game any further. I would be able to project backwards on the amount of habitat loss since that time and give you a number, but I can't do it off the top of my head.

Thomas' assessment was based upon the current record of documented owl numbers, an apparent arithmetical relationship between owl numbers and amount of habitat (the "applicable theory"), and the assumption that a significant amount of habitat loss (and therefore, spotted owl populations) had occurred between 1940 and 1992. These projections were detailed further in the Interagency Scientific Committee (ISC) report, which "concluded that the owl is imperiled over significant portions of its range because of continuing losses of habitat from logging and natural disturbances" (Thomas and others 1990, p. 1).

The purpose of this section of the report is an attempt to estimate the amount of spotted owl habitat that has existed in the study area at key points in time during the past 200 years. The 1892-1914 time period is of particular interest for three reasons: 1) a significant amount of documentation is available for that time, as evidenced by the maps, quotes and photographs of the preceding pages; 2) because spotted owl habitat typically features trees in excess of 100 years of age, information from 1892-1914 provides good insights into 1792 to 1814-era conditions; and 3) a reasonable baseline is developed for measuring increases or decreases in habitat to the present time.

Before proceeding with this line of inquiry, however, a cautionary note should be sounded. Given the great amount of attention to spotted owl populations in recent history and the apparent importance in measuring their "decline" and "recovery" in terms of "suitable habitat," it would seem as if measurements of historical conditions would be of primary interest. Curiously, and despite constant assertions of declining population and habitat relationships, the ISC committee takes the position that this information is of relatively little value (Thomas and others 1990, p. 20):

> Habitat for the owl has been declining since the mid-1800s, when European settlers arrived, although the extent of suitable owl habitat before the 1800s is difficult to quantify. Estimates of 17.5 million acres in 1800 and about 7.1 million acres remaining today indicate a reduction of about 60% (appendix C). This figure may, however, underestimate the full extent of the decline, based on recent inventory data collected by environmental groups. Most of this reduction occurred in the last 50 years. <u>The exact degree of reduction would be interesting to know but not very useful</u>. (emphasis added)

This cavalier approach to measuring historical conditions seems to be based on the simple assumption that there was just as much, or more, spotted owl habitat in 1800 as there was "50 years" ago [i.e., in 1940]. Historical documents appear to tell an entirely different story. Trees that were considered 200-year old "old growth" in 1940, for example, were merely 52-year old second growth in 1792, when Broughton first sailed the Columbia. And seedlings and saplings that grew from the ashes of the "Great Fires" of 1849 and 1868 (Zybach 1988), following European settlement, are today "mature forest habitat" of 125 and 145 years of age. It may well be that "most of [the] reduction" in spotted owl habitat occurred during "the last 50 years," but it also seems possible that over the past 400 years most increases of this type of habitat have occurred during this century.

1. Current Definitions, 1986-1996.

Definitions of spotted owl habitat have changed substantially in the past ten years. The dynamic qualities of these descriptions makes estimates of increase or decline in habitat extremely dependent upon the criteria that are used. In 1986, for example, "General Attributes of Habitat" focused almost entirely upon stand age. (USDA 1986, p. C-8):

> Forsman and others (1984) reported that 98 percent of the sites in Oregon, where spotted owls were located between 1969 and 1980, were dominated by old-growth forests or by mixed stands of old-growth and mature forest. They defined old-growth forests as stands in which the dominant overstory trees were over 200 years old and mature forests as stands in which the dominant overstory trees were between 100 and 200 years old. If the sites analyzed by Forsman and others (1984) are combined with the large number of sites located in Oregon since 1980, the portion of sites in old growth, or old-growth and mature forests is approximately 93 percent. The remaining 7 percent of the sites were found in stands that were dominated by trees that were 36 to 99 years old. Many of the latter stands included residual pockets of old-growth conifers that were interspersed among the younger trees.
>
> The preponderance of owl locations in older forests suggests that spotted owls strongly prefer such forests (Forsman and others, 1984). Preference for older forests was also indicated by a study in which Forsman and others (1977) found that, in Oregon, spotted owls were roughly 12 times more abundant in old-growth forests than in young second-growth forests. The situation with respect to habitat

preference appears to be similar in Washington State (Postovit, 1977; Garcia, 1979) and northwestern California (Gould, 1974; Marcot, 1979, Marcot and Gardetto, 1980; Solis, 1984, Sisco and Gutierrez, 1984).

These correlations of spotted owl populations to age classes were significant. For example, Forsman's finding of 98% of the owls "strongly preferring" mature old-growth (200-year old) trees was based upon 595 sites, while the 93% figure was based on nearly 1500 sites (USDA 1986, p. 3-5). Three other "general characteristics of suitable spotted owl habitat" from the same source (USDA 1986, p. 3-6) were listed as:

-multi-layered canopies with an overstory, mid-story and understory;

-large trees with cavities or platforms holding accumulated organic matter suitable for nesting; and

-dead standing trees and fallen decayed trees.

By 1990, correlations to stand age had largely been eliminated in descriptions of habitats "selected by northern spotted owls." (emphasis added). Instead, habitat definitions were based on: 1) moderate to high canopy closure; 2) multi-layered, multi-species canopies dominated by large overstory trees; 3) high incidents of large trees with large cavities or "other indications of decadence"; 4) numerous large snags; 5) heavy accumulations of logs and other woody debris on the forest floor; and 6) considerable open space within and beneath the canopy (Thomas 1990: 1).

Uses of adjectives such as "moderate," "numerous," "heavy," and "considerable" made determinations of "selected" habitats an exercise in subjective judgments, rather than the quantifiable age measurements used in the earlier descriptions. Although the 1990 definition noted that "these attributes are usually found in old growth," at least nine different definitions of that condition were provided (Thomas 1990, pp. 146-149). Of those definitions, however, five included an age class exceeding 200 years, and all nine required tree diameters greater than 30 inches at breast height. In other words, the principal measure for owl suitability had shifted from tree age (200 years or more) to tree diameter (greater than 30 inches at breast height).

The most current definition of spotted owl habitat is very similar to the 1990 definition, but with more specific measurements being employed to describe basic forest conditions. For example, "the multi-layered, multi-species" canopy is dominated by "large" trees that are specifically defined as "more than 30 inches dbh" (diameter at breast height), and the "moderate to high" canopy closure is specifically

defined as "60 to 80 percent" (USFWS 1995, p. xiv). In addition, the late successional forests that spotted owls "generally inhabit" (down from the over 90% "preference" previously noted), are specifically defined as both "mature" (generally 80-220 years of age) and "old-growth" (older than 175-250 years of age).

The current combination of age classifications (80 or more years), diameter measurements (31 inch or greater dbh), and canopy closure percentages (60% or more) thus makes it possible for independent determinations of spotted owl habitat to be derived without an over-reliance upon subjective assessments by wildlife specialists or by simplistic age classifications, as had previously existed.

2. Timber Volume Tables and Maps, 1902-1969.

Because definitions of spotted owl habitat have been evolving and now only recently established, it has been very difficult to relate most historical forestry data to specific habitat conditions. One useful tool for undertaking this task is the Scribner volume scale for measuring standing timber. The Scribner scale has been in common use since the time of the Civil War and continues to be used to this time. Most historical forestry maps, timber cruises, and tabular reports regarding commercial forests in the Pacific Northwest have used this form of measure during the past 120 years, so it provides good continuity for assessing forest conditions over time.

In order to assess the locations and amounts of spotted owl habitat that may have existed in the study area during the late 1800's and early 1900's, three useful sources of information (in addition to photographs) are Map 2, the USDI report on Cascade forests (Langille 1902), and a standard reference on Douglas-fir yield tables (McArdle 1961).

A workable method for transforming this data into a map of owl habitat locations and extents at the turn of the century is to:

1) Transform spotted owl habitat descriptions into age, species, and diameter classifications common to Scribner scale definitions;

2) Develop a standard volume table from this data;

3) Locate volume information from this table on the historical map;

4) Correlate these findings to a current map, using standard legal descriptions of township, range, and sections.

Step one of this process has been accomplished by publication of spotted owl habitat definitions (USFWS 1995). Step two is accomplished by the creation of the following table (based on McArdle 1961):

Table 1. Volume of Douglas-fir timber by age and diameter classes provided in current mature spotted owl habitat descriptions.

Site Class	Stand Age	No. of 31" dbh trees	Volume in Board Feet Per Acre	
I	60	0	55,900-	68,300
	80	15	117,000-	131,000
	100	27	141,500-	155,400
	120	32	157,300-	172,700
	140	35	169,900-	185,400
II	80	0	62,100-	78,000
	100	9	81,800-	98,900
	120	18	95,500-	114,100
	140	26	106,200-	125,500
	160	32	115,400-	135,400
III	100	0	52,400-	72,400
	120	4	63,900-	85,500
	140	10	72,900-	95,900
	160	15	80,100-	104,400
IV	160	0	42,200-	67,100
V	160	0	23,300-	31,900

The "Site Class" column in the table refers to the "site classification" of a forested area in the Douglas-fir region. This classification is determined by the height of the tallest trees in an area after they have grown either 50 or 100 years. The fastest growing trees are classified as "Site I" trees and typically grow in areas of high moisture, relatively warm temperatures, and good soils. "Site V" conditions, conversely, produce the smallest and slowest growing trees, generally depicting harsh weather conditions, low available moisture, and/or poor soils. Because this table does not include old-growth trees, most Site IV and Site V lands do not attain the minimum diameters required of spotted owl habitat conditions. On the other hand, it can be shown that Site I areas are capable of attaining these conditions in as few as 80 years, and Site II areas in as few as 100 years, which correlates very well with current definitions of "mature" forests as 80-220 years of age (USFWS 1995).

The Mt. Hood Reserve, in common with most of the Cascade Range, contains very little Site I land, most of which exists in the warmer, wetter and less broken coastal forests of western Oregon and Washington. Also, spotted owl habitat is infrequently found in Site IV and V areas because of the relative sparseness of growing conditions and the general harshness of those environments, many of which occur at the higher elevation forests that exist above the general range of spotted owls.

From this table, it becomes readily apparent that most fully stocked second growth forestlands meeting or exceeding minimum spotted owl habitat conditions (31" and larger dbh trees, 80 years or greater in age) contain a minimum of 63,900 board feet (bf) per acre (Site III 120-year old stands with an average of four 31" dbh and larger trees per acre) to 117,000 bf per acre (Site I 80-year old stands). The table shows that older stands contain even more volume in these Site classes. And, although Site IV lands on the limits of spotted owl range do not typically have trees 31" and larger in a second growth condition, by age 160 these stands average 42,200-67,100 bf per acre–a figure also expected to increase as the stands attain larger diameter trees over time.

As demonstrated by the table, fully stocked second growth stands of spotted owl habitat between the ages of 80 and 160 years can be expected to contain anywhere from 63,900 bf to more than 185,400 bf per acre (Site I figures were not developed for the 160-year age class) per acre. These figures can be expected to increase, or at least remain stable, as the trees become older. Because these figures are for fully stocked stands, however, it is likely that much spotted owl habitat exists in more sparsely timbered environments. Using the 60% to 80% canopy closure (USFWS 1995) to adjust for the difference between fully stocked and more open habitats, a minimum figure of 40 to 150 thousand bf/acre is derived. This figure correlates very well with the numbers used to develop Map 2 in 1902, and can probably be used with a certain level of confidence as a result.

Step 3 uses the methods described in the previous paragraphs, the areas most likely to contain spotted owl habitat at the turn of the century on the southern side of the Columbia Gorge corridor are mapped as "50,000 and over B.M. (board measure – a term synonymous to board feet) [per acre] Merchantable timber." This is shown as the darkest green (nearly black) color on the map color. Less likely areas are mapped as "25,000 to 50,000 B.M. [per acre] Merchantable timber," and are represented by the next lighter green shade.

The fourth step of this process is not taken at this time (it is beyond the scope of this paper). It is suggested that the completion of this methodology will result in the identification of specific areas most capable of being developed and retained as spotted owl habitat for significant periods of time. This process should also result in useful baseline data capable of measuring increases or decreases in spotted owl habitat conditions during the past 200 years.

3. Historical Documentation, 1792-1996.

Although the use of historical maps, volume tables and current definitions of spotted owl habitat provides some indication of past habitat conditions, it is necessary to consult other sources as well in order to determine historical structural patterns and the actual range of vertebrate species. This section of the report provides a number of historical quotations that can be correlated to the photographs, maps, definitions, and tables provided earlier in order to derive a clearer picture of past conditions, plant associations, and wildlife populations.

The earliest account of general landscape patterns in the Columbia River Gorge area is provided by Broughton (Vancouver 1920):

Tuesday, October 30, 1792

> Round Point Vancouver [opposite present day Rooster Rock] the river seemed to take a more northerly direction; its southern shores became very hilly with bare spots of a reddish color on the sides of the hills and their tops were thinly covered with pine trees. The opposite shore was low, well wooded and mostly composed of shingly beaches.

This basic description was further defined by Lewis and Clark during their two voyages along this stretch of the Columbia (Thwaites 1959). (also see Oct. 15-25 account previously quoted in Part III of this report.)

Thursday, October 24, 1805

> (Clark) The nativs of this village re[ce]ived me verry kindly, one of whome envited me into his house, which I found to be large and comodious, and the first wooden houses in which Indians have lived Since we left those in the vicinity of the Illinois.

Friday, October 25, 1805

> (Clark) This little [Mill] creek heads in the range of mountains which runs S.S.W. & N.W. for a long distance on which is scattering pine white oake &c. The Pinical of the round toped mountain [Mount Hood] which we Saw a Short distance below the forks of this river is S. 43o W. of us and abt 37 miles, it is at this time toped with Snow we called this the falls mountain or Timm mountain [this the Mount Hood or Vancouver] . The face of the Countrey on both

Side of the river above and about the falls, is Steep ruged and rockey open and contain[s] but a Small preportion of [h]erbage, no timber a fiew bushes excepted. The nativs at the upper falls raft their timber down Towarnehooks [Deschutes] River & those at the narrows take theirs up the river to the lower part of the narrows from this Creek, and carry it over land 3 miles to their houses &c.

Tuesday, October 29, 1805

(Clark) A Cloudy morning wind still from the West not hard . . . The Countrey begins to be thinly timbered with Pine & low white Oake verry rocky and hilley. . . Contrey on the Lard. Side has more timber than common and looks well for hunting high and ruged.

Wednesday, October 30, 1805

(Clark) Saw several species of wood which I never saw before, some resembling Beech & other Poplar. . . The bottoms above the mouth of this little [Wind] river is m[u]ch covered with grass & firn & is about 3/4 of a mile wide rich and rises gradually, below the river (which is 60 yards wide above its mouth,) the Countrey rises with steep assent. we call this little river from a Speces of Ash [new Timbered] that wood which grows on its banks of a verry large [size] and different from any we had before Seen, and a timber resembling the beech in bark but different in its leaf which is Smaller, and the tree Smaller. . . . The countary a high mountain on each side thickly covered with timber, such as Spruce, Pine, Cedar, oake Cotton & c. &c.

Saturday, November 2, 1805

(Clark) here the river widens to near a mile, and the bottoms are more extensive and thickly timbered, as also the high mountains on each Side, with Pine, Spruce pine, cotton wood, a Species of ash, and alder. at 17 miles passed a rock near the middle of the river, about 100 feet high and 80 feet Diameeter, proceed on down a smoth gentle Stream of about 2 miles wide, in which the tide has its effect as high as the Beaten [Beacon] rock. . . here the mountains leave the river on each Side, from which the great Shute to this place is high and rugid; thickly covered

with timber principalley of the Pine Species. The bottoms below appear extensive and thickly covered with wood. . . we made 29 miles to day from the Great Shute.

In contrast to the relatively quick downstream trip taken by the expedition, the return voyage was much slower and allowed time for greater detailed descriptions of local plants and animals:

Wednesday, April 2, 1806

(Lewis) 2 young men whom they pointed out were Cash-hooks and resided at the falls of a large river which discharges itself into the Columbia on it's South side some miles below us. we readily prevailed on them to give us a sketch of this river which they drew on a mat with a coal. it appeared that this river which they call Mult-no-mah discharged itself behind the Island which we called the image canoe [Sauvies] Island and as we had left this island to the S. both in ascending and descending the river we had never seen it. they informed us that it was a large river and run a considerable distance to the south between the mountains. Capt. Clark determined to return and examine this river accordingly he took a party of seven men and one of the perogues and set out 1/2 after 11 A.M., he hired one of the Cashhooks, for a birning glass, to pilot him to the entrance of the Multnomah river and took him on board with him.

* * *

Fir is the common growth of the uplands, as is the cottonwood, ash, large leafed ash and sweet willow that of the bottom lands. the huckleburry, shallon, and the several evergreen shrubs of that species which bears burries have seased to appear except that species which has the leaf with a prickly margin. among the plants of this prairie in which we are encamped I observed the passhequo, Shannetahque, and compound firn the roots of which the natives eat; also the water cress, strawburry, flowering pea not yet in blume, the sinquefoil, narrow dock, sand rush which are luxuriant and abundant in the river bottoms; a speceis of the bearsclaw of which I preserved a specemine it is in blume. the large leafed thorn has also disappeared. the flowering currant is found here in considerable quantities on the

uplands. the hunters inform me there are extensive praries on the highlands a few miles back from the river on this side. the land is very fertile.

Saturday, April 5, 1806

(Lewis) The dogwood grows abundantly on the uplands in this neighbourhood. it differs from that of the United States in the appearance of it's bark which is much smoother, it also arrives here to much greater size than I ever observed it elsewhere sometimes the stem is nearly 2 feet in diameter. we measured a fallen tree of fir No. I. [Douglas-fir] which was 318 feet including the stump which was about 6 feet high. this tree was only about 3 1/2 feet in diameter. we saw the martin, small gees, the small speckled woodpecker with a white back, the Blue crested Corvus, ravens, crows, eagles, Vultures [California Condors] and hawks. the mellow bug and long legged spider have appeared, as have also the butterfly, blowing fly and many other insects. I observe not any among them which appear to differ from those of our country or which deserve particular notice.

(Clark) The country on either side is fertile, the bottoms on the South Side is wide and intersperced with small ponds in which the natives gather their wappato. back of this bottom the country rises to about 200 feet and the soil is very rich as that also above the Q Sandy river quite to the mountains. the country on the N. side from a fiew miles above this place as low down as the enterance of Cah-wah-na-ki-ooks [Lewis] River rises to the hight generally of 150 or 200 feet is tolerably leavel, thickly timbered with Fir and white cedar. the soil of the richest quallity. Some small Praries on the bank of the river. . . Some plains can be seen to the N.E. of our camp of 10 or 12 miles in secumference. . .

Wednesday, April 9, 1806

(Lewis) the hills have now become mountains high on each side are rocky steep and covered generally with fir and white cedar. we saw some turkey buzzards this morning of the species common to the United states which are the first we have seen on this side of the rocky mountains.

Thursday, April 10, 1806

(Lewis) on entering one of these lodges, the natives offered us a sheepskin for sail, than which nothing could have been more acceptable except the animal itself. . . they offered us a second skin of a full grown sheep which was quite as large as that of a common deer. . . these people informed us that these sheep were found in great abundance on the hights and among the clifts of the adjacent mountains, and that they had lately killed these two from a herd of 36, at no great distance from their village. . . saw the white pine at this place.

Saturday, April 12, 1806

(Lewis) the mountains are high steep and rocky. the rock is principally black. they are covered with fir of several speceis and the white cedar. near the river we find the Cottonwood, sweet willow, broad leafed ash, a species of maple, the purple haw, a small speceis of cherry, purple currant, goosberry, red willow, vining and whiteburry honeysuckle, huckleburry, sacacommis, two speceis of mountain holley, & common ash. for the three last days this inclusive we have made only 7 miles.

(Clark) I observed a woman with a Sheep Skin robe on which I purchased for one Elk and one deer skin. the father of this woman informed me that he had killed the animal off of which he had taken this skin on the mountains imediately above his village, and that on those mountains great numbers of those animals were to be found in large flocks among the steep rocks. . . I saw a turkey buzzard which is the 3rd. which I have seen west of the rocky mountains. the 1st. was on the 7 inst. above quick sand river. for the three last days this inclusive we have made 7 miles only.

Monday, April 14, 1806

(Lewis) the mountains through which the river passes nearly to the sepulchre rock [Memaloose Island], are high broken, rocky, partially covered with fir white cedar, and in many places exhibit very romantic seenes. . .

Although the records of Lewis and Clark provide a colorful description and listing of past conditions in the Columbia Gorge area, they provide very little (with few exceptions, including the 318 foot Douglas-fir log along the Sandy River) in the way of quantitative measures or vegetation mapping. One of the earliest documents that does provide this kind of information is the 1902 USGS report on Cascade forests (Langille 1902) that accompanies the original copy of Map 2. In addition to relatively accurate colored maps of timber volumes, this report contains numerous tabular summaries of commercial tree species volumes, detailed photographs, qualitative descriptions of the environment, and brief summaries of the general forest conditions and histories of each township. They are also useful for mapping Lewis and Clark's progress along the Columbia (for interpreting past conditions) and for comparing to modern maps (Map 1) and photographs.

By correlating the information in the previous parts of this report with Map 2 and Langille's descriptive summaries that follow, five basic areas can be defined in terms of spotted owl habitat along the borders of the Columbia Gorge: (1) riparian lands that extend roughly 1/2 mile to 1 mile from the edge of the Columbia River; (2) a 6-mile (one township) wide buffer that extends from the edge of the riparian area; (3) eastern and (4) western components of a strip of land extending from 7 to 20 miles from the banks of the Columbia River; and (5) the high elevation peaks and timberlines (4,000 ft. and above) that are considered to be above the range of the spotted owl. The vegetational history of these identified areas are relevant to the consideration of likely past spotted owl occupancy and movements in and across the Columbia Gorge area.

Riparian lands

Recent information suggests that "historically, spotted owls probably were located along the northern and southern banks of the [Columbia] river" (Washington DNR 1996, p. 114). There is nothing in the historical record that supports this conclusion. There is no record of spotted owls in the study area (or anywhere in Oregon) before 1914 (Forsman 1986). And, in fact, if owl presence is based on spotted owl habitat conditions, there is even less reason to support this premise. Map 2, for example, shows no suitable habitat for several miles along the Oregon shore in 1902. The descriptions of the environment that accompany the original map (Langille 1902) also provide little support for the idea:

Tsp 2 N., Rng. 7 E.

> The Columbia River bluffs occupy all of that portion of this township lying south of the river. The timber along these walls is of little value, but along Eagle and Deadmans creeks there is a fair stand of merchantable size and quality. . . The ground is very rocky, with many perpendicular bluffs of

rock. The towns of Cascade Locks, Bonneville, and Warrendale are in this township. (Langille, 1902, p.42)

Tsp. 3 N., Rng. 8 E.

The surface of this township is broken by the deep canyons of the Zigzag River and Camp and Still creeks. The wide canyon of Zigzag River is filled with a mass of glacial sand and rocks, apparently carried down by the action of the stream from Mount Hood and deposited in this comparatively level basin. Upon this infertile deposit little timber grows or ever has grown. (Ibid. pp.54-55)

Tsp. 3 N., Rng. 9 E.

The small portion of this township lying south of the Columbia River is composed of steep bluffs and a narrow strip of bottom land along the river, a part of which is occupied by the village of Viento.

The timber consists mainly of red fir of small size and inferior quality, with an occasional yellow pine along the foot of the hills and some cottonwoods along the river bank. (Ibid. p. 67)

Tsp 3 N., Rng. 10 E.

A few good tracts of scattered timber remain, but these are of little value except for cordwood.

The town of Hood River is in this township.

Six-mile buffer

It is also interesting to note that the entire strip of complete townships lying south of the Columbia along the Gorge, totaling nearly 108 square miles, also contained very little spotted owl habitat at the turn of the century. Of the more than 65,000 acres in this strip, only a single stand--totaling about a 1000 acres--existed with an average of 50,000 board feet or more per acre (a description of this stand is included in the quotation of Township 2 North, Range 8 East excerpt below). This is less than 2% of the total six mile wide buffer, even if combined with all of the logged-off land in this township, would still constitute less than 10% of the total environment:

Tsp. 2 N., Rng. 8 E.

> The Columbia River and the deep-forked canyon of Hermann Creek cause this township to be extremely rough and rugged. The conditions are not favorable to timber growth. The bluffs along the Columbia rise precipitously, to an elevation of 4000 feet, to comparatively level but narrow ridges, on which the timber is small and rough and comprised mainly of subalpine species.
>
> Along the East Fork of Hermann creek, however, there is a body of excellent red fir of large size. A large part of this canyon has been burned over. On the divide between Hermann and Green paint creeks there is an old burn now partly stocked and overgrown with huckleberry bushes. (Langille 1902, p.43)

Tsp 2 N., Rng 9 E.

> this township touches the Columbia River on the north and adjoins the Cascade reserve on the west. . . Except upon the higher slopes the timber is of excellent quality. About four sections of the eastern side have been logged, and since all of the best timber is located upon it, it is probable that it will all be cut within a few years.
>
> . . . Fires have swept over all of the logged area and many other tracts have been burned off. (Ibid. p.66)

Tsp 2 N., Rng. 10 E.

> Most of the timber has been cut, and the land has been cleared at a rapid rate and set to fruit trees or berries. (Ibid. p.69)

Eastern forests, 7-20 miles inland.

As discussed in the text and documented by photographs, most of the eastern portion of the Columbia Gorge area is too dry and sparsely forested to be considered as spotted owl habitat. Less than 1% of the land in these townships could be classified as spotted owl habitat at the turn of the century. In addition, most of this area is contained in the blast zone shown on Map 4.

Tsp 1 N., Rng 10. E.

> The southeastern part of the township lies on the high divide east of the east Fork of the Hood River, and here much of the same conditions prevail as those described in T. 1 S., R. 10 E. Creeping fires have destroyed much of the timber, and dense brush has followed. Bald Butte formerly produced excellent bunch grass which afforded pasture for the settlers' horses, but the annual visitations of sheep have almost destroyed it. North of this mountain there is a scattered growth of yellow pine and red fir along the hillside, but it is not of much value.
>
> In the northern part of the township is a range of hills separating the upper from the lower valley. These hills at one time bore good timber, but fires have long since destroyed nearly all of it, and in its place is a very dense growth of willow and other shrubs. The best timber is between the East and Middle forks of Hood River. It is composed mainly of red fir with some yellow pine and white fir. Fire has injured it in many places, and the litter is often very heavy. These sections contain a large amount of good saw timber, estimating 25,000 feet per acre, but many of the trees are defective from old age. (Langille 1902, p.68-69)

Tsp 1 S., Rng 10 E.

> The greater part of this township has burned over and has grown up to a dense tangle of willow, ceanothus, and other shrubs. . . There is some fairly good timber in the northeast corner of the township, but it is mostly small and rough. The top and the western slope of the divide consist of burned, restocked, grazing, semi-barren, brush, and timber land. (Ibid. p.48)

Tsp 1 S., Rng 11 E.

> Along the east side of the township the southern exposures are almost barren of timber, but in places are densely covered by oak grubs. Sheep and cattle devour everything. (Ibid. p.49)

Western Forests, 7-20 miles inland

Virtually all of the spotted owl habitat within 20 miles of the southern edge of the Columbia Gorge is contained in this strip of land. However, an examination of Map 2 demonstrates that this type of forest pattern existed on less than 25% of the land in the area in 1902. Due to the effects of the 1902 Yacolt Fire located due northwest of this strip, an even smaller percentage existed on the Washington side of the Gorge.

Tsp. 1 N. Rng. 8 E.

> On the summits of the divide the timber is of little value, but the canyons and on the slopes there is an excellent stand. On the east side of Eagle Creek, under Chinadere Mountain, it is exceptionally fine. West of the East branch of Eagle Creek terrific fires have swept everything bare. (Langille 1902, p. 44)

Tsp 1 N. Rng. 9 E.

> This township lies outside the reserve, and is drained by the West and Middle of Hood River, the lake Branch, and Green Paint Creek. Between the forks of Hood River is a broad sloping ridge bearing excellent timber. Between the West and the Lake Branch an old burn has grown up to a very dense growth of ceanothus and willow. From the Lake Branch to the north line of the township is a good stand of timber everywhere except where the burns have taken place. (Ibid. p. 65)

Tsp 1 S. Rng 8 E.

> The basins of the West Fork of Hood River, Lost Lake, and Laurel Creek, which are included in this fractional township, contain the largest and most extensive stands of timber found in this region. The wide canyon of the West Fork has apparently been covered by sand and boulders washed down from Mount Hood, and this deposit has been covered with sandy soil or black loam to a depth of 3 or 4 feet. . . White pine has been quite abundant throughout this area, but a large percentage is now dead. (Ibid. p.45)

Tsp. 1 S. Rng 8 1/2 E.

> . . . The timber is of little value on the steep rocky slopes, but near the bottom of the canyon on the West Fork [of Hood River] there is some good timber, mainly red fir. (Ibid. p. 46)

Tsp 1 S., Rng. 9 E.

> This township includes the summit of the high, broad divide between the East and West forks of Hood River, known as Blue Ridge. . . East of this stream (Middle Fork) nearly everything has been burned and has grown up over the greater part to a dense growth of chaparral, or thickets of young trees. On the slopes of Blue Ridge and along Tony and Skookum creeks there is some magnificent timber. (Ibid. p. 47)

Peaks and high elevations (4,000-12,000 ft.)

Most of the significant areas of land meeting this criteria are more than 20 miles from the Gorge. Of more importance is the fact that high elevation forests are rarely considered as suitable habitat for spotted owls. For these reasons, consideration of the total percentage of owl habitat in these areas has not been further evaluated.

In sum, it appears that less than 10% of the forestlands lying within 20 miles south of the Columbia Gorge likely contained significant stands or patches of spotted owl habitat in 1902. Due to the effects of the Yacolt Fire of that year, the percentage was probably just as small for a similar strip lying to the north of the Gorge. Just as significantly, it appears that very little of this condition was due to logging or agriculture. More importantly, it appears as if the dynamic forces described in the first four parts of this report have likely created and maintained this general condition for the past several thousand years.

VI. CONCLUSION.

> The young growth of the timbered region, indicating as it does the character of the future forest, is very interesting. . . In all bodies of timber there is a uniformity of size, showing that the growth all began at about the same time during the past 200 years. (Langville 1902, p. 35).

This overview has examined historical primary and secondary causes of "fragmentation" in the forested lands to the north and south of the Columbia River in the Columbia Gorge area of the Cascade Mountains.

Forest fragmentation is defined as the existing descriptions, at any given point in time, of vertical and/or horizontal vegetation patterns. The primary causes of these patterns can be generally identified as a number of different, but interrelated, processes, including geological, climatic, biological, and cultural processes. This combination of processes is dynamic and in a constant state of change. Therefore, the condition of forest fragmentation is also constantly changing, sometimes dramatically, from hour-to-hour and day-to-day.

The timeframe considered in this report is 1792-1996, a period of over 200 years. Whenever possible, habitat definitions have been considered for areas as small as 80 contiguous acres.

1. Forest Cover/Wildlife Habitat Types: Horizontal Patterns.

The primary focus of consideration is northern spotted owl habitat in the area of the Columbia River Gorge, as defined by the US Fish and Wildlife Service (USFWS 1995) and, more recently, by the Washington Forest Practices Board (WFPB 1996). In addition to spotted owl habitat descriptions of horizontal and vertical vegetation patterns, it was determined that nearly all dominant patterns of vegetation and/or wildlife habitat occurring within the study area could be considered at most given points in time during the past two centuries as one of the following:

1) prairies and savannah (1792-1902);
2) meadows and berry patches (1792-1996);
3) shrublands (1792-1996);
4) riparian vegetation (1792-1996);
5) natural afforestation and reforestation by dominant species and age class(es) (1792-1996);
6) urban and transportation development (1845-1996);
7) grazing (unfenced) and pasture (fenced) lands (1845-1996);
8) agricultural and ornamental plantations (1845-1996);
9) plantation afforestation and reforestation by dominant species and age class(es) (1910-1996);
10) unforested barrens, glaciers, and high elevations (1792-1996).

To this list the two basic types of spotted owl habitat, mature and old growth conifer forests, should be added.

In most instances, patterns of these land use and vegetation type classifications can be readily determined or inferred in descriptions, photographs and maps of the study area for any given point in time.

2. Shifting Landscape Mosaic: Vertical Patterns.

The forested lands of the Columbia Gorge and its adjacent areas feature some of the most dynamic vertical patterns of habitat in the entire Cascade Range. The greatest variation in vertical habitat occurs in the difference between live and dead trees (i.e., snags): See Figs. 2, 3, 7, and 14. The principal reasons for this condition are the presence of active volcanoes, the existence and effects of the Columbia River (including daily and seasonal wind intensity), and the relatively large numbers of people compared to other areas of the Cascades. The combined effects of human burning and seasonal east winds along the Gorge have exaggerated the frequency and volatility of forest fires in the area during historical times; a condition that likely existed during prehistoric times as well.

Due to the incidence of catastrophic fires, winds and volcanic eruptions, the forests of the Cascade Range have been significantly affected and altered on many occasions during the past several centuries. These types of events seem to be more frequent in the Columbia Gorge area than in other areas to the north and to the south. Logging, flooding, insects, diseases, landslides and other disturbances have also had incidental and cumulative effects upon the structure and extent of these forests. Due to their proximity to the Columbia River Gorge, the effects of human settlement, development and resource management, have also probably been exaggerated (in comparison to other areas of the Cascades) within the boundaries of the area considered by this report.

3. Owl Habitat Size and Locations: Numerical Patterns.

As described in current literature, spotted owl habitat consists of stands of trees that are usually 80 years or more in age, of which a dominant overstory exists that consists of trees 31 inches or more in diameter at breast height (4 1/2 feet above the surface of the ground), and in which canopy closure is at least 60% (USFWS 1995). Using these criteria, it appears as if as little as 5%-15% of the study area may have included contiguous (80 acres or more) spotted owl habitat at any time during the past 200 years. This amount does not appear to change appreciably even with a more confined area centered directly in the Gorge. This pattern has likely existed for the past several thousand years as well. Whether this apparent lack of habitat has promoted or inhibited spotted owl populations to move between Oregon and Washington is highly speculative and likely impossible to determine.

4. General Conclusions.

Based upon the methods and documents used to assemble this report, the following conclusions were derived:

1. Due to the presence of large, active volcanoes, the Columbia River and concentrated populations of people, the forests adjacent to the Columbia Gorge of Oregon and Washington are probably the most dynamic (and therefore most fragmented) in the entire Cascade Range. This condition has existed for the past 200 years, and probably for the past 11,000 years as well.

2. The processes creating fragmentation in the study area can be identified and documented. Primary sources of fragmentation during the past 200 years have been climate (particularly as it relates to available moisture), volcanic eruptions, wind and windstorms, and human activities; particularly urban, agricultural, and transportation development, logging, fire suppression, artificial reforestation and afforestation, and broadcast burning. Secondary sources of fragmentation include insects, diseases, flooding, landslides, and changing wildlife populations.

3. Within the study area, the presence or absence of spotted owl habitat conditions is a function of distance from the Columbia River, (both horizontally and vertically) and a function of slopes, whether eastern or western, or northern or southern aspects.

a) Because of flooding, steep terrain (on the Oregon side), landslides (on the Washington side), seasonal winds, and people, the lands within 1/2 mile of the Columbia River have contained very little, if any, spotted owl habitat during the past 200 years.

b) Due to definitions of habitat and known range, little if any habitat exists between 4000 feet and 12,000 feet elevation within the study area.

c) Due to lack of available moisture, little if any spotted owl habitat (as described by current definitions) exists along the eastern border of the study area.

d) Due to human activities, wind, and unstable geological conditions (landslides, volcanic activity, and flooding), only a small percentage (less than 5-15%) of the land within six miles of the Columbia River has been in a spotted owl habitat condition at any time during the past 200 years.

e) Most spotted owl habitat in the study area is found more than six miles from the Columbia, less than 4000 feet in elevation, and on the northern

and western sides of Cascade peaks. In these particular areas, it is possible for old-growth and mature forest conditions to cover 50%, or more, of the land's surface.

4. Depending upon where boundaries are drawn, it appears that as little as 1% or 2%, and no more than 15%, of the study area has been in a "classic" old-growth condition (significant stands of trees in excess of 200 years of age) during the past 200 years. Given the same constraint, it also appears as if no more than 5%-40% of the remaining land has been in a mature forest condition (80-200 years of age) during the same period.

5. Any attempt to reduce forest fragmentation in the study area through the creation of contiguous older forest types will likely increase the potential for catastrophic forest fires. This is caused by increasing fuel loads and by linking areas of concentrated habitat with bands of flammable snags, litter, canopies and volatile ladder fuels. In other words, attempts to create larger stands of older trees than have existed during earlier times will probably result in greater risk to those stands throughout history.

A significant scientific and management opportunity exists to analyze current Columbia Gorge forestland changes through time. By converting the maps, photographs, tables, and texts referenced in this report to a digital (computerized) format, a series of useful GIS (Geographic Information System) products can be developed. The scientific use of this system would add a greater degree of accuracy and certainty to discussions of increases or decreases in wildlife habitat types over time. Management uses would include the identification of specific areas most likely and lease likely to be affected by catastrophic occurrences. High risk areas could be managed in shorter crop rotations, with contingency strategies for salvage operations. Low risk areas could be managed for long term crop rotations and for "mature" and "old-growth" forest habitat conditions.

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