LATE-SUCCESSIONAL RESERVE ASSESSMENT
Oregon Coast Province - Southern Portion
(RO267, RO268)

I. INTRODUCTION

This Late-Successional Reserve Assessment (LSRA) was developed to help facilitate implementation of appropriate management activities for the Late-successional Reserve (LSR) and assure that these activities meet the LSR standards and guidelines and further LSR objectives. It presents sideboards for determining where and when to employ various management techniques.

LSRAs are required by the Northwest Forest Plan (USDA et al. 1994). These assessments, for each LSR (or group of smaller LSRs), are to be developed prior to habitat manipulation activities.

Background

Late-Successional Reserves (LSRs) were created to provide a distribution of late-successional forests sufficient to avoid foreclosure of options for the management of late-successional forest species (USDA et al. 1994, ROD B-4,5). The networks of Late-Successional Reserves throughout the range of the Northern Spotted Owl are deemed to be sufficient over time, in quality and quantity, to provide habitat which supports viable populations of species that are associated with late-successional forests. The LSR network will help to ensure that native species diversity will be conserved (Map 1).

Throughout this document, the term late-successional will be used to define both mature and old-growth seral stages of forest development. Due to the type and timing of disturbances in this LSR Assessment (LSRA) area, older forest conditions are primarily in the mature seral development class with vegetation ranges from 75-150 years of age. Single layered canopy conditions also predominate.

The following goals and objectives have been established for late-successional reserves by the Northwest Forest Plan:

Objective: To protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional forest species. Late-successional reserves are designed to maintain a functional, interacting late-successional ecosystem.

Goals: 1. Create and maintain late-successional habitat and ecosystems
2. Create and maintain biological diversity associated with native species and ecosystems

In response to these goals and objectives, all management within LSR boundaries on federal lands must assure the protection and/or enhancement of conditions of late-successional forests. The standards and guidelines of the *Record of Decision* (ROD*)* (USDA et al. 1994) govern all management activities in the LSR. This LSR Assessment is tiered to the ROD.

Area Included In This Assessment

This LSRA covers two designated Late-Successional Reserves, RO267 and RO268 **(Map 2).** LSR RO267 occupies 175,280 acres of federal land, LSR RO268 occupies 370,972 acres of federally managed land. The total LSR land base included in this assessment is 546,252 acres **(Map 3)**. The assessment area includes lands managed by both the Siuslaw National Forest and the Bureau of Land Management - Salem, Eugene, Coos Bay and Roseburg Districts.

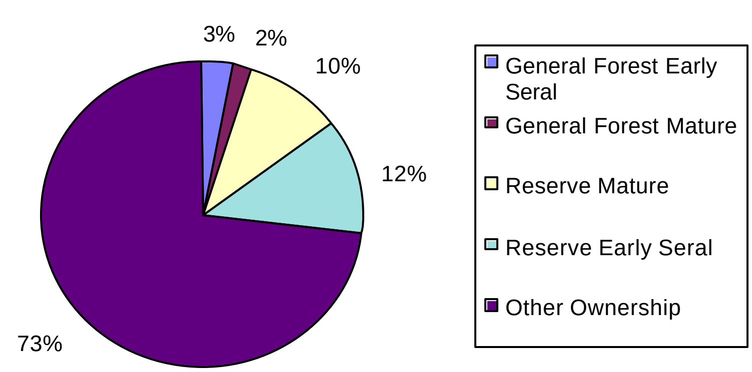
LSR	BLM acres	SNF acres
267	108,430	66,850
268	86,736	284,236

The majority of the assessment area is within the Oregon Coast Province. However, since terrestrial species are not confined by watershed boundaries, the LSR RO267 extends into a portion of the Umpqua River Basin which is in the Southwest Oregon Province. The assessment area ranges from the Umpqua River drainage on the south to the Yaquina River drainage on the north, west to the Pacific Ocean, and east to the Willamette Valley. This grouping of LSRs into one assessment occurred due to their proximity, their location within the Oregon Coast Province boundary, and their interdependence on each other. There are several additional LSR designations to the south (RO263, RO264, RO265, RO266) and to the north (RO269, LO269, RO270) **(Map 1)** of this assessment area which tie to and influence the populations of species within this LSR. It was determined that an analysis which covered all of these LSRs would be too broad and lack the specifics necessary for providing management recommendations.

Context Of This LSRA Area Within the Oregon Coast Province

Currently, 46% of all federal land in the Oregon Coast Province is in a late-successional stage of development with the majority of stands around 150 years old (USDA 1995). If one assumes that most other ownerships in the Oregon Coast Province have either converted forest land to farm land or manage their timber on a less than 80 year rotation, then only the lands managed by federal

Figure 1: Late-Successional Reserves and Mature Habitat in the Oregon Coast Province



agencies are supporting and will continue to support late-successional habitat. Given that assumption, about 12% of the vegetation in the entire Oregon Coast Province is currently in a mature condition (Figure 1).

How This Assessment Will Be Used

LSRAs are not decision documents. They are intended to establish criteria and guidance which will provide managers with the information necessary to make appropriate decisions.

LSRAs provide a context at the landscape scale for such things as disturbance regimes, vegetative parameters, and functional roles of different portions of the landscape. Finer scale assessments; i.e.,, watershed analysis, can utilize this information to understand the significance of local areas in relation to the larger landscape.

Along with other planning documents, this LSRA provides a landscape strategy for implementation of restoration activities by prioritizing treatment areas and itemizing types of appropriate treatments. In doing so, the LSRA facilitates inter agency working agreements about the type and timing of treatments across the landscape.

This is a broader perspective than that which is provided by watershed assessments. Watershed scale assessments are finer scale assessments which enhance our ability to estimate direct, indirect, and cumulative effects of management activities. They are better able to show relationships between terrestrial and aquatic systems and prescribe specific type, location, and sequence of appropriate management activities within a watershed. Refer to **Appendix H** for information from this assessment displayed by fifth field watershed.

The Assessment Process

As specified in the ROD, LSRAs include eight components: 1) a history and inventory of overall vegetative conditions; 2) a list of identified late-successional associated species known to exist within the LSR; 3) a history and description of current land uses in the LSR; 4) a fire management plan; 5) criteria for developing appropriate treatments; 6) identification of specific areas that could be treated under these criteria; 7) a proposed implementation schedule tiered to higher order plans; and 8) proposed monitoring and evaluation components to help evaluate if future activities are carried out as intended and desired results are achieved.

In July 1995 , an Assessment Report on Federal Lands In and Adjacent to the Oregon Coast Province (USDA 1995) was published. That document provides much of the background information utilized in this assessment. This LSRA expanded from the concepts presented in the Assessment Report to describe the vegetative patterns historically and currently found on this landscape. This included an understanding of climate, geology, landforms, and disturbance

regimes. Disturbances in this area include fire, wind, landslides, floods, insects, disease, and human influences.
Reference and current vegetative conditions on the landscape were used to determine how the LSRs are functioning in relation to objectives established in the Northwest Forest Plan. The best available information from County surveys from the mid-1900's was utilized to indicate a reference condition from which to evaluate current conditions of vegetation within the LSRA area. The effects on the populations of certain late-successional species were evaluated based on assessment of the changes in vegetative structure, pattern, and processes that have occurred on the landscape.

Criteria for developing appropriate management treatments included a determination of the conditions on the landscape which would trigger management activities. The determination was based on understanding functional or structural components of the landscape which are necessary to achieve attainment of late-successional characteristics. For each condition that would trigger a management activity, management criteria and appropriate treatment types were established which will assure that LSR goals and objectives will be achieved. Further guidelines for developing appropriate management treatments include: successional pathways which vary based on sub-series environments and disturbance regimes, and an indication of the ranges of structural components that are found in both mature and old-growth forests in this LSRA area.

Landscape analysis techniques were utilized to identify specific areas that could be treated and to propose an implementation schedule. This step in the process included a synthesis of the information collected to understand and characterize the landscape. Three LSR ZONES were delineated within the LSRA boundary. These zones include: an important CORE area which provides the genetic source for populations of late-successional species, two critical CORRIDORS which serve as refugia areas for late-successional species which are dispersing from and to adjacent LSRs, and a BUFFER zone which is important for dispersal of late-successional organisms within these LSRs and other portions of the landscape.

In addition to these broad areas, LANDSCAPE CELLS were delineated based on either amount and arrangement of mature forest vegetation or the functional role of that particular area in the reserve network. These LANDSCAPE CELLS were prioritized for treatment based on restoring the best remaining late-successional habitat first.

The final component of the assessment, monitoring and evaluating management activities, helps identify those key features that need to be measured to determine if the proposed activities are meeting LSR objectives.

Aquatic characterization efforts in this LSRA highlight priority watersheds and sub-watersheds for restoration. A detailed assessment of the aquatic resource was not an objective of this LSRA. A large scale assessment of aquatic resources was undertaken for most of this area in the Assessment Report - Federal Lands in and Adjacent to Oregon Coast Province (USDA 1995). Readers who are interested in aquatic characterizations at the landscape scale can refer to the information provided in the Assessment Report.

II. HISTORY AND INVENTORY OF CONDITIONS

Physical Characterization

LSRs R0267 and R0268 are in the Oregon and Washington Coast Ranges section of the Cascade Mixed Forest-Coniferous Forest-Alpine Meadow Province (McNab and Bailey 1994). This physiographic province is characterized by highly dissected low mountains that were shaped by debris slide processes on slopes of 20-120%. Incised valleys are distributed throughout the section. Dunes and bogs occur along the coast, with numerous headlands formed of more resistant rock. Elevation ranges from sea level to 4100 feet. Most mountain tops are below 2000 feet, though a few dominant peaks are 3000-4000 feet (i.e., Marys Peak, Grass Mountain, Prairie Peak, Roman Nose).

Soils generally developed from Cenozoic sandstones and marine volcanics. Typical soils are moderately deep and have dark, humus-rich surface horizons. Predominant soil orders are andisols and inceptisols that are not dry for more than a quarter of a year, with mean annual soil temperatures of 0-15 ^{o}C. In the coastal lowlands and hills, seasonal soil temperature differences are moderated by fog and sea breezes.

The LSRA area has a maritime climate resulting from its proximity to the Pacific Ocean and influence of the Japanese current. Cool, wet winters and relatively warm, dry summers are characteristic of the area. 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 persists for only a few days except for the tops of the highest peaks.

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. East of the Coast Range crest, in the Willamette Valley margin, annual precipitation averages about 50 inches.

High potential evapotranspiration and low precipitation during warm, sunny summers may produce moisture deficits where soil and bedrock have low waterholding capacities. Moisture deficits are more pronounced in the southern LSR , RO267, than in RO268 because soils are generally thinner, higher in rock fragments, and bedrock tends to be only slightly permeable to impermeable. Throughout the LSRA area, stands on ridges and exposed south-facing slopes with thin, rocky soils can develop substantial plant moisture stress in late summer.

Due to the geographic variability of soil and climate attributes in the Oregon Coast Province, we have developed soil/climate zones to describe the physical environment (USDA 1995). Each zone represents a unique combination of 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. **Table 1** summarizes the differences between each soil/climate zone found in the LSRA area with regard to climate, soil physical characteristics, soil temperature, and soil moisture regimes. **Map 4** displays the delineation of these zones with respect to the LSRs on the landscape.

Aquatic Characterization

Aquatic characterization efforts in this LSRA highlight priority watersheds and sub-watersheds for restoration. A detailed assessment of the aquatic resource was not an objective of this LSRA. A large-scale assessment of aquatic resources was undertaken for most of this area in the Assessment Report - Federal Lands in and Adjacent to Oregon Coast Province (USDA 1995). Readers who are interested in aquatic characterizations at the landscape scale can refer to the information provided in the Assessment Report.

Since 1990, there have been a myriad of efforts to prioritize watersheds in the Pacific Northwest for habitat restoration and recovery of anadromous fish runs. Earliest efforts focused on watersheds with the most intact landscapes and the most fish stocks of concern (Johnson et al. 1991; Nehlsen et al. 1991; Reeves and Sedell 1992; Scientific Advisory Team 1993; Siuslaw National Forest 1993). These ultimately led to the network of key watersheds in the Northwest Forest Plan (USDA et al. 1994). Subsequent efforts focused more on details of habitat and health of the fish stocks (Nickelson et al. 1992; Oregon Chapter American Fisheries Society 1993; Nicholas 1993; Huntington et al. 1996), while most recent efforts have been broader and included the above considerations as well as many other measurements of watershed health and risk (Daggett 1994; Bradbury et al. 1995).

Table 2 shows which watersheds and sub-watersheds in the LSR study area were identified as high priority by the above efforts. Because many of these reports are highly interrelated, and identification of a watershed as high priority in one report was in a large part due to its being identified as such in earlier efforts, any synthesis of them is highly subjective. Nevertheless, within this LSRA area, four basins identified in the most independent reports - Drift and Lobster Creeks of the Alsea, West Fork Indian Creek, and North Fork of the Smith River - appear to be the highest priority for projects that benefit anadromous fish. All are key watersheds and American Fisheries Society aquatic diversity areas and home to particularly healthy Chinook or coho salmon, or endangered Umpqua cutthroat trout. Next in priority is a group including Mill Creek, North Fork Beaver Creek, Yachats River, Cummins/Tenmile Creeks, North Fork Siuslaw River, and Five Rivers. The relationship of these watersheds to the priority treatment areas in this report will be discussed in chapter V.

Table 1: Soil Climate Zones Located Within LSRs R0267 And R0268

SOIL/ CLIMATE ZONE	CLIMATE	SOIL CHARACTERISTICS	SOIL TEMPERATURE	SOIL MOISTURE
COASTAL FOG	very high winter rainfall accompanied by high winds; fog and low clouds common	deep to very deep, moderately fine-textured soils overlying slowly to moderately permeable bedrock; high in amorphous clays--often thixotropic; high accumulation of organic matter	slight difference from summer to winter (isomesic)	high in summer (except on few very shallow soils on south slopes); fog and low clouds increase effective soil moisture in summer
CENTRAL INTERIOR	wet winters and moist summers; occasional high winds in winter	deep to very deep moderately fine-textured soils overlying slowly to moderately permeable bedrock; high biologic activity accompanied by high decomp - osition rates and moderate accumulations of soil organic matter	significant difference between summer and winter (mesic) below 3000 feet; winter temperatures range to very cold (mesic to cryic) above 3000 feet	moderate fluctuations from winter to summer; summer levels varying from very high on lower slopes to moderately dry on upper sideslopes
SOUTHERN INTERIOR	very wet winters and moist summers; occasional high winds in winter	shallow to deep, fine to medium textured soils overlying impermeable bedrock; high biologic activity accompanied by high decomposition rates and moderate to low accumulations of soil organic matter	significant differences between summer and winter (mesic) below 3000 feet; winter temperatures range to very cold (mesic to cryic) above 3000 feet	moderate to great fluctuations from winter to summer
VALLEY MARGIN	moist winters and dry summers; high winds are uncommon	shallow to deep fine textured soils overlying moderately permeable bedrock; moderately high biologic activity and moderate decomposition rates and low to moderate accumulation of soil organic matter	significant difference from summer to winter (mesic)	high fluctuations from winter to summer, with low soil moisture common in summer

Table 2. High-Priority Watersheds And Sub-Watersheds Identified By Various Authors.

Watershed Name	Key W'shed	AFS ADA	ODFW SRCE	SNF/ BLM	BRAD-BURY	DSL	Healthy Chinook	Healthy Coho	T&E Cutthroat	Chum
Mill Cr. - Yaquina R	X		X	X						X
N.Fork Beaver Cr.	X	X	X	X						
Drift Cr. - Alsea R.	X	X	X	X	X	X	X			
Five Rivers			X	X	X	X	X			
Lobster Creek	X	X	X	X	X	X	X			
Tobe Creek				X						
Canal Creek		X	X							X
Yachats River	X	PART	PART	X						
Cummins/Tenmile	X	X		X						
Bailey Creek	X			X						
W.Fork Indian Cr.	X	X	X	X			X			
Lake Creek				X			X			
Upper Siuslaw R.				X			X			
N. Fork Siuslaw R.	X		X	X			X			
W. Fork Deadwood			X	X			X			
Whittaker Creek				X			?			
North Fork Smith R.	X	X		X			X	?	X	

Key watershed - USFS and BLM 1994.
AFS ADA - Aquatic diversity area; Oregon Chapter American Fisheries Society 1993
ODFW SRCE - OR Dept. of Fish and Wildlife source watershed; Bradbury et al. 1995
SNF - Siuslaw National Forest 1993.
BLM - Personal communication, Salem, Eugene, Coos Bay Districts, Bureau Land Management
Bradbury et al. 1995.
DSL - Daggett 1994, Oregon Division of State Land
Healthy Chinook and coho salmon - Huntington et al. 1996; ? = assessment of healthy is questionable.

Vegetative Characterization

Plant series describe forest vegetation by the dominant, or climax, tree species that would be maintained over time without disturbance (i.e., western hemlock series) (Franklin and Dyrness 1973). A series describes the general biological environment, in terms of potential natural plant communities, climate, geology, and soils. Plant series distribution provides us with a general sense of large-scale biological environments. This can be related to overall site potential.

Four plant series are present in this LSRA area. The Sitka spruce series occupies the maritime, coastal fog zone in the western most portion of these LSRs **(Map 5)** . The western hemlock series is the most dominant series present in the LSRA area, occupying 77**%** of the landscape **(Map 5)**. It is found in the interior soil/climate zone, associated with a range of environments. The noble fir series is limited to highest peaks of the Coast Range (Marys Peak, Grass Mountain, etc.) in the interior soil/climate zone. The grand fir series is found on the far eastern fringe of the LSRA area, associated with the margins of the Willamette Valley. Noble and grand firs series are not delineated, mapping is currently underway.

Table 3: Relationship Between Series, Sub-Series Environments, and Plant Associations Found In LSRs RO267 and RO268

SERIES	SUB-SERIES ENVIRONMENTS	UNDERSTORY INDICATOR SPECIES IN PLANT ASSOCIATIONS
Sitka Spruce*	WET	*devil's club, salmonberry
Sitka Spruce	MOIST	Oregon oxalis, swordfern, fool's huckleberry/red huckleberry
Sitka Spruce	DRY	salal, salmonberry/salal
Western Hemlock* (Douglas-fir/red alder)	WET	devil's club, salmonberry, salmonberry/vine maple
Western Hemlock (Douglas-fir/red alder) (Western hemlock/Douglas-fir/red alder) (Western hemlock/Douglas-fir)	MOIST	Oregon oxalis, swordfern, vine maple/swordfern, vine maple/salal
Western Hemlock (Douglas-fir) (Douglas-fir/Oregon white oak) (Douglas-fir/Western hemlock)	DRY	Oregon grape, Oregon grape/salal, salal, salmonberry/salal, rhododendron/Oregon grape, rhododendron/salal, rhododendron/evergreen huckleberry, rhododendron/ swordfern, evergreen huckleberry, (ocean spray/herbs, chinquapin/madrone)
Noble Fir	COLD	(vine maple/rhododendron)
Grand Fir	WET	(snowberry/swordfern)
Grand Fir	DRY	(salal-snowberry/swordfern)

*Plant Association and Management Guide, Siuslaw National Forest, Hemstrom and Logan 1986.
( ) current tree and understory species. Resource Management Plan USDI, BLM, Salem District Office, May 1995 and Resource Management Plan USDI, BLM, Eugene District Office, June 1995

Plant associations describe the dominant plant community (a combination of tree and shrub and/or herb layers) that would inhabit a site over time without disturbance (Hemstrom and Logan 1986). A plant association defines a biological environment in terms of the species composition, productivity, and response to management. Knowledge of the presence and distribution of indicator understory species further refines the biological environment, allowing us to more accurately assess site potential.

Plant associations with similar attributes have been aggregated into groups **(Map 5).** These plant association groups have been arranged into "sub-series" based on the broad environmental conditions in which they are found. This is a key stratification in identifying the range of structural and compositional characteristics that can be expected under natural conditions on a given site. Sub-series characterizations will be referred to throughout this assessment. **Table 3** characterizes the relationship between series, sub-series environments, and plant associations found in these LSRs.

Disturbance Processes

Historical and Current Land Uses

Settlement Patterns

The coastal and interior valleys of western Oregon have been the homeland of culturally and economically diverse American Indian societies for millennia. The Euroamerican settlement of western Oregon resulted in catastrophic population decline and displacement among the region's Indian peoples. During the mid-1850s, surviving Indians from throughout western Oregon were placed on a large, multi-tribal Indian reserve encompassing parts of the Oregon coast and Coast Range. Throughout the late-1800s, in an effort to bring tribal peoples into the "American mainstream", and to open the area to white settlers, this reserve was drastically reduced in size. Tribes living there were finally "terminated" from Federal supervision and control in the early 1950s; western Oregon's reservations were closed. A reversal of American Indian policy in the mid-1970s has led to federal re-recognition of western Oregon tribal peoples. Today, western Oregon's Indian peoples are grouped into Tribal confederations whose centers of government and small reservations are located in Coos Bay, Grand Ronde, and Siletz.

The assessment area includes areas once used by American Indian peoples as villages, fishing and shellfish gathering stations, religious sites, and cemeteries, and thus is rich in archaeological evidence and artifacts. Land ownership maps and archival data document the boundaries of the Coast Range reservation and the location of Indian Allotments. Current Tribal interest in management issues include fisheries, wildlife, water quality, special forest products, and timber.

The Oregon Coast was "discovered" by European maritime explorers in the late 1700s.

Soon thereafter, land-based explorations and the fur trade brought mountain men, fur traders, and missionaries into the Willamette Valley and Coast Range. Trading outposts in the wilderness, such as Fort Vancouver on the Columbia River, eventually attracted settlers to the fertile soils of the Willamette Valley. The Donation Land Act of 1850, and the Homestead Act of 1862, provided enough incentives for settlement that the Willamette Valley and the Coast Range were quickly populated. Large tracts of timberland, and homesteads that never "proved up", became incorporated in the National Forest System.

BLM ownership patterns in Western Oregon were created in 1866 when Congress granted to the Oregon and California Railroad Company all odd numbered sections of land 30 miles on each side of the railroad right-of-way. When the stipulations of the grant were violated, Congress passed legislation to have the lands revested to the United States government, eventually to be managed by the Bureau of Land Management.

Eventually, agriculture, logging, and commercial fishing provided the economic foundation for the development of large communities and the current way of life in the Willamette Valley, Coast Range, and the coast.

Pioneer cemeteries, historic trails and wagon roads, homestead remains, and fruit orchards are the remnants of Willamette Valley and Coast Range pioneer history, and occur throughout the assessment area. Related to these historic remains, implementation of various federal "homestead" acts (i.e., Forest Homestead Act of 1906, Western Scattered Settlers Project of 1906) required close government scrutiny of "homesteads", resulting in inspection records, inventories, and detailed maps denoting building locations, land features, and vegetation types. Thus, these records not only add insight into local pioneer and settlement history, they are an invaluable source of baseline data about the area's environment at the turn of the century.

The assessment area likely contains an abundance of historic sites dating from the mid-1850's to the 1930's. Some sites have likely been recorded during previous cultural resource inventories for timber sales and other projects. These records are housed in the Siuslaw National Forest Supervisors and Ranger District Offices and the Bureau of Land Management District Offices. These files should be consulted preparatory to any project in the assessment area. Additional compliance-level cultural resource inventories may also be required. The Siuslaw NF has developed a detailed data base concerning extant settlement records and these should be used to guide effective field inventories. These records would also provide temporal/baseline information useful in reconstructing the historic Coast Range environment. For example, Coast Range settlers logged the forest, created innumerable meadows and forest openings for buildings, gardens and pasture, planted fruit orchards and other "exotics" trees and shrubs. Settlers were responsible for many of the huge fires that swept through the Coast Range since the 1850s with many areas being repeatedly burned. While the specific impacts of these homesteads may be difficult to see today, cumulatively they are in part responsible for the current condition of the assessment area, and human land use patterns within it.

Logging
Logging operations in the assessment area began in earnest in the latter half of the 19th century. In the Siuslaw River system, stream channels were cleared, and logs were floated out to sawmills or to the estuary for shipment. Most major tributaries of the Siuslaw River were splashed-dammed, and “high grade” logging of bottom areas was common.

Timber patents also played a significant role in shaping the economy of the assessment area as they enabled local mills to tap the supply of Federally owned timber. Beginning in the early 1900s, timber patents were granted by agents of the Government Land Office to timber companies, allowing a company to harvest timber from a specific tract of Federal land for a set rate.

There were a number of mills operating in the area during the first two decades of the twentieth century. The dominant commercial activity in the assessment area has been, and continues to be, timber harvesting.

Agriculture
Agriculture is limited mainly to the flatter, wider interior Coast Range valleys, and the coastal plain. Residential areas are located primarily in association with agricultural lands.

Minerals
The Siuslaw Basin is within an area considered to have moderate potential for the leaseable minerals of oil and gas. This classification is based on the indirect evidence of geologic inference.

The assessment area in general is considered to have low potential for locatable minerals.

Salable minerals in western Oregon are often located in areas where volcanic rock was deposited as dikes, sills, flows, etc. Several prospective and/or developed rock quarries are located along another large volcanic deposit crossing public and private lands. Small feeder dikes and sills of basaltic rock have also been identified, but have not been developed as salable mineral sources. The alluvium along many river bottoms is considered to have moderate potential for sand and gravel. However, at this time, none of the area within the LSRA with alluvium have been developed as a mineral material source. The location and status of existing quarries is available in GIS at each administrative unit. (Existing quarry sites impact local habitat but are not considered to have an overall effect on the integrity of LSRs.) Since quality bedrock areas are so few, expansion of quarry activities in the future is not expected to inhibit attainment of LSR objectives.

Recreation
Recreational uses include but are not limited to canoeing, kayaking, drift boating, fishing, hunting, All Terrain Vehicle (ATV) use, driving for pleasure, sightseeing, mountain biking, professional bicycle racing, water play activities, watching wildlife, and hiking along coastal trails. Recreation attracts moderate to heavy amounts of visitation throughout most of the year, focused primarily on the coastal strip. Some specific recreational uses (i.e., hunting, berry picking) are strictly seasonal.

Refer to BLM Land Management Plans and the Siuslaw National Forest Land and Resource Management Plan for details on proposed and existing recreation in the LSRA.

Wilderness and scenery objectives tend to be compatible with late-successional reserve objectives. Old-growth areas, patches of old growth, and individual trees are valuable for scenery and Wilderness. There are remnant mature and old growth trees in many developed recreation sites within the assessment area.

The types of recreational impacts that potentially affect the ability to attain LSR objectives are mostly related to harassment of wildlife species and changes in habitat by manipulation of vegetation. For example, if All Terrain or Off Highway Vehicle use expanded into new, now relatively undisturbed areas, disturbance could affect viability of wildlife (i.e., northern spotted owl) and some plant species. Cummins Creek Wilderness Area was identified as an area of potential impact because of the intensity of human use there. In the Marys Peak area, large numbers of people near northern spotted owl nesting areas are a potential impact. Road construction and access are issues where human use of the assessment area has potential impact on attainment of late-successional reserve objectives. Impacts can range from illegal removal of live trees or snags, to dumping of waste.

Radio tower and other administrative sites (i.e., campgrounds, facilities, picnic areas, parking lots, progeny sites, utility and road right-of-ways) influence the ability to attain late-successional reserve conditions locally, because of permanent clearing of the site. However, a number of administrative sites are located either in developed areas, or on hills that are currently in a very early seral stage of development. Maintaining these early seral conditions is thought to have little impact on the overall late-successional reserve conditions (ROD, C-15,17,18).

Economic Values

The area contains substantial economic values, predominantly in the form of wood fiber or timber. Of considerably less economic significance are other forest products including firewood, decorative grasses and boughs, Christmas trees, mushrooms, mosses, bark, and burls. Anadromous fish spawning and rearing habitat, recreational facilities, and activities (campgrounds, visitor centers, etc.) contribute economic value as well.

Fire

Fire and wind are the two dominant natural disturbance processes affecting the terrestrial vegetation pattern at the large scale in this LSRA area. The frequency, severity, and size of these disturbances have greatly influenced the composition and structure of habitats across the landscape. Understanding the geographic variability of soil/climate and disturbance effects can guide expectations of spatial landscape patterns and structural landscape components. Since plant and animal species and populations have adapted to the range of historic landscape patterns, an understanding of these patterns is important in managing LSRs.

Both physical and biological elements of the landscape affect disturbance patterns. Physical features such as landform type (relief and drainage density patterns), soil, and geologic substrates influence fire behavior patterns. Climatic features, such as precipitation, fog and east wind patterns, control fire spread and effects on vegetation composition and pattern. The distribution of sub-series environments, successional stages, and the arrangement, composition, and structure of vegetation all influence the amount and arrangement of fuel and thus fire behavior patterns.

The long-term history of fire in the entire area has 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). Ongoing and recently completed projects in these LSRs have refined this general description. Analysis of charcoal distribution in a sediment core from Little Lake (in LSR R0268, revealed a mean fire return interval of 160-190 years from 2000 years ago to the present (Long 1995). Preliminary results from a large-scale dendrological fire history project covering approximately 340,000 acres, spanning from the coast to the valley margin, indicate that there is spatial variability in historic fire patterns over the last 500 years. Coastal and interior zones in the study area were dominated by single or two-age class stands, with fire return interval ranging from 200-300 years. Southern interior/valley margin sites had a much higher proportion of two to four age-classes, with fire return intervals ranging from 100-200 years (Impara, personal communication). This information suggests that there is large-scale geographic variability in fire regimes across the landscape. A Fire Management Plan is included in **Appendix A** to establish a fire control strategy should a fire event occur within the LSR boundary.

Native American and Euroamerican settlement of the area during the period 1850-1940 was responsible for many of the large-scale fires in that time period. Teensma et al. (1991) mapped age class distributions (inferred from various sources) at four years: 1850, 1890, 1920, and 1940. Several human-caused fires between 1850 and 1940 have changed landscape patterns; from a young/old forest in 1850 to a multi-aged landscape in 1940. The total number of age-class patches has increased from 1850 to 1940 as a result of small human-caused fires and suppression efforts on potentially large-scale events . Geographic variability is apparent in both the number and type of age-class patches within these LSRs.

Disturbance Regime Blocks

Fire history Information suggests there is spatial variability in fire effects across the LSRA. An attempt was made to map, at a landscape scale, the general geographic distribution of fire regimes in the Assessment Report of Federal Lands in and adjacent to the Oregon Coast Province (USDA 1995). The concept that fire regimes are stable temporally and spatially, and can be discreet geographic entities, are working hypotheses that will be revisited and refined as more information becomes available.

Distribution of physical and biological environments were used to map disturbance regimes across the North Coast Province. Landform types (USDA 1981) and plant series delineations were used to group geographic areas into blocks predicted to have similar fire behavior patterns. Relief patterns and climatic influences (fog, east wind) were considered in the groupings (**Map 4)**.

These working boundaries were overlaid on the age-class distribution maps (Teensma et. al, 1991) to validate assumptions about the effects of physical and biological elements on disturbance processes and resultant vegetation patterns. Geographic variability in patch sizes and types was captured fairly well in overlaying the working boundaries on the age-class distribution maps. This supported the hypothesis that landform/topography, climate, and vegetation distribution influence disturbance processes and landscape pattern. The fire patch sizes were used to describe each block. These hypothesized disturbance regime blocks are continuing to be refined and represent *an* initial attempt to group landscapes. Watershed analysis will test our assumptions of the relationships of landscape patterns and disturbance.

Five of the eight disturbance regime blocks described in the Assessment Report (USDA 1995) are located within these LSR boundaries. Since only the very southern edge of the Central Interior -- Lincoln County (Block 5) was present in a small portion of LSR 268, we grouped this block with the Central Interior --Alsea (Block 6). It will be referred to as the Central Interior -Alsea block in the following discussion. **Table 4** displays the environmental conditions that describe each of the fire disturbance regime blocks.

Wind

Wind is also a natural disturbance process within this LSRA area. Its significance is dominant in the Coastal Fog Zone. In this zone, there are frequent small disturbances. Yearly windstorms are responsible for small patches, often less than 10 acres in size, of blowdown across the Zone.

Infrequently, windstorms can cause blowdown of large (hundreds to thousands of acres) tracts of land. Efforts to predict wind patterns and potentials for blowdown across the landscape have not been successful in the past.

Insects

The Douglas-fir beetle is indigenous to the Coast Range of Oregon. This beetle maintains its normal low-level populations by infesting trees weakened by root disease or other stress factors and in scattered windfall. After a significant disturbance event, populations will increase in down and damaged Douglas-firs to levels at which beetles, in subsequent years, will attack and kill healthy standing trees. If significant amounts of windthrow do not occur in following years, these outbreaks typically will last only 3 years with the beetles attacking and killing successively fewer trees each year (Hostetler et al. 1996*)*.

Table 4: Disturbance Regime Blocks

DISTUR-BANCE BLOCK	LAND-FORM	SUB-SERIES ENVIRONMENT	DISTURBANCE TYPE; REGIME DESCRIPTION*	LANDSCAPE PATTERN
COASTAL FOG BLOCK	low relief, scattered headlands and hummocks same area as soil / climate zone	wet and moist Sitka spruce dominate area	wind dominant process; operates at two scales. High-mod.frequencies of small-medium size/ and high severity. Also, storms occur with low frequency/large-giant size with high severity; fire very uncommon; low frequency/large-giant size - high severity. Native Americans and European settlers have influenced fire pattern.	heterogeneous mix of patch sizes and seral stages; earlier seral patches most frequently small to medium, resulting from small-scale wind events; large and giant patches created infrequently and move from early to late seral conditions
CENTRAL INTERIOR-ALSEA	moderate relief and high dissection	moist and wet environments of the western hemlock series dominate; wet and moist Sitka spruce found along stream corridors and in local fog zones	fire occurs at low frequencies/large-giant size/high severity	single to few large to giant patches of the same seral stage that will move through time to late seral conditions
CENTRAL INTERIOR-MARYS PEAK / ALSEA VALLEY	variable; valley fringe, moderate to high relief features, and mountain peaks	variable; noble fir occupies highest peaks; wet and dry grand fir may occupy eastern fringe; wet, moist and dry environments of the western hemlock series about equal area throughout block	fire occurs in variable regimes; heavy use by Native Americans and European settlers have influenced fire patterns	variable sized patches (medium to giant), with high variability of remnant trees within and between patches
SOUTHERN INTERIOR	moderate relief, high dissection	moist to dry environments of the western hemlock series dominate; grand fir may be located along eastern fringe	fire occurs in low to moderate frequencies/variable size/moderate to high severity	variable size (small to giant) patches, with some patches developing into late seral, and some patches experiencing more than one non-stand replacing disturbance (variable distribution of remnant trees and stands)
VALLEY MARGIN	valley foothills of low relief, low - mod. dissection	dry western hemlock and wet and dry grand fir	fire occurs at shortest intervals; variable sizes and severities	variable pattern

***Disturbance Frequency (years)**
Low >300
Moderate 100-300
High <100

***Severity (% mortality)**
Low <30%
Moderate 30-70%
High >70%

***Size (acres)**
Small <100
Medium 100 - 1,000
Large 1,000 - 10,000
Giant >10,000

This Douglas-fir beetle-caused mortality can be benign, beneficial, or harmful, depending upon management expectations and desired forest conditions. Moderate amounts of beetle-caused tree mortality, for instance, can significantly improve habitat diversity for numerous species of vertebrate and invertebrate fauna. Conversely, large amounts of mortality can severely damage high value recreation sites, timber stands, old-growth areas, habitat conservation areas, or adjacent landowners and plantations. It is of particular significance that some of these areas depend on the number and sizes of old-growth trees to meet habitat requirements. Some of the older, less vigorous trees, weakened by disease or other factors, will be the most vulnerable to the Douglas-fir beetle. (Hostetler et al. 1996).

Disease

Laminated root disease, caused by the fungus *Phellinus weirii*, is the most commonly encountered and damaging forest disease disturbance agent in the analysis area. This fungus is a highly effective and efficient parasite that kills host trees of all sizes and ages. The fungus extensively decays roots of highly susceptible host trees and either causes windthrow or kills standing trees by destroying their ability to take up water and nutrients. Infected saplings and small poles usually die standing; larger trees are more likely to be windthrown (Hostetler 1996). *Phellinus weirii*, like other root pathogens, has co-evolved with its host through time and thus is a natural, perhaps even *a* necessary, part of many forest ecosystems. Laminated root disease spreads through forest stands by means of root contacts. It kills susceptible host trees, resulting in scattered groups of dead trees. This condition creates openings in the canopy, increases volume of down woody debris, increases species diversity in the plant community, and enhances visual quality on a landscape scale (Hostetler 1996).

Before human activities became the dominant agents of disturbance on the landscape, the distribution and spread of the fungus was most likely mediated by the fire history and pattern in an area: the fire determined the location, spread and longevity of the host trees over the landscape and thus, that of the fungus. A study in the northern Oregon Coast Range found a significant association between laminated root disease and slope position in 70 to 100-year-old Douglas-fir stands. The percentage of plots containing *P. weirii*-infected Douglas-firs was highest on ridges and decreased downslope. No relation was found, however, between laminated root disease and plant community type or aspect (Hostetler 1996). This disease moves relatively slowly through stands and is persistent for up to 50 years in large roots and stumps of trees that have been cut or killed (Hostetler 1996).

Suppression of natural fire and planting stands dominated with Douglas-fir are the human activities that have contributed the most to the potential for increasing the spread and intensification of laminated root disease in those stands where it existed prior to harvest. Because of the *extensive* amount of human disturbances in the Indian/Deadwood and Upper Five Rivers/Lobster portions of the assessment area (**Map 5**) where the concentrations of this root rot are dense, it is likely that in the future laminated root rot levels will be higher and the disease more widely distributed than in the past.

Landslides, Floods, and Earthquakes

Landslides and floods are integral to the formation of Coast Range landforms, soils, streams, and fish habitat. They introduce sediment (including gravels necessary for spawning) and large trees that act as energy dissipaters and sediment storage sites into the stream systems.

Logging and attendant road construction altered landslide rates by destabilizing steep slopes within most watersheds in the LSRA area. Instead of a single short period of intense landsliding which would have normally been associated with large-scale fires, repeated sliding results from moderately severe storms. Landslides from logged sites mainly introduce sediment without the large logs that control stream channel gradients and sediment load over several decades. The supplies of large trees to the stream channels have been greatly reduced or eliminated. Although no systematic studies of this effect have been conducted across the area, these activities are thought to have drastically changed stream channel shapes and function. Instead of complex step/pool profiles with multiple side channels produced by log jams, many channels in heavily logged watersheds have become simple bedrock chutes. The streams are lacking the pools and side channels necessary for quality anadromous fish habitat. As a result, during flood events there is a lack of calm water areas for the fish to rest in and many fish get swept into the lower channels or out to sea where they cannot survive.

Locally, landslides and floods influence the productivity of a site and its ability to produce vegetation. Successional stages of development and thus, attainment of LSR objectives, locally can be delayed.

Periodic earthquake activity can result in large mass failures. The relationship of earthquake activity to slope movement has not been quantified.

Vegetative Patterns - Reference and Current Conditions

Disturbance processes, plant series and sub-series environments, and successional trends all influence the range of landscape patterns. Comparisons over time of the amount and distribution of seral stages allow us to evaluate landscape changes. Plants and animals have adapted to the range of natural conditions across the landscape. Knowledge of the range of patterns allows us to evaluate and prioritize future management direction.

Ideally, comparisons in vegetative pattern should be made at many points in time over a long period (several hundred years) to get a complete picture of the range of natural conditions. Comparisons can provide some insight into historic pattern, and allow us to put current condition in context. It is rarely possible to get specific landscape pattern information for such long time periods. We can make assumptions about historic landscape pattern based on what we know about historical disturbance regimes and management history.

Seral stage distribution was only available for two points in time. A mid-1900s seral class map was derived from a series of county-wide vegetation coverages completed between 1940 and 1956 **(MAP 7**). Although some industrial forest practices were in effect prior to the 1940s, this seral class map provides the best information available on the composition of post-fire, pre-intensive forest management vegetation pattern. Logging had been occurring on private land for about 50 years. Intensive logging on federal lands was just beginning. We are not setting the mid 1900s time period as our desired future condition but, instead, are using it in conjunction with what we know about disturbance regimes to compare against current vegetation pattern. The maps derived from other sources (Teensma et al. 1991) were too coarse of a mapping unit to use for this exercise.

Current vegetation seral stage condition was developed by combining BLM and Forest Service vegetation layers. **Appendix B** describes the process for delineating and the definitions of seral stages. With these two efforts to delineate seral stages, we can compare the effects of our forest practices on landscape patch distribution.

Because mapping standards between the mid-1900s coverage and the current vegetation coverage are different, care must be taken in interpreting exact vegetation distribution changes. However, several general trends in vegetation pattern across the landscape emerge from the above analysis (USDA 1995).

- **Patch Size:**

Patch sizes on the landscape are reduced from reference conditions (mid 1900s) in all disturbance regimes. The largest change has occurred in the Central Interior Alsea (**Map 7**) with a shift in dominant patch size from jumbo (>10,000 acre) to medium-sized patches (100-1000 acres in size).

- **Number of Patches:**

The number of patches across the landscape has increased for mature conditions. Numbers of patches within each disturbance regime have at least doubled. The biggest change occurs in the Central Interior Alsea disturbance block where current mature patches are six times as many as occurred in the mid-1900s.

- **Area of Mature:**
  The percentage of the disturbance regime blocks in a late seral condition has been reduced. The greatest change, based solely on federal ownership, is in the Central Interior Alsea disturbance block with a 46% reduction in late seral vegetation (78% to 42%). The smallest change is in the Central Interior Marys Peak/Alsea Valley block with a 15% reduction in late seral vegetation (60% to 51%)

LSR R0267 landscape pattern in the mid-1900s was largely that of a late seral forest, with approximately 75% of the LSR acres in that seral stage (USDA 1995). Current conditions consist of a landscape composed of approximately 46% late, with early-mid seral conditions significantly represented (**Map 8**) (**Table 5**).

SERAL STAGE	PERCENT OF LSR BY SERAL STAGE	
	RO267	**RO268**
GRASS/FORB	0%	1%
VERY EARLY <10 yrs	6%	6%
EARLY 11-24 yrs	16%	14%
EARLY 25-50 yrs	18%	15%
MID 50-80 yrs	7%	7%
LATE >80 yrs	46%	46%
HARDWOOD/MIX	6%	10%
UNTYPED	1%	1%

Table 5: Current Seral Stage of Federal lands in LSR RO267 and RO268

The mid-1900's vegetation pattern in LSR R0268 was dominated by the late seral stages encompassing approximately 70% of the LSR acres (Assessment Report 1995). Disturbance history indicates that many of these stands generated in the 1840-50 fire period (Teensma et al. 1991).
Today, the landscape is more varied, with 46% in late seral, and higher proportions of early-mid seral stands than occurred previously (**Map 8**) (**Table 5**).

Loss of late seral conditions, increases in patch numbers, and decreases in patch sizes have contributed to late-successional habitat loss and fragmentation across the two LSRs . Both LSRs are affected, but LSR RO268 has a higher degree of fragmentation and loss of giant patches (USDA 1995).

III. CONDITION OF THE LSRs FOR WILDLIFE AND PLANT SPECIES

Late-Successional Forest Species

As defined at the beginning of this assessment and in the FSEIS, the term "late successional" is applied to both mature and old-growth stands. However, from a functional standpoint, these two stand types are used differently by wildlife species. Thus the term "mature" will be used in this section to describe natural stands which are approximately 80-150 years old.

Due to the extensive homesteading and forest management activities within the LSRA area since the turn of the century, most of the forest habitat has been heavily fragmented and consists of a mosaic of mature stands (predominantly 150 yrs old), hardwood mixed stands, young plantations, and early seral types (**Map 8**).

Consequently, habitat conditions for late-successional species within the LSRA area are marginal. Large patches of contiguous mature forests (>2,000 acres) are limited to areas where road access and timber harvest activities were difficult or restricted (i.e., Wilderness areas, unstable areas). **Map 7** shows the condition of mature forest habitat around the mid-1900s (prior to extensive logging), while **Map 9** shows the remaining amount and distribution of larger patches (>2000 acres) of mature stands within the LSR area today. These contiguous mature patches currently occupy approximately 18% of federal lands in the LSRA area.

Forest fragmentation has also diminished the amount and quality of interior forest habitat. Interior forest habitat is defined as the portion of a stand which is beyond the "edge effect". Edges have been shown to influence stand dynamics, understory vegetation, species composition, humidity, and microclimate a distance of two tree lengths or more into the stand (approximately 500 feet) (Chen 1991 and Spies 1994). For this analysis, only the effects of "severe" edges (i.e., mature stands adjacent to young plantations or pure alder stands) were analyzed at the landscape scale. For some late-successional forest species (such as spotted owls and marbled murrelets), increased forest fragmentation and edge effects may directly affect survival due to increased predation and/or competition for limited resources, such as food or nesting sites. **Map 10** shows the proportions of the remaining mature forest stands within the LSR which are functioning as interior forest versus the portions which are considered to be edge (See also **Appendix H.4**). Species which are potentially negatively affected by forest edges include many of the non-vascular plants, amphibians, several species of mammals (such as red tree voles), and many species of birds (Lehmkuhl, 1991).

LSR Condition for Listed Species and Species Proposed for Listing

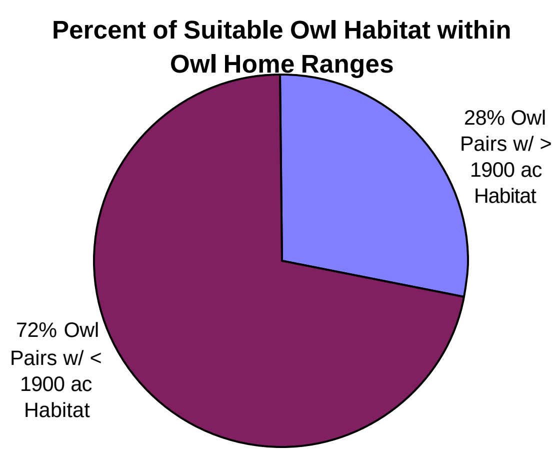
There are numerous species of vertebrates, invertebrates, and vascular and non-vascular plants associated with late successional forests that are known or suspected to occur within the LSR analysis area (**Appendix C)**. However, there is little or no specific information about the abundance and distribution of most of these species. Since survey information and coverage is relatively good for the northern spotted owl (marbled murrelet and bald eagle to a lesser extent), the condition of these sites was used to determine habitat quality and function of the remaining mature forest for other late-successional species. Spotted owl inventories cover approximately 80% of the LSRA area whereas inventories for marbled murrelets are limited to individual project sites (i.e., timber sales, commercial thinning, stream enhancement).

Owl pairs with less than 1900 acres of suitable habitat (nesting, roosting, and foraging) within the median home range (1.5 mile radius circle) are considered to be marginally viable, based on US Fish and Wildlife Service definition of "incidental take". Any further removal of suitable habitat within these activity areas may result in loss of the pair site.

The following chart displays the percent of owl activity sites within the LSR which are considered to be healthy (i.e., have sufficient habitat) compared to the number of sites which are considered to be marginally viable.

Draft recovery goals for the spotted owl are aimed at reaching self-sufficient population levels within the designated habitat conservation areas (approximately 20 pairs/area). Current population levels are far below recovery goal objectives.

Figure 2:



Most of the spotted owl sites are at or below marginal levels for habitat availability. While owls and other late successional forest species may be surviving in the Coast Range, habitat limitations are affecting reproductive success and survival. The continued existence of these species will depend on habitat protection and restoration.

In lieu of adequate information for most of the remaining terrestrial vertebrate species which occur within the LSR, a guilding analysis was used to evaluate habitat quality and function for different species guilds at the landscape scale. Species guilds are defined as groups of species which have similar habitat requirements, home range sizes, and dispersal abilities. The guilding analysis (HABSCAPES) is a computer model which analyzes the quality, size, and distribution of habitat patches on the landscape and then rates them based on their contribution for a given species guild. The resulting maps and habitat ratings allowed us to look at how the landscape as a whole is functioning for most of the terrestrial species and to identify key areas for protection and/or areas of concern.

For late successional forest species (both small and large home ranges), the HABSCAPES model run correlated well with the interior forest habitat analysis (**Map 10**) and seral patch map (**Map 9**), and rated the habitat based on quality and distribution across the landscape. For the complete guilding analysis, please refer to the Forest-wide Assessment.

The habitat analysis for late successional forest species was verified by overlaying known locations of spotted owls (ranked by the amount of suitable habitat for each site) and marbled murrelet-occupied sites and proved to be an accurate representation of how the landscape is currently functioning for these species. This process proved to be instrumental in identifying areas of concern (such as important linkages or isolated populations) and helped us to prioritize areas for restoration (building from the refugia concept). This analysis was utilized in determining LSR Zones and Landscape Cells - Chapter V.

There are additional known Spotted Owl reserve areas outside of LSR boundaries. These were identified prior to January 1994. There are 2 on the Siuslaw, 1 on Salem BLM, 1 on Eugene BLM. Locations are available at Siuslaw National Forest Headquarters and District offices and at BLM District offices. This will be referenced in Chapter 3 pages 22-23. Vegetation within
these areas if less than 80 years of age, will be treated as defined by the management triggers section in this document. Canopy will not be reduced below 40% cover. Goals that are consistent with the adjacent LSR landscape cells will be applied.

Of the more than 280 vertebrate species which are documented to occur within the LSR (coastal species were excluded from the analysis), approximately 33% are habitat generalists; that is, they have no particularly strong associations with any stand age class or vegetation type and utilize the landscape in an opportunistic fashion. Approximately 25% are strongly associated with mature and older forest types. Many of these species have relatively large home ranges (such as the spotted owl, goshawk, and marten). Another 25% or so prefer early seral habitat types. Most of these species have relatively small home ranges (i.e., rodents, reptiles, waterfowl) and include some non-native species or species which have moved west with increased forest fragmentation. Of the remaining species, about 10% require a mosaic of patch types and prefer edge habitats (i.e., elk) while the rest have special habitat requirements (cliffs, caves, etc.). Many of the edge species have mid-sized or larger home ranges. There is a considerable amount of overlap in the way most of these species utilize the landscape and very few are found exclusively in one habitat type or another. This breakdown merely gives us a representative picture of how species are utilizing the various habitat types on the landscape. Please refer to tables in the **Appendix C** for these species lists.

Habitat conditions for fish stocks of concern (primarily coho and cutthroat trout, but also including some populations of steelhead and chum) within the Oregon Coast Range has been evaluated in several aquatic assessment efforts (ODFW, Siuslaw NF, American Fisheries Society). Aquatic habitat conditions and status of fish stocks of concern, as well as integration of the aquatic and terrestrial emphasis areas within the LSR, are addressed on **pg. 7** and **pg. 63** of this assessment.

Connectivity Among LSRs

Lands that surround these LSRs are either checkerboard public/private lands, blocked public lands, or large sections of private lands (**Map 2)**. The checkerboard public lands are managed primarily by the Bureau of Land Management and the majority of habitat conditions are early seral (approximately 35% mature conifer when considering only federal land but less than 20% mature conifer when considering all ownerships). These checkerboard lands, as a result, have isolated and highly fragmented older forest conditions.

Many of the public lands outside of this LSRA area are managed under a variety of Land Use Allocations as identified in the ROD. Along the southern boundary of LSR RO267, the public lands are designated as a combination of LSR and Matrix (60 - 80 yr. rotations). Public lands along the east and southeast of LSR RO267 are designated predominately as Connectivity/ Diversity blocks. The Connectivity/Diversity blocks were designed to be managed on 150-year rotations with a minimum of 25-30% of the designated block in a late-successional condition (ROD C-42). These blocks are designed to provide connectivity (along with other allocations such as Riparian Reserves) between LSRs for animal and plant species associated with older forest habitat.

Due south of the western edge of the LSR RO267 area is the Smith/Umpqua block. It is managed by the Siuslaw National Forest and Coos Bay District of the BLM and contains contiguous late-successional forested habitat. This block is a designated LSR RO265. It currently contains habitat conditions suitable for use by late-successional forest species.

North and East of LSR RO268, private land holdings predominate. Directly north of LSR RO268, there is no federally managed land within 12 miles. After that point, scattered sections of BLM land, which have been designated as LSR in the North Coast Adaptive management Area, are encountered.

Private lands can generally be classified as industrial forest lands, agricultural lands, or small private in-holdings. Many of the industrial forest lands are currently early seral forests stands (< 60 yrs old) and are assumed to be managed on a short rotation (40 - 50 yrs) into the future. These lands will have an impact on the ability of some late-successional forests species to migrate to adjacent

LSR lands that occur outside of this LSRA area. Species with limited dispersal mechanisms (i.e., salamanders, ground beetles, fungus) may find it difficult, if not impossible, to disperse to older forest habitats outside the boundaries of these LSRs.

Agricultural lands will remain in very early seral habitat. In a natural condition, these valleys were a mix of open, native grassland habitats and forested habitats, many of which have been cleared by landowners to make way for homes, food crops, and pastureland.

The management of lands owned by small private landowners will vary greatly. These lands are not expected to have a major impact on the ability of these LSRs to function as late-successional forest habitat due to the small amount of area occupied across the landscapes. Industrial forest lands will likely continue to be managed on short harvest rotations (40-50 yrs.) providing scattered areas of early seral habitat conditions throughout the LSR over time.

By following the management objectives and activities as described in **Table 7**, current stands in early to mid-seral conditions will begin to develop late-successional stand characteristics. This will increase the available habitat for the existing late-successional associated species as well as provide opportunities for some of the extirpated species to become reestablished.

While the late-successional habitat within the LSR is expected to gradually improve over time (under current management direction), habitat conditions on private lands adjacent to the LSRs likely will remain constant (early seral classes). As late-successional habitat conditions improve on BLM lands in the SE section of the LSR, connectivity between this reserve and reserves in the Cascades will improve. However, due to the amount of private lands to the north of the LSR, dispersal conditions will likely remain similar to the current condition.

Other Species of Concern (State Sensitive, ROD, and Species of Social Value)

Since the major habitat type within the Oregon Coast Range historically was a forested ecosystem, with openings limited to the river bottoms and the tops of the highest peaks, most of the species in this LSRA area adapted in an environment with little or no forest fragmentation and relatively long disturbance return intervals (Teensma, 1991 and Agee, 1991). Habitat alteration and fragmentation by humans since the turn of the century has resulted in a shift in species composition (both plant and animal) from species which prefer a forested environment to those which benefit from openings (Lehmkuhl, 1991). While populations of many species, such as elk and some neotropical migratory birds, have been positively affected by this shift in habitat condition over the past 50-100 years, most of the late successional forest species and several species of large carnivores, such as gray wolf, grizzly bear, and Pacific fisher, have either been extirpated entirely from the Coast Range (**Appendix D**) or are listed as threatened or endangered **(Appendix E).** In addition, loss of overwintering habitat in Central and South America affects many populations of migratory species, making recovery efforts for some species an international challenge.

The white-footed vole is listed as a sensitive species at both the state and federal level. Due to their scarcity and limitations in trapping techniques for this nocturnal species, little is known about the distribution and condition of the population of this species in the Coast Range. Research studies indicate that this species is strongly associated with riparian hardwood stream habitats, especially those containing large logs. The LSRA is right in the middle of this species' distribution range. Aggressive conversion of alder-dominated stands in riparian areas, especially small streams systems, may negatively impact white-footed voles. More studies are needed to determine the impacts of this activity to the populations of this species.

There are a few species of management concern which may be negatively affected by the LSR objectives (i.e., species which require early seral or severe edge habitats). These include some sensitive (state and federal) species or species which have a high public profile. The level of impact from this conflict is difficult to accurately assess due to a variety of influences which are not directly associated with LSR management objectives; i.e., migratory species. Also, it is assumed that the ownership pattern associated with this LSR area will provide the early seral habitat conditions with which some of these species are associated. While management of the federal lands towards a late successional forest condition is not likely to cause populations of any of these species to decline within their ranges, it may cause a shift in their distribution and habitat use within the LSR area over time. Species which depend primarily on early seral habitats to fulfill their life requirements likely will move to the industrial forest lands (assuming approximately 40-year harvest rotations) and valley habitats. These species were part of the biological diversity across the landscape prior to European settlement and, therefore, were always present in the Coast Range.

The species of concern which prefer a combination of early seral and forest edge habitats include the Roosevelt elk (a species of social and state value), the western bluebird, purple martin, and mountain quail. While some of their life requirement needs, such as feeding, breeding, and resting, are associated with early seral conditions (grass/forb through early seral), all of these species are dependent on forest ecosystems (snags and winter/summer thermal cover) for at least portions of their life cycles.

Botanical Resources

Of the more than 200 plants, primarily non-vascular, that are listed for survey and manage in Table C-3 of the ROD, 182 species are found in forested habitats. Of these, 177 are strongly associated with late-successional forests**.** Similarly, of the 39 species which are found in riparian or wetland habitats, 30 are strongly associated with late-successional forests.

Little is known concerning vascular and non-vascular plant and fungal species distribution. Less than 5% of the area within the LSRA area has been surveyed for vascular plants. The acres surveyed have been associated with various management activities (e.g., timber sales, silvicultural projects, roads, etc.). Even less is known about the health and distribution of non-vascular (lichens and bryophytes) and fungal species.

One threatened species, Nelson's checkermallow, (*Sidalcea nelsoniana*), and several sensitive species and species of management concern may occur within the LSRA (**Appendix E**).

A conservation management plan was prepared in April 1992 for loose-flowered bluegrass, *Poa laxiflora*, the only sensitive species known to occur within the LSRA. This species has since been downlisted and known populations are being monitored.

The FSEIS/ROD identified many vascular and non-vascular plants and fungi to be considered under ecosystem management. Under the ROD, implementation of the standards and guidelines for Survey and Manage (S&M) species (Table C-3 of ROD) will be required. Standards and guidelines for survey protocols and plans for the implementation of these surveys are currently being drafted.

The lack of current information about Survey and Manage species and their distribution, abundance, and habitat preferences, makes it difficult to predict the potential occurrence of these species in the LSRA area. Information currently provided that describes potential habitat for these species is likely to change as more information is available. It is likely that there will be habitats within the assessment area to support several of these species other than those currently known to occur within the area **(Appendix E)**.

Field surveys to specifically locate S&M species have not been implemented in the LSRA area. However, three S&M species on the Strategy 1 list, *Allotropa virgata* (candystick), *Bauxbaunia piperi* and *Loxospora sp. nov. "corallifera* (a lichen), are known to occur within the assessment area. The FSEIS/ROD indicates that known sites of Strategy 1 species should be managed for these species.

Noxious and Non-native Plants

The following list of "noxious" weeds, designated by the Oregon Department of Agriculture (ODA), are known to occur in the LSRA area:

Meadow knapweed	*Centaurea pratensis*
Canada thistle	*Cirsium arvensis*
Bull thistle	*Cirsium vulgare*
Field bindweed	*Convulvulus arvensis*
Scotch broom	*Cytisus scoparius*
St. Johnswort	*Hypericum perforatum*
Japanese knotweed	*Polygonum cuspidatum*
Tansy ragwort	*Senecio jacobaea*
Evergreen blackberry	*Rubus laciniata*

Gorse (along coast)	*Ulex europaeus*

Invasive exotic plant species that are not designated by ODA as noxious weeds are also present in the assessment area. Invasive exotic plant species may present as large a threat to biological resources as those species designated "noxious". Some species of particular concern known to occur in the LSRA area include:

Common burdock	*Arctium minus*
Foxglove	*Digitalis purpureum*
Teasel	*Dipsacus sylvestris*
Burnweed	*Erechtities minima*
Robert's geranium	*Geranium robertianum*
Sweet pea	*Lathyrus latifolia*
Creeping buttercup	*Ranunculus repens*
Himalayan blackberry	*Rubus discolor*

All noxious and other non-native species may pose a threat to the future development of late-successional and old-growth forests, since these species tend to dominate early seral plant communities and inhibit the ability of the site to convert back to a forested ecosystem. Non-native plants are generally very successful competitors, particularly within the disturbance regimes that humans generally impose on the natural environment. Non-native plants generally have dispersal mechanisms (e.g., wind-born and animal-carried seed) that allow for their rapid spread. Weeds are especially advantaged by movement along disturbed road corridors. However, all of the non-native plant species of concern thrive in open-sun environments and decline in abundance once a forest overstory develops. Thus, once trees do become established on a site, these species will drop out of the system with canopy closure.

Noxious weeds are particularly a threat to early seral native plants. Early seral native plants that inhabit light gaps and small disturbance patches are important additions to the overall species diversity in older forest ecosystems. We do not know the interactions and thus the importance of these early seral species in the overall functioning of these mature and old-growth forest systems. Replacement of early seral native species with invasive, highly competitive (and often times, monocultural growth) species certainly has ramifications beyond our current understanding. We should stick to the concept of "keeping all of the cogs and wheels" in order to maintain functioning ecosystems, particularly in light of our uncertainty of the functioning of these systems.

The standard and guidelines outlined in the ROD give guidance on the management of non-native species in late-successional reserves. In addition, a recent policy was signed regarding the control of non-native plants on federal lands within the region (Forest Service, 1994).

IV. IDENTIFICATION OF SPECIFIC AREAS FOR TREATMENT

Landscape Analysis

The objective of forest management in LSRs is to protect and enhance conditions of late-successional forest ecosystems. Following successional pathways with prescriptions that focus on desired structural characteristics will meet those objectives. In addition, attainment of late-successional conditions can be accelerated by focusing treatments both spatially and temporally.

The following section, which defines a landscape analysis process, attempts to set that strategy for future management activities. This strategy is based on conservation biology - conserving the best habitat first and then working with more degraded habitats.

LSR Zones

Coarse scale functional differences in the landscape were derived from a synthesis of physical, biological, and social attributes. The dominant difference was in the ability of certain portions of the landscape to produce contiguous late-successional habitat while other areas could not be expected to serve that function. Another functional difference that surfaced during this synthesis of information was the importance of specific areas within these LSRs for providing connectivity to and from adjacent LSRs. Initially, three zones were delineated based on the above functional differences. These LSR Zones are described below.

The CORE LSR Zone located in the western portion of the LSRA area **(Map 11)** is primarily managed by the Siuslaw National Forest with contiguous federal ownership (except for minor areas adjacent to larger streams that are in private ownership). Fire disturbance regimes in this area have historically resulted in the largest patches within this LSRA area. Most of the spotted owl sites with sufficient habitat to be considered viable in the future are located within the CORE. As a result, the function of this LSR Zone is to provide the genetic source for populations of late-successional species (especially those with large home ranges) within and to populations outside of the CORE surrounding this area.

There are significant opportunities in this area to restore aquatic habitat and assist in recovery of Coho Salmon. One of the components of late-successional forests is the accumulation of large wood in the stream channels. Fish habitat quality is poor throughout much of this LSRA area. This is primarily due to the loss of large wood and elevated stream temperatures. Some of the same processes that result in forest fragmentation and loss of mature forest vegetation on the landscape are responsible for the loss of in-stream structure and conditions which will not supply large wood to stream channels within the foreseeable future.

The conservation strategy for aquatic species supports restoration of the best aquatic habitat first. The prioritization of restoration practices for late-successional habitat for terrestrial species highlights all but one of the key watersheds as high priority for restoration. The blending of these two strategies for restoration, provides a focus to restoration activities for whole landscapes, from stream channels to the ridgetops. **Map 13** shows the relationship between these LSRs and Key watersheds. **Appendix H** lists information from this report by watershed.

The CORRIDOR LSR Zones **(Map 11)** are located in the north of LSR RO268 and southeast of LSR RO267. They provide a key connectivity function with the surrounding LSR network. The majority of spotted owl sites within these areas do not currently contain adequate levels of suitable habitat and are considered to be marginally viable. Habitat restoration on federal lands will improve this condition. Due to the checkered federal ownership patterns within the CORRIDOR zones, this area will serve as a refugia area for late-successional forest species which are dispersing from the stable populations in the CORE to adjacent LSRs and vice versa.

To the north, the closest designated LSR is 12 miles away and current suitable habitat is minimal with limited checkerboard federal ownership. The northern portion of LSR RO268 could provide the first suitable habitat for large home range late successional species migrating south. This migration both coming south and going north is critical to mixing of gene pools and ensuring survival of these associated species. The southeastern portion of LSR RO267 has also been identified as a critical wildlife corridor for the same reasons. In this case, however, this is a critical passage for linking the gene pools of the Cascade Range with the Coast Range. This is the first forested corridor over which large home range species can travel to mix with Cascade species south of the Columbia River. The Northwest Forest Plan has identified the area directly south and southeast of LSR RO267 as a critical connecting corridor by allocating sections of federal land as Connectivity/Diversity Blocks.

The BUFFER LSR Zone designation is for that portion of the LSRs which does not directly link to areas outside of these LSRs but is important for connectivity and dispersal of organisms within these LSRs and between other portions of the landscape **(Map 11)**.

Both the CORRIDOR and BUFFER LSR Zones are in fire disturbance regimes which have historically produced variable patch sizes with much more landscape variability in seral conditions than would have been found in the CORE LSR Zone. Intermediate disturbances in this area were common and the multilayered characteristic of late-successional forests may have established earlier in this LSR Zone. As a result, this area will support a different species mix of organisms than the CORE LSR Zone. These areas have the potential to support late-successional animal species that have small home ranges. Late-successional habitat and connectivity will be provided based on ownership with small to medium patches in mixed ownerships and large patches where possible.

Based on the potential ecological functions of these different areas, we have established specific goals that future management should consider when prescribing activities within these LSRs.

CORE LSR Zone goals:

- Minimize fragmentation. Provide contiguous large patches of late-successional habitat.
- Increase connectivity and dispersal habitat both within large interior blocks and by development of late-successional habitat in the mixed seral areas adjacent to the large interior blocks.

CORRIDOR / BUFFER LSR Zone goals:

- Improve, create, and maintain connectivity across the landscape.
- Within stands, increase connectivity and dispersal habitat. Priority is on northern spotted owl site centers that do not have good habitat.

For all LSR Zones, the primary goal is:

- To maintain and restore habitat to support well-distributed populations of late-successional forest species.
- Maintain high priority fire protection, especially along high use travel corridors and on the mixed ownership areas in the CORRIDOR/BUFFER LSR Zone designation.
- Land exchanges and changes in land use allocations i.e., changing some allocations to block up areas should be considered wherever it assists in attainment of the above goals.

Landscape Cells And Treatment Priorities

Intermediate scale functional differences were used to further divide the LSR Zones into "Landscape Cells". Each cell was based either on its existing condition or the functional role that that portion of the landscape needs to play to facilitate the attainment of a landscape which will allow species survival and dispersal. The initial landscape analysis was done for the whole area, disregarding land use allocations or ownerships. Therefore, existing condition (size and distribution of remaining mature forest) is based on information known or assumed (i.e., 40-year rotations on industrial forest land) from all ownerships. This provided an overall assessment of the conditions for late-successional species. The amounts of mature would be higher if only federal lands were considered. With this process, the landscape was divided into six Landscape Cells.

These areas have been delineated on maps to display the concepts of the landscape analysis. They are not intended to be another land allocation. It is inappropriate to calculate acreages of certain treatment opportunities within these areas. They are conceptual boundaries.

Within these Landscape Cells, treatment priorities were established based on the concept of protect and stabilize the best. Priority 1 areas were given to the large contiguous patches of mature conifer habitat. With focused effort, connectivity and increase in the size of these blocks could be attained.

Priority 2 areas focus on building late-successional habitat between smaller patches that currently exist. In the case of Landscape Cell # 4, priority was given to the existing large contiguous mature blocks and the desire to connect this habitat.

Priority 3 areas were given to those portions of the landscape where the late-successional conditions are currently of low quality. Even though these areas are important for establishing connectivity between LSRs, considerable efforts will need to be employed to restore these landscapes.

The 4th priority was given to that portion of the landscape where the late-successional conditions are of low quality and the area is not in a critical corridor. While these lands contain small patches of late-successional habitat which are important to maintain, these areas will take considerable efforts to restore.

Landscape Cell #1 (Contiguous Mature -Dark green patches on Map 12) contain the largest contiguous blocks of late-successional vegetation. The minimum patch size within these Landscape Cells is 2000 acres. These areas currently contain over 40% late-successional habitat. When the existing active northern spotted owl site centers are overlayed on these Landscape Cells, nearly all of the sites within these areas contain adequate levels of suitable habitat to be viable over the long term. These areas are the foundation for recovery of contiguous late-successional habitat in the CORE and CORRIDOR LSR Zones. **Treatment Priority = 1**. Management goals within Landscape Cell #1 include:

- Accelerate attainment of late-successional characteristics
- Treat the complete range of seral stages in plantations, prescribe treatments which set the trajectory to accomplish objectives with a limited number of entries.
- Emphasize road closures consistent with the ATM/TMO plans
- Leave some stands to develop on their own; i.e., if mid-seral 50 to 80 year old stands are on a suitable trajectory, do not treat

Landscape Cell #2 (Mixed Seral - Light green patches on Map 12) are those portions of the CORE LSR Zone where there are a variety of seral classes. The late-successional habitat in these Landscape Cells ranges from 27% to 40% with the majority around 33%. Most active Spotted Owl site centers within Landscape Cell #2 do not have sufficient suitable habitat and are considered minimally viable by the US Fish and Wildlife Service. There are two overall goals for this Landscape Cell.

- Goal # 1 is to grow out from the adjacent large late-successional blocks that are in Landscape Cell 1. Specific management goals are exactly the same as for Landscape Cell #1. **Treatment Priority = 1**
- Goal # 2 is to create new and enlarge existing small, scattered late-successional patches. **Treatment Priority = 2.** Specific management goals within these portions of Landscape Cell #2 are:
  - Use successional pathways as guidelines for prescriptions
  - Prescribe treatments which will attain late-successional characteristics with continued implementation of management activities. Multiple entries are appropriate.

Landscape Cells #'s 3 - 6 are all currently in an early seral condition. They have been separated because of the different functional roles that they play in the landscape. This resulted in either different overall management goals or in different treatment priorities.

Landscape Cell #3 (Early Seral - Brown patches on Map 12) are those areas within the CORE LSR Zone that are blocks of contiguous early seral vegetation. There is currently less than 20% late-successional habitat in these Landscape Cells. **Treatment Priority = 3.** Management goals within Landscape Cell #3 include:

- Maintain dispersal habitat. This is critical habitat that is being used
- Around T&E species locations, use low risk silvicultural treatments
- Treatments should first focus on lands that are currently unsuitable habitat within northern spotted owl provincial home ranges (i.e., within a 1.5 mile radius of the activity center).

Landscape Cell #4 (Early Seral Link to Mature - Red patches on Map 12) are those areas outside of the CORE LSR Zone which were identified as critical linkages between large patches of late-successional habitat. There is currently less than 20% late-successional habitat in these Landscape Cells. **Treatment Priority = 2.** Management goals within Landscape Cell #4 are exactly the same as Landscape Cell #2.

Landscape Cell #5 (Early Seral Connectivity - Purple patches on Map 12) are those areas in the CORRIDOR LSR Zone identified as critical links between adjacent LSRs. There is currently less than 20% late-successional habitat in these Landscape Cells. **Treatment Priority = 3.** Management goals within Landscape Cell #5 are exactly the same as Landscape Cell #3.

Landscape Cell #6 (Early Seral - Light blue patches on Map 11) are in the BUFFER LSR Zone. There is currently less than 20% late-successional habitat in these Landscape Cells. **Treatment Priority = 4.** Management goals within Landscape Cell #6 are exactly the same as Landscape Cell #3.

Access and Travel Management / Travel Management Objectives

It was beyond the scope of this assessment to do a site-specific road plan. This assessment has provided objectives to develop Access and Travel Management or Transportation Management Objectives within the LSR Zones and Landscape Cells. Many other objectives, besides LSR objectives, need to be considered in that planning effort. The Siuslaw ATM plan has been completed and a very cursory review by the team did not see major conflicts with meeting LSR objectives given the current ATM plan. TMO plans are currently being developed. These planning efforts need to be a cooperative effort with integrated plans as an outcome. BLM is constrained by mixed ownerships. Also, shared construction costs and user fees fund some of the roads on BLM lands. The ROD B-19 and C-16,19,32 all provide direction for roads within LSRs.

When finalizing access and travel management (ATM) plans or travel management objectives (TMOs), consideration for the type of management cell should be considered when designating routes; for instance, contiguous large mature blocks should be a priority consideration for road closures/obliterations. This allows for large blocks of harassment-free landscapes where some of the more recluse species could be reintroduced.

V. CRITERIA FOR DEVELOPING APPROPRIATE TREATMENTS

It is important that activities that are employed within late-successional reserves maintain all of the pieces necessary to attain late-successional stand characteristics. This section of the assessment describes the criteria and the process for developing appropriate treatments within LSRs. **Figure 3** is a flowchart which depicts the process and displays some examples of how an Interdisciplinary Team (IDT) would utilize this section of the document.

There are 5 steps to the process. The first is the identification of a condition on the landscape which would trigger a management action (**Table 7**). Second is a determination of the seral stage of development. Third and fourth steps are done in conjunction with each other. The IDT determines what the site-specific issues of an area are and then works as a team to establish the appropriate management criteria (**Table 7**) and sideboards **(Tables 8-12)** that guide implementation of the project through an integrated prescription. The outcome, the fifth step in the process, is a proposal of an appropriate management activity.

Management Triggers

There are a variety of existing or potential conditions on the landscape which would trigger a management action. Site-specific analysis is necessary to determine if an area would require some sort of vegetative manipulation to accelerate attainment of late-successional characteristics.

Site-specific analysis may determine that an area is on a trajectory for attainment of late-successional characteristics (refer to discussion on the range of late-successional characteristics and **Tables 8-12**). When this situation is encountered, regardless of seral stage of development, that area should be left to develop on its own.

There are certain conditions that exist on the landscape that result from past land use patterns and/or practices that would trigger a management activity within late-successional reserve land allocations. It must be remembered, however, that all activities that occur within the LSR land allocation must be beneficial to the creation of late-successional forest conditions over the long - term. (ROD C-12).

Studies have shown that accelerated development of many of the structural components of late-successional stands can be achieved (Oliver 1992, Marshall 1991). Wide spacing provides the site condition for open-grown trees and the development of lateral branches which result in a "wolfy limb" character to individual trees. Through time, the large wood will die, decay, and fall to the ground as a source, first as snags, then as large woody material that will either stay on site or move into a stream channel. As a result, it can be suggested that growing big trees also accelerates development of the down wood and snag

component in size classes typical of late-successional structural character. Multiple canopy layers, canopy gaps, and the development of a patchy understory can be created. However, understanding the spatial distribution of these features at the stand and landscape scales is currently a research topic.

The effects of accelerated development of structural characteristics on ecosystem processes (i.e., tree growth and maturation, death and decay, disturbances), and functions (i.e., nutrient and hydrologic cycling, buffering of microclimates, storing carbon) is not known. Some processes and functions cannot be accelerated, such as time since disturbance. Thus, there should be enough variability in treatments and enough unmanaged land to serve as refugia for any unknown elements, functions, and processes.

Dense uniform conifer stands in managed plantations (25-50 yrs) will be the primary focus for manipulating vegetation to provide the structural conditions associated with late-successional characteristics. Although dense, uniform stands have been a part of the landscape, the amount and distribution of these stands now occurring in these LSRs is inconsistent with the range of natural conditions. Trees which have been uniformly spaced from planting and precommercial thinning will interact differently when developing through the inter-tree competition phase or stem-exclusion phase than natural stands seeding in after a stand replacement disturbance. Trees have less chance to express dominance when they have all been put on an even footing in terms of growing space and selection through precommercial thinning. Therefore, when these stands reach density levels in which individual trees are competing with each other for growing space, it will take longer for individuals to express dominance. As trees go through this stagnation stage, stems will become tall and slender as height growth continues but diameter growth drastically slows in response to loss of crown. These trees will become more dependent on neighboring trees for support. Eventually, as some trees dominate and others fall behind, the dominant trees will develop more crown and diameter growth and therefore more individual stability. Still, as trees go through this period, they are more likely to blow down or, if drought conditions persist, be more susceptible to insects and disease.

The uniformity of trees within a stand determines the rate of differentiation and self-thinning. Although plantations are generally more uniform, portions of the stands are as non-uniform as many natural stands, and some portions of natural stands developed as uniformly as the plantations. So it's a continuum, with a wide range of development which has taken place in natural stands. The plantations are skewed towards the more uniform end of the spectrum. Thinning dense, uniform stands such as these to a wider spacing would provide the remaining trees more of an opportunity to differentiate without stagnating.

Active management, such as thinning and underplanting, would accelerate attainment of at least some late-successional stand conditions (large trees, multiple layers, for example). Many of these conditions begin to develop within 30 - 75 years. Without thinning and underplanting, the managed stands would eventually develop late-successional characteristics. However, attainment of many of stand characteristics, such as large snags and logs, may take centuries.

Stands less than 80 yrs old currently occupy about 211,898 acres (**Table 6**) of land within the LSR allocation across the landscape. Approximately 86,000 acres are in 25 to 50-yr old managed stands, while younger plantations (0 and 24 yrs old) make up approximately 114,000 acres. Many of these stands may require some sort of density management within the next 30 years. There is scientific research to support that it is appropriate to change these stands from the current trajectory that they are now taking with activities that manipulate the density and spacing of trees (Oliver and Larson, 1990; Marshall, 1991) in order to achieve more natural stand characteristics. In addition, another 37,000 acres are in 51 to 80 year old stands (i.e., fire-regenerated stands, early railroad logging). While the majority of the stands in this older age group are natural or on a trajectory which meets LSR objectives, a few of these stands may also benefit from some vegetation manipulation.

Commercial thinning opportunities are predominately in the "dense uniform conifer stands" in the 25-50 year old age group (**Table 6**). Throughout the LSR, federal forest management agencies are predicting that about 6500 acres per year will be scheduled for manipulation of vegetation to accelerate the attainment of late-successional conditions. Only a small portion of the 50 to 80 year old stands would be treated. Locations of these treatment areas will be based on the priorities described in Landscape cells with the "best" habitat areas being secured first then moving treatments to restore the more degraded habitats (pp. 56.57). Habitat conditions within spotted owl activity centers will be evaluated and if vegetative treatment is required to restore suitable habitat, 40% canopy closure will be maintained to provide dispersal habitat.

Table 6. LSR Acres With Potential Treatment Opportunities

LSR	AGE CLASS	ACRES BLM	ACRES SNF
RO267	0-10 YRS	9,652	1,525
RO267	11-24 YRS	16,864	11,615
RO267	25-50 YRS	23,304	7,606
RO267	51-80 YRS	9,532	3,025
RO268	0-10 YRS	7,403	14,358
RO268	11-24 YRS	12,112	39,987
RO268	25-50 YRS	15,439	39,474
RO268	51-80 YRS	10,537	14,215

Another condition on the landscape where management activities would assist in attainment of late-successional characteristics is when soil productivity is so severely degraded that the site can no longer support or maintain the plant communities that it was once capable of supporting. Soil restoration activities could be employed to restore the soil quality at the sites.

Every effort should be made to employ management practices which maintain a low risk of creating catastrophic disturbances. However, there may be times when a catastrophic disturbance, whether insects, disease, wind or fire, occurs and has led to conditions that if allowed to persist, would be detrimental to the goals and objectives of the LSR. In this situation, it is appropriate to employ some management activities. In the case of insect outbreaks, only as a last resort should activities which apply chemical treatment be employed. All management responses to disturbance events will follow the guidelines in the ROD.

The area outlined on **Map 6** indicating Phellinus includes both mature and young stands. Treatment would occur in plantations within that area. Seral classes within that delineation are:

Grass/Forb	518 ac	Very Early (<10 yrs)	2,858 ac
Pole (11-24 yrs.)	9,892 ac	Young Conifer (25-50 yrs)	10,442 ac
Conifer (51-80 yrs)	1,584 ac	Mature Conifer (>80 yrs)	26,109 ac
Hardwood	4,872 ac		

The majority of treatment would occur in the 25-80 year age classes, as described for a preventative treatment. We estimate that about 300 acres per year may be treated. This acreage would be included in the total LSR acreage treated per annum.

In some areas, existing species mixes may be inappropriate for the site and detrimental to the attainment of late-successional characteristics. This is often the case when past disturbances, especially if human-caused, result in a species shift from what was there naturally, or has introduced noxious or non-native species onto a site which are inhibiting the regeneration of the native plant communities.

At times, there will be conditions on the landscape which are unacceptable and are in conflict with Aquatic Conservation Strategy objectives. These areas will be manipulated to bring them in line with ACS objectives over time.

There are some areas in the assessment area which are not and are not expected to be on the trajectory of attaining late-successional structural characteristics. These areas occupy a small component of the landscape (less than 1%) and are considered unique and important for the contribution they add to diversity across the landscape. These include areas in a non-forested condition for a variety of reasons which include rock outcrop areas, wetlands, and meadows. Management activities will be employed to maintain these special characteristics.
Non-silvicultural activities which manipulate vegetation may be proposed within these LSR boundaries. These activities need to be neutral or beneficial to the LSR. The ROD C- 16, 17, 18 provides good direction on these types of activities. Existing facilities (i.e., campgrounds, electronic sites) are compatible with LSR objectives. Most existing and planned recreation facilities are along the coastal strip which is not within the LSR designation. Areas that exist or are planned, within LSR boundaries, occupy such a small area when looking at the whole LSR that the function of the overall LSR will be maintained. There may be some site-specific areas that are outside of ACS objectives. These will need to be reviewed at a finer scale either in Watershed Analysis or project environmental assessments. Marys Peak and the Wilderness areas are identified as areas that may possibly have conflicts with LSR objectives if increased use or major expansion of developed recreation occurs. All projects must meet ACS Objectives over the long term, meet T&E species requirements, and avoid known T&E locations. This list is for projects that actually disturb vegetation.

In **Table 7** we have delineated those site conditions which would trigger a management action. We also noted, in some cases, that such site conditions would have different objectives and thus a different response from management, depending on the seral stage of development. For example, in the very early seral stage, (i.e., less than 10 years of age), a management activity would not space trees so widely that the risk of predation by animals or competition with herbs and shrubs would be so high that the desired tree species would be lost. Instead, a management goal in the very early seral stage would be to plant and maintain enough trees on site that one could be assured that adequate stocking to meet long-term objectives would be attained. It would not be until the later seral stages that confidence in survival would be high enough that a management activity would risk thinning trees widely.

Management Criteria

Management criteria have been established (**Table 7**) to guide prescriptions for the appropriate management activities. These criteria are designed to help to "keep all the pieces" and assure attainment of late-successional characteristics. Not all criteria will be applicable with every project. The criteria vary by condition on the landscape (or "Management Trigger") and/or seral stage of development. If these criteria cannot be met with a proposed prescription, then that prescription must either be revised or the project dropped or sent to the REO for project-specific approval.

Existing Guidelines For Habitat Manipulation

The US Fish and Wildlife Service recommends that silvicultural activities be limited to stands which do not currently serve as suitable habitat for spotted owls and other T&E species. Suitable habitat for owls includes nesting, roosting and foraging habitat. Nesting habitat is defined as mature stands with sufficient structure and large snags or old-growth remnants which provide nesting opportunities. However, owls frequently use younger stands including natural stands 50 to 80 yrs old for roosting, and foraging. So, caution needs to be taken when recommendations are made to treat these stands, especially if they are located within 1.5 miles of a known owl activity center, as they are likely being used by the resident owl pair.

The ROD addresses maintaining dispersal habitat for terrestrial species through Riparian Reserves (RRs). The RR network was designed to facilitate dispersal of both terrestrial and aquatic species. The reserve system and other mitigating measures found in the ROD replaces the 50-11-40 rule. Dispersal habitat for the owl is defined as stands with an average tree diameter over 11" dbh and a minimum crown closure of 40%. Stand treatments which reduce the crown closure to below 40% (or approximately 60 trees per acre in a 35-yr.-old stand in the Coast Range) may affect dispersal for owls. The effects of silvicultural prescriptions on dispersal habitat will be identified and evaluated at the watershed (5th field) level in consultation with USFWS and the level one consultation team for the Oregon Coast Province.

In these LSRs, the RR network covers approximately 80% of the landscape. In general, activities proposed in this assessment are planned both inside and outside of RR boundaries within LSRs. Many of the objectives for LSRs are similar to RR objectives and thus, similar treatments are appropriate.

Activities should be directed at stands that were regenerated following previous harvest activity and that show no significant development of multi-canopy tree structure.

Appendices F.1 and F.2 contain two letters of direction from the Regional Ecosystem Office (REO) which outline specific types of treatment that are already exempt from REO review. It has been sufficiently demonstrated that implementation of the activities listed is consistent with the attainment of late-successional characteristics.

Appropriate Management Activities

The activities listed in **Table 7** are a list of management options that may be appropriate for a given management trigger.

Activities not addressed may be appropriate on a site-specific basis and should be brought to the REO for approval.

The appropriate management activities listed in **Table 7** are intended to be the result of an integrated prescription which considers the management criteria, the successional pathways appropriate for a given site, and the desired future conditions of the area. Implementation of these activities will accelerate attainment of late-successional characteristics. Resource managers are presented with a range of appropriate treatments so that they are able to select the most appropriate treatment following site-specific assessment of certain areas.

Although we have listed many management activities that would be appropriate in late-successional reserves, they have been kept very general. This was done purposefully to allow specialists to make recommendations based on site specific evaluation. However, some management activities are so encompassing that they do need clarification.

Density treatment means any manipulation of the density of vegetation on a given site. Activities to achieve desired density will vary by site condition and to be exempted from further REO review, typically will include:

- Manual release for survival of individual trees in younger plantations (<24 yrs.)
- Thinning of young trees to provide adequate growing space for adjacent trees.

- Selective thinning in young conifer and older stands to create groups of trees or provide variable spacing (25-80 yr. old stands).
- Creation of openings - generally less than 1 acre in size in 25 - 80 yr. old stands.
- Thinning densities can vary depending on the management objective and the successional pathway for a given environmental condition. Densities normally range from 40 - 110 trees per acre in 25-80 yr. old plantations.
- In Riparian Reserves if there is less than 50% suitable dispersal habitat, densities should not be reduced below 40% crown closure (or about 60 tpa at age 30-35).
- Unthinned areas (all age classes).
- Snag and CWD levels within the ranges indicated in **Tables 11 and 12**.

Treatments not meeting all of the above items will remain subject to REO review.

Salvage is defined as the removal of trees from an area following a stand-replacing event such as those caused by wind, fires, insect infestations, or diseases. Removal of dead trees from an area is an appropriate management tool. The decision to do so must be based on site-specific conditions, with the understanding that salvage operations should not diminish late-successional habitat suitability now or in the future. Appropriate reasons to remove trees from an area are defined on pages C-13-16 of the ROD.

Treatment from disturbances on less than 10 acres of land may be appropriate in the following instances, although these conditions were not specified in the standards and guidelines of the ROD. However, for these salvage or risk reduction treatments, REO review would be required. These conditions include:

- When the quantity of fresh material (less than 1 year old) on the ground is sufficient with a distribution that is contiguous and poses a high risk of Douglas-fir bark beetle outbreak. Consideration must be given to whether or not the predicted kill of surrounding large trees would render the surrounding stand non-functional for late-successional habitat (Hostetler, 1996).
- When disturbance occurs adjacent to private property boundaries, removal of portions of trees would be allowed if they: threaten the survival of trees on adjacent land owners, are a hazard to surrounding owners, or impact the management of surrounding lands.

Table 7: Management Triggers, Criteria, and Appropriate Activities Within Late-Successional Reserves

The following management criteria will be referenced throughout **Table 7**

1. Maintain minor native species, gaps, clumps, animal predation, natural mortality
2. Maintain site occupancy (stocked to maintain options for LSR objectives)
3. Maintain vigor and health to keep options open
4. Provide for natural regeneration from edges
5. Provide for variable spacing
6. Encourage natural diversity of floral species in the overstory and the understory
7. Grow large trees
8. Maintain snags and CWD to levels shown in tables 11 and 12
9. Create wolfy limbs
10. Grow large wood for fish habitat structure
11. Maintain and or establish multiple canopy layers
12. Recruit snags in larger diameter classes to levels shown in tables 11 and 12
13. Consider windfirmness
14. Consider understory shrubs/herbs/fungi/lichens
15. Provide CWD for structure in streams
16. Maintain Connectivity function of stand
17. Maintain Wolfy limbs
18. Restore soil productivity
19. Reestablish natural communities
20. Protect Green Trees
21. Maintain low risk of and reduce incidence of insect and disease outbreaks
22. Protect investments
23. Provide for safe conditions
24. Reduce sediment
25. ATM/TMO consistency
26. Provide adequate light for growth of conifer
27. Restore hydrologic function
28. Maintain early seral conditions
29. Meet RNA, ACEC, Botanical area objectives

MANAGEMENT TRIGGER	SERAL STAGE	MANAGEMENT CRITERIA	APPROPRIATE MANAGEMENT ACTIVITIES
Area on trajectory for attainment of late-successional structural characteristics (confirmed by site-specific evaluation) a. Natural hardwood stands b. Diverse natural stands c. Dense natural stands (50-80 yrs)	All (except mature) Refer to dense conifer for management objectives by seral stages	LSR management objectives are being met (Tables : 9,10,11,12)	No treatment Recruit snags Close roads

Table 7 cont.: Management Triggers, Criteria, and Appropriate Activities Within Late-Successional Reserves

MANAGEMENT TRIGGER	SERAL STAGE	MANAGEMENT CRITERIA	APPROPRIATE MANAGEMENT ACTIVITIES
Dense Uniform Conifer	Very Early < 10 yrs	1 - 8	Density treatment No treatment if management objectives cannot be met
	Early 11-24 yrs	1 - 10	Stand density treatment Fertilization No treatment if management objectives cannot be met
	Early 25-50 yrs	1, 3 - 15	CWD placement in streams Snag creation (refer to LSR components Table 11) Prescribed fire for creation of structure and control of species composition Underplanting Stand density treatment Down wood recruitment Fertilization No treatment if management objectives cannot be met
	Mid seral 50-80 yrs	1, 3 - 17	All of the above
Long-term productivity issues	All (except mature)	18	Silvicultural treatments to add nutrients to the site (i.e., fall and leave) Recruit snags Close roads

Table 7 cont.: Management Triggers, Criteria, and Appropriate Activities Within Late-Successional Reserves

MANAGEMENT TRIGGER	SERAL STAGE	MANAGEMENT CRITERIA	APPROPRIATE MANAGEMENT ACTIVITIES
An Existing Condition Of Phellinus >10 Ac. In Size That May Affect The Goals And Objectives Of The LSR	All (except mature)		Thin to low densities Replant resistant or non-host species No treatment if management criteria cannot be met
An Existing Condition Of Disturbance > 10ac And <40% Canopy Closure That Affects The Goals & Objectives Of The LSR	All (includes mature)	ROD C-13 - C-16	
a. Insect and Disease			Thin to low densities
1. Phellinus		1, 2, 4 - 8, 11, 14 - 16, 19 - 22	Replant resistant or non-host species Replant appropriate species
2. Douglas-fir Beetle		same as above	No treatment if management criteria cannot be met Apply pheromones, insecticides
b. Fire		1, 2, 4 - 8, 11, 14 - 16, 19, 20, 23	If objectives cannot be met with other treatments, salvage excess over CWD and snag requirements (refer to successnl. pathways and Tables 9-12)
c. Windthrow Areas		same as above	Salvage to ensure safe conditions ______________________________
d. Landslides / debris torrents		23, 24, 25	Road restoration Slope stabilization

Table 7 cont.: Management Triggers, Criteria, and Appropriate Activities Within Late-Successional Reserves

MANAGEMENT TRIGGER	SERAL STAGE	MANAGEMENT CRITERIA	APPROPRIATE MANAGEMENT ACTIVITIES
Existing Species mix inappropriate for site potential a. Hardwood established in original conifer site i.e., conversion of site b. Inappropriate species for plant community c. Brush field (understocked) d. Noxious weeds/ non-native species	All	1,2,4 - 12, 14 - 17, 20, 26	Site conversion Establish appropriate species Control exotics/ noxious plants Stand density treatment Release Prescribed fire No treatment if management objectives cannot be met
Aquatic Conservation Strategy needs a. Degraded in-stream habitat b. Excess sedimentation c. Accelerated runoff d. Elevated stream temperatures e. Restore conifer recruitment potential	All	24, 27	Road closures / obliteration Slope stabilization Culvert replacement/ maint. Create stream channel complexity Place CWD in channels Soil restoration; i.e., subsoiling Recruit wood off-site Plant conifers in riparian zone
Special Habitat Areas a. Alpine Meadows b. Wetlands c. Rock outcrops d. Homestead meadows	Very Early	3, 6, 14, 28, 29	Prescribed fire Manual or mechanical clearing of vegetation Soil restoration Control exotics / noxious plants No treatment if management objectives cannot be obtained

Table 7 cont.: Management Triggers, Criteria, and Appropriate Activities Within Late-Successional Reserves

MANAGEMENT TRIGGER	SERAL STAGE	MANAGEMENT CRITERIA	APPROPRIATE MANAGEMENT ACTIVITIES
Non-Silvicultural Activities: Recreation: Improvement of existing facilities Expansion of existing facilities Development of new facilities Recreation Events	All	15,16,19, 22, 23, 24, 25, 29 ROD C-17 Meet ACS objtvs. Neutral effect on T&E species Apply Seasonal Restrictions Focus and Control Use	Trails/site relocation or construction Campsite construction or relocation Roads: stabilize, close, obliterate Culvert replacement / maintenance Restore Riparian condition Control exotic and noxious plants Designate appropriate use areas Provide information on resource protection
Genetic Development; i.e., Progeny sites Seed Orchards	All	22, ROD C-17	Manage existing sites
Special Forest Products	All	ROD C-18 Siuslaw NF Forest Products EA, BLM Handbook	Monitor to evaluate long term effects
Grazing	Early	ROD C-17	Upgrade or develop allotment management plans
Research	All	ROD C-18, 19	Allow as appropriate
Other: Rock Quarries Mining Mineral extraction Realty Actions Habitat Improv. Projects Electronic Sites * This is not an all-encompassing list *	All	ROD C-17	Identify appropriate areas

Desired Condition, Based on Successional and Structural Pathways

The overall goal for management of the LSR is to protect, maintain, and create late-successional forest ecosystems which serve as habitat for late-successional and old-growth related species. Management treatments will strive to re-establish connectivity of that habitat in the least amount of time to maintain functional, interacting late-successional forest ecosystems.

When attempting to accelerate attainment of late-successional characteristics, it is important to understand how successional pathways will affect proposed management activity. Successional pathways are defined by the typical, dominant compositional and structural stages that can be expected as vegetative communities develop following a disturbance. They describe the dominant tree species, relative tree density patterns, regeneration and lower layer species development, and ground cover trends through time. The pathways are controlled by local environment, original composition, and type of disturbance. Sub-series vary in their successional pathways both in the variety of species supported and the number of individual plants of a given species present.

To use successional pathways in evaluating proposed management requires knowledge of the physical environment (soil/climate zone, landform, and slope position), the biological environment (sub-series environment), and where the stand is in its successional development. This information would be used, in addition to other concerns (ACS, wildlife habitat distribution, etc.), to determine if the outcome of a particular management activity was acceptable. There may be instances when the dominant vegetation development pathways are bypassed to create conditions desired for specific purposes. For example, a wet environment in the western hemlock series densely stocked with conifer would be an uncommon site condition for that environment but, due to a severe deficit of large woody structure in the stream system, it might be desired and maintained for the benefit of other ecosystem components.

In characterizing the vegetative communities, sub-series environments (which group plant associations and communities into broad biological environments from wet to dry) (**Table 3**) (**Map 5**) were described and delineated. Sub-series environments were selected as the appropriate vegetation filter through which to assess possible management prescriptions.

Appendix G displays graphic examples of the successional pathways for each plant series environment by sub-series and by disturbance regime. Conceptual models of succession were developed for each environment by using inventory information (**Table 9**) and field observation. The following is a working hypothesis of successional pathways that would occur for four different climax vegetation series and their sub-series environments.

Series - Sitka Spruce
Zone - Coastal Fog

Environments - Wet, Moist, and Dry

Stands with a mix of western hemlock, Douglas-fir, Sitka spruce, and varying amounts of red alder, are found across all environments. Sitka spruce and western hemlock are prevalent throughout all environments because they are prolific seeders and shade tolerant enough to compete in all environments. The primary intermediate disturbance is wind. Unlike fire, these non-stand replacing events favor regeneration of the shade-tolerant conifers, such as western hemlock and Sitka spruce. Finer scale successional pathways and refined differences between environments need to be explored.

Series - Western Hemlock
Zones - Central Interior Alsea, Central Interior Marys Peak/Alsea Valley, Southern Interior

Environment -Wet

- The wet environments occur most often on lower slopes and in riparian areas. Soils have a high water table. Moving west to east through the Coast Range, from Central Interior Alsea to Southern Interior, the wet area becomes more restricted to narrow bands in the valley bottoms. After disturbance, regeneration of conifers is sporadic due to high vegetation competition. Salmonberry is the predominant understory shrub species. Red alder has a larger presence than conifer in early seral stages and remains a large component in young and mature stages.

- Two dominant tree communities occur in this environment. The first is a pure alder type, usually found in areas too wet for Douglas-fir, and in areas in which a significant amount of bare soil following a disturbance has created a desirable seed bed for alder. If undisturbed, the alder areas will begin to lose vigor and decay after 80 to 100 years of age. Shade-tolerant conifer species (western hemlock, western redcedar) will become established on a variable basis, depending on seed source. These conifers will begin to occupy the overstory as the alder deteriorates. In areas on or near the floodplain which experience higher frequencies of flooding or debris torrents, the alder will constantly be regenerated and kept in the system.

- The second type of tree community occurs where microsite conditions allow establishment of scattered Douglas-fir. A mix of red alder, in some places bigleaf maple, and Douglas-fir will predominate through the early and mid-seral stages. If no major disturbance occurs, alder will decline. The site will be dominated by scattered large Douglas-fir and variable amounts of shade-tolerant conifers filling in through the stages. **Table 9** illustrates this mature condition with 63 total trees per acre, 28% red alder and 40% Douglas-fir as the dominant species. This type has the lowest total trees per acre and the highest percentage of red alder of all the sub-series environments.

- Stands consisting of pure hemlock will also occupy these sites. Salmonberry brush fields may dominate in some areas as well. However, these types are considered more minor in distribution.

Environment - Moist

- The moist environments occur on deep, well-drained soils, usually mid-slope. After disturbance, regeneration of conifers is predominant, with initial densities dependent on exposure of organic/mineral soil, density of competing vegetation, and seed source.

- Two dominant tree communities predominate in this type. The first is a pure conifer type, usually found in areas following a disturbance which has created some exposed mineral soil seed bed that Douglas-fir prefers. Varying amounts of shade-tolerant species (especially western hemlock) may be present, depending on how much litter and duff exist in the newly disturbed stands. In these areas, usually dominated by Douglas-fir, stands will develop at a variety of densities. Herbs and shrubs will occupy most of the growing space the first 10 years after a stand-replacing disturbance. From age 11 to 80, Douglas-fir will dominate the growing space, in dense areas, going through intense inter-tree competition. By age 80, portions of these areas could be occupied by dense stands with slim tree boles and crown ratios less then 25%. Portions of stands with initial stocking levels of less then 100 trees per acre would have significantly larger diameters and crowns. Ground vegetation will begin to appear as these stands become more open. From age 81 to 150, mortality by inter-tree competition will continue and tree density will be reduced. As the stand opens, shade-tolerant conifer species will become established or be released, on a variable basis, depending on seed source and tree suppression conditions. **Table 9** illustrates this stand condition with 81 total trees per acre, 57% of which are Douglas-fir. Red alder accounts for only 10% of the stand density.

- The second type of tree community occurs in areas wet enough and with adequate seed source to favor some alder establishment. These areas could subsequently take two successional pathways, depending on the disturbance regime. Areas with small disturbances, such as landslides, will have frequent regeneration of alder. Without disturbance, the alder will begin to lose vigor and decay after 80 to 100 years of age, leaving more of an open Douglas-fir stand or establishment of shade-tolerant conifer species, depending on seed source.

- In all stands, after age 150, wind, root rot, inter-tree competition, and insects will continue to lower the overall density of Douglas-fir trees creating more variation in stocking. Varying densities and ages of alder, shade-tolerant conifer species, and Douglas-fir will be found in the understory.

Environment - Dry

- The dry environments occur on upper slope positions which experience droughty conditions in the summer. Due to the dryness of this area, fires usually burn hotter, removing competing vegetation and providing a good seed bed for Douglas-fir. Pure Douglas-fir stands are predominately found in these areas.

- Shrubs, such as salal, Oregon grape, and Pacific rhododendron will occupy most of the growing space the first 10 years after a stand-replacing disturbance. Like the moist sites, from age 11 to 80, Douglas-fir will dominate the growing space and in dense areas will be going through intense inter-tree competition. The primary differences between the moist and dry areas is the higher proportion of dense stands and lower site productivity due to droughty soil conditions and lower available nutrients.

This lowers the rate of stand development. By age 80, as in the moist areas, portions of these areas could be occupied by dense stands. From age 81 to 150, mortality will continue and overall tree density would be reduced. As the stand opens up, shade-tolerant conifer species will become established on a random basis depending on seed source. After age 150, wind, root rot, inter-tree competition, and insects will continue to lower the overall density of Douglas-fir trees creating more variation in stocking. **Table 9** shows that these stands are the most dense of the three environments with an average of 99 trees per acre; 68% of these are Douglas-fir and only 1% are red alder.

Mid-seral disturbances - Moist and Dry Environments

- Fires have a variable severity and occur more frequently in the Central Interior-Marys Peak/Alsea Valley and Southern Interior Disturbance Zones. These fires create more diversity in stand structure due to low-moderate intensity fires. This results in a two or more layered overstory canopy. Late seral conditions are achieved earlier here than in the Central Interior Alsea Zone.

- Wind is a common intermediate disturbance in the dry environment, producing small patches of blowdown along upper ridges and ridgetops. It may also accelerate late-successional structural characteristics if it occurs in mid-seral successional stages by removing overstory Douglas-fir and releasing shade tolerant western hemlock.

Series - Grand fir

Zone - Central Interior Mary's Peak/Alsea Valley, Southern Interior (outside of LSR boundaries)

Environment - Wet

- The wet environment for the grand fir occurs along creek bottoms that characterize the low elevations of the eastern slopes of the Coast Range.

- After a major disturbance the successional pathway would start with the establishment of sedges and grasses. Western swordfern, common snowberry, and vine maple are common ground cover in the early stages after disturbance. Co-dominant hardwoods such as Oregon ash and bigleaf maple are scattered in the early stages. Initially, conifers will be scattered due to high competition from the ground cover. As the hardwoods mature and the area begins to differentiate into different layers, scattered amounts of grand fir regeneration underneath the hardwood canopy begins to emerge in increasing density. The ground cover will become less dense as the canopy begins to close due to less light reaching the forest floor. Grand fir, western red cedar, and western hemlock are found in along the creek bottoms in this environment.

As the canopy cover begins to close, the shade-tolerant Grand fir would begin to increase in the understory and ground cover species would begin to thin out due to competition for available light filtered by the dense overstory. Eventually, as the forest reaches late seral conditions, Grand fir will become the dominant conifer species in the canopy layer.

Environment - Dry

- The dry environment occurs on the slopes and rolling ridges that characterize the low elevations of the eastern slopes of the Coast Range.

- After a major disturbance, the successional pathway would start with the establishment of sedges and grasses from the valley, and a shrub layer of swordfern, salal, and common snowberry. The majority of the sedges and grasses would be annuals which would persist for 10 years and then decline. As ground cover becomes well established, seedlings of Douglas-fir, Oregon white oak, bigleaf maple, and lesser amounts of grand fir would dominate.

- As the area begins to differentiate into understory and canopy layers, several other tree and shrub species would become dominant. These species include bigleaf maple, golden chinquapin, oceanspray and poison oak. The ground cover will become less dense as the canopy begins to close.

- As the canopy cover begins to close, the shade-tolerant grand fir and golden chinquapin would begin to increase in the understory. As the forest matures, the canopy would be codominated by Douglas-fir, Oregon white oak, and bigleaf maple. Grand fir would then become the dominant conifer understory species. If the forest were to reach its climax stage, grand fir alone, or grand fir in combination with Douglas-fir, would become the dominant conifer in the overstory. In an old-growth condition, Douglas-fir, grand fir, and hardwoods would occupy various strata within the stand and coarse woody debris would become common and scattered throughout the forest.

Series - Noble Fir

Zone - Central Interior Marys Peak/Alsea Valley

- The alpine environment occurs at elevations greater than 3200 feet in this zone. Primary locations include Marys Peak, Grass Mountain, and Prairie Mountain. However, there is little noble fir on Prairie Mountain; western hemlock dominates this site, which tends to be dryer , with extensive grassy balds to the south.

- The successional pathway after a major disturbance would start with the immediate establishment of a variety of sedges and grasses; vine maple and Pacific rhododendron would soon follow. Shortly after the establishment of ground cover noble fir seedlings would become established. As the vegetation begins to differentiate into understory and overstory layers, the sedges and grasses will retreat to the shallow-soiled grassy balds. A major component of this environment, the grassy balds will remain dominated by sedges and grasses, with noble fir reproduction common around the perimeter. It is unclear how stable these balds will remain without some level of disturbance (wind, fire, or heavy snowpack, for example).

- Noble fir will continue to grow and be the dominant overstory conifer species for about the next 80 years. Douglas-fir and western hemlock will slowly become established as the understory conifer species sometime during the first 15-20 years after the disturbance and will remain there until a minor disturbance (i.e., snow or wind event) creates openings in the noble fir overstory. Where openings have been created, the Douglas-fir and western hemlock will then create a mixed canopy layer in this environment (a more mixed canopy layer of noble-fir, Douglas-fir, and western hemlock will be common at the lower elevations of this environment). The understory can be characterized as mostly open with the dominant shrub species consisting of vine maple and Pacific rhododendron. As the stand matures, so will its complexity, with conifers occupying various strata within the stand.

Management Implications Of Successional Pathways

Specific prescriptions for management activities should consider what is possible and appropriate for a given site. **Table 8** highlights some of the key components of late-successional forest habitat and evaluates the **potential** for a given environment to be able to support that component (or management objective). These are general relationships.

Table 8: Potential for sub-series environments to meet key structural components when considering dominant natural successional pathways.

MANAGEMENT OBJECTIVES RELATING TO LATE-SUCCESSIONAL STRUCTURAL COMPON	SUB-SERIES ENVIRONMENT (western hemlock series)		
	WET	MOIST	DRY
Grow large trees	H	H	M
Establish multiple canopy of conifer	M	H	M-L
Establish multiple canopy of conifer/hardwood or hardwood	H	H	M-H
Recruit large diameter snags/coarse woody debris	M-H	H	M-L
Maintain high stocking (high stand density)	L	M	H
Provide coarse woody debris for aquatic structures	M-H	H	L
Provide variable spacing (gaps, clumpiness)	H	H	M-L
OTHER MANAGEMENT OBJECTIVES			
Consider wind firmness	L	M	H

H=High probability M=Moderate probability L=Low probability

Table 8 displays that not all management objectives occur equally in every environment. These are not absolutes; these conditions occur over a continuum throughout the various environments.

THE "WET" ENVIRONMENT has as the highest probability of supporting:

- A low density of conifers and have high spacing variability (due to competitive nature of shrubs)
- A canopy composed of a variety of species in each layer, with a large component of hardwood species
- A place to grow the largest trees (but not many of them)
- A good place to recruit those few large trees for future aquatic structure.

THE "MOIST" ENVIRONMENT, on the other hand, would have slightly different potential:

- The overstory will have moderate density of conifers and have variable spacing
- There will be multiple species in the canopy composed mainly of conifers with some hardwood component.
- There will be multiple canopy layers of conifer
- This is the place to grow and recruit a quantity of large diameter snags and coarse woody debris both on-site and for aquatic structure.

THE "DRY" ENVIRONMENT would support different structural characteristics:

- The highest density of conifers could be expected here, spacing could be less variable, however, harsh sites with shallow soils and fine scale disturbances may result in variably spaced trees with gaps.
- Wolfy limbed trees may be found in this environment, due to either fine scale disturbances (wind or disease) or harsh site conditions.
- There would be few hardwoods in the canopy
- Wind firmness is a consideration for management activities

IN ALL ENVIRONMENTS management activities would strive to:

- Maintain health and vigor of the plant communities on site
- Encourage natural diversity of species in all layers for all flora
- Maintain existing structure i.e., large trees, wolfy limbs, CWD, snags;
- Recruit snags and CWD
- Encourage vertical and horizontal diversity in stand development

Late-Successional Structural and Compositional Characteristics

The structure of natural Douglas-fir forests is extremely diverse because of numerous processes operating at different spatial and temporal scales. Stand development and succession are important processes that determine forest habitat. Differences in forest structure should be viewed on a continuum rather than in discrete classes (Spies and Franklin 1991). No one condition is appropriate across the landscape. Knowledge of late-successional structural and compositional characteristics is key in identifying the desired future conditions to strive for in management activities.

Differences In Forest Structure: Young - Mature - Old

Changes in vegetation structure and composition occurs between young, mature, and old-growth that may influence late-successional forest function (Spies and Franklin 1991). The condition of existing late seral forests within the LSRs provides a reference point to compare younger stands against when determining desired future conditions. Since the majority of the late-successional stands currently present in the LSRA are 75-150 years of age (USDA 1995, Teensma et al. 1991), there is sufficient local information available to characterize mature age-class conditions only. There is limited information available for the old- growth condition of late successional forests in the Coast Range. Recent (1994,1995) photo interpretation of vegetation for a few watersheds shows that 1.5 to 3 percent of those landscapes are in an old-growth, multilayered condition. Higher percentage may be found in areas where Wilderness areas have been established.

Tree density, mean stand diameter, and basal area are most important in discriminating among age classes. Tree density is about twice as high in young stands as it is in mature and old-growth stands. Basal area increases with age class, and mean tree diameter is highest in mature stands which lack the smaller diameter shade-tolerant trees common in the old-growth (Spies and Franklin 1991).

Stand condition also is influenced by the age of the stand. Percentages of snags with natural cavities, percentage of Douglas-fir boles with resinosis, and percent of tree crowns with broken tops all were higher in old-growth than in the younger age classes (Spies and Franklin 1991).

Understory vegetation also changes with stand age. Herb and deciduous shrub cover increased with stand age class. Density of shade-tolerant saplings is highest in old-growth, lowest in mature stands, and intermediate in young ones (Spies and Franklin 1991).

General characteristics of old-growth forests that differ from mature include: codominance of western hemlock in the overstory, diverse vertical distribution of vegetation, and large amounts of CWD.

Mature Forest Structural Characteristics

In **Table 9**, the description of stand conditions is expressed in terms of trees per acre by species and size class. Data is based on plot information from the 1987 Siuslaw National Forest Vegetation Resource Survey and the 1984 Siuslaw Ecology Intensive Survey. Those surveys sampled late-successional mature (less than 200 years old) and old-growth (greater than 200 years old) stands, so the data represents a mix of these conditions; however, given the limited occurrence of old-growth on the Siuslaw National Forest, the effect on the average is insignificant.

These structural element data represent the averages of mature conifer stand conditions. They should not be targeted as an average stand condition. There are a wide range of stand conditions that are found across the Siuslaw National Forest. They do, however, provide a reasonable representation of the differences in species and trees per acre by sub-series environments. This information is appropriate within the Siuslaw National Forest boundaries in the LSRA. On lands in the eastern portion of the LSRA, stand structural components could be different. Identification and mapping of sub-series environments on these lands are currently in progress, and data from these inventories should be utilized when it becomes available.

The following statistically significant trends have been interpreted from the information in **Table 9 for mature stand conditions :**

Western Hemlock Series:

- total live trees per acre significantly increase from wet to dry environments
- the number of Douglas-fir trees per acre increase from wet to dry environments
- the percentage of red alder decreases from wet to dry environments

Western hemlock and western redcedar were found in all environments. Trends in snags and coarse woody debris (CWD) were not significant.

Sitka Spruce Series:

- live trees per acre increase from wet to dry to moist environments

Western hemlock is a common codominant component in all environments, more common than western redcedar. Snags and CWD did not significantly vary among environments and were not included in the table.

It is important to note that these trends may also be associated with fine-scale disturbance differences as well as environmental differences. Dry environments may experience more within-stand wind and disease-related events than the other environments, for example.

Table 9. Structure and Composition of the Mature Condition of Late-Successional Stands by Sub-Series Environments. Information is expressed in number per acre

	Hemlock- Dry (120 plots)					Hemlock- Moist (73 plots)					Hemlock- Wet (95 plots)				
Species	Small	Med.	Large	Giant	Total	Small	Med.	Large	Giant	Total	Small	Med.	Large	Giant	Total
Bigleaf maple	3				3	3				3	4	1			5
Red alder	8				8	7	1			8	15	2			18
Sitka spruce						1	1			2					
Douglas-fir	34	22	9	2	67	16	15	13	3	46	7	8	8	2	25
Western redcedar	4	1			5	4	1			5	6	1			7
Western hemlock	13	3	1		17	11	5	1		17	5	2	1		8
Total Live Trees	62	25	10	2	99	42	22	14	3	81	38	15	9	2	63
	Spruce- Dry (13 plots)					Spruce- Moist (45 plots)					Spruce- Wet (32 plots)				
Red alder	4				4	10	1			11	11	1			12
Sitka spruce	6	5	4		15	11	10	6	1	28	13	6	3	1	23
Douglas-fir	10	14	12	1	37	10	7	4	1	21	14	10	7		30
Western redcedar	1				1	2				2	2	1	1		3
Western hemlock	25	10	3		38	24	12	4		40	4	3	2		8
Total Live Trees	46	29	19	1	95	58	30	13	2	102	43	21	12	1	76

Data Sources: 1987 Vegetation Resource Survey- 194 plots.
1984 Siuslaw Ecoplot Intensive Survey- 184 plots.

Size classes: Small= 9.0-20.9 inches dbh
Medium= 21.0-31.9 inches dbh
Large= 32.0-47.9 inches dbh
Giant- 48.0+ inches dbh

Old-Growth Forest Structural Characteristics

Basal area of shade-tolerant tree species is an important characteristic of old-growth forests. In general, moist sites have higher basal areas of shade-tolerant species than do moderate or dry sites. The density of large-diameter Douglas-fir decrease with increasing moisture in the Coast Range. The density of subcanopy trees generally decreased with increasing site moisture, probably as a result of increasing basal area of shade-tolerant trees in the upper canopy that creates low-light conditions unfavorable to understory trees (Spies and Franklin 1991). **Table 10** outlines significant structural and compositional characteristics by moisture classes. Moisture classes are similar to the sub-series environments identified earlier in this document.

Stand condition (snags, cavities, broken tops, etc.) did not seem to vary by moisture class in the Coast Range in work done by Spies and Franklin, 1991.

Table 10. Mean And 95% Confidence Limits Of Some Structural Components Of Old-Growth Stands In The Coast Range By Moisture Classes (From Spies And Franklin 1991)

STRUCTURAL COMPONENT	DRY	MODERATE	MOIST
Basal area of shade tolerants (ft^2/acre)	9.6 (0 - 47.5)	69.7 (26.1 - 139.4)	135.0 (43.6 -274.4)
Basal area of shade-intolerant (Douglas fir) trees (ft^2/ac)	261.6 (147.8 - 369.7)	222.4 (117.5 - 322)	169.6 (17.4 - 317.6)
TOTAL basal area (ft^2/acre)	283.1 (200.4 - 405.1)	304.9 (222.2 - 418.2)	313.6 (196.0 - 500.9)
> 40 inches dbh Douglas-fir density (#/acre)	12 (4-23)	10 (4-19)	7 (1 - 10)
> 40 inches dbh total tree density (#/acre)	12 (4 - 23)	11 (4 - 21)	10 (2 - 25)
Density subcanopy trees (#/acre)	17 (0 - 59)	21 (2 - 61)	0

Snags and Coarse Woody Debris (CWD)

Coarse woody debris (CWD) includes both snags and down logs, however, for this LSRA, CWD will be separated into snag components and down log components, since these ecosystem components are evaluated separately in management prescriptions. Research indicates that the numbers of fallen trees are generally similar to those of snags - or, about 50 percent (range 40%-60%) of the coarse woody debris component of a stand is snags (Spies et. al. 1988).

Both snags and down logs are important components of forest ecosystems. The variability with which they are expressed across the landscape, however, needs to be understood. Recent work by the Pacific Northwest Forest and Range Experiment Station (Spies in progress) with the Pilot Province Monitoring Project has shown that the two forest structural characteristics that help to define late-successional and old-growth forests are: 1. The number of trees in the larger size classes (70cm and 100cm respectively); and 2. The degree of layering. Although CWD is a critical component of old-growth ecosystems, the number of snags and log biomass were not good predictors of late-successional and old-growth forests due to the wide variation of these structural components in forest ecosystems. The following recommendations for management of the CWD components in young forest plantations need to always be balanced with the need to apply thinning regimes which will accelerate the attainment of other late-successional and old-growth structural components as well.

Snag Levels in Unmanaged Forests

Table 11 displays the range of snags levels for various size classes found when natural forest conditions were assessed in the Oregon Coast Range. This table represents the best information available at this time for natural conditions in the Coast Range and will be utilized to indicate reference and desired conditions. When looking at the values, the degree of variability becomes readily apparent. The greatest variability shows up in the numbers of snags less than 20" in diameter for both the young (26-70 tpa) and mature (1-105 tpa) age classes. Variability should be applied in both quantity and spatial arrangement of snags in prescriptions.

The measured field data in **Table 11** shows that the majority of snags found in natural forests are less than 20 inches in diameter at breast height (dbh). While all size classes serve an important ecological function, it is the larger snags (greater than 20" dbh and 20' tall) which are critical for wildlife, such as cavity-dependent species. Large snags provide nesting habitat for the northern spotted owl and are used by colonies of bats and swifts.

The values for "all heights" represents the number of snags greater than 4 inches in diameter and greater than 4.5 feet tall. Also included in **Table 11** are the cu.ft./acre values from a recent CWD model done for the Siuslaw National Forest. The values from the Wright Model represent half of the CWD component that is modeled to occur in these systems, the other half of the values are displayed in **Table 12** with the down wood component.

Table 11: **Range of Snag Levels in Natural Stands in the Oregon Coast Range. The numbers represent the mean values with the expected ranges of conditions shown in parentheses.**

	Number of Snags/Acre (Spies 1988)			**Snag Biomass**	
Stand Age	Total >= 20" dbh all heights	>= 20" dbh and > 16' tall	Total < 20 dbh all heights	cu.ft./ac (Spies 1988)	cu.ft./ac (Wright Model)
Young (<80 yrs)	7 ** (3-31)	48 ** (26-70)	1230 ** (615-1845)	1230 ** (615-1845)	3794 (2844-4839)
Mature (80-199 yrs)	7 (0-14)	3 (0-7)	53 (1-105)	1488 (200-2775)	1644 (1603-1686)
Old-Growth (>199 yrs)	7 (4-10)	4 (2-6)	17 (14-20)	2117 (229-4006)	1906 (1867-1946)

** Knowledge of the types of forests where this data was taken suggests that these values and ranges are on the low end of the range of conditions for the Oregon Coast Range. Natural forests that are less than 80 years of age that were sampled included many stands that resulted from settlement-related fires (some burned 2-4 times) after the Yaquina fire. Under this type of disturbance, the levels of down wood would be low. To find the average levels of woody material following a single disturbance event, other studies may be more appropriate.

\+ Modeling completed recently by Wright suggests that the mean range for CWD in young stands at 30-50 years of age under natural conditions would be 265 m3/ha or 3794 cu.ft./acre. These values represent what would be expected following a single fire event in 30-50 year age class of forest stands in the Central soil/climate zone. (note: values displayed are half of the actual values modeled since model values included snags and down logs which are found in approximately equal proportions in stands)

Existing Condition of Snags

Management activities (i.e., falling, yarding, and site preparation), resulted in a loss of snags in harvest units across the landscape. Much of the material described as the "lost legacy" (**Figure 4)** - that quantity of wood that has been removed from the system during timber harvest activities - would have contributed to this snag component.

Loss of that large snag component is long-term. There is very limited opportunity to create snags >20" in diameter in the 25-50 year old plantations. Prescriptions can be implemented which would establish conditions that would accelerate the attainment of green trees in the larger size classes for creation of snags at a later date. **Table 11** provides guidelines for snag levels over time on a landscape level. At the time of initial commercial entry, i.e. 25-50 years, prescriptions are usually not going to meet the young stand levels of snags, even those in the small size classes. Treatments should set stands on a trajectory to meet the mature and old-growth snag levels and sizes.

Management Options for Snags

- Considerations for prescriptions in young managed stand ages could include:
- Protect all existing large snags. Smaller existing snags, if knocked over during management activities, will be retained as down wood.
- Accept a short-term deficit in the quantity of snags in order to manage for long-term gain in appropriate sizes and numbers - establish trajectory. This is appropriate since smaller trees are not persistent as snags, mostly sap wood.
- May have few 15-20" snags in younger age classes (25-50 years).
- The largest green trees available may be ones you want to keep for future structural components (i.e., to become wolf trees for marbled murrelet nesting habitat).
- Leave enough trees to grow and become snags at a later date
- Stem inoculation of small trees to initiate heart rot so that cavity nesters can use them earlier.
- Create snags in adjacent mature stands

The priority decision is to meet the range of snag levels outlined in **Table 11** in the mature and old-growth stands. If conditions are appropriate to meet the larger size classes of snags in young stands, then meet those levels in young stands. Subsequent entries (i.e., at 60-80 years), may be needed to initiate snag development in the larger size classes. It's more important to reserve larger green trees at the initial entry and not be so concerned about the numbers of snags less than 20" in diameter in the younger age classes.

In stands over 50 years old, snag numbers within the ranges listed on Table 11 will be met if recruitment trees of sufficient size are available within the stand, or the project will remain subject to REO review. In stands younger than 50 years, meeting Table 11 numbers in the short term may prevent meeting snag requirements in the longer term. Where that is the case, short term snag numbers will be reduced from Table 11.

Log Levels in Unmanaged Forests

Table 12 displays the mean and the range of conditions that could be expected in the Oregon Coast Range under natural conditions. The amount of down wood in young natural stands (measured at 50-80 years of age) ranges from 525-4839 cu.ft./ac. These values represent conditions following various types of disturbances. At the time of measurement, much of the initial input of down wood from the disturbance event (**Figure 4**) had already been incorporated into the soil. Mature forests have less down wood ranging from 300-3162 cu.ft./ac. Old-growth forests have higher levels of down wood at 1382-5141 cu.ft./ac.

Table 12 represents an assessment of current ranges of the variability, both measured and modeled, in the down wood component in natural forests in the Oregon Coast Range. This information, along with the inventory of existing down wood levels in plantations (**Tables 13 & 14**) and the management alternatives at the end of this section will be utilized when prescribing down wood for activities implemented in the LSR.

Table 12. **Range of down wood in unmanaged forests in the Oregon Coast Range**

	Down Wood Biomass (Spies 1988)		**CWD Biomass**
Stand Age	cu.ft./ac (Spies Data)	Percent Cover **!**	cu.ft./ac (Wright Model)
Young (<80 yrs)	1102 ** (525 - 1979)	3.8% ** (2.5 - 5.1%)	3794 (2844 - 4839)
Mature (80-199 yrs)	1731 (300 - 3162)	5.2% (1.6 - 8.8%)	1644 (1603 - 1686)
Old-Growth (>199 yrs)	3262 (1382 - 5141)	6.2% (3.5 - 8.9%)	1906 (1867 - 1946)

! Coast Range had the lowest % down wood ground cover of PNW ecosystems assessed. Percent cover is an expression of projected horizontal area covered by wood. It is from log length and diameter.

** Knowledge of the types of forest where this data were taken suggests that these values and ranges are on the low end of the range of conditions for the levels of down wood found in the Oregon Coast Range. Natural forests that are less than 80 years of age that were sampled include stands which resulted from repeated settlement-related fires (some may have burned 2-4 times) after Yaquina fire. Under this type of disturbance, the levels of down wood would be low. To find the average levels of woody material following a single disturbance event may require additional research

+ Modeling completed recently by Wright suggests that the mean range for CWD in young stands at 30-50 years of age under natural conditions would be 265 m^3/ha or 3794 cu.ft./acre. These values represent what would be expected following a single fire event in the Central soil/climate zone. (note: values displayed are half of the actual values modeled since modeled values included both snags and down logs which are found in approximately equal proportions in stands)

Dynamics of CWD (Snags and Down Wood) Over Time and Space (Information from Research)

The CWD Cycle

Figure 4 displays the cycle of coarse woody debris over time for a single disturbance event. It is presented to display the quantities of coarse woody material that are initially input following a disturbance event (Spies 1988, Wright -in progress). This diagram also assists in development of a number of alternatives that can be employed by management that will guide the levels of CWD that are prescribed.

Stand Age (years)

Figure 4. CWD Accumulation and Decay Over Time Following a Disturbance Event (Spies and Cline 1988)

As discussed by Spies and Cline, 1988, **Figure 4** displays that:

- Following an initial disturbance event, new CWD is not added into a stand until the stem exclusion and understory reinitiation stages. Mortality rates of young stands are estimated at 1-2% per year. These are mainly small (<4" trees) that will decay rapidly.
- CWD accumulates slowly over the 1st 100 years and more rapidly between 100-400 years.
- At 100-150 years, CWD accumulations begin to increase as trees die.
- The dynamics of CWD modeled for 3 fire histories each beginning with an initial fire in an old growth stand but differing in number and severity of subsequent fires. All three models exhibited low values of CWD between 80-200 years. The lowest and most prolonged minimum in CWD during succession occurred when additional fires burned early in succession (Spies et. al. 1988).
- Researchers have found three main differences in CWD between natural and managed stands (Spies and Cline 1988):
    1. The quantity of CWD is drastically different immediately following the disturbance event.
    2. The size of wood is different; what's left after logging is smaller and it decays faster
    3. In plantations, loss of trees is slower due to thinning and spacing of management. Thinned material is harvested and removed from the site.

- At least six times more wood carries over after wildfire in old-growth systems than is left after logging in old-growth.

These statements support the need to provide for CWD in density management prescriptions in the LSR to achieve wildlife habitat objectives.

The following is from Pam Wright's draft of "Coarse Woody Debris Groups of the Siuslaw National Forest:

- CWD enters the system in two ways:
    1. Through incremental mortality from the live stand
    2. Through disturbance. This is the biggest factor and the existing level of CWD depends on:
        a. the time since disturbance
        b. the magnitude of the disturbance
- Due the rapid decomposition rates in the Coast Range, most of the CWD from the previous stand is not detectable 100-150 years after it reaches the forest floor.
- It's important to look at levels of CWD based on soil climate zones. The Coastal Fog Zone has the greatest CWD mass of the ecosystems assessed at about a 10% increase over the Central Interior Zones in young stands and 33% increase in older stands.

These statements support evaluation of the types of disturbances and time since disturbance on individual sites to help establish appropriate levels of CWD. Soil/climate zones especially play a role in CWD levels and should be considered in management prescriptions.

Decay Classes

According to Spies, Franklin and Thomas, 1988:

- In general the proportion of total biomass in highly decayed material (decay classes IV, and V) was highest in young stands and lowest in old-growth.
- The distribution of woody debris in young stands (<80 years) was concentrated in decay classes III, IV, and V. In mature stands, woody debris was more evenly distributed among decay classes II through V, with a higher proportion of total CWD biomass attributed to decay class II. In old-growth stands, woody debris was concentrated in decay classes II and III.

The above statements from the Spies study support high proportions of CWD in young stands (<80 years) in the advanced decay classes III, IV and V. Under natural conditions, trees killed in a major disturbance would eventually fall and decay on the forest floor.

Distribution of CWD

Coast Range stands have less CWD in all three age classes than stands in the two Cascade provinces. Mass and volume in young stands (<80 yrs) in the Coast Range was <40% of the values in young stands in the Cascade provinces (Spies et.al. 1988).

Coarse woody debris is unevenly distributed in the forest. The amount may vary tenfold between closely adjacent areas and more than half of the coarse woody debris may fall on less than one-fifth of the total area. Several factors contribute to such patchy distribution: The large successional overstory trees that contribute heavily to the dead wood supply are irregularly distributed. Mortality from natural causes is often patchy. Dead wood may be moved downslope to accumulate at a resting place on concave topography (Spies and Cline 1988).

For Coast Range stands, aspect and topographic position alone accounted for 63% of the variance in CWD biomass. Moist sites had the highest amounts of CWD (more live biomass, larger tree boles, wetter, more slowly decaying wood, less subject to surface fires that can consume CWD). The importance of site characteristics in the Coast Range in explaining variation in CWD in relatively young stands suggests that fire history, as affected by topography, controlled the amounts of CWD in stands <150 years old. It is probable that stands on north facing slopes and moist sites experienced less severe and less frequent fires than the drier sites. Consequently young stands on more protected sites probably inherited more CWD than fire-prone sites because they were preceded by older, more massive stands rather than young stands or mixed-aged stands (Spies et. al. 1988).

These statements from Spies' study support the need for variability in the prescriptions to create varying levels of CWD relative to soil/climate zone as well as stand age and fire history.

Existing Condition of CWD

In order to evaluate down wood needs on a site specific level, existing levels of down wood should be evaluated. **Tables 13 and 14** display two data collection efforts on the Siuslaw National Forest which provide an indication of the average and range of down wood levels that can be found in managed stands. The existing levels are spatially highly variable.

Table 13 represents the levels of down wood at the time of final harvest. This information was collected for a fuels inventory by Peterson and Barnes and compared favorably to previous fuels data inventories. The information shows the majority of material is in the 9" to greater than 20" size classes. The smaller material is consumed by slash burning at a higher rate than the larger size classes. On the average, 2901 cu.ft./ac. of material remains on site after harvest activities. Approximately half is this is lost during site preparation, with an average of 1487 cu.ft./ac. remaining after slash burning.

Table 13: Down Wood Conditions Following Clearcut Harvest (1980 - 1990)

CWD Levels

(cu.ft./ac by diameter class)

Site Condition	3-9”	9-20”	> 20”	Total
Pre burn[1]	801630	1082	1018	2901
Post burn[2]	81	541	865	1487

[1] Peterson, J.L. and D.A. Barnes, Comparison of Biomass Characteristics on clearcut units on the Siuslaw National Forest with other western WA and Oregon

[2] Post burn consumption based on professional judgment of worst case scenario. Assumed 3-9" material 90% consumed. 9-20" material 50% consumed, over 20” material 15% consumed.

Table 14 displays down log information collected from Siuslaw National Forest Managed Stand Survey data. The values indicate the average and one standard deviation (in parenthesis) representing the range. Depending on the plantation age, the average down wood volume ranges from 3010 to 3409 cu.ft./ac. This information is within the ranges reported by BLM - Salem and Coos Bay where stand exam information for 40 year old plantations shows down log quantities mostly in the larger diameter classes with an average of 3085 cu.ft./ac. (range 1831 - 4083 cu.ft./ac). Most of the down wood volume is in the soft log category (decay classes III-V). This is consistent with information presented by other researchers (Spies et.al. 1988). Log lengths were also surveyed. On the average, 51% of the down logs inventoried were greater than 20 feet in length. The values ranged from 29% to 61% greater than 20 feet in length.

The variability of CWD in plantations is readily apparent. Both the low and high ends of the range of existing conditions found in the managed stands are outside of the range of variability measured by Spies or predicted by Wright (**Table 12**). When these conditions are encountered, there are opportunities to bring CWD values within the historic range (low end) or to exceed the historic range (high end).

Table 14: Existing Down Log Volumes in Plantations

Plantation Age	Average Hard Log Volume (cu.ft./ac)	Average Soft Log Volume (cu.ft./ac)	Total Log Volume (cu.ft./ac)
11 - 24 yrs	630 (0 - 2094)	2423 (0 - 5049)	3010 (0-6084)
25 - 49 yrs	413 (0 - 1346)	2946 (0 - 7216)	4309 (0 - 7787)

The variation in the levels of down wood can be attributed to both natural and managed conditions. Age at which the stand was harvested and past disturbance regimes can effect the condition at the time of harvest. The amount of yarding and piling of unutilized material, the utilization standards, and the site preparation techniques all play a role in the quantities of woody material left on site following timber harvest activities.

The existing level of down wood should be assessed during project planning. Several inventory techniques are available (Harmon 1996) and the use of fuels inventory transects or stand exam information should be assessed. Statistically valid inventories of down wood, however, require extensive survey involving a number of transects. It is recommended that an individual on each interdisciplinary team take on the responsibility of assessing down wood levels. It is expected that the individual would be able to make qualitative assessments (low, moderate, high) based on previous experience of having done transects or surveyed areas with known down log biomass.

Management Alternatives

The peak in **Figure 4**, represents the "Lost Legacy." This is the organic material (CWD) that has been removed from the system and sold as commercial forest products. We cannot expect to replace this loss. At this point, the existing levels of CWD are lower than the natural systems would be. The predominate reasons for this is that:

- The forest was harvested at an age when the levels of CWD were naturally at the lowest level in the chronosequence of development (Spies et al 1988).
- The majority of the biomass that would have been killed by a fire event and reincorporated into the system was removed and sold as commercial timber.

CWD levels identified in Table 12 will be met by existing and new material left after thinning. Table 12 lists a range, however. Where to hit on that range depends on the age or the stand and the conditions in and around the stand. Our decision space is to start at the decay portion of **Figure 4** in early stand development and select an approach which will determine at what rate the stands will approach the accumulation phase line of the CWD cycle. Management should not try to strive for the average condition all the time. There are opportunities to work within the whole spectrum of the historic natural range to replicate the natural variability found on the landscape and to take advantage of opportunities to exceed the natural range. Below are 4 alternatives which will help to determine that rate.

Alternative Prescriptions for Coarse Woody Debris

Alternative #1
Leave Large Amounts of CWD in the Short Term

Objective: Provide for soil nutrient/ fungal and soil invertebrate health and maintenance.

Prescription: Input down wood in the short term: Drop as many trees as possible, to meet the high end values of **Table 12** (1979-4839 cu.ft./ac) for young stands. Half of the CWD should be left as snags to spread the down wood input over time.
Goal: Provide CWD as a substrate for soil micro-organisms to restore nutrient cycling regimes in areas which currently have very low levels of CWD.

Consider this alternative when one or more of the following conditions occur:

: there is a need to recover microorganisms, soil nutrients and or soil structure
: areas have experienced hot or repeated burns which have resulted in low levels of soil organic material
: severe erosion has occurred and bare mineral soil is exposed

It is expected that this alternative would only be applied in fairly isolated instances on sites or portions of sites that have experienced very harsh disturbances.

Benefit: Provides immediate increase in CWD levels for a while, a peak in CWD levels. Maintains fungal, microorganism, small mammal habitat.

Disadvantages: Short term, small diameter, rapid decay, lost potential for larger CWD and larger snags in the future. Size class insufficient for species that need large logs and snags. Minimum economic return for projects in short term. Limited number of trees left on site for the future.

Alternative #2
Leave Small Amounts of CWD Over Time

Objective: Supply a steady input of down wood and snags over time to provide conditions for down wood processes and snag-dependent species over time.

Prescription: Fell some now, leave some for the future: Drop trees and/or create snags to meet low to moderate ends of **Table 12** (1102-3794 cu.ft./ac.) at each entry. Leave up to half the volume as snags. Consider topping trees in adjacent mature stands to provide snags in the larger diameter classes. Insure that the prescription will be able to meet the low to moderate values of **Table 11** (0-7 snags >20" dbh which includes 0-3 >16' tall) and **Table 12** (300-1731 cu.ft./ac of down logs) in the mature condition in the future. Half of the CWD should be left as snags to spread the down wood input over time.

Goal: Balance long-term and short-term needs.

Consider this alternative when one or more of the following conditions occur:

: nutrients in the forest floor, soil, and fungal communities are low, but not a major concern

: primary cavity nester population levels are at or below the 40% level on the landscape.
: the surrounding older forests can carry the habitat for most species in the short-term.

It is expected that this alternative would be the one of two (alternatives 2 and 3) applied most frequently.

Benefit: Provides incremental input of CWD and snags over time. Strives to maintain habitat for CWD and snag dependent species while still maintaining future options. Some economic benefit in creating snags and CWD at a later date.

Disadvantage: May not have the optimum levels of CWD and snags in short-term. May take longer to get at desired sizes and quantities in the long-term since a higher number of trees per acre would be left on site to incorporate over successive entries.

Alternative #3
Grow Large Diameter Trees for Inclusion as CWD in the Future

Objective: Provide quality conditions for down wood and snag dependent species and processes in the future.

Prescription: Leave minimum levels of CWD and snags in the short term. Drop trees and/or create snags to meet the lowest ranges of **Table 12** (525-2844 cu.ft./ac.). Consider topping trees in adjacent mature stands to provide snags in the larger diameter classes. Half of the CWD should be left as snags to spread the down wood input over time.

Goal: Maximize long-term quantities and sizes of CWD and snags.

Consider this alternative when one or more of the following conditions occur:

: the current levels of CWD and snags are within the parameters outlined in **Table 12** for natural young stands
:the adjacent stands have sufficient CWD and snags to carry the habitat.

It is expected that this alternative would be one of the two (alternatives 2 and 3) applied most frequently.

Benefit: Maximizing the size and quality of down wood and snags for future use by down wood and snag dependent species and processes. There is an increased probability of providing large CWD and snag habitat in a mature condition. More economical to pay for logs and snags at a later date

Disadvantage: Minimizing short-term habitat for down wood and snag dependent species and processes.

Alternative #4
Let Natural Successional Processes Incorporate CWD

Objective: Allow natural succession processes to dominate

Prescription: No Action - natural suppression, no thinning.

Goal: Maintain some untreated areas.

Consider this alternative when one or more of the following conditions occur:

: vegetation manipulation is not scheduled to occur in an area
: stands are already on the trajectory for attainment of late-successional conditions
: adjacent stands provide habitat.

Benefit: Diversity of habitat, constant input of wood over time. Can be used as an experimental control to monitor differences between treatments.

Disadvantage: No economic return. Will take longer to attain other LSR objectives and to accumulate quantities of large CWD and snags.

Selecting an Alternative:
For project implementation, the "best" option, ecologically, is not known. As a result, it is important to apply the range of alternatives described above, sometimes even varying the treatments within a specific unit to accommodate special conditions. Management prescriptions need to balance the benefits and disadvantages of the various prescriptions to account for the overall LSR structural objectives. In addition, the application of any one of these alternatives needs to be considered in context with the conditions on the surrounding landscape. For multiple entries, consider what would/could be done at each entry.

The process to determine which Alternative(s) are appropriate in a given situation would include the following steps:

1. Determine the overall objectives of the area under consideration i.e. LSR Zones, Landscape Cells, and the objective for attainment of other structural features including accelerating growth to achieve the desired stand diversity and large diameter green trees as well as CWD levels.
2. Evaluate existing levels of CWD (qualitatively if quantitative measures are not known) in context of both the individual plantation and the surrounding landscape.
3. Determine specific project area resource objectives for soil, wildlife and aquatic resources.

Selecting CWD Levels Within an Alternative
Within each alternative there is a specified range of values for the volume of CWD that would be appropriate. These values are taken from **Table 12** and represent the range of historic conditions. There may be times, depending on specific resource objectives, when the target value selected may be above this range. An example would be when it is determined that the opportunity exists to provide habitat for small mammals or cavity-dependent species and the objective is to exceed historic levels to accomplish that objective. There are a variety of reasons to leave varying levels of CWD within a unit. It is not appropriate to always meet the low end, the middle, or even the high end of the range. CWD is naturally variable on the landscape and prescriptions should strive to retain that variability.

In addition to the quantity of down wood, the quality of down wood (features such as size and decay class) and arrangement should be a consideration for management. While all size classes serve an important ecological function, it is the larger diameter logs and snags that are important for many wildlife species. Large logs serve as denning sites for marten and fisher and retain moisture through the summer months, thus providing important habitat for terrestrial amphibians and small mammals. Large snags provide critical habitat for many species, including spotted owls, bats and swifts. Bears also utilize the large hollow snags for denning.

Research has shown that in young natural forests, the down wood component is found mostly in decay classes III-V. The majority i.e. 60% of log pieces are in the small (<12") size class. A third of the pieces are in intermediate size classes (12"-24"), and about 6% are greater than 24" in diameter (Spies et.al 1988). If the larger size classes are not currently existing, prescriptions should accommodate the addition of this material at a later date. By the time a forest is in an old-growth condition about 11% of the down wood and snags are greater than 24" in diameter.

Determination of appropriate levels of CWD to leave would include:

1. Determine specific site resource objectives for soil, wildlife and aquatic resources.
2. Evaluate economics - the ability to pay for the operation versus the value. Current funding mechanisms often do not allow for some of the prescriptions that would be appropriate to employ. The choice is often between doing nothing or removing more trees from the site than is desirable in order to pay for the operation. ID teams often struggle with weighing the benefit of thinning plantations to encourage growth of larger trees and more diverse structure with attainment of CWD levels.

Evaluate the risk to the stands or watershed (blowdown, beetle, root rot, fire, etc.).

Example:
An Inter-disciplinary team (IDT) is assessing an area within the LSR to accelerate attainment of late-successional characteristics. Initial consultation of this LSRA shows that the planning area is within the CORE LSR Zone and specifically within Landscape Cell #3, which means that the vast majority of the landscape is in early an seral condition (about 30 years old). The goal of this area is

to provide contiguous late-successional habitat and to increase the connectivity and dispersal habitat across the landscape. After reconnaissance, it was determined that the majority of the plantations in the planning area had low levels of down wood and snags, around 700 cu.ft./ac. The units have been densely planted to 350 tpa. The site-specific resource objective is to provide connectivity for late-successional species in both the short- and long-term.

Alternative 2 would be appropriate in this case - provide for CWD over time.

Using an average size tree for a 30-or 35-yr. old plantation in the Oregon Coast Range (12"dbh and approximately 90 feet tall to a 4 inch top), the volume of the average tree would be 31 cu.ft.

Alternative 2 provides a range of values that will provide CWD habitat over time (i.e., 1102 - 3794 cu.ft./acre). To be within this range, it would be appropriate to leave between 13 and 106 trees per acre as snags or down wood.

The great variability that is found in CWD levels leaves the team with a variety of levels that would be appropriate in different parts of the same unit or in different plantations throughout the planning area, depending on the desired resource objectives.

The number of trees in the stand (350 tpa) and the need to leave a fairly dense stand (100-120 tpa) for future recruitment of CWD and to maintain sufficient canopy closure for connectivity, still leaves a sufficient number of trees to sell to pay for the operation. The contract value of the sale is such that up to 40 tpa could be left as down wood or snags and the project still pay for itself. No hazard from a fire, insect, or disease standpoint is involved, so the team chooses to leave 40 tpa (or about 1200 cu ft./acre) as down wood and snags. This would be in addition to the existing CWD biomass of 700 cu.ft./ac, bringing the total up to 1900 cu.ft./acre after harvest operations.

If the current level of CWD in the above example was more in the average range of the existing conditions (i.e., around 3300 cu.ft./ac. from **Table 14**), a different determination of CWD needs would be made. In this case, the desired range (1102-3794 cu.ft./ac.) would result in a prescription which varied from 0-16 tpa needed for down wood and snags ((3794-3300)/31)=16. Since the contract value supports leaving up to 40 TPA as down wood or snags, the team may decide to leave a minimum of 16 TPA as CWD or perhaps take the opportunity to exceed the natural range and again leave 40 trees per acre as down wood or snags which would result in a volume of CWD of 4500 cu.ft./ac.

Projects may be appropriate which do not employ this method of assessment and determination of CWD levels. These projects will be submitted to the REO for review prior to implementation.

VI. MONITORING

Monitoring is critical to evaluating our success in achieving late-successional structural characteristics across the landscape. Several large scale ecological questions surfaced in this assessment. These questions generally revolve around management activities to improve older forest patch function by increasing the area of interior forest, the connectivity between patches, and/or controlling human access. These questions are not new and have been extensively discussed in the literature and locally in the following documents: FEMAT (1993), First Approximation of Ecosystem Health (1993), in the Assessment Report. (1995), and a biodiversity conservation plan by Noss (1992). The following provides some background on the significance of these questions to this assessment.

Interior Habitat

It is assumed that the bigger the patch of older interior forest, the better it will function as habitat for old-growth dependent species. Interior forest conditions occur when microclimate conditions are stabilized -- beyond the influence of edge-effects. In this province, microclimate edge effects are stabilized within 3 tree lengths (Concannon 1996, Chen 1991). Patch size based on this definition provides an absolute minimum based only on microclimate. Other approaches to defining patch size have ranged from individual (OWL) or species groups (HABSCAPES) to historical landscape vegetation pattern analysis. Species approaches typically build on known home range sizes and progressively increases the patch size as a function of number of species. The historical landscape pattern approach assumes that patterns of the past to which the biota have adopted will be suitable for conserving these species into the future. Hence, knowing the range of historical landscape patterns will help us manage for the appropriate mix of patches in the landscape. Both approaches were considered in the establishment of these LSRs in the Northwest Forest Plan.

Interior forest habitat conditions and area may be increased by altering the structure of plantations next to or within existing older forest patches. Accelerating the development of these plantations to more nearly approximate the characteristics of the surrounding forest should stabilize microclimate changes at the perimeter and interior of older stands. These changes in humidity, temperature, light, and wind have important implications to growth rates, species composition, and organic matter decomposition rates (Concannon 1996, Chen 1991).

We would expect interior forest microclimate to develop and function differently depending on the silvicultural prescriptions. If plantations are "left alone", dense stands would develop which would reduce air flow, increase humidity, and reduce light in the surrounding natural stands. In some cases, this may be a desirable response. Eventually, these dense stands would self-thin and microclimate conditions would be expected to stabilize. This would likely take much longer than if the plantations were thinned because of the age-size gap between the natural stands and plantations.

If plantations are managed to "look" or function more like the surrounding natural stands, then microclimate variability would be expected to be similar to the surrounding stands over time. Following thinning, an abrupt change in micro-climate should occur depending on the density of remaining trees. Initially air flow, temperature and light would be expected to increase and humidity to decrease. This effect could be moderated by light thins with multiple entries.

Alternatively, plantations could be managed to maximize old growth characteristics. In a landscape dominated by 100 to 150-year old homogeneous Douglas-fir stands, thinning plantations would create islands of diversity with very different structure than the surrounding natural stands. Through underplanting and multiple entry thinnings, this approach would moderate wind flows, and increase shading and humidity over time. However, if a heavy thinning is applied, considerable drying would be expected until the underplanted trees were well established.

At the stand scale, many alternative approaches are being tried and evaluated (Cataract-Wildcat-Yachats, Big Elk, Grant/Feagles, and Callahan Cr. Density Treatments, Black Rock, Hebo Restoration). These stand level treatments will help us better understand the responses of vegetation and some small home range animals to various silviculture density and coarse woody debris treatments. Whether these stand level treatments will produce the desired habitat response for animals preferring large areas of interior older forest conditions is questionable.

Since the ecosystem response, especially the cumulative landscape effects, to these three approaches (leave alone, look alike, or max old-growth) is unknown, it seems that the most prudent and effective approach would be to try all of them in a systematic way. In essence, use an adaptive management approach as described by Bormann et al. 1995. This will yield a variety of stands and landscape conditions which could then be compared, monitored, and evaluated by future managers, scientists, and citizens. Using an adaptive management approach to develop a landscape design directed towards monitoring will provide future managers with better information and more choices about what should or shouldn't be done to manage for older forest habitat.

Appendix G provides an example of how adaptive management could be used to increase the effectiveness of a monitoring program. This example is hypothetical and needs to be further refined and developed before it could be implemented. Development of a proposal would be in coordination with all BLM and National Forest management areas involved in the design.

Human Access

The Coast Range has been extensively roaded. Prior to 1945, the average size of security areas (areas greater than 1/4 mile from a road) was 3,000 acres. By 1990, it was reduced to 137 acres. This reduction corresponds to the loss of wolves, fisher, and wolverine (Siuslaw 1995). Indirect human disturbance and roads may have effects on use of older forest habitat for many other species. Considering the human population growth projections in the valley and coastal strip and the greater interest in outdoor experiences, these potential effects may become more significant over the next 20-30 years than possible positive effects from silviculture treatments.

The Access and Travel Management Plan for the Siuslaw N.F. identifies 700 miles of roads maintained for public travel. The existing road system is 2200 miles. To date, approximately 800 miles of road have been hydrologically stabilized. This reduction in miles of maintained roads has been driven by declining road budgets. To evaluate the influence of roads and human disturbance on the functioning of older forest habitat, access and travel management plans should be addressed in a landscape design.

Connectivity

"Connectivity is a measure of the extent to which the landscape pattern of the late-successional/old growth ecosystem provides for biological and ecological flows that sustain late-successional/old growth animal and plant species" (FEMAT, IV-52). The term "connectivity" may have different connotations, depending on the species, ecological process, or scale being considered. Connectivity for large home range species such as spotted owls will require a province-wide perspective while stands or groups of stands may be a sufficient perspective for a mollusk species.

The Forest Ecosystem Management Assessment Team (FEMAT) developed a strategy of a network of reserve areas with an intervening matrix to meet the needs of late-successional forest species. This strategy was adopted in the Northwest Forest Plan. Connectivity, as addressed in the strategy, can be broken into 3 major categories:

1) The LSRs are intended to be large, contiguous blocks of habitat that can sustain populations or sub-populations of most late-successional associated species. The LSRs are spaced close enough together to allow for mobile species to disperse between LSRs and interact with at least an occasional genetic interchange. The intervening matrix does not need to be late-successional habitat but must provide needs for dispersing individuals.

2) Riparian Reserves (RRs) provide connectivity in the way of contiguous habitat for less mobile species unlikely to survive outside late-successional forests even during dispersal. "Riparian Reserves are used to ... improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors among the Late-Successional Reserves." (ROD, B-13)

3) The matrix is designed to maintain small blocks of late-successional habitat to provide both "stepping stones" for species to move between LSRs and refugia for immobile species. "Isolated remnant old-growth patches are ecologically significant in functioning as refugia for a host of old-growth associated species, particularly those with limited dispersal capabilities that are not able to migrate across large landscapes of younger stands." (ROD, C-44)

Landscape scale connectivity corridors were identified in this assessment (**Map 12)**. Monitoring the effectiveness of these corridors will need to be done at the province scale if not larger.

Snags and CWD

Assessing levels of CWD on the landscape is proposed as an essential component of the CWD assessment process. The field techniques to ascertain CWD levels have not been developed and agreed upon at this time. An essential monitoring component is to assure that these techniques are: developed; appropriate for IDT use; reliable qualitative estimate of existing CWD levels. Implementation monitoring will ascertain if a variety of CWD levels are being left on the landscape. Effectiveness monitoring should determine the value of providing new, small diameter CWD and/or no additional CWD during the initial commercial entry into young plantations for resources which might benefit from that addition.

Risk Assessment

One critical phase of monitoring is testing assumptions and revising management actions when those assumptions are inappropriate. In this assessment, several hypothesis have been put forward to assist in the understanding of landscape function. The following is an assessment of the benefits and risk associated with following those hypotheses with management activities.

Landscape Analysis

LSR Zones provide a coarse assessment of the functions and roles of different areas of the landscape. Landscape Cells help to set priorities for treatment opportunities. These designations do not restrict management only to these areas. Prioritization of treatment areas does not restrict the management of plantations in lower priority landscape cells. There will be ecological or biological reasons to manage areas across the landscape; i.e., treatment windows, T&E habitat restoration. The prioritization scheme was developed to suggest to managers that with limited funding and people to implement activities that the most benefit, based on restoration of the best habitat first, would be gained by implementing treatments in certain areas before others.

Priorities were established based on the same approach that was taken for aquatic restoration. It ties to the refugia concept. Large blocks that are relatively intact and support intact populations of organisms, are more important to restore than more degraded habitats. Our goal is to create and maintain the most late-successional habitat within the least amount of time. With reduced budgets, it's important to focus efforts in areas where we can be most successful. Another option is to work with the most degraded habitat. In these areas, there are isolated, scattered blocks of mature forest and limited places to link those blocks; one would have to grow the vegetation more or less simultaneously. This approach would take much longer to achieve the desired goal and more funding would be necessary to treat larger areas of the landscape. However, management of these areas is important to help recover areas that once had habitat. If the priorities are wrong, there is a low risk to meeting LSR objectives. Project implementation will only be accomplished on relatively small acreages within the LSRs; it will take decades to implement activities. There will be enough flexibility to redirect our emphasis.

The team understands that some funding allocations are limited to work in matrix land use allocations. This assessment in no way attempts to guide type or spatial allocation of management on matrix lands.

Successional Pathways

The successional pathway models are a first attempt to understand how vegetation changes on the landscape based on site condition and disturbance processes. There are scientific articles which discuss successional models but we found none that try to understand succession by sub-series environment. It is expected that further refinement of these successional pathways will occur as more people begin to evaluate these concepts. Historic photography of the area suggests that these differences in vegetative conditions on the landscape do occur and are predictable. The drawbacks of following these pathways are, for example, that wider spacing in the wet environments cuts down on future options for conifer or you may loose the existing conifer due to erratic blowdown. Its strength is in the variability of prescriptions that can be expected across the landscape. Another alternative is to devise a limited number (1 or 2) of prescriptions that will be employed across the whole area. If in the wet environment, 80-100 conifers per acre is the prescription, for example, managers would have to spend extra money trying to reduce vegetative competition with the conifers in an area where wider spacing of conifers would have occurred naturally. ROD B-6 directs that silvicultural prescriptions be varied across the landscape. These successional pathways provide some guidance for achieving that diversity. Whatever prescription is employed, it is important to leave all the pieces that are necessary to maintain the health of the ecosystem.

Disturbance Regimes

There is a low risk of not attaining LSR objectives if the delineation of disturbance regime blocks is not accurate. These are an initial attempt to understand the processes operating in the landscape. Disturbance regimes were only one of the factors that went into landscape analysis. Types of appropriate management prescriptions that will be employed do not follow regime blocks at the stand level. On the landscape level, treatments will be spread out spatially and temporally. Implementation of activities will take decades, and the focus can always be changed if new information becomes available.

LSR Landscape Monitoring Goal

The long-term goal is to provide future managers, scientists, and citizens with better information and the opportunity to evaluate the effectiveness of different management approaches to achieving LSR objectives.

Many of the important issues about how to manage for older forest conditions will take at least 20-40 years to begin to address. This response time, which is relatively short, is due to the productivity of the Coast Range. While this response time is short, it is much too long for human careers. Consequently, we must setup and implement our management activities so future natural resource managers can evaluate the effectiveness of the treatments we prescribe.

Currently we approach activities on a "project by project" basis with emphasis being given to stand or reach level monitoring. Cumulatively, this approach may not "add-up" to the desired landscape level objectives for older forest ecosystems. Without a landscape monitoring strategy, this "project by project" approach may not provide adequate comparisons for future generations.

Monitoring Components

The ROD 1994 has outlined the minimum implementation monitoring components that need to be addressed in LSRs. Bureau of Land Management Resource Management Plans and the Siuslaw National Forest Plan all have incorporated sections on implementation monitoring. Those monitoring plans will be tiered to for LSR concerns.

Currently there are several ongoing efforts to evaluate effectiveness monitoring strategies. The REO and several subgroup task forces are addressing specific components that should be included in an overall strategy. The Eugene and Salem Districts of the BLM, the Siuslaw N.F., and the Pacific Northwest Research Station are initiating an effort to devise a pilot Province Monitoring Plan that will be implemented throughout the Region. Those strategies will address LSR components that must be monitored. Locally, we will tier to those higher level plans.

This LSRA highlights the following specific monitoring components that need to be addressed:

- An interagency evaluation of landscape structural changes over time. This would include an assessment of mature patch sizes, the number of mature patches and the acreage of mature forest.

- Specific T&E species habitat trends need to be evaluated. This would look at the changes in the conditions of, for example, known northern spotted owl activity centers over time.

VII. SUMMARY AND CONCLUSIONS

Several management concepts were developed during the LSRA process. They are summarized below.

Basing Prescriptions on Ecological Principals

1. There are differences in the composition and structure of young, mature, and old-growth forests. Site prescriptions need to acknowledge these differences. In general:
   - Older forests have large, shade-tolerant tree species in the overstory
   - Diverse vertical distribution of vegetation
   - Large amounts of CWD

2. Silvicultural treatments should be aimed at "keeping all the pieces", i.e., not focusing on growing larger trees or developing an understory at the expense of other stand characteristics.

3. Silvicultural prescriptions should use the natural successional pathways that occur based on disturbance regime, and sub-series environment as a guideline to achieve LSR objectives.

4. Management objectives vary by seral stage of vegetative development. Prescriptions should employ objectives which are attainable given the seral stage of the vegetation.

Management Guidelines / Sideboards

1. Both the spotted owl and marbled murrelet draft recovery plans emphasize the need for a variety of silvicultural treatments to promote the natural diversity and variability found on the landscape.

2. Owls frequently use younger stands (i.e., natural stands 50-80 yrs old) for roosting and foraging. Thus, it is not recommended to treat these stands if they are located within 1.5 miles of a known owl activity center

3. The ROD emphasizes the need for the Riparian Reserve network to provide dispersal habitat for owls and other terrestrial species. All proposed activities which alter dispersal habitat should assure that adequate dispersal habitat exists prior to implementation.

Prioritizing the Landscape

1. The LSR assessment process identified the need to secure the "best" habitat areas first before devoting limited funding and resources in more degraded areas. This strategy affirms the aquatic conservation/restoration strategy objectives and priorities developed by the Northwest Forest Plan.

2. Based on the current condition, amount and distribution of remaining late-successional habitat within the LSR and ownership patterns, three primary zones were identified.
   - 1. The Core LSR Zone is designed to serve as the genetic pool or seed source for late-successional forest-dependent species.
   -2. The Corridor LSR Zone will serve primarily to connect this LSR to adjacent LSRs to the North (Hebo) and East (Cascades)
   -3. The Buffer LSR Zone consists primarily of checkerboard BLM lands in the central eastern portion of the assessment area. This area is vital for maintaining small patches of late-successional forest habitat.

3. From these zones, Landscape Cells were developed. Prioritization was based on securing the best habitat first, blocking up large patches and connecting isolated patches.
   - Priority 1 = Landscape Cell #1(areas colored in dark green on **Map 12)**
   - Priority 2 = Landscape Cell #2 and #4 (areas colored in light green and red on **Map 12**)
   - Priority 3 = Landscape Cell #3 and #5 (areas colored in brown and purple on **Map 12**)
   - Priority 4 = Landscape Cell #6 (areas colored in light blue on **Map 12**)

4. At the watershed scale, the terrestrial priorities and restoration emphasis areas outlined above will be integrated with other resource concerns, such as aquatic and social needs.

Opportunities for Restoration and Potential Conflicts to Meeting LSR Objectives

1. The LSRA identified that certain areas, i.e., the Connectivity/Diversity blocks to the southeast of LSR RO267, the blocks of matrix in the Five Rivers, and the Big Elk areas are important for maintaining: connectivity to the Cascades; the integrity of the CORE; and connectivity to other LSRs, respectively. When finer-scale assessments, i.e., watershed analysis are done which evaluate Riparian Reserve widths, this importance should be considered. Until that time, as the ROD states (C-30,31), 1-2 tree height buffer recommendations should be maintained.

2. There has not been any site-specific identification of areas for changes in land use allocation. This assessment provides the manager with some guidance of where those changes would be appropriate should they be proposed in the future. Land Use Allocation (LUA) changes should be considered where they would assist in the ability of the LSR to function. The highest priority is in the Core and Connectivity LSR Zones and in Landscape Cell #4. The Buffer LSR Zone would have areas where

like-kind changes in LUA (i.e., change LSR to Matrix in this area for Matrix to LSR in other areas) would be appropriate if it would benefit the functioning of other higher priority areas. Although change proposals should assess the ecological value of these isolated blocks.

3. Land ownership exchanges or acquisitions of lands should be considered when it would facilitate the ability of the LSR to function. The ROD (C-17) itemizes legitimate reasons for land exchanges providing the benefits are equal or greater to current conditions of the LSR either in area distribution or habitat quality. The priorities of these exchanges are as follows.
   - Priority 1 = linkage areas, i.e., "Landscape Cell" #4
   - Priority 2 = strategic points in the "Corridor" LSR Zone
   - Priority 3 = other strategic places within the LSRs
   - The "Buffer" LSR Zone has the lowest priority for blocking ownership

It is not the intent of this document to prescribe activities on lands other than LSR allocations. REO requested (January 1996) that LSRAs consider the condition of adjacent lands and understand how they may influence the function of the LSRs.

Limitations of the LSRA and Analysis Needs at the Watershed Scale

The late-successional reserve assessment was a landscape level look at terrestrial ecosystems, how they are currently functioning, how they could be functioning, and how to identify and prioritize habitat restoration needs for late-successional forest species.

Several limitations were encountered during the analysis process which will need to be refined at the watershed analysis level. For example,

1. We were unable to analyze the current condition of vegetation within the riparian reserves across ownership lines. This limited our ability to determine the condition of dispersal habitat within the riparian reserve network.

2. We were not able to determine how much of the mature stands were remnant old-growth (i.e., what portion of the LSR currently met the desired future condition). The vegetation analysis will thus need to be further refined at the watershed level in order to assess these biological "hot-spots" or refugia.

3. Due to limitations in the vegetation coverages, the interior forest habitat analysis included a 500-foot buffer around all mature conifer patches. This results in a worse case assessment of the interior forest habitat condition. This analysis can be much more refined when done at the watershed scale and variations in edge severities and types are taken into consideration (buffer distances will vary, depending on edge type).

4. The TE&S species analysis was instrumental in determining priority restoration areas, refugia, and future recovery potential of owls and murrelets on the landscape scale. At this scale and given the limitations of matching survey efforts and species coverages, only the "big picture" pattern and distribution on the

landscape was analyzed. Survey coverage, data gaps, locations of other TE&S species, and the condition of individual sites (reproductive viability, etc.) will need to be further analyzed at the watershed scale.

5. Special habitats were not mappable at the LSR scale. Wetlands, meadows, and other unique features on the landscape will need to be addressed at the watershed scale.

6. Integration of the terrestrial system with the aquatic elements of an area is more appropriate at a smaller scale (i.e., watershed) and was not included in this LSR assessment. **Appendix H** provides information, attained through this assessment process, by 5th field watershed so that it can be utilized for finer-scale assessments.