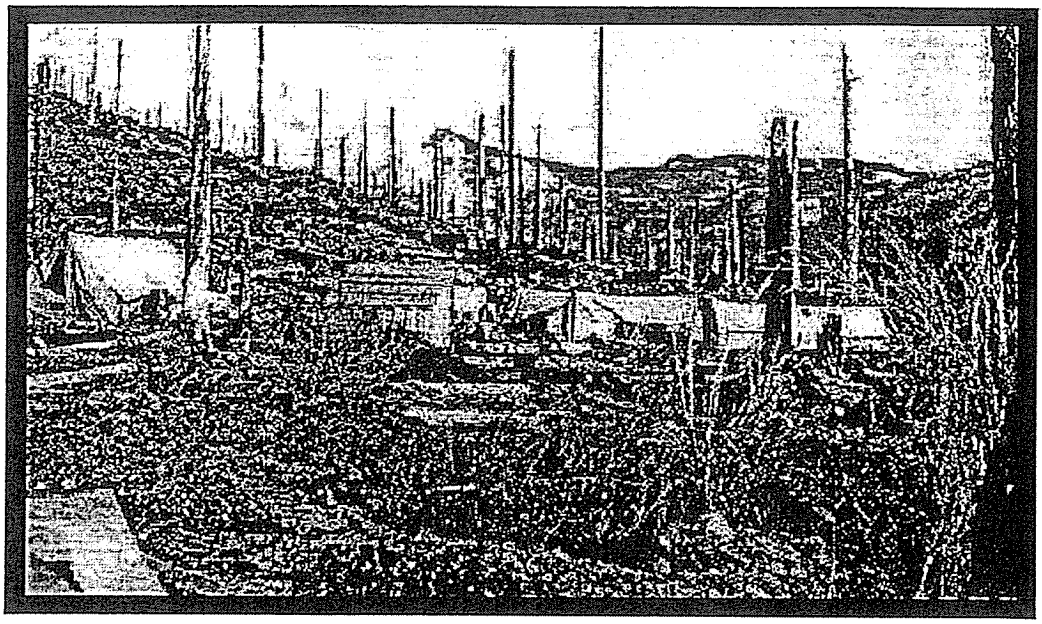
IIIA. Vegetation



1921 tree planting camp and tree shelter on the Firecamp Lakes burn (1914)

Original tree shelter in 1995.

III. BIOLOGICAL DOMAIN

A. Vegetation

1. Characterization

a) ****What is the array and landscape pattern of plant associations and structural stages in the watershed (riparian and nonriparian)? What processes caused these patterns (e.g., fire, wind, mass wasting)?***

Plant Association Series: There are four major plant association series in the watershed. Roughly half of the watershed is in the Pacific silver fir series, about a third is in the western hemlock series, and the remainder is mountain hemlock and Douglas-fir series. These series reflect differences in local environmental conditions as shown in *figure III-1*. The tree species which define each series indicate the potential climax species and not necessarily the species currently occupying the site at this time.

Figure III-1: Plant Association Series

Plant Association Series	Percent of forested portion of watershed	Site Temperature	Elevation	Tree Growth
Douglas-fir	2	warm	low	high
western hemlock	35	|	|	|
Pacific silver fir	51	V	V	V
mountain hemlock	12	cold	high	low

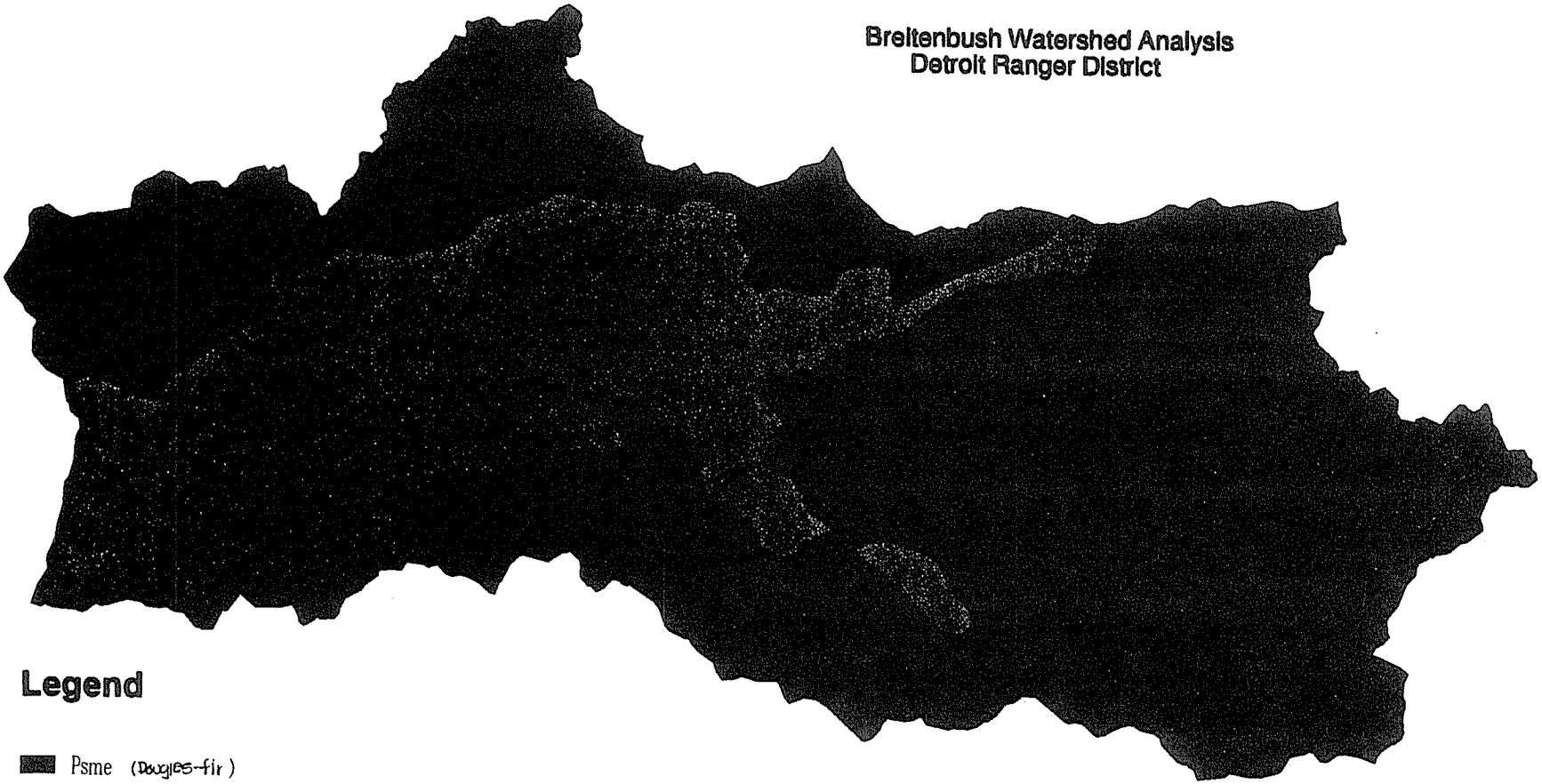
The distribution of the plant associations series across the landscape is depicted in *figure III-2* for the entire watershed and in *figure III-3* for riparian reserves.

The plant association series for the eastern landform block is about half mountain hemlock and half Pacific silver fir, although some western hemlock and Douglas-fir series can be found in the valley bottoms. The lower elevation valley bottoms of the western and central landform blocks are western hemlock series, while the upper elevations are Pacific silver fir series.

Overall, vegetation in the Breitenbush is very diverse because of variability in elevation, topography, soils, precipitation, disturbance, and past management. Within the four plant association series, District data bases show 79 individual plant associations that have been mapped within the watershed, ranging in size from ½ acre to many thousands of acres.

Plant Association Series

Breitenbush Watershed Analysis
Detroit Ranger District



Legend

- Psme (Douglas-fir)
- Tshe (western hemlock)
- Abam (Pacific silver fir)
- Tsme (Mountain hemlock)

N

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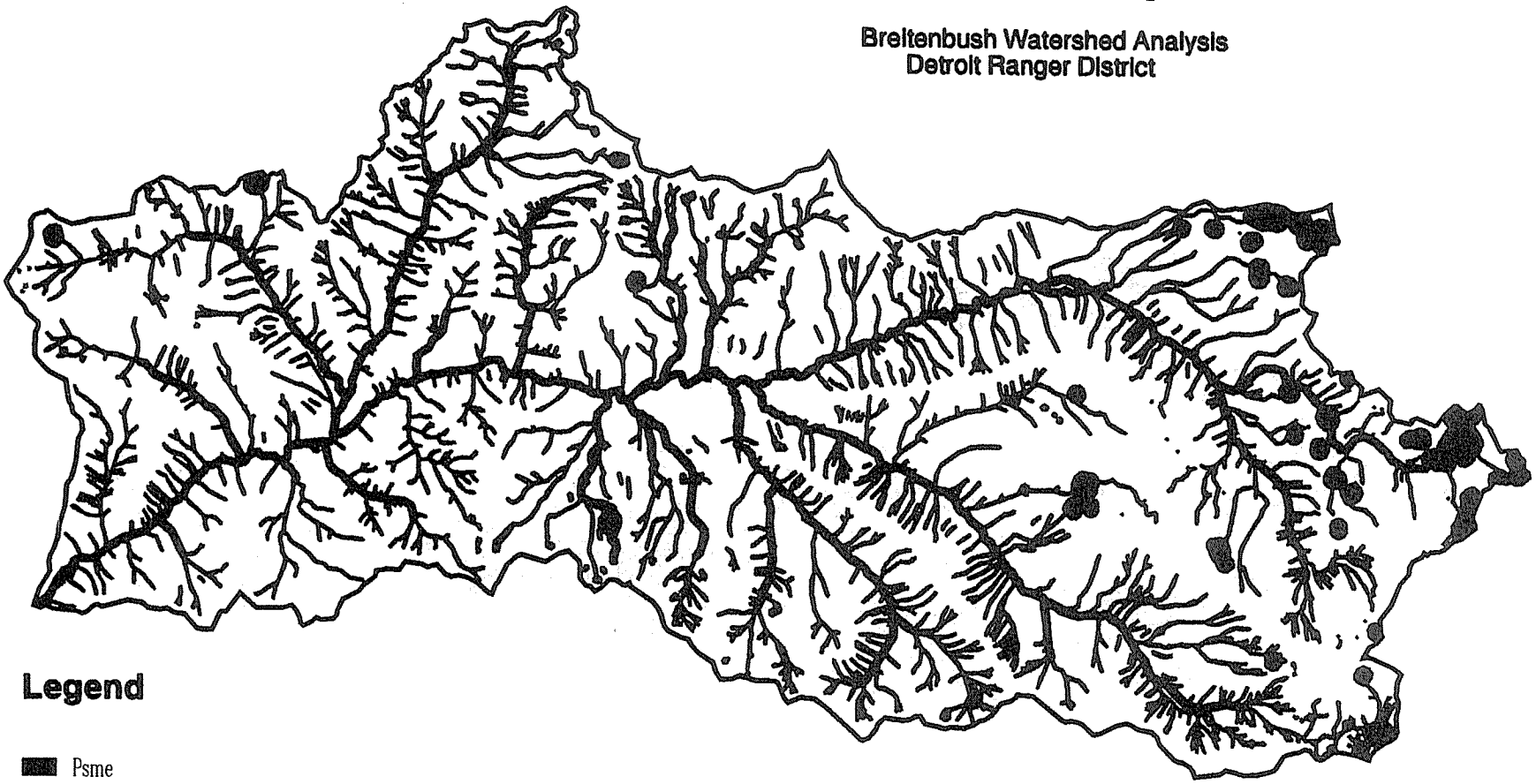
Plant Association Series in Riparian Reserves

Breitenbush Watershed Analysis
Detroit Ranger District



Legend

- Psme
- Tshe
- Abam
- Tsme

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Differences in plant associations between riparian and non-riparian areas may vary in degree locally, depending on stream class, topographic features, water availability, air drainage, soils, and other factors. Differences in vegetation from riparian areas and upslope sites may be significant enough to classify adjacent sites in entirely different plant association series or there may be no difference at all. In general, riparian plant associations tend to be wetter and cooler than adjacent upslope sites, but these differences decrease or may disappear completely with intermittent streams. For clarification, Riparian Reserves widths may or may not represent the actual zone of influence that streams have on vegetation. In general, differences in vegetation from the upslope disappear in a shorter distance than that defined by Riparian Reserve widths.

Structural Stages: The structural stages represented in the Breitenbush today are generally the result of either timber harvest or past fires. There are four structural stages represented in this watershed: stand initiation, stem exclusion, understory reinitiation, and old growth. The following is a brief description of each structural stage:

- *Stand Intiation Stage* - In this stage, stand ages range from 1 to 20 years old depending on site conditions and degree to which the stand has been managed. In the Breitenbush, most stands in this stage were the result of timber harvest and almost all were planted. Harvest units were planted at a density of about 400 to 600 trees per acre with one or more tree species, generally Douglas-fir, noble fir, and western white pine, depending on site conditions. Commonly, additional tree species seeded into these plantations naturally. At the lower elevations, shade-tolerant species such as western hemlock, western redcedar and Pacific silver fir seeded in, while at the higher elevations mountain hemlock and Pacific silver fir seeded in.

  About 1/3 of these plantations have been precommercially thinned, leaving the largest, most damage free trees, as well as seedlings under one foot tall, free to grow in the plantations.

  Non-tree vegetation is also present in this structural stage, although species and numbers are highly variable. On most sites, species such as rhododendron and vine maple resprout after timber harvest and broadcast burning. At higher elevation, beargrass also survives timber harvest and burning and may cause severe competition for planted trees. Invasion of harvested sites by non-sprouting plants is highest at lower elevations, < 3000 feet, and on southerly and westerly aspects. Snowbrush invasion occurs on some sites, especially those with frequent fire return intervals. The degree of plant species diversity declines with increasing elevation and coldness of site. Many of the sites in the mountain hemlock series undergo very little change in the composition of plant species following fire or logging.

  Until about 1990 most of these plantations had very few snags, green trees, or significant levels of course woody debris. Almost all were broadcast burned. After 1990 most units that are in this structural stage have met the Willamette National Forest standards and guidelines for snags and down woody material.

- *Stem Exclusion Stage* - This structural stage includes a very large range of stand conditions and includes trees that range in age from about 20 to 150 years, with diameters from 5" to 20.9", depending on site conditions and degree of management. These stands have dense crowns which block out light to the forest floor, and limit additional tree regeneration in the understory. Typically, shade tolerant understory trees that are present persist but grow very slowly. Intermediate or suppressed trees that do not tolerate shade well, suffer from competition and have a high mortality rate. Shade intolerant shrubs and forbs frequently disappear during this stage.

  In natural stands, this stage is typically dominated by one or two tree species. Precommercial thinnings, which normally preceed this stage, may reduce competition and mortality by favoring the best growers. Commercial thinnings further reduce competition and increase average stand diameter. Shade tolerant understory trees and other plants may benefit from increased light and respond with vigorous growth.

- *Understory Reinitiation Stage* - This stage is characterized by stands as young as 80 years to stands as old as 250 years, depending on site conditions. The vast majority of these stands have not been managed. In this stage, the dominant tree layer begins to break up due to mortality and a second canopy layer, generally pole sized, develops underneath. Although this may simply happen naturally, given enough time. In the Breitenbush, past underburning has created these stands in many areas, by killing sufficient overstory trees to stimulate regeneration underneath. This underburning was more prevalent in the past than has been generally recognized, partially because it was not of intense interest until recently and also because it is difficult to distinguish through querying of databases.

  In this watershed, management-induced understory reinitiation has resulted from old salvage logging and more recently, commercial thinnings. These practices have resulted in release of tolerant understory trees that are developing a second canopy layer at a much earlier age than would have developed under natural conditions, especially with fire suppression and a lack of natural underburning.

- *Old Growth* - These stands are generally the largest and oldest found in the watershed. They may range from over 200 to over 600 years old in this watershed. While a complete record of stand ages is not available, it is believed that over 90% of the stands, in this stage, date back to the 1600's. Most of these stands still have a high component of Douglas-fir or other fire regenerated species in the upper canopy layers. Second and third canopy layers are usually well developed with shade tolerant species. Other vegetation, primarily shrubs, may reach high levels because of more open canopies. Diseases such as dwarf mistletoe in hemlocks or true firs, and heart rots and root rots contribute to mortality and bole defects. In the oldest stands, especially those in the upper elevations, mortality and rots may occur at high levels. Heavy competition from rhododendron, other shrubs or beargrass may reduce replacement of mortality, leaving stands more open.

The following chart depicts the percentage of area occupied by each structural stage in the various plant association series for the entire watershed and for riparian reserves.

Current Structural Stages by Plant Association Series					
Structural Stage	**Plant Association Series**				
	Douglas-fir	**Western Hemlock**	**Pacific Silver Fir**	**Mountain Hemlock**	**Total**
	% of watershed	% of watershed	% of watershed	% of watershed	% of watershed
Entire Watershed					
Stand Initiation	0.1	9.5	10.6	0.4	20.1
Stem Exclusion	0.9	12.5	12.5	8.4	34.4
Understory Reinitiation	<0.1	2.9	9.4	1.6	13.8
Old Growth	0.8	6.0	11.5	<0.1	18.3
Non-Forest	0.1	1.3	3.5	8.0	12.9
Totals	2.0	32	47.4	18.4	
Riparian Reserves					
Stand Initiation	0.3	6.9	8.8	0.2	16.1
Stem Exclusion	0.7	12.2	11.0	8.0	31.9
Understory Reinitiation	<0.1	2.5	10.9	2.1	15.4
Old Growth	0.9	7.4	14.2	<0.1	22.6
Non Forest	<0.1	1.6	4.0	8.3	13.9
Totals	1.9	30.7	48.8	18.5	

From the chart above, it appears that structural stages in the riparian reserves are similar to the rest of the watershed, except there is slightly less stand initiation and slightly more old growth.

Figure III-4 shows the landscape distribution of stand structural stages across the watershed. *Figure III-5* depicts stand structural stages within riparian reserves.

Structural stage differences between riparian and non-riparian sites may vary and are influenced both by management activities and by similar factors that influence plant association distribution. Major disturbances such as fire and logging have had a differing level of influence on structural stage development which varies greatly by stream class. Except for early railroad logging in the lower Breitenbush, larger streams were excluded from regeneration harvests. Salvage logging was practiced in these streams but this would not usually be significant enough to alter stand structural stage. Intermittent streams were generally not buffered from logging until the 1970's and many not at all.

Past fires tended to burn in intermittent stream valleys as they did in upslope areas and may have burned with even greater intensity where heavy fuel accumulations were present. On larger streams, there was more of a tendency for fires to burn less intensely or to go out entirely. These fires were more likely to leave remnant trees or unburned islands of vegetation. Reinvasion of burned areas may have varied greatly or very little from upslope areas due to factors previously discussed.

Floods and debris torrents may have created significantly different vegetation in localized riparian areas, but overall these differences are probably not significant in the watershed.

ii) What is unique about the vegetation in the Breitenbush?

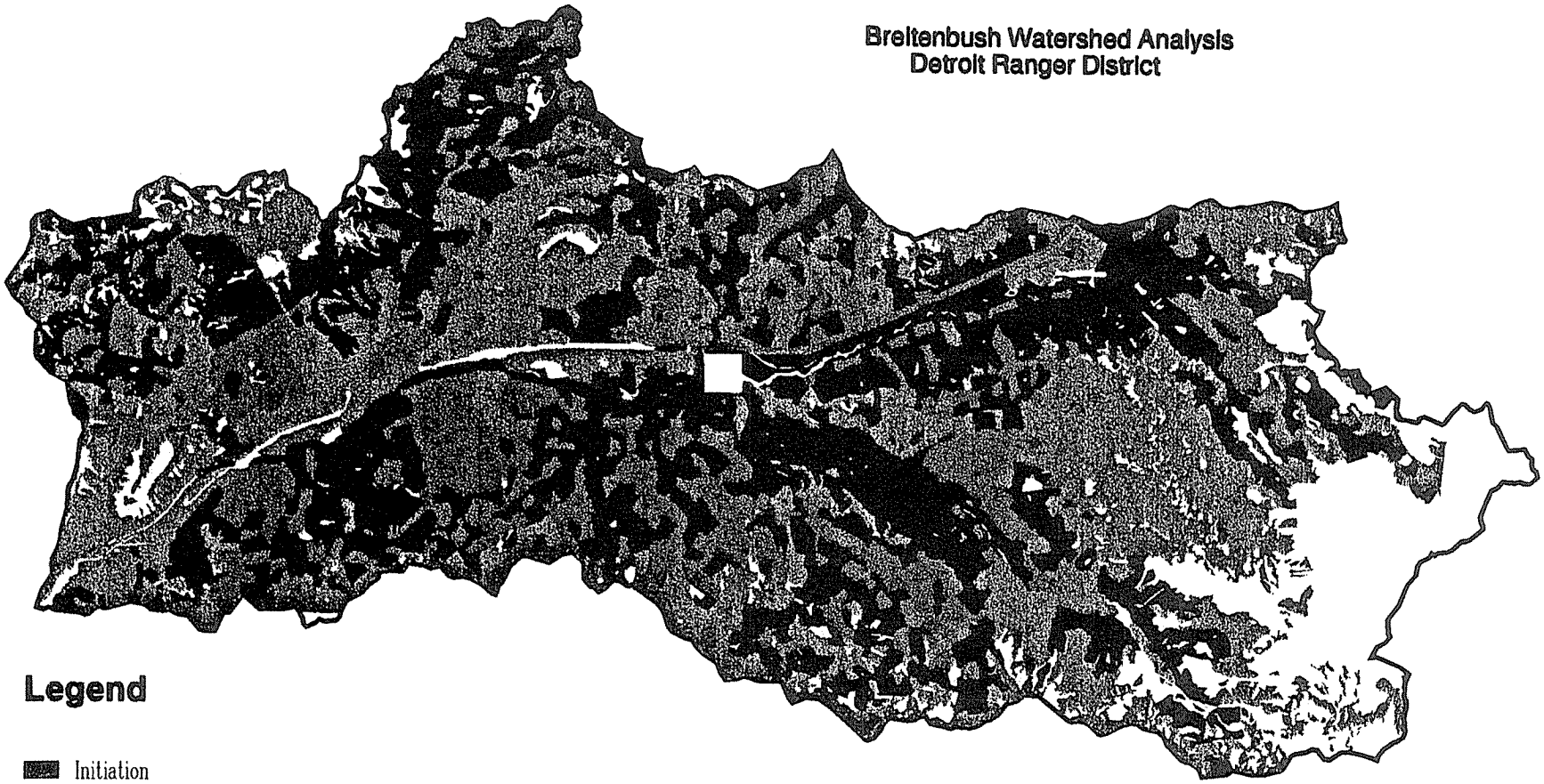
There are some interesting and unique plant populations in the Breitenbush. For instance, the watershed supports the largest population of sugar pine on the Detroit District and the northern most significant population in the range of the species. Unfortunately, these sugar pine have experienced high mortality due to blister rust, bark beetles and drought. High mortality, combined with inherently low reproduction rates and stand conditions that are not conducive to sugar pine survival, have threatened the unique population.

Furthermore, there are three known sensitive plant species within the watershed Gorman's Aster, Brewer's reedgrass and Thompson's mistmaiden. Of these, Brewer's reedgrass (Calamagrostis breweri), has only been found in Oregon at Jefferson Park (Mt. Jefferson Wilderness) and Mt. Hood.

Whitebark pine is another unique species that inhabits the Mt. Jefferson Wilderness portion of the watershed. Currently, very little is known about the extent and distribution of whitebark pine populations because no surveys have been done. Regeneration success for this fire-dependent species may have been hampered by many years of fire suppression and individual trees have succumbed to blister rust, but there is no data showing whether

Structural Stages

Breitenbush Watershed Analysis
Detroit Ranger District



Legend

- Initiation
- Exclusion
- Reinitiation
- Old Growth

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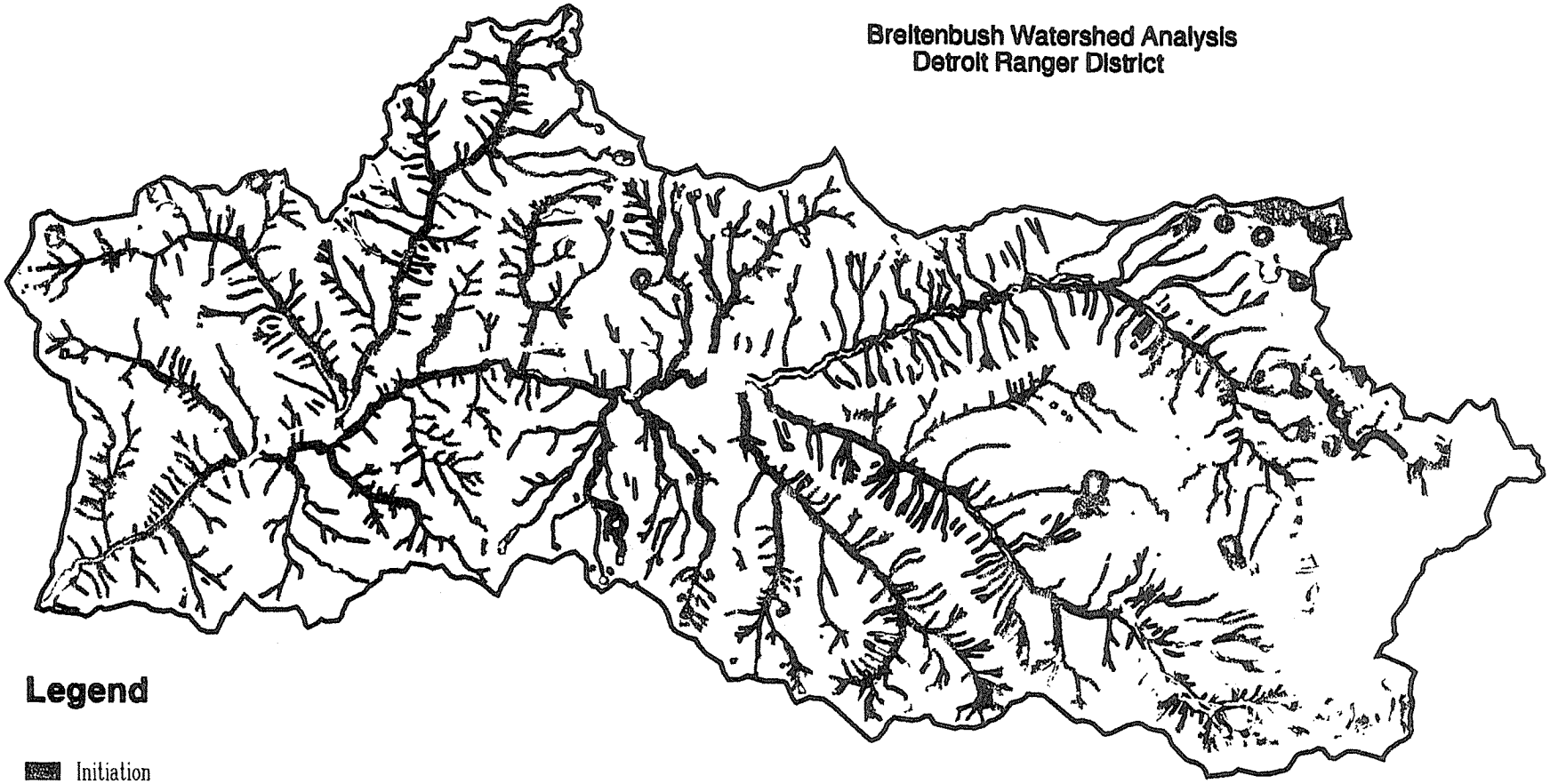
Structural Stages in Riparian Reserves

Breitenbush Watershed Analysis
Detroit Ranger District



Legend

- Initiation
- Exclusion
- Reinitiation
- Old Growth

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populations on the whole are increasing, decreasing or static in comparison to reference conditions.

Noxious Weeds: A large portion of the district's noxious weed populations occur in the Breitenbush drainage. St. John's-wort and Scotch broom present the largest problem, followed by Canadian thistle, tansy ragwort, and bull thistle. Control efforts will focus on Scotch broom, which has moved into the flats around Breitenbush Hot Springs and dispersed from there along interior forest roads. Scotch broom has the tendency to dominate disturbed and semi-disturbed areas due to its size, large seed bank, and its ability to modify the surrounding environment.

2. What values are associated with vegetation?

a) Vegetation has economic, life-sustaining, aesthetic and spiritual value (i.e. trees and other vegetation provide commodities, many plants provide food/shelter to humans, fish and animals, old growth provides aesthetic and spiritual value, huckleberries and cedar trees are important to Native American cultures for tribal ceremonies and basket making, etc.)

b) Natural species richness and diversity has ecological value. Plants are the oxygen providers and the base of the food chain that allows all other forms of life to exist. A variety of plant species supports a variety of other life forms. Plant/animal interactions can range from a simple indirect association as in the case of carnivores, to very complex interdependencies where neither the plant species nor the animal species can exist without each other (coevolution). Animals can use vegetation for food, shelter, camophlogue, poisons, and tools.

Without variety, living systems become simpler, and are more prone to reduction or extinction during stochastic events such as environmental disturbance or disease outbreaks.

3. What are the highest priority issues or resource concerns associated with vegetation?

a) For a variety of reasons, old growth is a highly valued component of the ecosystem. Since most of the old growth in the watershed, takes many human lifetimes to develop to the stage it is at now, many people do not want to see any more of it harvested. Therefore, management activities that involve harvest of old growth timber, and for that matter, timber harvest of any kind have become very controversial.

b) Fire suppression has been a management goal for many decades, now the issue is whether fire suppression has significantly altered plant community and seral stage distribution and timber stand conditions within the watershed.

c) Land allocations and management goals are often based on compromise rather than

science, so they are not always compatible with historic ecosystem conditions or dynamic natural systems. Management goals for land allocations such as late successional reserve, riparian reserves, scenic areas, summer home tracts, etc. require that vegetation be managed in ways that may be in conflict with historic ecosystem conditions within the watershed.

d) Recent wind storms and floods have resulted in a lot of downed timber throughout the watershed. This often results in increased bark beetle populations that eventually kill adjacent live trees. In addition, there have been some recent concentrations of spruce budworm infestation resulting in pockets of dead trees scattered about the watershed. Furthermore, accumulations of downed and dead trees increase risk of catastrophic wildfire. The issue is whether management should actively respond to these events or let them run their natural course.

e) Noxious weeds, such as scotch broom, and invasive non-native plants are a threat to native plant diversity in the watershed. These species are able to thrive in a new environment because they arrive without the complement of predators, disease, and other ecosystem components found in their native region of the world. Most of these species take advantage of disturbance gaps such as logged units, roads, rock quarries, burned areas, the areas surrounding human structures, and trails. Once established, these populations can serve as a seed source for further dispersal, generally along road and trail corridors.

f) There is a concern about maintaining natural biodiversity within the watershed. The occurrence of special habitats (non-forested communities) and their distribution across the landscape is important for biodiversity of plant and animal species. Hickman (1976) estimated that eighty five percent of flowering plant species in the central western Cascades are found in non-forest areas such as rock outcrops and meadows, which only comprise about five percent of the land base.

4. What are the management direction/activities, human uses, or natural processes that affect vegetation?

a) Current Condition

i) What were the disturbance factors that led to the current vegetative conditions in the watershed described in the characterization?

Fire

The 1890's has been the period of the most extensive fire activity in the watershed since the 1600's. In 1901, mapping of the Central Cascades Forest Reserve indicated that about 33 thousand acres (48%) of the watershed were recently burned at that time. Although it is difficult to reconstruct the method of mapping used in 1901, comparison with current size class mapping indicates a good correlation between both map locations and the scope of disturbance. Panoramic fire lookout photos taken during the 1930's clearly show evidence of extensive burning that would correspond to the 1890's period. Additionally, public land survey notes from the late 1800's refer to the more recent fires and give an estimate of acres burned per township.

Using current size class mapping and known stand ages, it appears that about 35% of the watershed was in a recently burned or younger age class, < 50 years old, by 1895. Difficulty in obtaining a greater degree of accuracy is limited by the completeness of stand information and by underburned stands which may be classified as either young or old depending on the severity of burning and the amount of older trees left as remnants. In general, it is felt that the amount of underburning is underestimated since it may be difficult to identify during aerial photo stand mapping.

In 1995 an intensive study (Garza) was completed of the fire history in the East Humbug, Fox, and Scorpion Creek drainages, 8850 acres (these areas are mostly within the central landform block). This area of the Breitenbush probably has the most active fire history in the entire watershed.

Reburning of the same area accounts for a substantial percentage of these acres. This study also classified the area by Fire Regime Type:

Fire Regime Type	Acres	% Area
3-4	2194	25
4	1696	19
5	173	2
5-6	4687	54

3 = infrequent, light surface fires (>25 years)
4 = short return interval crown fires (25>100 years)
5 = long return interval crown fires (100>300 years)
6 = very long return interval crown fires (>300 years)

There have been numerous large fires in the Breitenbush since 1900 including the following:

Fire Name	Year	Acres
Firecamp Lakes	1914	2000
Dunlap Lake	1920	1500
Byars Ridge	1920	480
Canyon	1958	1025
Eagle Rock	1967	1288
Devil's Ridge	1967	423
Total		6716

Fire suppression activities have been very successful in reducing the number of fires since 1900. Public policy to minimize resource loss and threats to public safety led to increasing abilities to keep fires small. Increasing technology, personnel, road access, timber harvest and subsequent fuel treatment, have combined to reduce acres burned.

Lightening has been the primary cause for most of the historic large fires in the watershed. Although human-caused fires have been a factor since humans first occupied the area, there is no established evidenced that either deliberately or accidentally set fires have been of the scope that appears to be the case with lightening caused fires. Lightening is the probable cause for the large number of fires dating to the 1890's. Numerous stands across the Detroit Ranger District dat

back to this period and are so widespread that no other cause is likely.

The most active area of the watershed in terms of past fires has been the area north of the main Breitenbush River and east end of the watershed roughly defined by the wilderness boundary. The area to the north of the main Breitenbush River is predominantly south facing slopes and is also characterized by lower precipitation averaging between 60 and 70 inches per year. The east end of the watershed is the most susceptible to fall east winds and is primarily in the mountain hemlock plant association series. Approximately 87% of the mountain hemlock zone is currently in earlier seral stages due to fires over the past 150 years. Western spruce budworm, and other insect and disease mortality have likely contributed to high fire occupance in the mountain hemlock zone.

Timber Management

Logging: The first significant timber harvest began in the 1930's with railroad logging in the lower Breitenbush from Detroit up to about the confluence of Humbug Creek. Railroads were also built up Canyon Creek and Humbug Creek for logging. Regeneration cutting, primarily clear cutting, was by far the most common method used and was viewed as both a disturbance comparable to stand replacement fires and as being the most economical. It was practiced as a successful method to regenerate Douglas-fir, the premier commercial species.

Decade timber harvest in the watershed was as follows:

Years	Clearcut Acres	Shelterwood Acres	Commercial Thinning Acres	Tot Acres
1920 - 1929	61			61
1930-1939	1031			1031
1940-1949	-			-
1950 - 1959	842			842
1960 - 1969	3786	6		3792
1970 - 1979	2411		232	2643
1980 - 1989	3816	1963	638	6417
1990-1995	361	132	325	818
Totals	12,308	2,101	1,195	15,604

In general, logging practices from the 1920's into the 60's consisted of logging the lower elevation, easier ground first. This permitted use of ground skidding with tractors and hi-lead cable yarding. The 1960's brought the use of skyline logging and road access into the higher elevation areas. The 1970's saw continued improvement in logging systems and increased use of partial cutting for both visual and reforestation reasons. The 1980's saw the end of machine piling and the beginning of restricting tractors to designated skid roads. It also began the practice of over-the-snow logging on overstory removal units, and the beginning of commercial thinning in second growth stands. The 90's brought regeneration modified to meet wildlife and long-term productivity objectives, increased stream protection and helicopter logging.

Reforestation: The first reforestation documented on the Detroit District and some of the earliest in the Pacific Northwest was done following the Firecamp Lakes Burn in 1914. The next major reforestation effort appears to be planting in the late 1930's and early 1940's of the railroad logged areas previously mentioned.

Following World War II timber harvest became more consistent and as a result reforestation became a more sustained program. Both planting, and natural and artificial seeding were options used from the 1940's into the 60's. Douglas-fir was the preferred species at lower elevations but was not always successful at higher elevations, especially in frost prone areas. Noble fir was a preferred planting species above 3000 feet elevation. Engelmann spruce and ponderosa pine were used on some severe frost pockets where Douglas-fir planting was not successful.

In the 1970's planting became the sole reforestation method due to its reliability and requirements in the National Forest Management Act to assure reforestation within five years after harvest. The shelterwood regeneration method was also used on sites with high frost potential and on warm droughty sites. The 1980's saw the addition of most of the indigenous conifer species to the list of species planted. The most notable species was the addition of rust-resistant Western white pine which had been significantly reduced in the watershed due to blister rust. Western redcedar, Western hemlock, grand fir, Pacific silver fir, sugar pine, mountain hemlock and lodgepole pine were also planted depending on local site conditions. The use of shade cards was introduced in the 1980's for seedling protection on warm droughty sites. The Forest Cultivator/subsoiler began operating during this period to help break up old compaction from prior logging and to help reduce vegetative competition. Also The 1990's have added increased hardwood planting on some local areas, especially in root rot pockets. Increased use of containerized versus bareroot seedlings has resulted in significantly increased survival for certain tree species.

Site Preparation and Fuel Treatment: Throughout the period that timber management has taken place in the watershed, site preparation for planting and fuel treatment have been closely linked. Prior to the 1960's, the record of what fuel treatment was used is not particularly clear but it is generally recognized that the use of broadcast burning was much less than in recent decades and this coincided with less tree planting and therefore less need to prepare sites. Snags were felled for fire hazard reductions from the earliest harvest dates. Utilization standards for timber were relatively low during this period, so a great deal of large material was left following logging and if unburned additional material was left. On gentler slopes, tractor piling was also used with variable effects on soil productivity.

As tree planting became more or less standard practice, along with concern for minimizing fire hazard, broadcast burning became more prominent. During the 60's most of this burning was done in the Fall and frequently was associated with dry conditions which resulted in hot burns and excessive duff consumption. The 1970's saw the introduction of yarding of unmerchantable (YUM) material off of units and for a few years using this as a substitute for burning. This was discontinued as a substitute for burning because it did not treat the small diameter slash, was less than adequate as site preparation, and didn't set back vegetative competition. YUM yarding was continued to help reduce broadcast burn intensities and increasing timber utilization further increased reductions in wood from the sites. The broadcast burning season was extended late Spring to Fall and night burning instituted to take advantage of higher fuel moisture conditions to reduce burning impacts.
In the early 1980's tractor piling of slash was ended due to unacceptable impacts on soil productivity. Broadcast burning was the preferred treatment on most sites. From the late 1980's to the present brought the need to leave green trees, snags, Pacific yew, and logs on harvest units. This coupled with increasing restrictions aimed at meeting air quality standards, created conditions which necessitated a

reduction in the number of acres burned. Grapple piling was also used increasingly on gentler slopes since it provided more flexibility in the timing of burning will minimizing soil damage.

Timber Stand Improvement: Timber stand improvement began in the early 1950's, with pruning and precommercial thinning. Both activities remained at fairly low levels through the 50's and 60's and pruning was discontinued by the mid-60's. Precommercial thinning accelerated during the 1970's and has continued at high levels into the 1990's at a rate of about 500 acres per year for the entire District (precise figures for the watershed alone were not analyzed). Fertilization began in the late 1970's and has averaged about 500 acres per year to the present. Some stands have had multiple treatments. Pruning was reintroduced in 1989 and has averaged 300 to 400 acres per year on the District. Brush release has been a very minor treatment on the District, with snowbrush, Ceanothus velutinus, pulling being the most common method.

Early precommercial thinning tended to leave stocking levels higher than are currently regarded as optimum for acceptable growth. Starting in the early 1970's, fewer trees, generally about 300 per acre were left and this level has continued until the present. Prior to the 1980's Douglas-fir was, in most cases, the preferred crop tree at lower elevations and with noble fir also favored at higher elevations. Other species were left if they were the largest and most healthy trees. In most cases the other species had not been planted and as a result were smaller and therefore not left as crop trees. Beginning in the 1980's provisions were taken to leave representati of all species present which in some cases also resulted in additional trees being lef With the planting of a much wider selection of species, minor species also were in a better position to compete.

Insects and Diseases

Historic levels of diseases and insects are difficult to reconstruct, however, certain stand conditions are known to favor some of these agents. An understanding of past stand conditions may give an indication of what insects or pathogens were most prominent.

One disease, white pine blister rust, was introduced into the region in the early 1900's and has seriously affected both Western white pine and sugar pine. Whitebark pine is also susceptible and although no inventories have been conducted to assess the extent of infection, it is probable based on reports from other localities, that it is also reducing populations here. Of the three susceptible tree species found here, white pine was the most widespread, being found at all elevations. In conjunction with mountain pine beetle attacks, upwards of 90 per cent of the original white pine population may have been killed by this disease. In the early 1980's rust resistant white pine planting stock became available and has been a substantial component of planting since that time. Infection can also be reduced by thinning and

pruning which makes micro climatic conditions less favorable for the rust.

Sugar pine, which is found primarily from Humbug Creek to Scorpion Creek, is in serious decline due to blister rust and other factors. In the previously cited study (Garza, 1995), reduced disturbance by fire, competition from more shade tolerant tree species, and bark beetles are also contributing to high mortality rates in sugar pine. Lack of disturbance is also creating few opportunities for regeneration of the species. Unlike white pine, rust resistant sugar pine have not been confirmed from trees sampled on the District. Limited planting of stock without confirmed resistance has been done to help maintain population levels.

The two primary bark beetles acting in the watershed are the Douglas-fir beetle and the mountain pine beetle. The Douglas-fir beetle is generally found at low levels except when other disturbances such as wind or fire create habitat conditions favorable to its buildup. This was the case following a major windstorm in 1990 and has likely been so when conditions were right in the past. Populations built up in downed trees and spread to standing trees which were additionally weakened by several years of drought. Mortality in the Breitenbush was the highest on the District following the 1990 storm and reached its peak in 1992. Tree kill was probably equal to or greater than the number of trees blown down. Concentrations are highest from about Scorpion Creek east to about the Wilderness boundary and also in the South Breitenbush and Devil's Creek. Additional down trees have been reported as a result of flooding, wind and heavy snow during February 1996. Increased Douglas-fir beetle activity can be expected within the next few years. In stands that have had previous mortality, cumulative impacts may become significant in changing stand structure.

Mountain pine beetle primarily attacks white pine, sugar pine, and lodgepole pine. It appears to be most active in older white pine and sugar pine, especially those that are experiencing high levels of competition or have received some mechanical damage.

Root rots, primarily Phellinus weirii and Armillaria mellea, are endemic to the watershed today and would also have been in historic periods. There is evidence from research that suggests short rotation, single species forest management may increase rates of infection. Certain tree species are less susceptible or resistant to root rots than others and multi-species stands have a greater ability to break root contact between infected and non-infected trees. Root rot infection centers tend to be more difficult to spot in older stands due to other mortality factors so that it may not appear to be as prevalent as in more uniform second growth stands. It is not clear whether the overall impact of infection is significantly greater than historic levels.

Western spruce budworm has been a significant defoliating insect affecting most of mountain hemlock plant association series adjacent to the crest of the Cascades. It is

associated with stands composed of the most susceptible species, Pacific silver fir, mountain hemlock, Douglas-fir, and Engelmann spruce. Severe outbreaks may als affect generally less susceptible species such as lodgepole or white pine. Historic evidence of defoliation in the watershed only was available as far back as 1947. A budworm control spray project was conducted in the early 1950's with aerial spraying of DDT. Previous outbreaks were probably common given the favorable habitat and weather conditions. The most recent outbreak began in 1987 and continued through 1993. Infestation in the Breitenbush was fairly limited in scope and severity but may have had significant effects in some localized areas. It was primarily limited to mountain hemlock plant associations.

Other Disturbances

Other disturbances such as wind, floods, or landslides, are generally localized in their effects and not generally major factors in shaping vegetation patterns over broader areas. Recent wind storms such as the 1962 Columbus Day Storm and the 1990 windstorm severely impacted specific areas. The 1990 storm had its greatest affect adjacent to recently created openings, in partial cuts, along roads, power lines etc. Historically this effect may have been seen along edges of burned areas or other natural openings. During the 1990 storm it appeared than other considerations being equal, younger stands received less blowdown than older, larger stands. The level of blowdown in the past was probably also regulated by the pattern of natural fires, local stand conditions, and timing and location of wind events. As previously mentioned, subsequent Douglas-fir bark beetle kill may add to the direct blowdow mortality and be locally significant. Flooding impacts tend to be localized to a fairly restricted area except in such events as the 1964 flood in which case water levels may undercut trees and scour out other vegetation outside the seasonal floodplain. Large conifers may be replaced by smaller shorter lived red alder. Salvage of logs from the riparian area has widened flood plains and lengthened the recovery period for large confers.

Heavy snow, during January 1996, has resulted in a lot of tree breakage in some stands; adding to fuel loadings and subsequent bark beetle kill.

ii) What are the current condition of late successional habitat?

Late Successional: The oldest stands of trees, for which there is documented information in this watershed, are approximately 550 years old. There may be older stands than this, but they have not been intensively inventoried. Individual trees older than 550 are more likely to be present than are stands of that age, but their infrequency makes them less likely to be sampled during an inventory. The vast majority of the older stands, found in the watershed, date from the early 1600's when fires burned over most of the watershed. This is consistent with stand ages found throughout the rest of the Ranger District.

The harvest of late successional timber has slowed, in recent years, as public controversy over this practice has increased. To ensure protection of this unique resource, land management allocations have been established to protect it. The following chart shows approximately 40 percent of the forested portion of the Breitenbush watershed is in late successional habitat. Of that, about 31 percent is protected from timber harvest, while 9 percent in available for timber harvest.

Late Successional = (old growth and reinitiation stages)		
Land Allocation Category	**Acres of late successional stands**	**% of Forested Portion of the Watershed**
Matrix lands that are forested but unsuited for harvest	2468	4%
Matrix lands that are suited and available for timber harvest	5615	9%
Non-Matrix (other allocations such as riparian reserves, Late Successional Reserves, etc.)	15,933	26%
Total	24,016	39%

Total watershed acres = 69,400; non-forested acres = 8,957; so total forested acres = 60,443

iii) What is the status of non-native species in the watershed? Where are non-native plant populations located? What factors have contributed to their spread?

The following table lists some of the invasive non-native plants found in the Breitenbush watershed. The occurrence column indicates which species are most predominant.

Common Name	Scientific Name	Biological Control	Occurrence
ox-eye daisy	*Chrysanthemum leucanthemum*	No	Widespread
chicory	*Cichorium intybus*	No	Isolated
foxglove	*Digitalis purpurea*	No	Patchy
spotted cat's ear	*Hypochaeris radicata*	No	Widespread
wall lettuce	*Lactuca muralis*	No	Widespread
reed canarygrass	*Phalaris arundinacea*	No	Patchy
self-heal	*Prunella vulgaris*	No	Patchy
red sorrel	*Rumex acetocella*	No	Widespread
curly dock	*Rumex crispus*	No	Patchy
common mullein	*Verbascum blattaria*	No	Patchy

The table below shows five established noxious species occur in the Breitenbush watershed.

Common Name	Scientific Name	Biological Control	Occurrence
Canada thistle	*Cirsium arvense*	**Yes**	**Widespread**
bull thistle	*Circium vulgare*	**Yes**	**Widespread**
Scotch broom	*Cytisus scoparius*	**Yes**	**Widespread**
St. John's-wort	*Hypericum perforatum*	**Yes**	**Widespread**
tansy ragwort	*Senecio jacobaea*	**Yes**	**Widespread**

iv) ***What is our current knowledge of Table C-3 (ROD) and Appendix J2 (FEIS) species occurrence in the watershed, and what is the current status of survey protocols for survey and manage species (C-3)? What other species of concern are found in the watershed?***

A large number of late successional forest plant, animal, and fungal species were identified as needing protection or monitoring in the ROD and S&G for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA and USDI 1994). Habitat for these species has declined in the watershed due to recent harvest of old-growth and associated road building.

The Regional Ecosystem Office (REO) is collecting location information and developing survey protocols (due out in June 1995 and in 1996 respectively). Survey strategies include the following:

Survey strategy 1: manage known sites;
Survey strategy 2: survey prior to activities and manage sites;
Survey strategy 3: conduct extensive surveys and manage sites;
Survey strategy 4: conduct general regional surveys.

Activities implemented in 1995 and later must include provisions for known sites if the species is under survey strategy 1. For species under survey strategy 2, activities implemented in 1999 or later must have completed surveys. Survey strategies 3 and 4 are more general and must be underway in 1996. Surveys have not been initiated for the vast majority of these species. Mitigation measures for these species can be found in Appendix J-2 of the FEIS (Holthausen et al. 1994). Table -- lists species documented on the Detroit District. Those species located in the Mt. Jefferson Wilderness have a high probability of occurring within the Breitenbush watershed.

Survey and manage species documented on the Detroit Ranger District.

Category	Species	Location	Survey Strategy
False truffle	*Rhizopogon albietis*	Breitenbush	3
Rare false truffle	*Alvopa alexsmithii*	Mt. Jefferson Wilderness	1, 3
Rare undescribed false truffle	*Hydnotrya sp. nov. #Trappe 787.792*	Mt. Jefferson Wilderness (Jefferson Park)	1, 3
	Martellia sp. Nov. Trappe 5903	Mt. Jefferson Wilderness	1,3
Nitrogen-fixing lichens	*Lobaria oregana*	Forestwide	4
	Lobaria pulmonaria	Forestwide	4
Vascular plants	*Allotropa virgata*	Forestwide (Roaring Creek)	1, 2

The species locations that are documented on the Detroit District are from herbarium collections and incidental sightings. Appendix J2 of the FSEIS (Holthausen et al. 1994) provides descriptions of the habitat and range of many of these species. Otherwise, no systematic surveys have been conducted by the Forest Service for any of these species. Vascular plants that are on both the C-3 list and the Region 6 Sensitive Plant List suspected or documented to occur on the Willamette National Forest (*Botrychium minganense* and *Botrychium montanum*) have been subject to survey during the normal course of field work. To this date, habitat descriptions of most C-3 plant and fungal species are not specific enough to determine probable locations with existing data.

In addition to the incidental sighting of a Roaring Creek population of *Allotropa virgata* (candystick), ecoplot data reveals an additional Breitenbush population to the immediate east of the Breitenbush Community.

v) What TES species occur in the watershed, and what is the current condition of these populations?

Three plant species found on the Region 6 Sensitive Plant List have been documented in the Breitenbush watershed. These species occur in non-forested habitats, such as meadows and rock gardens. Discussion of sensitive species documented in the watershed can be found in the Botany report. Approximately 10-15% of the Forest Service land in the watershed has been surveyed for sensitive plants, mostly in conjunction with proposed timber sales and other projects. No

surveys for rare plants have been done on private lands in the watershed. Ecoplots have been characterized in the Mt. Jefferson Wilderness, but no systematic sensitive plant surveys have been conducted there.

Sensitive plants located in the Breitenbush watershed.

Common Name	Scientific Name	Number of Pops.	Geographical Area	ONHP status
Gorman's Aster	*Aster gormanii*	5	Byars, S. Breitenbush, Outerson Mtn.	1
Brewer's reedgrass	*Calamagrostis breweri*	1	Jefferson Park	2
Thompson'smist maiden	*Romanzofiia thompsonii*	1	Roaring Creek	1

The Oregon Natural Heritage Program (ONHP) maintains four lists of rare plants based on rarity: List 1 contains species which are endangered or threatened throughout their range. List 2 contains species that are threatened or endangered in Oregon but are more common or stable elsewhere. Lists 3 and 4 are explained below.

Gorman's aster (*Aster gormanii*): Gorman's aster populations in the Breitenbush watershed are located in the vicinities of Outerson Mountain, Byars Peak, and adjacent to the South Breitenbush River trail in the Mt. Jefferson wilderness. All populations appear to be stable.

Thompson's mistmaiden (*Romanzoffia thompsonii*): The documented occurrence of Thompson's mistmaiden in this watershed is located near Roaring Creek. Recent visits have not indicated any significant change in this population.

Brewer's reedgrass (*Calamagrostis breweri*): Threats to this plant mostly involve recreational use of Jefferson Park, including trampling and camping outside of designated areas.

***Other Plant Species of Concern*:** In addition to those species that are sensitive, there are five plant species on Watch or Review Lists documented in the watershed. Definitions of these lists can be found below the table.

Plant species of review and watch lists that occur in the Breitenbush watershed.

Common Name	Scientific Name	Number of pops.	Geographical Area	Status
Larsen's collomia	*collomia larsenii*	1	Park Butte	Watch
	Douglasia laevigata	1	Park Butte	Review
hairy elmera	*Elmera racemosa*	1	Park Butte	Watch
cascade daisy	*Erigeron cascadensis*	1	Boulder Peak	Watch
Suksdorg's silene	*Silene suksdorfii*	1	Park Butte	Watch

The Review List (List 3) contains species for which more information is needed before status cna be determined, but which may be threatened or endangered in Oregon or throughout their range. The Watch List (List 4) contains species of concern that are not currently threatened or endangered. In addition, the Willamette National Forest maintains a Concern List for locally rare species that are not included in the above lists.

b) Reference Conditions

*i) *What is the historical array and landscape pattern of plant communities and structural stages in the watershed? *What processes causes these patterns (e.g., fire, wind, mass wasting)?*

The reference date is assumed to be approximately 100 years ago because there was not much human influence at that time and because of an active fire period that followed that time period. Some of the discussion regarding reference conditions is interspersed in the current conditions section of this document.

The following graph, shows the structural stages by plant association for the 1895 period. Figures were derived from mapping current size classes for unmanaged stands and "growing" them backwards to 1895. Managed stands were assumed to be the same size class as surrounding unmanaged stands for purposes of reconstructing pre-management conditions. In the mountain hemlock plant association series it was somewhat difficult to use this technique to separate out how much area was in stand initiation versus stem exclusion since there were large fires in both the early and late 1800's. Currently both of these fire episodes are predominantly in the stem exclusion stage, but in 1895 there would have been more differentiation.

ii) ***What was the status of non-native invasive plants 100 years ago?***

Oregon was settled by Europeans more than 100 years ago. Chances are that some non-native stock grasses had established by 1895. Because human caused disturbance was limited at that time, these populations were probably insignificant.

iii) What was the historical relative abundance and distribution of species of concern (ROD, TES, others) and the condition and distribution of their habitats and other special habitats in the watershed?

Although there is no data regarding the status of these species 100 years ago, inferences can be made based on habitat. Species associated with habitat that was converted to serve other purposes have probably experienced population decline in size and distribution. Habitat that was not intentionally converted may have incurred some incidental losses. Habitat that was protected may have associated species that realized population increases, if not just population stabilization. Of course, protected areas tend to be high elevation habitat, where harsh environment usually influences species success.

Formation and development of SHABs is mostly a function of changing geomorphology, in which changes are measured in millennia. The more important comparison to make to a 100 year reference point is changes in SHAB structure, function, and species composition.

c) Comparison of Current and Reference Conditions

i) *What are the natural and human causes of change between historical and current vegetative conditions? How and where are current vegetation types and distribution different from historic conditions?

Differences and Similarities Between Past and Current Vegetation - 1895 & 1995

- Smaller openings now than in the past
- Disturbances episodic in the past with fires, rather than continuous currently with timber harvest and sustained yields
- Tree reestablishment after disturbance slower in the past versus current reforestation
- Underburned conditions common in the past, no comparable condition now, other than shelterwoods
- Understory Reinitiation time line speeded up now by thinning versus natural time frame.
- Increased abundance of shade tolerant tree species due to lack of fire.
- Multi-species planting results in more species at earlier age than usually found in natural fire regenerated stands

- Meadow and other special forest habitats currently being encroached by conifers with current fire suppression
- Fewer snags and logs on harvested units in areas that have a long fire return interval, less difference where fires were frequent
- Higher fire hazard, fuel buildup due to fire suppression in areas with short fire return interval
- Higher spruce budworm mortality due to stand conditions resulting from fire suppression
- Increased tree growth in managed versus natural stands at a comparable age.

ii) What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed?

Based on the assumptions made under "reference conditions", species dependent on older forested habitats (the C-3 species) probably have seen decline in populations due to both permanent habitat conversion and habitat conversion to an early seral stage. Species that occur in low to mid-elevation non-forested habitats, such as Aster gormanii, Romanzoffia thompsonii, and Erigeron cascadensis, have probably incurred some population loss based on incidental disturbance (road building) or habitat conversion for more limited uses (rock quarrying). High elevation species including Calamagrostis breweri, Collomia larsenii, Douglasia laevigata, Elmera racemosa, and Silene suksdorfii occupy generally protected habitat, but are subject to harsher environmental conditions, more limited habitat, and the relatively new threat from recreation.

iii) What are the natural and human causes of change between historical and current special habitat quality and distribution in the watershed?

Management disturbance threats to field verified special habitats appear to be harvest units and adjacent roads (8 and 10 percent respectively). Although current numbers of these habitats effected by disturbance are relatively low, an increasing trend in the number of wet meadows surrounded by harvest units and adjacent to roads, and in the number of moist meadows surrounded by harvest units and containing invasive non-native plants could cause an irretrievable local loss of specific plant communities. Management created openings will increase the exposure of meadows and wetlands to fluctuating wind, sun, precipitation, and temperature conditions that alter the micro environment which in turn can alter species composition and distribution (Chen 1994). The FW-211 standard and guideline now requires us to buffer habitats that may be adversely effected by disturbance. In addition to moderating micro climatic changes, buffering can provide a barrier to some human and animal disturbance, as well as invasive non-native seed dispersal. Roads represent permanently disturbed created openings that foster establishment and long term occurrence of invasive weeds, and harbor propagule sources for further weed expansion. The result is reduction and

displacement of various stable native plant communities represented in the landscape. Drier special habitats are presumably less effected by created openings since they generally occur on exposed sites. However, hydrology changes and invasion of dry adapted weeds still needs to be monitored.

Excepting moist meadow, rocky, and shrubby habitats, the scarcity of the other habitat types outside the wilderness in the Breitenbush makes it imperative that these areas be protected from further disturbance.

iv) What are the effects of nonnative plant and animal species on diversity?

Compared to the reference condition 100 years ago, invasive weeds are much more common today. Most of these species originated in Europe, some in Asia, and were either intentionally introduced by humans, or accidentally introduced by humans via ship ballast dumping, stock feed, etc. This invasion of Europeans and the non-native plants they brought with them, resulted in disturbance and establishment of the non-natives, displacing both the native vegetation that existed in the disturbed areas, and competing with native plants of a weedy nature. The increasing disturbance brought about by management and other human activities combined with natural disturbances in these same areas has caused a shrinking of areas dominated by native vegetation. The decline of native vegetation in turn, limits the distribution of associated animals.