C. LARGE-SCALE NATURAL PROCESSES

Bailey's ecoregion classification of the United States places the Study Area in the Oregon and Washington Coast Ranges section of the Cascade Mixed Forest-Coniferous Forest-Alpine Meadow Province (McNab and Bailey 1994). The Coast Ranges section is primarily highly dissected low mountains that were shaped by debris slide processes on slopes of 40 to 120%. Incised valleys are distributed throughout the section. Dunes and bogs occur along the coast, with numerous headlands formed of more resistant rock. An elevation range from sea level to 1,800 feet is dominant. Most mountain tops are below 2,000 feet, though several are 3,000-4,000 feet elevation and a few have meadows on top, which offer spectacular views on clear days.

Soils are developed from Cenozoic sandstones, siltstones, shales, and marine volcanics. Typical soils are moderately deep or deeper, and have dark, humus-rich topsoil. Predominant soil orders are andisols and inceptisols that are not dry for more than a quarter of year, with mean annual soil temperatures of 0-15°C. In the coastal lowlands and hills, seasonal soil temperatures are moderated by fog and sea breezes.

Where high waterholding capacities exist, plant communities are dominated by deciduous or deciduous/conifer mixed stands on all slope positions, with understory vegetation communities typically composed of salmonberry, devils club, and other moisture-requisite plants. Where low waterholding capacities exist, plant communities are dominated by conifer stands on flat to convex slopes and alder occurs only in concave draws. Understory plants are primarily those that tolerate dry summer months, such as salal.

Potential natural vegetation types are Sitka spruce forests in the coastal fog belt. Western redcedar is present in drainages and lower elevations where soil moisture is abundant. In the interior of the Coast Range, sites adjacent to riparian areas are often dominated by western hemlock. The dominant type on mid-to-upper slopes is a climax western hemlock forest, generally composed of Douglas-fir with minor western hemlock and western redcedar.

The major natural factors affecting ecosystem dynamics are fire, wind, and landslides.

CLIMATE

The Oregon Coast Province has a maritime climate resulting from its nearness to the Pacific Ocean and influence of the Japanese Current. Cool, wet winters and relatively warm, dry summers are characteristic. Low-pressure systems feed a stream of cool, moist air from the North Pacific Ocean onto the Oregon Coast from November through March. The moist air rises over the Coast Range and drops large amounts of precipitation. Occasionally, Arctic air meets an onshore flow, producing snowfall. In general, snow persisting for more than a few days is limited to the tops of the highest peaks.

Temperatures are relatively mild. The average annual temperature on the Forest is 50°F. The average high in August is 73°F, but summers are hot and dry in

the interior of the Forest. Along the coast is a cool, damp "fog belt" which can extend inland up to 1 mile. The average low in January is 36°F. In the winter, when high pressure obstructs the onshore flow of relatively warm air, skies clear and nightime frost may appear. High pressure usually develops off the coast in the summer, deflecting most storms north into Canada. The high-pressure system occasionally breaks down during late summer, resulting in rain during August and September. Although precipitation amounts are typically small, the tendency for summer rains is greatest on the North Coast. Fog occurs often along the coast and inland river valleys during the summer. Fog drip may contribute significantly to available mositure during the summer in the immediate coastal strip.

Orographic effects are pronounced in the Oregon Coast Range. Major ridges receive substantially more precipitation than do nearby lowlands. Coastal areas average 75 to 95 inches of precipitation annually, and interior areas west of the crest receive an average of about 120 inches annually. Higher precipitation occurs in the northern Coast crest area, with up to 190 inches annually around Cedar Butte in the Tillamook State Forest, and about 175 inches annually in the mountainous terrain east of Siletz Bay. East of the Coast Range crest, in the Willamette Valley border area, precipitation averages about 50 inches each year.

High potential evapotranspiration and low precipitation during warm, sunny summers may produce moisture deficits where soil and bedrock have low waterholding capacities. Moisture available to plants varies greatly between different areas of the province. The primary cause is the inherent differences between areas in moisture-holding capacity of soils and bedrock. Moisture deficits are more pronounced in the south half of the Forest than in the north half because soils are generally thinner and bedrock tends to be only slightly permeable to impermeable in the south. Soils in the north half are generally deeper and the bedrock is more highly fractured and permeable. However, in all zones, stands on ridges and exposed south-facing slopes with thin, rocky soils can develop substantial plant moisture stress in late summer. These conditions are especially common on the south end of the Forest.

Prevailing winds are moderate northwesterly in summer and strong southwesterly in winter. Dry easterly winds can occur for 2-3 days at any time of the year. Also, generally during the winter, several windstorms each year reach velocities up to 100 miles per hour. Relative humidity is generally above 40%, except during easterly winds.

Within the Sitka spruce area, wind is the dominant force shaping the landscape (Agee 1993). Fires occur in this area, but the moister climate makes them less frequent. Windstorms, often associated with rainstorms, may occur during the fall and winter. One severe windstorm in this area was the Columbus Day storm of 1962, when windspeeds of 120 miles per hour were measured at Newport. This storm blew down many timber stands throughout the Coast Range.

A more recent storm in November 1981 had wind speeds of 140 miles per hour measured in Yachats. Such storms, especially during periods when the soil is saturated with moisture from recent rainfall, often trigger extensive blowdown. Each year, because of strong winds, small gaps are created in the forest canopy as storms pass through.

SOIL/CLIMATE ZONES

Derivation of Zones

For the purposes of forest-wide assessment, the Study Area has been divided into five soil/climate zones (hereafter referred to as "zones"). Each zone represents a unique combination of the key building blocks that form a foundation for the ecosystem: landforms, soils, geology, and climate. These groupings of physical factors, in combination with natural disturbance processes such as fire and wind, influence the vegetation characteristics of each area.

In order to delineate the unique soil/climate zones, the Study Area is first divided into several components called Landtype Associations (LTAs) that have distinct physical and climatic characteristics. Each Landtype Association is composed of various Soil Resource Inventory Mapping Units, or landtypes, that were described in the Siuslaw National Forest Soil Resource Inventory. The landtypes that make up each association are generally similar in geology, landform, soils, and hydrologic response. A detailed description of each Landtype Association can be found in Appendix C.1 (Landtype Associations).

The geology, landform, and soils characteristics of each LTA is combined with climatic factors to develop the soil/climate zones. Five zones are described for the Study Area (Map C.1):

1) Coastal Fog Zone
2) Northern Interior Zone
3) Central Interior Zone
4) Southern Interior Zone
5) Valley Margin Zone

The five zones will be described, then the role of natural disturbances and subdivision of the zones into eight smaller disturbance-regime blocks.

Description of Zones

1) Coastal Fog Zone

- High winds commonly in winter
- Very high winter rainfall;
- Fog and low clouds that result in slight differences from summer to winter air and soil temperatures (isomesic), and increase effective soil moisture in summer;
- High soil moisture in summer (except on few very shallow soils on south slopes);
- Very high accumulations of soil organic matter;
- Soils high in amorphous clays - often thixotropic; and

- Vegetation dominated by spruce, cedar, and hemlock with salmonberry and alder as important components;

2) Northern Interior Zone

- Occasional very high winds in winter;
- Very wet winters and moist summers;
- Significant differences in soil temperatures from summer to winter (mesic) below 3000 feet;
- Winter soil temperatures that range to very cold (mesic to cryic) above 3000 feet;
- Generally high soil moisture with moderate soil moisture fluctuations from winter to summer;
- High biologic activity accompanied by high decomposition rates and moderate to high accumulations of soil organic matter;
- Very deep fine-textured soils overlying highly permeable bedrock; and

- Plant communities on most slopes that include alder, salmonberry, and devils club with Douglas-fir and western hemlock as the dominant conifers; mixed deciduous/conifer stands occupy most forested sites

3) Central Interior Zone

- Occasional high winds in winter;
- Wet winters and moist summers;
- Significant differences in soil temperatures from summer to winter (mesic) below 3000 feet;
- Winter soil temperatures range to very cold (mesic to cryic) above 3000 feet;
- Moderate soil moisture fluctuations from winter to summer with summer soil moisture levels varying from very high on lower slopes to moderately dry on upper sideslopes;
- High biologic activity accompanied by high decomposition rates and moderate accumulations of soil organic matter;
- Deep to very deep moderately fine-textured soils overlying slowly to moderately permeable bedrock;

- Plant communities are mixed conifer and alder/salmonberry with <u>either</u> alder or conifer dominating on higher slope positions depending upon summer soil moisture levels;
- Douglas-fir and western hemlock compose the majority of forest communities

4) Southern Interior Zone

- Occasional very high winds in winter;
- Very wet winters and moist summers;
- Significant differences in soil temperatures from summer to winter (mesic) below 3000 feet;
- Winter soil temperatures range to very cold (mesic to cryic) above 3000 feet;
- Moderate to very great fluctuations in soil moisture from winter to summer;
- High biologic activity accompanied by high decomposition rates and moderate accumulations of soil organic matter;

- Shallow to deep, fine to medium textured soils overlying impermeable bedrock;

- Conifers dominate plant communities on most slopes with alder/salmonberry and mixed conifer communities generally only in draws and along perennial streams;
- Douglas-fir and hemlock dominate the majority of forest communities

5) Valley Margin Zone

- High winds are uncommon;
- Moist winters and dry summers;
- Significant differences in soil temperatures from summer to winter (mesic);
- High soil moisture fluctuations from winter to summer with low soil moisture common during summers;
- Moderately high biologic activity and moderate decomposition rates and low to moderate accumulations of soil organic matter; and

- Vegetation ranges from madrone and oak in the easternmost areas of these areas to mixed-conifer forests in the western-most areas;
- Douglas-fir is the dominant conifer species in forest communities.

Watershed boundaries do not neatly coincide with soil/climate zones, but about half of the watersheds are within a single zone. The other watersheds contain 2-3 zones. Appendix C.2 provides a list of the soil/climate zones located in each of the watersheds.

NATURAL DISTURBANCE PROCESSES

Fire and wind are the two dominant disturbance processes affecting vegetation pattern at the large scale in the Oregon Coast Province. The frequency, severity, and size of these disturbances have greatly influenced composition and structure of both plant and animal habitats across the landscape. Geographic variability of disturbance effects will provide baseline information and guide the type and arrangement of future ecosystem management activities.

Both physical and biological elements of the landscape affect disturbance process patterns and effects. The physical environment includes geologic and climatic processes. Physical features such as landform type (relief and drainage density patterns) and soil and geological substrates influence fire behavior patterns and vegetation response. Climatic features, such as precipitation, fog, and east wind patterns may control fire spread and effects on vegetation composition and pattern. Biological distribution of the major forested vegetation series (Sitka spruce, western hemlock) identify macro habitats and potential fuel loading. The Sitka spruce series, for example, is located in areas with high coastal influence (high humidity, frequent fog).

Knowledge of ecosystem processes and effects provides baseline information for ecosystem management. Plant and animal species have adapted to the edaphic, temporal, and spatial patterns on the landscape. An understanding of the range of vegetation patterns can provide us with a template for providing habitat for the myriad of species we manage.

Fire History

The long-term history of fire activity and effects in the Study Area have not been systematically documented. Fire disturbances in Northwest coastal zones are described as low frequency (more than 200 years between disturbances), high severity regimes (Agee 1993). Projects are currently underway to provide much-needed information to determine temporal elements of fire activity in the Coast Range. Although studies are ongoing, preliminary results indicate distinct differences in disturbance frequency, intensity, or both from coastal to interior to valley margin zones. Variability within zones also appears to be important (Impara, personal communication).

Large scale fire activity in the Study Area from 1850-1940 has been reported. Teensma et al. (1991) mapped age class distributions (inferred from various sources) for four time years: 1850, 1890, 1920, and 1940. The distribution of age classes across the Study Area is listed below in Table C.1.

Table C.1. Percentage of landscape burned between 1850 and 1940

Age Class (years)	1850	1890	1920	1940
	-------Percentage of Landscape----			
Recently burned	42	8	10	3
0-49	--	17	2	19
50-99	--	24	14	3
100-199	21	2	24	37
200+	20	32	33	21
untyped	16	16	16	16

Age-class distribution has changed within these periods, from a bimodal young/old landscape in 1850 to a multi-aged landscape in 1940. The percentage of area occupied by the 200+ age-class remains fairly constant throughout time. The total number of age-class patches has increased 57% from 1850 to 1940 (Table C.2). Patch sizes are decreasing, especially in the 100-199 age class. Geographic variability is apparent in both the number and type of age-class patches within the Study Area (see Maps C.2 and C.3).

Table C.2. Number of patches in 1850 and 1940

Age-class (years)	1850	1940
	--Number of patches--	
Recently burned	68	2
0-49	3	56
50-99	7	26
100-199	22	80
200+	21	26
TOTAL	121	190

Post-settlement fire activity has been high in the Study Area since the mid 1800s. Sites across the Study Area were burned, then reburned from one to three times. Frequency of burning activity in the Study Area is as follows:

-- 3% unknown
-- 42% burned before 1850
-- 48% burned once since 1850
-- 5% burned twice since 1850
-- 1% burned three times since 1850

Map C.4 details numbers and areas of reburn from 1850-1940. This estimate is probably conservative because only large fires were reported, many of which were actually several fires that burned and reburned within the mapped period (Munger 1944, Juday 1976, Teensma et al. 1991). Many smaller scale settlement-related reburns may have also occurred between mapping periods (Teensma et al. 1991). In addition, the number of reburns has risen dramatically from pre-settlement to post-settlement periods (Teensma et al. 1991).

The frequency of reburns can significantly influence stand characteristics. Snag density and coarse woody debris loadings may decline. Reburns may also reduce seed source and favor early seral or fire-adapted species (Agee 1993). Stand development may be delayed, lengthening early seral conditions on the landscape.

Development of Disturbance Regime Blocks

Landtype Associations and Vegetation Series maps were used to stratify the landscape into disturbance regime blocks. The Associations were grouped into areas predicted to have similar disturbance behavior patterns. Relief patterns and climatic influences (fog, east wind) were considered in the grouping. The Plant Association Groups (PAGs) (Map C.5) were then used to refine the boundaries of the disturbance regime blocks. Appendix C.3 provides a description of the PAGs associated with the Study Area.

These working boundaries were overlayed on the age-class distribution maps (Maps C.2, C.3, and C.4) to validate assumptions about the effects of physical and biological elements on disturbance processes and resultant vegetation patterns. The overlay provided an accurately description of the geographic variability of patch distribution across the landscape. It also validated the inferred strong influence of landform/topography, climate, and vegetation distribution on disturbance processes and landscape pattern.

Eight disturbance regime blocks were identified (Map C.1), each with a unique combination of disturbance elements, vegetation composition, and patterns. Block locations reflect a distinct east/west gradient, concurring with Coastal, Interior and Valley Margin zones observed by Impara (personal communication) and Juday (1976), described earlier. Within-zone distinctions were based on variability in vegetation composition and development or patterns on the landscape.

The following groupings are used to describe each disturbance block:

Disturbance size and behavior:

- **Small**: <100 acres. Creeping and smoldering ground fires with occasional torching of individual or clumps of trees in pockets of heavier fuels.
- **Medium**: 100-1000 acres. Torching of individual or clumps of trees is more frequent with runs of crown fire. Wind dictates the spread and direction of the fire.
- **Large**: 1001-10,000 acres. Crown fires independent, fire runs through the crowns without support from an intense surface fire. The crown fire may race far ahead of the front of the surface fire. Spotting and major fire runs occur. Wind dictates the spread and the direction of the fire.

  Jumbo: >10,000 acres. Fire behavior is the same as large size.

Disturbance frequency:	Low	> 300 years
	Moderate	100-300 years
	High	< 100 years
Disturbance severity:	Low	< 30% stand mortality
	Moderate	30-70% stand mortality
	High	> 70% stand mortality

The eight disturbance regime blocks are described below, grouped by soil/climate zones. Analysis of the vegetation in each block has not been completed. Comparisons of pre-logging and current seral stage distributions can help determine management related impacts on vegetation pattern. This information can be used in conjunction with knowledge of historic pattern to guide management priorities and activities within each disturbance block. Completed analysis is scheduled to be completed this year.

Coastal Fog Zone

Coast (Block 1): Landforms in this zone are characterized by low relief, with scattered headlands and hummocks. Wet and mesic Sitka spruce plant association groups dominate the area.

Wind is the dominant process affecting landscape pattern in this zone, varying from small to medium disturbances at high to moderate frequencies, and large to jumbo size disturbances at low frequency. Fire is very uncommon (low frequency) and severe, creating jumbo patches on the landscape. Potential for lightning ignition is virtually absent, with high humidity/low evapotranspiration discouraging severe fire activity under all but extreme drought and high east wind conditions.

A unique landform in this fire block is the Rock and Cummins Creek complex. These drainages are oriented east to west, funneling east winds at high speeds, which could lead to rapid fire spread through this area. Aboriginal and settlement activity has played a major role in shaping pattern as well. Portions of this block have burned at least three times since the 1850s.

Repeated burning could be responsible for increases in the number of small and medium patches. High reburn frequency may also affect snag density and coarse woody debris loading in some areas.

Landscape pattern is a heterogeneous mix of patch sizes and seral stages. Early seral patches are most frequently small and medium, resulting from small-scale wind events. Large and jumbo patches move from early to mid, often to late seral based on the low frequencies of fire and large scale wind events.

Successional pathways vary depending on disturbance type. Wind thins from above, which may accelerate succession by favoring a shade-tolerant understory of Sitka spruce, with western hemlock and western redcedar as cohorts in places. Downed wood serve as nurse logs that favor later seral species such as Sitka spruce and western hemlock. Fire thins from below, which may arrest succession by favoring earlier seral species like red alder and Douglas-fir. Early seral brush species such as salal and salmonberry are also favored.

Seral distribution patterns--Seral distribution patterns reflect the heterogenous nature of this block, with all seral stages represented on the landscape in variable amounts (Fig. C.1). Appendix D.1 provides a description of seral designations used in this report. In 1948-56, mature conifer was the dominant seral stage, covering 40% of the area, distributed chiefly in large patches across the landscape (Fig. C.2 and Fig. C.3). Mature conifer areas are much reduced under current conditions (25% of area), with over a 100% increase in the number of patches. Distribution patterns have shifted more to medium patches (Fig. C.3). Jumbo patches have disappeared under current condition, fragmenting into smaller patches. The number of acres of all seral stages in the small patch class has increased (Fig. C.4).

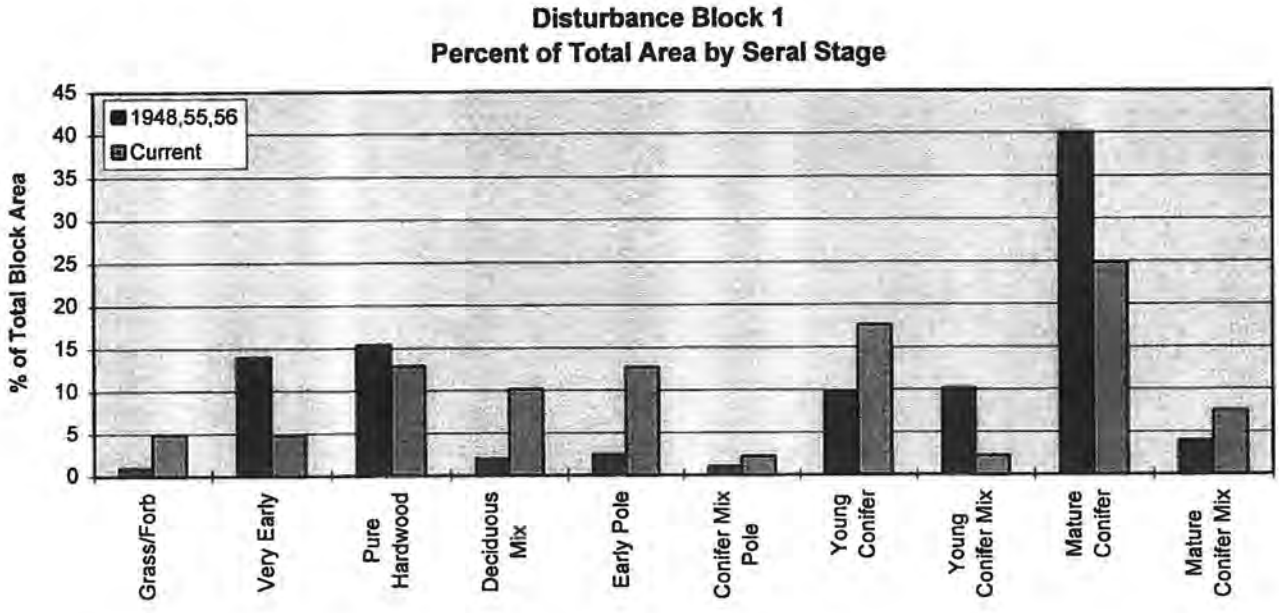

Figure C.1 Disturbance Block 1, Percent of total area by seral stage

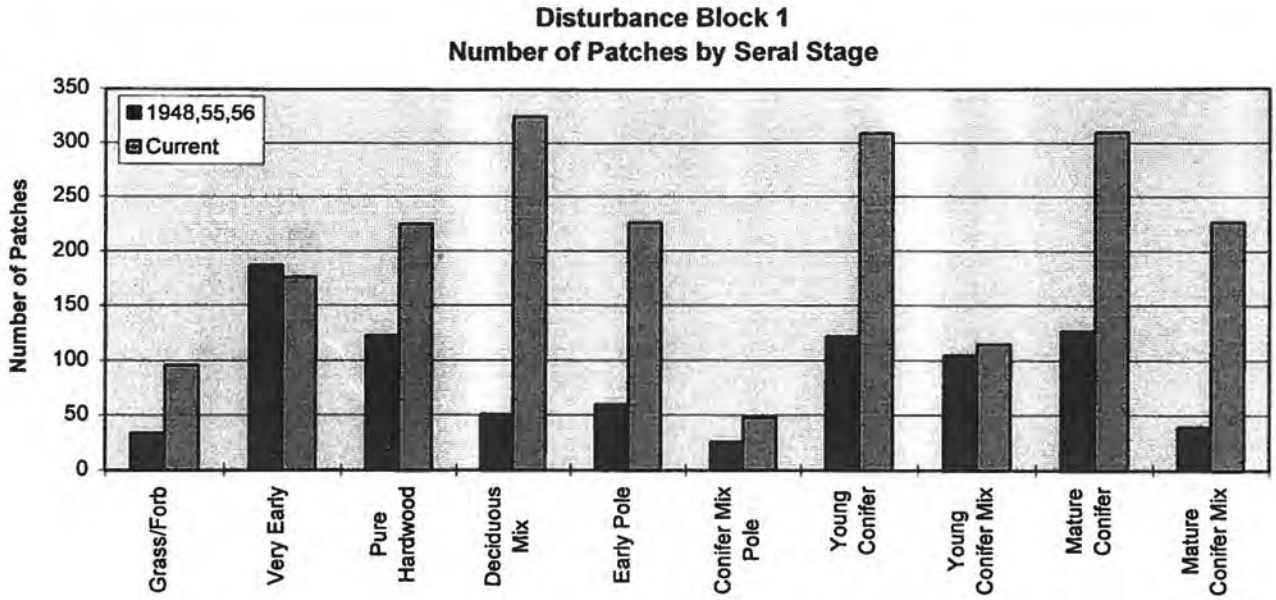

Figure C.2 Disturbance Block 1, Number of patches by seral stage

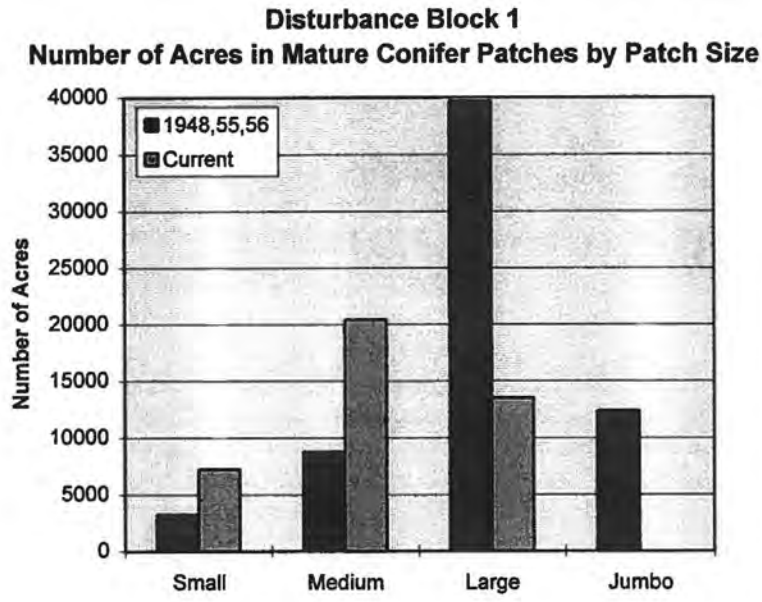

Figure C.3 Disturbance Block 1, Number of acres in mature conifer patches

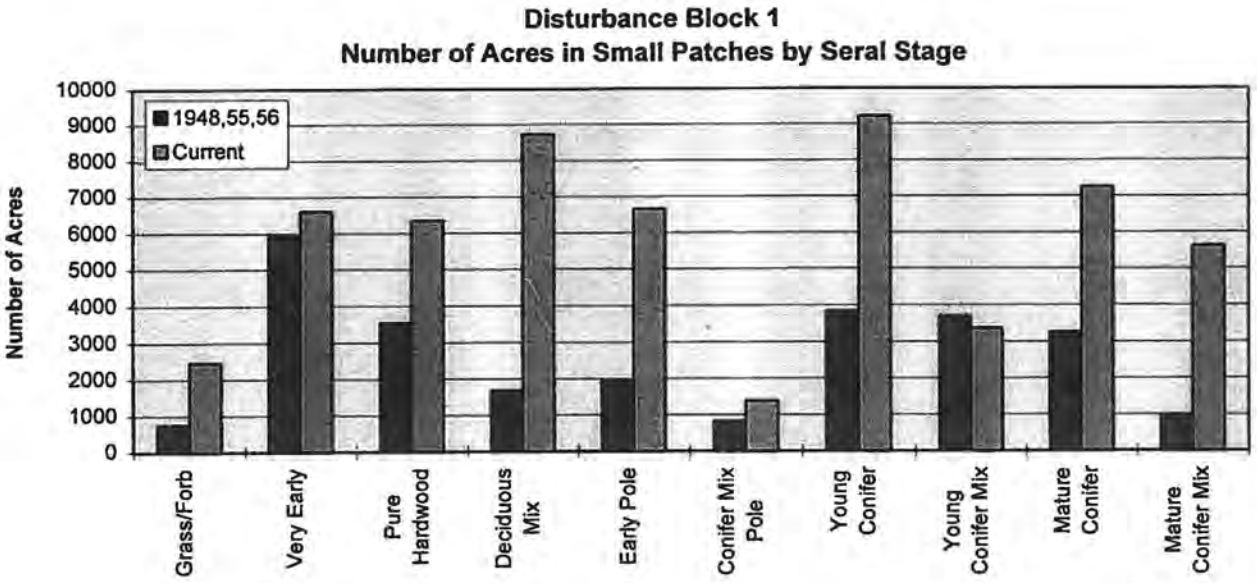

Figure C.4 Disturbance Block 1, Number of acres in small patches

Management implications--Loss and fragmentation of mature conifer habitat, and fragmentation of many seral stages (especially pure hardwood, deciduous mix and young conifer) are evident in this block. Management activities that accelerate succession and aggregate patches are recommended to encourage mature conifer restoration. Aggregation of early seral patches is desirable to reduce fragmentation, and produce large to jumbo patches. Scattered small to medium patches of the early seral component may continue to be distributed across the landscape.

Northern Interior Zone

Northern Interior-Tillamook (Block 2). Steep,highly dissected bedrock-dominated ridge systems characterize the landforms in the Tillamook block. Both western hemlock and Sitka spruce zones are present. Mesic and well-drained western hemlock plant association groups occupy about half the Siuslaw National Forest land, with wet and mesic Sitka spruce groups in 35% of the Siuslaw land base.

Fires in this block are infrequent and severe. A strong east/west ridge system, coastal influence, and high precipitation decrease chances of fire spread. The Columbia River corridor funnels east winds of powerful force; consequently fires burn hot and spread rapidly in periods of drought. When fires occur they are wind driven. Lightning potiential exists in the interior of the block on higher ridges. Historically, fires may have been ignited by aborigines and settlers from both the Tillamook basin and the Willamette Valley

margin. The fires of 1850 produced one patch in this block that occupies 21,000 acres.

Large and, more commonly, jumbo patches dominate the landscape. A single seral stage will dominate this zone, proceeding from early through mid, often to late seral, given the low fire frequency of this block.

Alder is a dominant component in early seral conditions, and remains an important cohort throughout later seral stages. Douglas-fir may be common in mid-seral stages, with Sitka spruce, western hemlock and western redcedar dominating in late-seral stages.

Northern Interior-Hebo (Block 3). Landforms in the Hebo block consist of low, hummocky relief, with scattered peaks. Dominant plant association groups consist of mesic (44%), well-drained (28%), and wet (22%) western hemlock types.

Landscape pattern in this zone has been heavily affected by settlement and post-settlement burning practices, so that the pre-settlement pattern is difficult to determine. At least a quarter of this block has burned at least twice since the 1850s. This estimate of reburns may be conservative because many settlement fires were not recorded. Fire potential and behavior under drought and strong east wind conditions are similar to those of Northern Interior-Tillamook (2), although Block 2 may serve to protect this zone from milder east wind effects. On the east edge of the block, conditions are somewhat drier and fires that would burn without drought and strong east winds could smolder and creep in logs and duff, with occasional individual and clumps of trees torching. This fire behavior leads to a potential regime of low frequency, moderate to high severity, medium to large fires in this zone.

Landscape vegetation pattern in this zone can consist of medium to jumbo patches, with variable residual tree densities within patches. Either a single seral stage dominates this zone, moving through succession from early to mid to late conditions, or a more complex post-fire pattern of early, mid-late can be found, depending on fire behavior elements. Because this regime is episodic, early seral conditions would succeed to mid-seral, and potentially late seral over time.

Alder plays a major role in all seral stages, dominating many early seral conditions, and persisting in mid and late seral stages. Douglas-fir is a major component of mid-seral conditions, with western hemlock and western redcedar dominating late seral stages.

Central Interior Zone

Central Interior-Lincoln County (Block 5). Landforms of the Lincoln County block are characterized by low relief, gentle bedrock-dominated ridges and valleys. About half of the Siuslaw National Forest in this block are covered by mesic western hemlock plant association groups, with wet (25%) and well-drained (17%) also well represented.

Low relief combined with a wide coastal zone adjacent to this block (the coastal zone is widest at this point) create variable fire conditions. Fire

behavior in this block would be influenced by the strong north east winds in drought years. Fire effects in the western portion of the block would be dampened by the strong coastal influence. Lightning activity would be most likely in the higher topography in the north-central section of the block. The fires of the 1830s to 1840s, for instance, consisted of 15 patches: one small, six medium, six large, and two jumbo. These factors create a regime of low frequency, variable severity (moderate to high), and medium to jumbo size disturbances.

Landscape pattern has been heavily influenced by settlement and post-settlement activities. The southern half of this block has burned at least twice since the 1850s. This area was probably used and homesteaded by both Native American and European settlers, with easy access from the Willamette Valley.

Alder is a component of earlier seral stages, but it is beginning to decrease in importance, especially towards the south end of the block. Douglas-fir, dominates mid-seral stages, with western hemlock and western redcedar major components of late seral conditions.

Central Interior-Alsea (Block 6). Landforms of moderate relief and high dissection occupy the Alsea block. Most vegetation lies within the mesic and wet plant association groups of the western hemlock series. Wet and mesic Sitka spruce associations are found along stream corridors and in local fog zones.

Fire is an infrequent, severe process in this block. Coastal headlands serve as a moderate barrier to marine influence. Lightning activity is very low. This block lies in a remote area with little to no aboriginal or settlement activity. Fire behavior in this block dependa on strong east winds in drought years. During the summer, this area can receive additional east wind events from the thermal low that moves along the coast from the Sacramento Valley and then moves inland over the northern portion of the block. These conditions serve to create a fire regime of low frequency, high severity and large to jumbo fires (a single burn patch from the fire of 1849 occupied 265,000 acres).

Large to, more commonly, jumbo patches compose the landscape. One to few patches cover most of the area in this zone, creating a strong matrix consisting of a single seral stage. This dominant seral stage will change over time, from early to mid, probably to late seral conditions, given the low frequency of disturbance.

Post-disturbance succession can follow several pathways, depending on disturbance type, frequency, and post-fire conditions. Alder becomes an infrequent component in early seral conditions, being relegated to stream channels or frequently disturbed sites in the southern end of this zone. Douglas-fir, western hemlock, and western redcedar are components of mid and late seral conditions. Stand density and species composition are a function of topographic conditions, reburn frequency, seed source availability, and brush competition.

Seral distribution patterns--Seral distribution patterns in 1940-56 reflect this block's disturbance regime (Figs. C.5 and C.6), with about 60% of the landscape occupied by mature conifer, distributed among 100 patches. Mature

conifer patch area was dominated by two jumbo patches (Fig. C.7). Mature conifer mixed stands were distributed over 18% of the landscape in a few more than 100 patches. Patch area was covered by mostly large and medium patches. Total mid-late seral conditions were distributed over 78% of the landscape.

Current conditions display a much different vegetation pattern (Fig. C.5). Mid to late seral conditions occupy 41% of the block area--a decrease of 90%. Mature conifer stands are distributed across 30% of the landscape in over 650 patches. No jumbo patches exist (Fig. C.7). Medium patches now dominate the landscape area, with many small patches also represented. Mature conifer mixed stands occupy about 11% of the landscape, in close to 500 patches. No large patches exist, with medium and small patches representing the size-class distribution (Fig. C.8).

Numbers of patches and acres in the small patch class (Fig. C.9) for all other seral stages has also increased dramatically from 1940-56 to present.

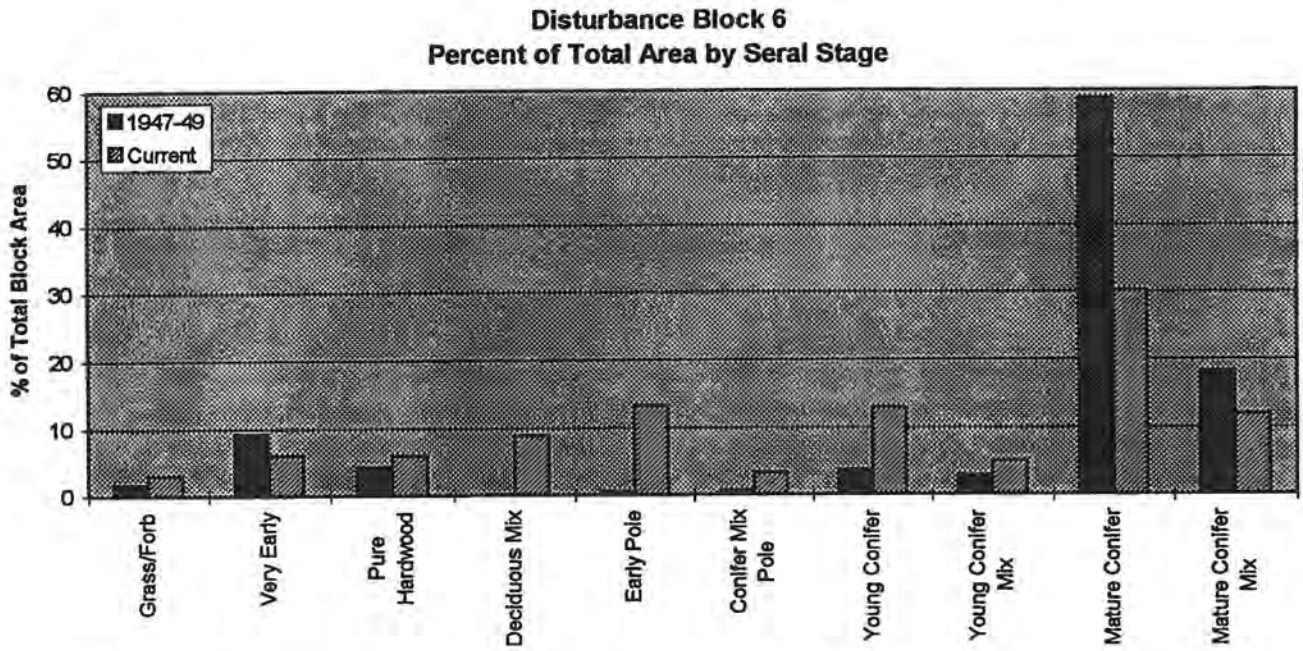

Figure C.5 Disturbance Block 6, Percentage of area by seral stage

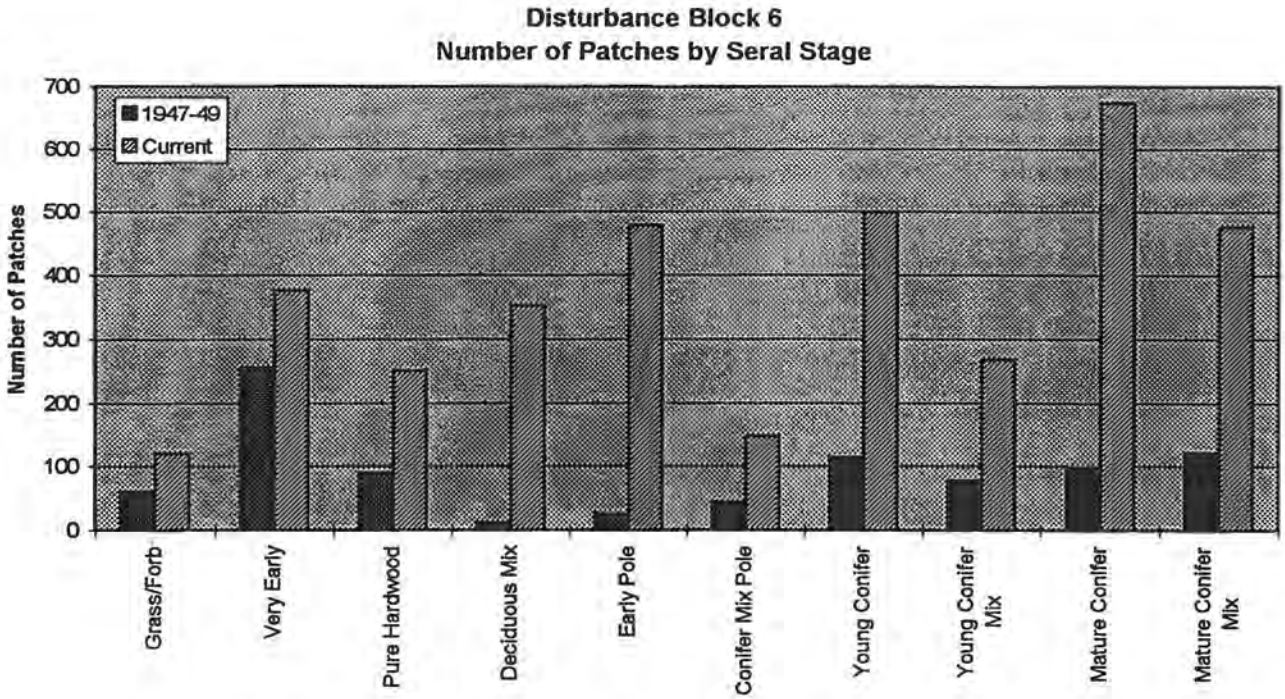

Figure C.6 Disturbance Block 6, Number of patches by seral stage

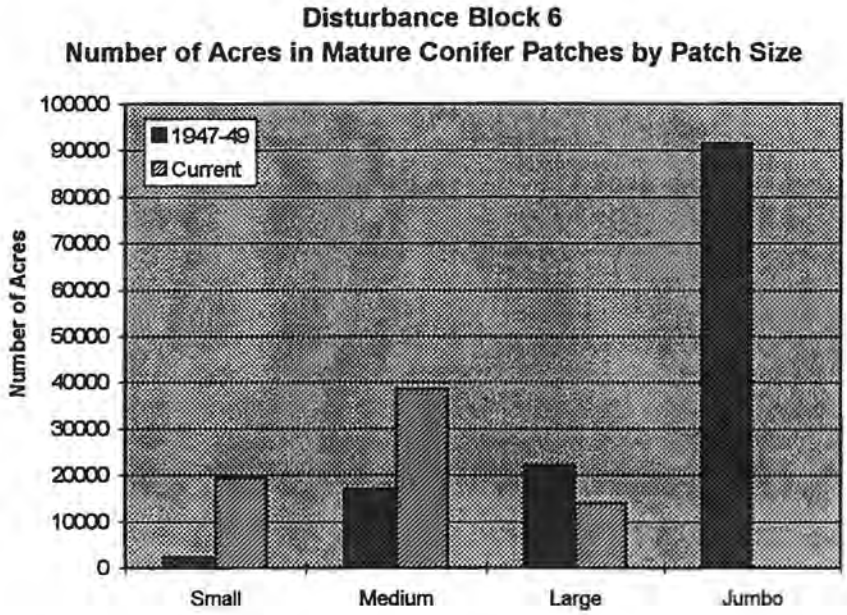

Figure C.7 Disturbance Block 6, Number of acres in mature conifer patches

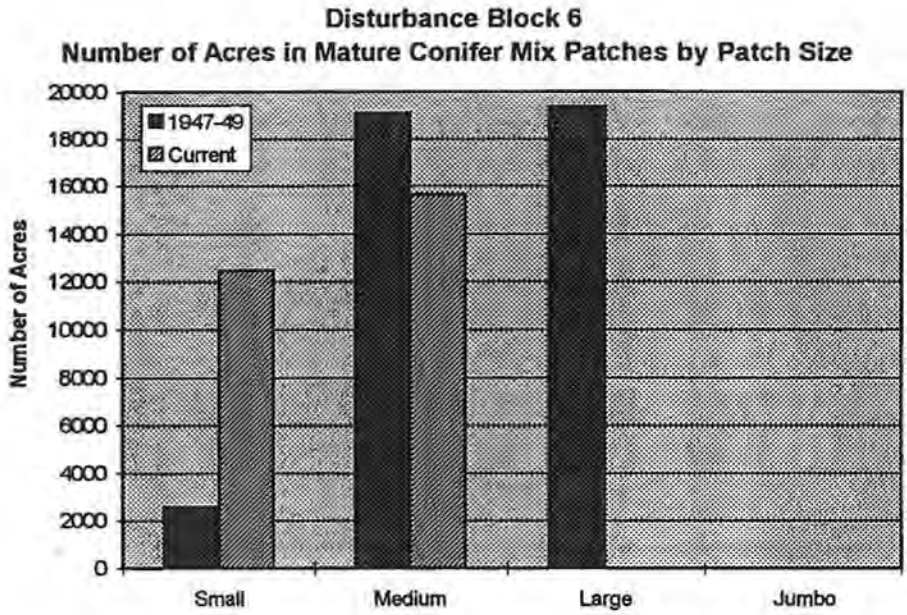

Figure C.8 Disturbance Block 6, Number of acres of mature conifer-mix patches

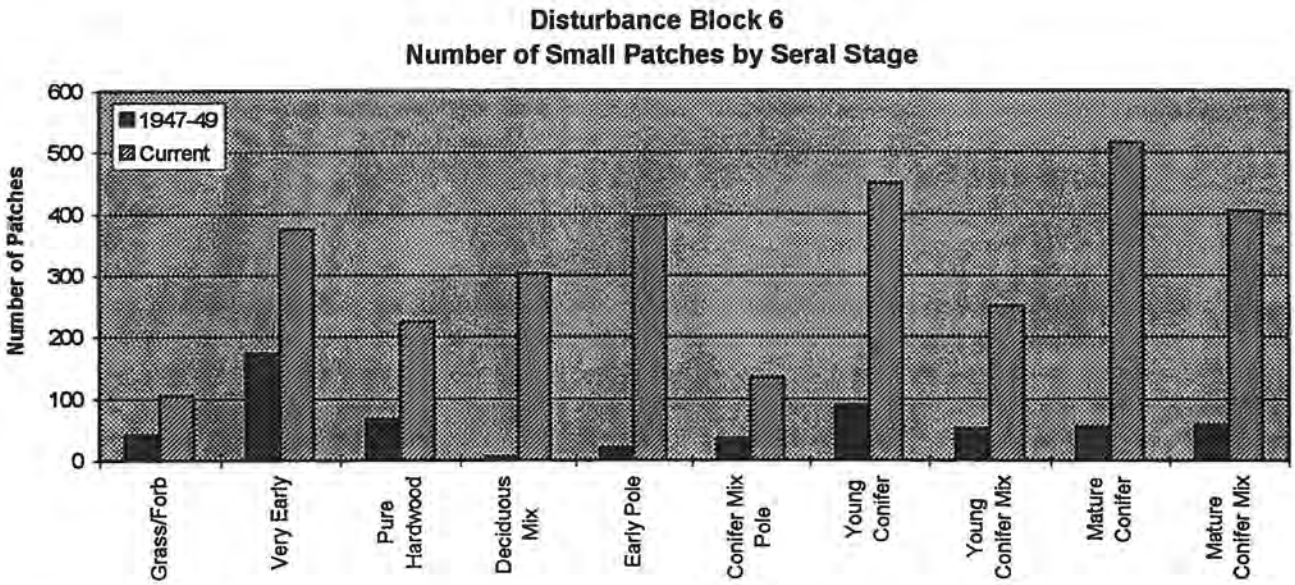

Figure C.9 Disturbance Block 6, Number of small patches by seral stage

Management Implications--Loss of mid-late seral conditions and fragmentation of existing habitat are two driving issues in this block. Management activities to aggregate patches and accelerate succession should be considered.

Central Interior-Marys Peak/Alsea Valley (Block 7). The Marys Peak/Alsea Valley block includes variable landforms, with valley fringe (Alsea Valley), moderate relief features and peaks (Marys Peak). Vegetation types are variable as well, with well drained, mesic and wet western hemlock associations occupying about equal area throughout the block.

Alsea Valley and Marys Peak have been heavily used by both Native Americans and European settlers. Fire patterns may have been affected by this use. A portion of the block has had at least three reburns since 1850. Marys Peak is a potential lightning source. Fire behavior and effects should be more severe to the east of Mary's Peak because of the rain shadow. The steep slopes that surround Marys Peak and the gentler relief around Alsea Valley also produce variable fire behavior within this block.

The variable vegetation pattern reflects the physical and biological variability on the landscape. Separating human from process effects is difficult. Landscape pattern potentially consists of medium to jumbo patches, with high potential for variability of remnant trees within and between patches.

Southern Interior Zone

Southern Interior-Siuslaw River (Block 8). Landforms in the block have moderate relief and high dissection. Mesic to dry plant associations in the western hemlock series occupy the site, with over 90% of the dry Plant Association Groups distributed within this block.

Fire pattern in this block has variable size, low to moderate frequency and moderate to high severity. The Siuslaw River acts as a funnel for east winds, creating conditions that could lead to large or jumbo fire events, similar to block six. Deeply dissected ridges create barriers to wind movement and potentially fire spread, and could be responsible for variable fire effects, especially across the central and southern portions of the block. The Goodwin Peak/Baldy Mountain ridge system has the highest lightning probablity. Some aboriginal and settlement influences have affected landscape pattern, with small portions of the block burning at least twice since 1850.

Vegetation patterns in this block are variable in size, ranging from small to jumbo patches in early or mid-seral stages, with some patches developing into a late seral stage.

Conifer species, such as Douglas-fir, dominate most upland seral stages, with western redcedar and western hemlock often found first as cohorts, then as dominants in late seral conditions. Alder is found only in frequently disturbed upland zones and drainage bottoms.

Valley Margin Zone

Valley Margin North (Block 4N). The North block forms the western tip of the valley margin that extends to the Willamette Valley. This section, the Van Duzer corridor, serves to funnel strong east winds to the Interior and Coastal Zones. Because so little of this block lies within the Study Area it will not be discussed further.

Valley Margin South (Block 4S). The landforms of the South block consist of valley foothills of low relief, and low to moderate dissection. Plant association group information is unavailable for this block.

This block has the highest potential for lightning-caused fires because of the storm track out of the south that allows for drier storms. Numerous settlements in the Willamette Valley create high potential for human-ignited fires.

The smaller fire sizes in this block may be due to lower fuel loadings that result from frequent burning. Variability in vegetation between north and south aspects is pronounced, resulting in higher fuel loadings on north aspects. The fire return interval in this block is the shortest of any of the blocks.

Appendix C.2 provides a list of fifth-field watersheds and the predominant fire blocks contained within each of them.

Disturbance Block Summary

Geographic variability is apparent in disturbance sizes and frequencies, severities, or both throughout the Study Area from Coastal to Interior to Valley Margin zones. Age class patterns (composition and distribution) have changed from 1850-1940, and they have been influenced by reburn activity. Patch sizes have decreased since 1850, especially in the 100-199 age class. Seral stage distribution has continued to change over time. Mid to late seral acreage has decreased by 40% since the 1940's. Mid to late seral jumbo patches have become fragmented into smaller stands.

Loss of mid to late seral conditions, and fragmentation of mid to late seral stands are two major issues affecting our current landscape pattern in federal lands. Management activities that may accelerate successional status, aggregate patches into larger blocks on the landscape, or both should be explored. Larger scale assessments of the relation of physical processes, soil conditions, and vegetation pattern will help guide the range of sites and treatments necessary to reach these goals.

Management Implications

Table C.3 displays a summary of disturbance block characteristics and management implications.

Table C.3 Summary of disturbance blocks

Block	Dominant Process	Freq.	Size	Landscape Pattern	Management Recomms.
COASTAL FOG					
Coast (1)	Wind	Moderate	medium small	Mixed sizes. Alder - large component.	Create large and jumbo mature/old stands, with scattered earlier seral stages. Alder is an important component in earlier seral stands.
	Wind	Low	large/ jumbo	PAG- S.spruce. wet and mesic	Sitka spruce (some western hemlock and Douglas-fir) are important components of later seral stages.
	Fire	Low	jumbo	High historic use has affected pattern.	
NORTHERN INTERIOR					
Tillamook (2)	Fire	Low	jumbo/ large	Single seral stage. Alder prevalent on most slopes in most stages. PAG: W.hemlock - mesic, well-drained sites. Sitka spruce - well-drained, mesic sites.	Create jumbo patches of single seral stage. Alder is important cohort in most seral stages.
Hebo (3)	Fire	Low	medium-jumbo	Single or 2-3 seral stages present. Alder prevalent on most slopes in most stages. PAG: W.hemlock mesic to well-drained. High historic use has affected pattern.	Create med-jumbo stands. Alder is important cohort in most seral stages.

Table C.3 continued.

Block	Dominant Process	Freq.	Size	Landscape Pattern	Management Recomms.
CENTRAL INTERIOR					
Lincoln Co. (5)	Fire	Low	medium-jumbo	Variable. Alder component of early stages only. PAG: W.hemlock - mesic, common. High historic use has affected pattern.	Medium to jumbo stands of one to a few seral stages. Alder component of some early seral stands.
Alsea (6)	Fire	Low	jumbo	Large patches of a single seral stage. Alder component of early stages only.	Create jumbo patches of a single seral stage. Alder is scattered component of early seral stages only.
Marys Peak (7)	Fire	Var.	Variable	Medium-jumbo patch. Alder infrequent, only in early stages. Heavy human use has affected pattern.	Create medium to jumbo patches of single or a few seral stages. Alder occurs infrequently in early seral patches.
SOUTHERN INTERIOR					
Siuslaw River (8)	Fire	mod-low	Variable	Variable sizes. Alder only in drainage bottoms. PAG: W.hemlock dry to mesic sites.	Create variable sized patches of one to several seral stages. Alder is component of riparian early seral stages only.
VALLEY MARGIN					
North (4N)	Not studied.				
South (4S)	Fire	mod-high	Variable	Variable. No alder.	Create variable patch sizes and seral stages.

LANDSLIDE RISK

Landslides are integral to the production of Coast Range landforms, soils, streams, and fish habitat. They introduce sediment (including gravels necessary for spawning), and large trees that act as energy dissipators and sediment storage sites into the stream systems. Eventually, over geologic time periods, landslides reduce stream gradients and flatten slopes. However, the timing of landslides is critical to whether they produce mostly benefits, or also cause disruption and degradation of natural processes.

Periodic large scale fires and wind storms killed trees on critically unstable steep slopes. The soils on many of those slopes failed, and introduced massive amounts of sediment and trees into the stream systems. For a decade or two these streams were in disequilibrium and produced difficult times for fish and other aquatic life. But then the good times came. Once log jams had settled the sediment flows, the complexity of the stream channels was greatly increased. This resulted in very much increased aquatic habitat - especially for anadromous fish. Excepting a few smaller fire and wind events, and large storms that caused scattered landslides across the landscape, this enhanced stream/habitat condition lasted until the next catastrophic event, usually one to several hundred years later.

Logging and attendant road construction altered landslide rates by destabilizing steep slopes in a chronic, persistent way within most drainage basins in the Coast Range. Instead of a single short period of intense landsliding, the channels were hit with a steady input of landslide debris whenever a moderately severe storm occurred. Also, landslides from logged sites only introduce sediment without also introducing the large logs that controlled stream channel gradients and sediment distribution. This resulted in two problems for streams and their aquatic life. First, the sediment inputs were more constant and unrelenting. Many channels have experienced elevated sediment loads for several decades. Second, and most important, supplies of large trees to the stream channels was greatly reduced or eliminated. This drastically changed stream channel shapes and function. Instead of complex step/pool profiles with multiple side channels produced by ever forming log jams, many channels in heavily logged basins have become simple bedrock shoots connecting the ridges with the rivers or ocean with few pools or side channels so necessary for anadromous fish habitat.

Based on landslide inventories in the 1970s and 1980s and on original interpretations of slope stability, landtype mapping units of the Siuslaw National Forest Soil Resource Inventory (SRI) have been ranked according to landslide frequency following major storms. Two distinct types of landslides are considered--debris slides and slumps.

Debris Slides

Sliding of low cohesion soils as on steep slopes after periods of high intensity rains that produce very high soil pore water pressures are called debris slides. Landtypes with high frequency of debris slides are typically steep, highly dissected, even-faceted slopes with shallow to moderately deep soils over impermeable bedrock or substrate. By determining the amount of the component landtypes within each Landtype Association (LTA), each has been

ranked as generally high risk or low risk for debris slides and slumps. See Map C.6 for Landtype Associations having high risks for landslides.

Landtype Associations with high risk for debris slides are:

2P, 2PSR1, 2PSR2, 3B, 3C, 3C1, 3E1, 3F, 3F1, 3M, 4F, 4G

Table C.4 lists the fifth-field watersheds in the Study Area that are made up predominantly of LTAs with high risk for landslides.

Table C.4. Watersheds with predominant high risk for debris slides

Watersheds (5th field)	Area in high risk LTA (%)
Wilson-Trask-Nestucca River Basin	
Kilchis	56%
Lower NF Trask	100
Lower Trask	100
Upper MF NF Trask	85
Wilson	64
Siletz-Yaquina River Basin	
Schooner/Drift (Siletz)	54
Siletz	57
Alsea River Basin	
Alsea	68
Big/Rock/Cape	54
Five Rivers	100
Lobster/Lobster Cr.	65
Tenmile/Cummins	77
Yachats	88
Siuslaw River Basin	
Deadwood	100
Esmo Whitt	82
Knowles	100
Indian	78
Lower Lake	100
Lower Siuslaw	76
N Fk Siuslaw	56
Upper Lake	100
Wildcat	54
Umpqua River Basin	
Lower Umpqua	60
N Fk Smith	70
Smith	95
West Fk Smith	86

Deep Seated Slumps and Earthflows

Deep, high cohesion soils and perennially high groundwater on moderately steep to steep slopes often fail, or move as large blocks called slumps or earthflows. Landtypes with high frequency of slumps are typically hummocky, uneven, broken and deeply incised by stream channels. Slopes are often convex, and soils are usually very deep to shattered, weak, highly permeable bedrock.

LTAs most prone to slumping or earthflow are:

2B, 2C, 2PSR3, 2T, 3Q, 3S, 3T

Table C.5 lists the fifth-field watersheds that are made up predominantly of LTAs with high risk for slumps and earthflows.

Table C.5. Watersheds with high risk for slumping

Watersheds (5th fields)	% area in high risk LTA
Wilson-Trask-Nestucca River Basin	
Nestucca	100
Three Rivers	92
Lower Nestucca	65
Yamhill River Basin	
Willamina	100
Yamhill	99
Alsea River Basin	
Berry	59
Big/Rock/Cape	47
N Fork Alsea	47
Upper Willamette River Basin	
Marys Peak	79
Tumtum	56

A list of all the fifth field watersheds and the number of acres and percentage area located within Landtype Associations with high risk for landslides (debris flow and slumping) is provided in Appendix C.4.

Management Implications

Areas prone to debris slides, e.g., primarily in the southern portion of the Siuslaw NF and in Drift Ck-Siletz, should be avoided for any extensive and intensive management activity from road-building and harvesting. Light distribution of silviculture management would be more appropriate for these areas.

Areas prone to slumping, e.g., Marys Peak and much of Hebo District, are expected to have higher road maintenance costs. Consider reducing or removing many of the roads built on landtypes with high risk for slumping.

SOIL PRODUCTIVITY

Productivity is defined as a site's ability to produce biomass. It is a function of climate, relief, parent material, and especially soils. Generally, soils developed in climates that provide optimum moisture and warm temperatures throughout the year that have high water-holding capacities, and high nutrient capital in organic and mineral forms, are the most productive.

Although Coast Range forests are generally considered very productive, significant variations in productive potential result from local differences in soil, climate, and past wildfire, and management activities.

Effects of Wildfire and Timber Harvest Activity

All areas that have had repeated, intense, frequent fires, clearcut harvests with subsequent slash burns, or both have suffered some decline in the potential amount of biomass that can be produced in the future. This decline is due to the volatilization of nutrients sequestered in the burned materials, and, in areas of clearcut logging, the long term reduction or elimination of large logs on the soil surface that act as reservoirs for moisture, fungal, and macro and micro-invertebrates.

Though volatilization of nitrogen and other nutrients during intense fires and slash burns may measurably reduce site productivity in some areas, the most profound changes in soil/site characteristics have occurred where logging activities have interrupted the steady, though sporadic inputs of large logs to the forest floor.

The majority of biologic activity in any forest takes place below the ground surface. Micro and macro organisms such as fungus, insects, arthropods, and bacteria are the integral components of the below ground food web. They are the factories that process all organic matter to make the nutrients available for recycling through subsequent generations of plants. Ideal temperate marine climatic conditions across the Study Area encourages growth of huge quantities of organic matter, and very large populations of soil organisms. The result is the uniquely prodigious nutrient capital and biologic potential of the Oregon Coast Range soils.

Continuity of the intense processing of organic matter by soil organisms in the temperate rainforest ecosystem depend to a very large extent on long term supplies of organic materials contained within all forest residue, but especially logs. Rapid turnover of organic materials by the soil organisms incorporates even large logs into the soil in a few dozen decades. Periodic new supplies ar critical to the continuity of the ecosystem.

Past fires have (with few exceptions) provided replenishment of large logs on a 100 to 400 year cycle. (Conveniently, almost as if nature knew what it was doing, the longer the cycles, the larger are the logs; which, by virtue of their size, are able to last through the next long cycle). Sites where harvest has removed the large logs now must contend with a significant gap in the normal cycle of replenishment. That gap will significantly reduce the total below, and above ground biologic activity.

Higher life forms such as birds, and small mammals depend upon the availability of insects and fungus associated with the decomposition and nutrient mineralization associated with the forest's large wood. Therefore, all life associated with coastal forests is affected by log removal. The continued presence of large wood and associated biologic activity may well be the most universally requisite component of mature and ancient conifer forest ecosystems.

Management Implications

The actual amount of decline varies greatly between sites and will have to be assessed at the Watershed Analysis scale. Those areas with the lowest inherent productivity have suffered the greatest relative potential productivity losses from fires and logging. LTAs with the lowest inherent productivity (compared to other LTAs in the Coast Range) include:

Coastal Fog zone: 4X
Northern Coast Crest zone: 2P, 2PSR1
Central Coast Crest zone: 2PSR2, 2PSR3, 2T1, 3Q
Southern Coast Crest zone: 3F, 3F1, 4F, 4G
Valley Border zone: 2H, 2S, 2Y, 3H, 3W, 4J