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Plant Association and Management Guide

Siuslaw National Forest

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PLANT ASSOCIATION AND MANAGEMENT GUIDE SIUSLAW NATIONAL FOREST

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INTRODUCTION

Intensive management of National Forest lands requires accurate evaluation of resource condition, capability and response to management. How can different forest types be distinguished? How do they respond to manipulation? How productive are they? Complete knowledge--acre by acre--of species populations, growth rates, biomass, soils, and environment cannot be compiled at present. A reasonable alternative is to let the vegetation and soils of a site indicate potential species composition, productivity and response to management.

Plant populations that have developed on a site over a long period have come into balance with, and are useful indicators of, their environment. A classification of long-term, stable plant communities (or associations)--combined with soils information--can be the basis of resources evaluation, project planning, and land management planning (USDA Forest Service Handbook 2090.11, 1986).

Classification of plant associations allows us to:

1. Plan management strategies--evaluate resource condition, productivity, and responses to manipulation.

2. Communicate--record successes or failures of management actions, provide common descriptions of resource conditions and responses for various disciplines.

3. Apply research--provide a direct link between research results and and management practices.

OBJECTIVES

The objective of this project is to provide a vegetative basis for land stratification in the Siuslaw National Forest which can be used for project level and land management planning. Three major tasks were involved:

1. Describe plant associations on the Siuslaw National Forest and provide a means for managers to identify them in the field.

2. Compile environmental profiles and management implications for these associations from field measurements, research results, and management experience.

3. Sample tree growth, wildlife habitat, and soils for each plant association and provide estimates of site capability.

Our sampling in the Oregon Dunes National Recreation Area and non-forest areas was not sufficient to develop plant association descriptions. These areas will be sampled and a addendum to this guide published in the near future.

Classification of the Siuslaw National Forest lands is part of a larger project to classify all lands in Region 6. The ecology program has been involved in this project for several years and the Regional Forester has set a deadline of 1987 for finishing the classification work.

CLASSIFICATION CONCEPTS

Although climax stands have not developed on the Siuslaw National Forest, a scheme based upon potential natural vegetation was used for classification. Extensive, catastrophic fire swept nearly all the landscape in the past 150 years. The few areas not burned support old-growth Douglas-fir and will not move into climax condition for at least one or two centuries, even if left uncut. The use of potential natural vegetation (i.e., climax) to describe plant associations does not mean that stands must be in climax status to be classified or even that we will ever see climax conditions. Instead, the concept relates to the environmental conditions that determine where a species could be climax and where it could not.

Two major series are found on the Siuslaw National Forest, the western hemlock series and the Sitka spruce series.

The western hemlock associations presented in this guide--taken together--form the western hemlock series. The western hemlock series has a particular set of environmental, management and resource attributes that distinguish it from the Sitka spruce series. Douglas-fir and red alder, in combination or alone, could dominate the existing canopy on sites from either series. However, the plant community as a whole is used to distinguish the series and association for the site, and therefore its environmental and biological characteristics.

In order to understand the current successional and ecological status and capability of a site, we must assess current conditions (species, age, stocking level, etc.), environmental conditions and successional patterns. We need an inventory of current conditions and knowledge of response to activities which may change current conditions. Plant associations allow relatively easy assessment of site potentials for a variety of resources.

This guide is based on classification of approximately 700 reconnaissance and 186 intensive plots sampled throughout the Forest. Plots were sorted into groups using a variety of computer and manual techniques (Volland and Connelly, 1978; Gauch, 1979). The resulting groups of plots represent different plant associations and are named for the dominant climax conifer and the dominant understory species. Some species--swordfern and vine maple, for example--occur so widely that they are not used to name associations except where they indicate an important difference or where no other species dominate the understory.

METHODS

Data presented in this guide come from three kinds of sample plots. Reconnaissance plots are designed for quick measurement of site physical factors, conifer productivity, stand structure, wildlife use, forage, and plant species composition and dominance. The intent of reconnaissance sampling was to develop a very large information base on plant community composition, site environment, and general productivity across the Forest. Intensive samples were installed in a subset of reconnaissance plot locations after the preliminary plant association classification was completed. The purpose of intensive classification was to more carefully characterize stand volume, volume increment, snags (sizes, numbers and use), down woody debris (condition and amounts), and productive potential by plant association. The third kind of data comes from reforestation survey plots collected by Ranger Districts.

Reconnaissance sampling of the entire Forest was completed in three field seasons and resulted in a data base of over 700 plots. The Forest was sampled drainage by drainage from south to north. Relatively undisturbed, natural stand over 70 years old (with a few exceptions) with relatively uniform vegetative composition were sampled as they were encountered. The samples are not a systematic representation of forested plant communities on a per acre basis. Measurements taken on each plot included:

1) Site physical factors - elevation, aspect, slope, landform, slope position, and total cover of canopy, shrubs and herbs.

2) Wildlife habitat features - snag tally with a 40 factor prism, presence of cavities in snags, presence of game trails, presence of elk and deer pellet groups, evidence of browse by species, evidence of use by other species (eg. mountain beaver burrows), and pounds of green weight forage per acre for shrubs by species and all herbs combined on three clipped subplots.

3) Age, height (measured with a tape and clinometer), diameter, current diameter growth rate for at least one dominant conifer (Douglas-fir if possible), and total stand basal area.

4) Percent canopy cover estimates for all trees, shrubs and herbs present in a 500 meter square circular plot.

Plots were grouped into plant associations using a set of multivariate stastical analysis, association table analysis, and ecological data analysis computer programs.

Intensive plots were far more time consuming to install. Due to budget and time restrictions, intensive sampling was limited to one six month field season (186 plots). Each intensive plot consisted of measurements collected on a series of points in a single stand and plant association, usually in the same general location as a previously sampled reconnaissance plot. The points were arranged in a grid (Figure 1) with each point 70 feet and 60 degrees from the previous point. The basic sample design and menasurement techniques follow the guidelines prescribed for formal Resource Inventory Plots (USDA Forest Service 1985). In addition to reconnaissance plot information, the following data were collected:

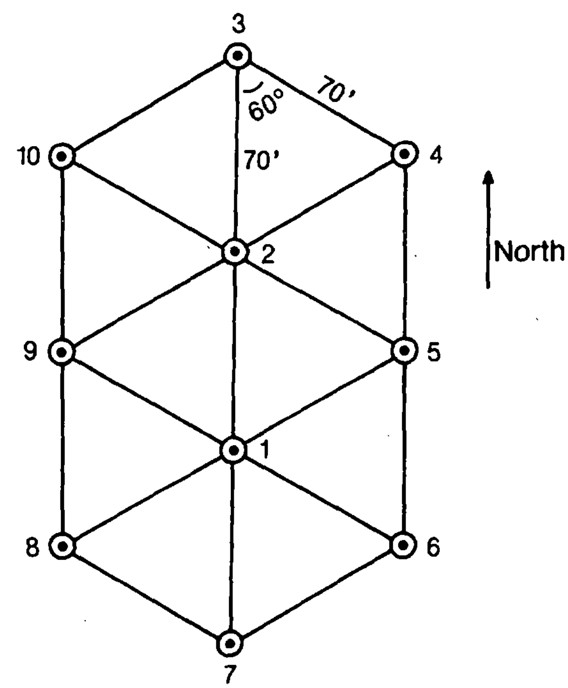


Figure 1. Intensive ecology plot design. Adapted from USFS Region 6 Resources Inventory methods (1985).

1) Live tree measurements (collected at each point)

   - total height, diameter breast height (DBH) to the nearest 0.1 inch, total age at breast height from an increment core, crown ratio, and sapwood thickness for the first dominant tree of each species encountered

   - species and DBH to the nearest 0.1 inch for each live tally tree in a BAF prism plot

2) Snag measurements (collected at each point)

- DBH estimated to the nearest 5 inches, height estimated to the nearest 5 feet, decay class (Neitro et al., 1985), presence of small (0 to 2 inches), medium (2 to 5 inches), and large (over 5 inches) cavities, and presence of feeding use for each snag encountered as "in" with a 20 BAF prism swung at point center

3) Down woody debris characteristics (collected at the first third and fifth points)

- the total length estimated to the nearest 5 feet, diameter at each end estimated to the nearest 2 inches, and decay class (Bartels et al. 1985) for all pieces of down, dead wood contained within the slope corrected boundaries of a 1000 meter square circular plot

Reforestation survey plot data were used to develop estimates of early seral vegetation-development clearcuts. District Silviculture programs collect reforestation survey data on all clearcuts at 1, 3, and 5 years following harvest. Plots are arranged on a grid superimposed on the harvested area and are designed to sample the survival and stocking of crop trees on a per acre basis. At each plot (generally 1/250th acre), the number and height of crop trees is recorded along with the canopy cover and height of several important species of shrubs and herbs. Contact the Forest or Ranger District Silviculturist for more information on reforestation survey procedures.

THE STUDY AREA

CLIMATE

Cool, wet winters and relatively warm, dry summers characterize the Oregon Coast Range (Figures 2 through 6). 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 (Figure 7). Occasionally, Arctic air meets an onshore flow, producing snowfall. In general, snow persisting for more than a few days is limited to the tops of the highest peaks.

High pressure may develop in winter, producing periods of cold, clear weather and frost. High pressure usually develops off the Coast during summer, deflecting most storms north into Canada. This high pressure system occasionally breaks down during the late summer, resulting in rain during August and September. Although precipitation amounts are typically small, the tendency for summer rain is greatest on the North Coast (Figure 8). Fog occurs often along the Coast and inland river valleys during the summer. Fog drip may contribute significantly to available moisture during the summer.

Orographic effects are pronounced in the Oregon Coast Range. Major ridges receive substantially more precipitation than nearby lowlands. A precipitation station south of Florence recorded 15.95 inches of rain in November of 1983, while a similar station 10 miles inland on a ridge received 22.02 inches in the same period (Figure 9). Areas of consistently high precipitation center around Mt. Hebo, Cummins Peak, Upper Drift Creek (Alsea System), and Mt. Greyback. Long-term climatic records indicate that higher inland sites may receive 40 inches more annual precipitation than sites on the coastal strip (Figures 2 and 5).

High potential evapotranspiration and low precipitation during warm, sunny summers may produce moisture deficits (Figures 2 through 5) (Johnsgard, 1963). Although data are limited, moisture deficits appear to be more pronounced in the south half of the Forest (Reedsport) than in the north half (Valsetz and Cloverdale). Unless there is some movement of water onto the site from upslope or from fog drip, soil moisture storage capacity must be at least equal to the evapotranspiration to ensure an adequate moisture supply through the summer. Stands on ridges and exposed south-facing slopes with thin, rocky soils can develop substantial plant moisture stress in late summer, especially at the south end of the Forest.

Winter temperatures are usually mild (Figure 6). When high pressure obstructs the onshore flow of relatively warm air, skies clear and nighttime frost may occur. In general, winter conditions allow moderately high rates of evergreen plant photosynthesis. In fact, the pattern of relatively warm, moist winters and dry summers may explain the predominance of evergreen forests in the Pacific Northwest as opposed to the deciduous forests of the Northeast (Waring and Franklin, 1979).

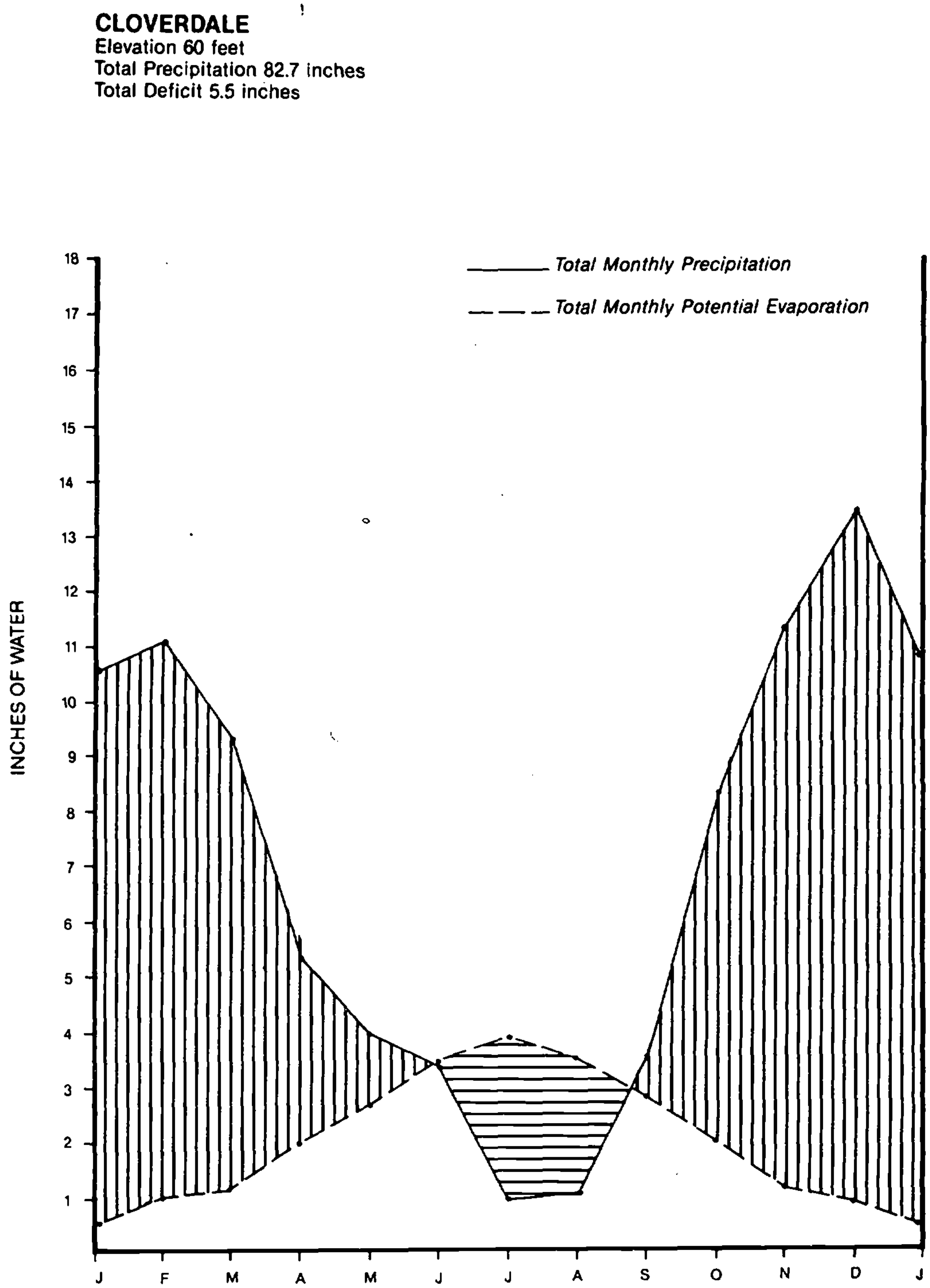


Figure 2. Precipitation and potential evapotranspiration, Cloverdale, Oregon (Johnsgard, 1963).

REEDSPORT
Elevation 55 feet
Total Precipitation 74.2 inches
Total Deficit 7.7 inches

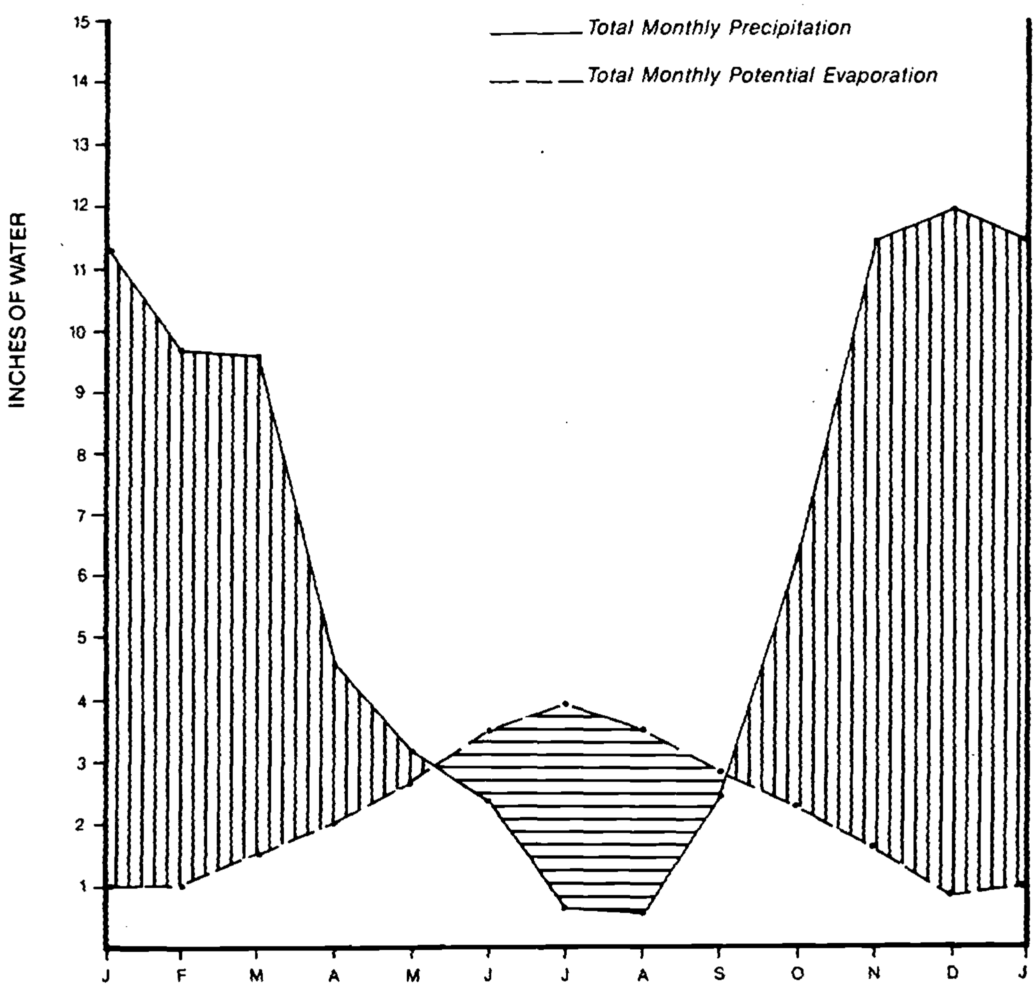


Figure 3. Precipitation and potential evapotranspiration, Reedsport, Oregon (Johnsgard, 1961).

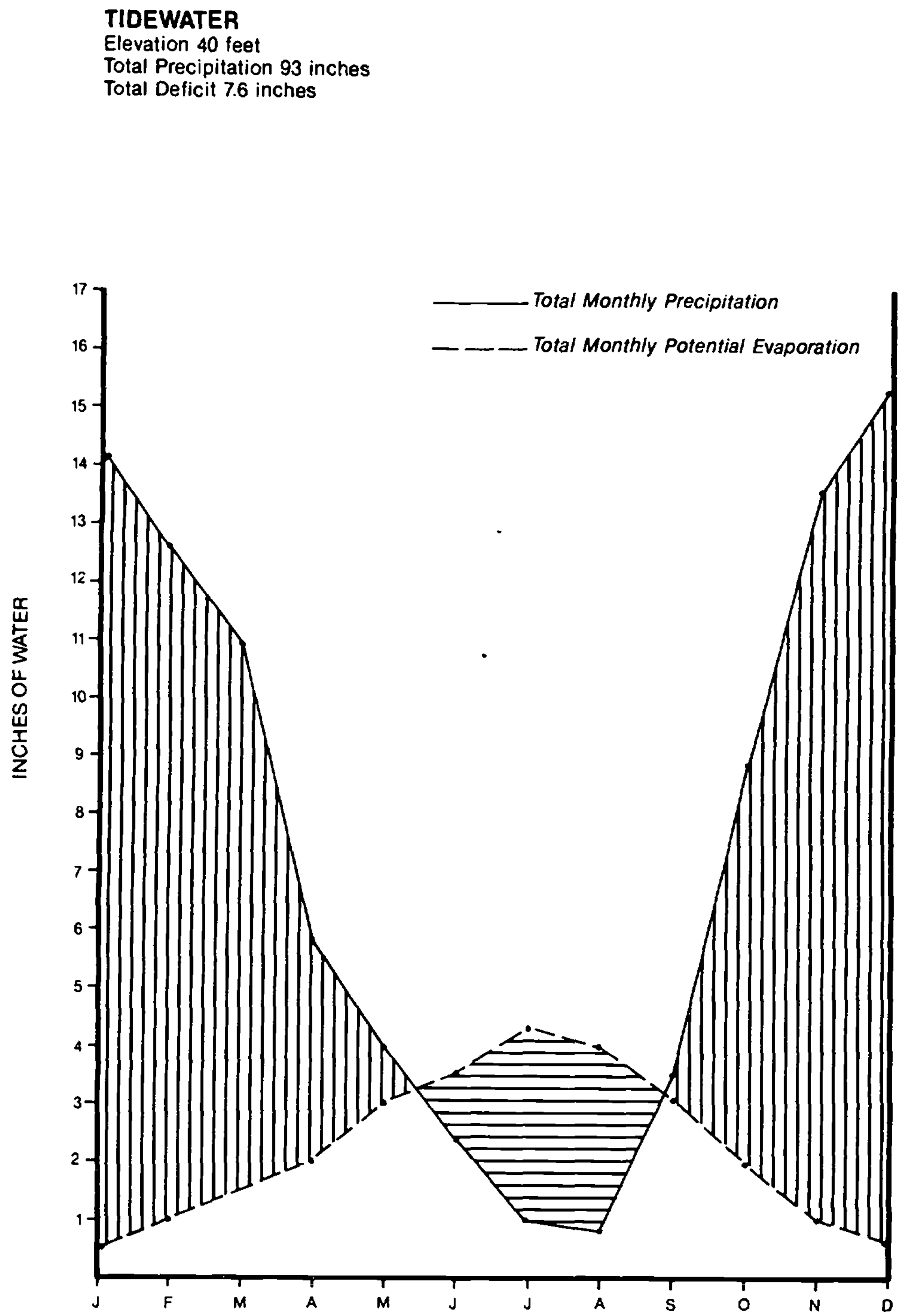


Figure 4. Precipitation and potential evapotranspiration, Tidewater, Oregon (Johnsgard, 1963).

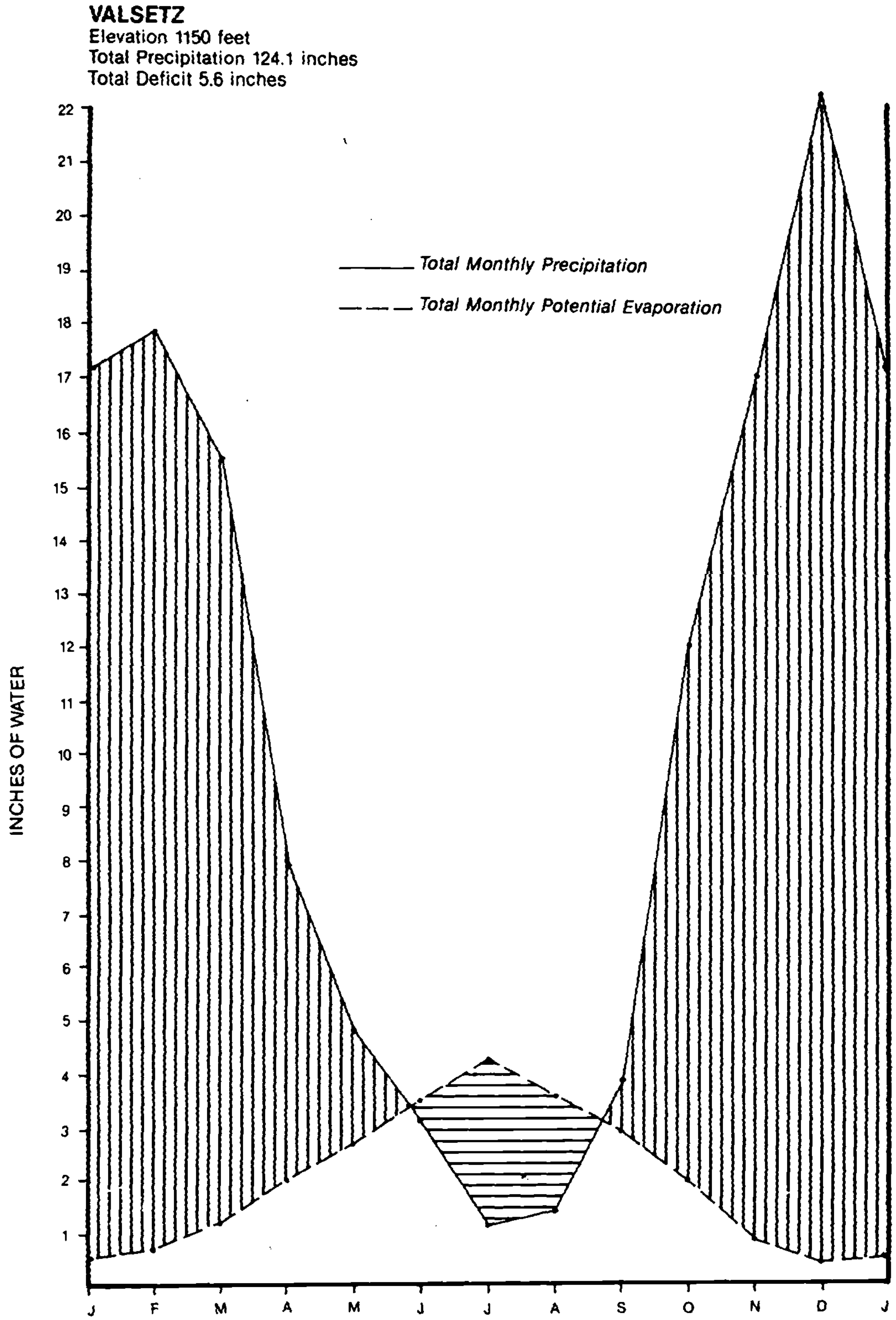
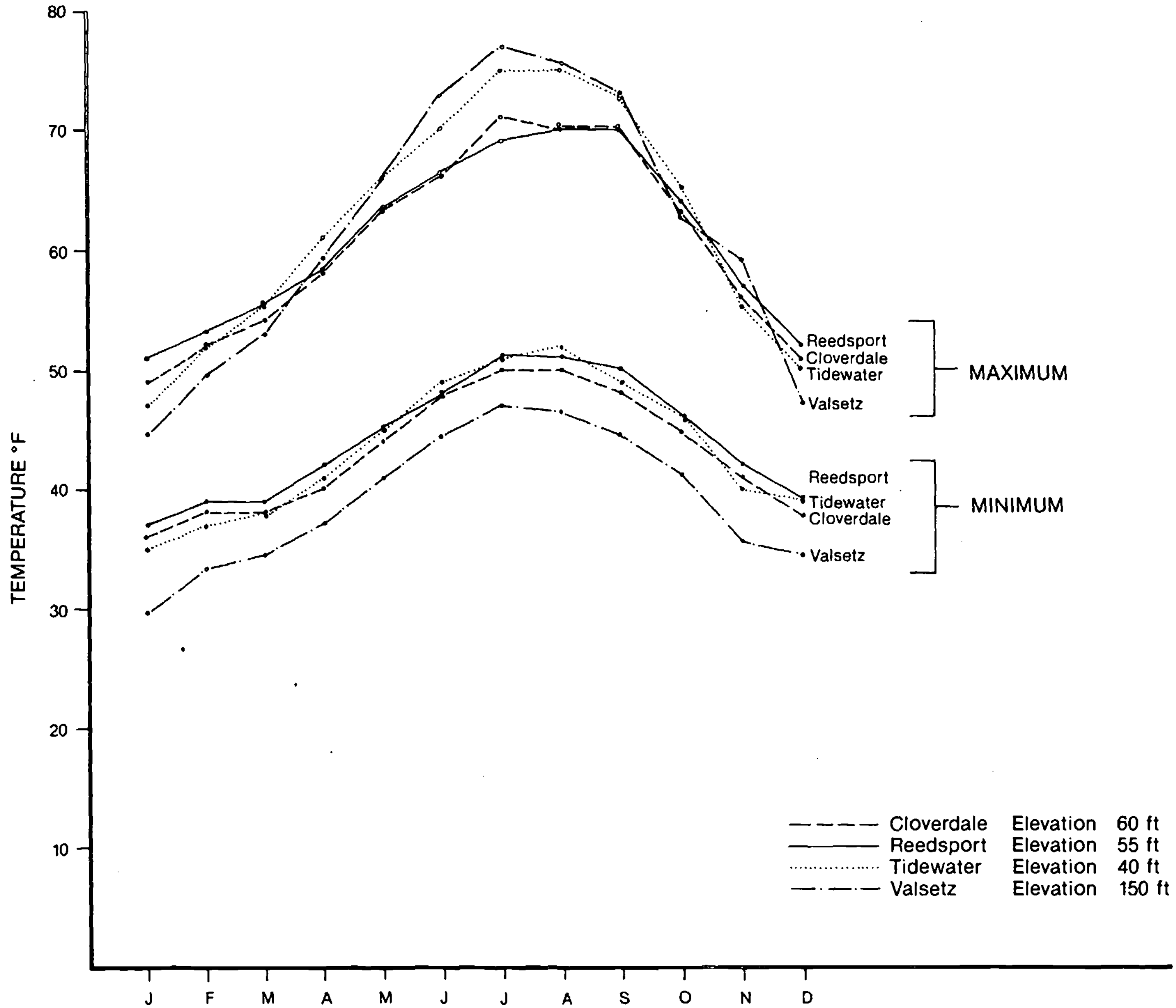


Figure 5. Precipitation and potential evapotranspiration, Valsetz, Oregon (Johnsgard, 1963).

Figure 6. Mean maximum and mean minimum air temperatures for Cloverdale, Reedsport, Tidewater, and Valsetz, Oregon (Johnsgard 1963, US Department of Commerce 1965).



TOTAL ANNUAL RAINFALL
North Half
Siuslaw National Forest

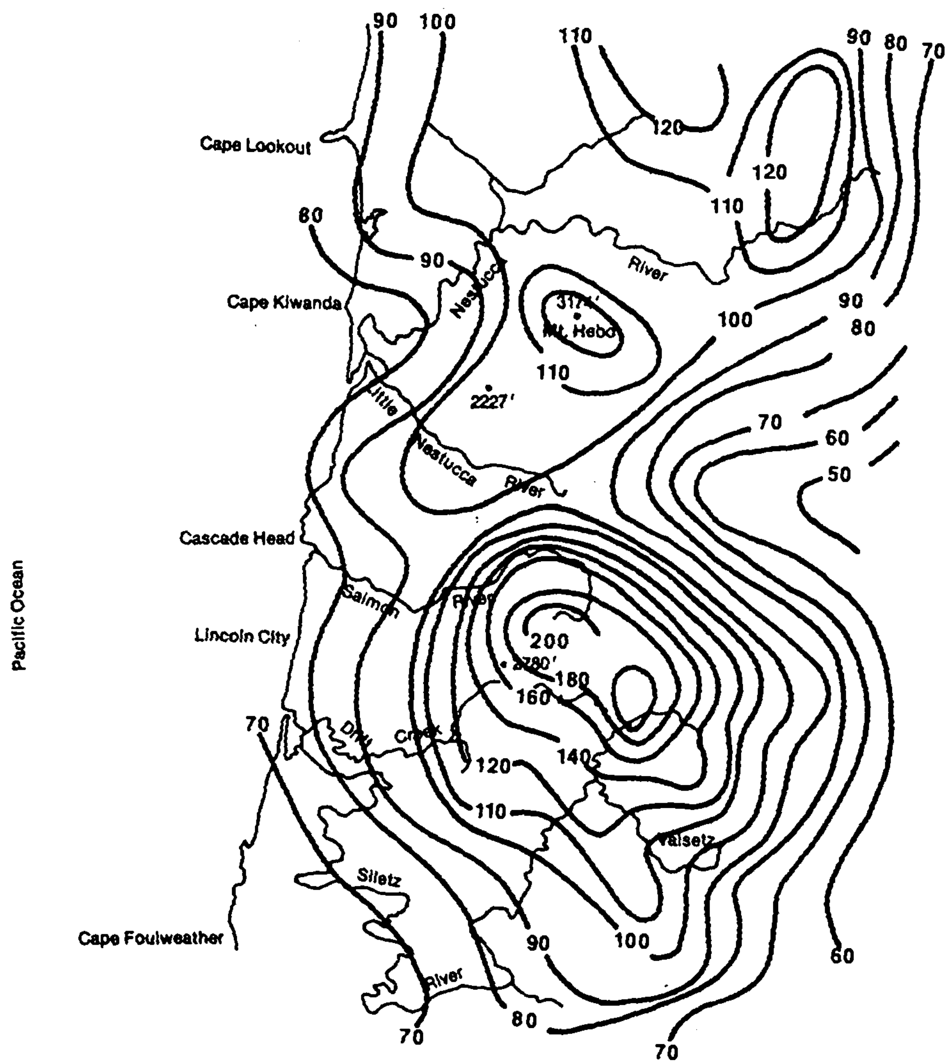


Figure 7. Total annual rainfall, North half, Siuslaw National Forest (US Department of Commerce, 1965).

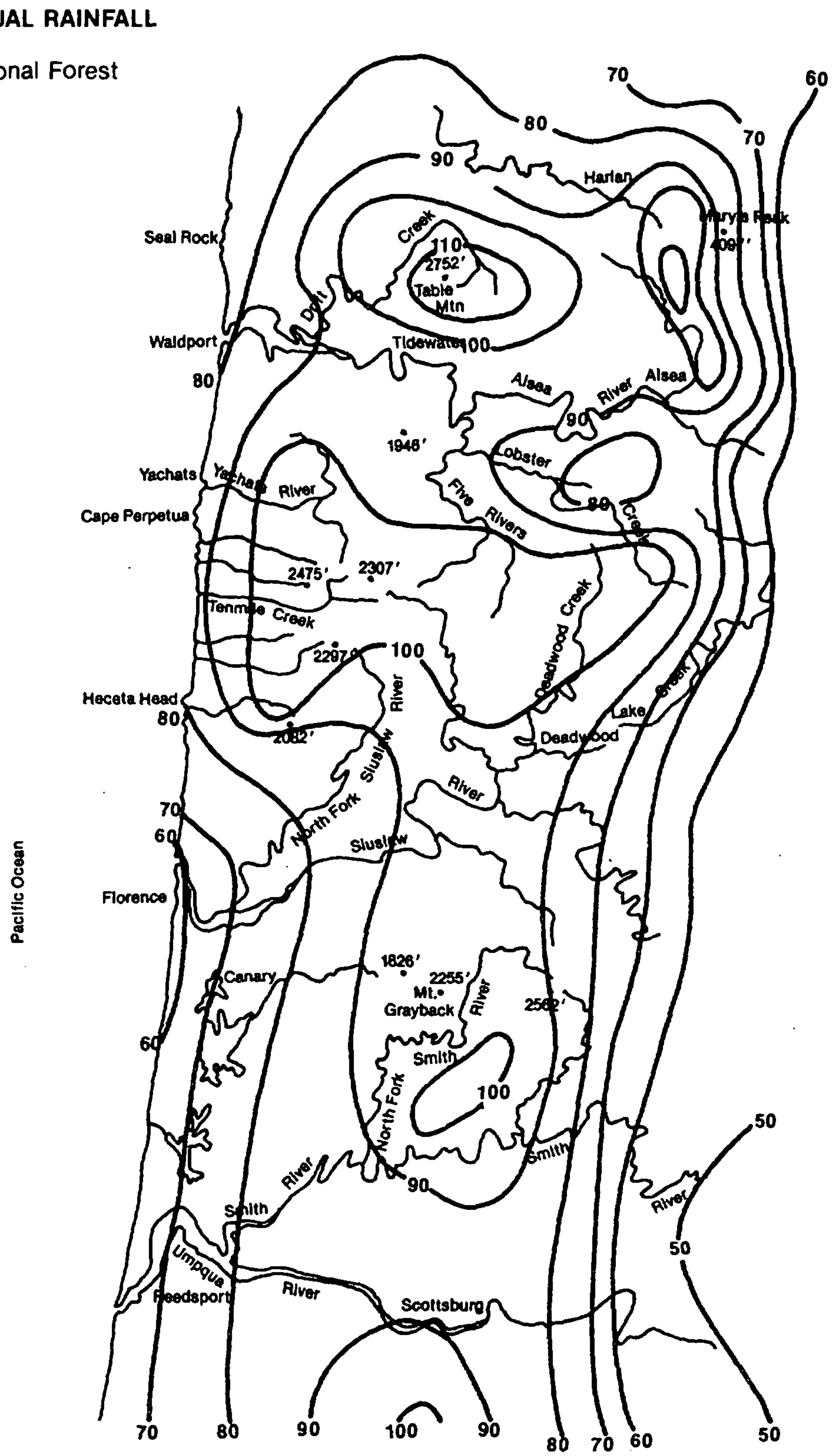


Figure 7 (continued). Total annual rainfall, South half, Siuslaw National Forest (US Department of Commerce, 1965).

AUGUST 1983 RAINFALL
North Half
Siuslaw National Forest

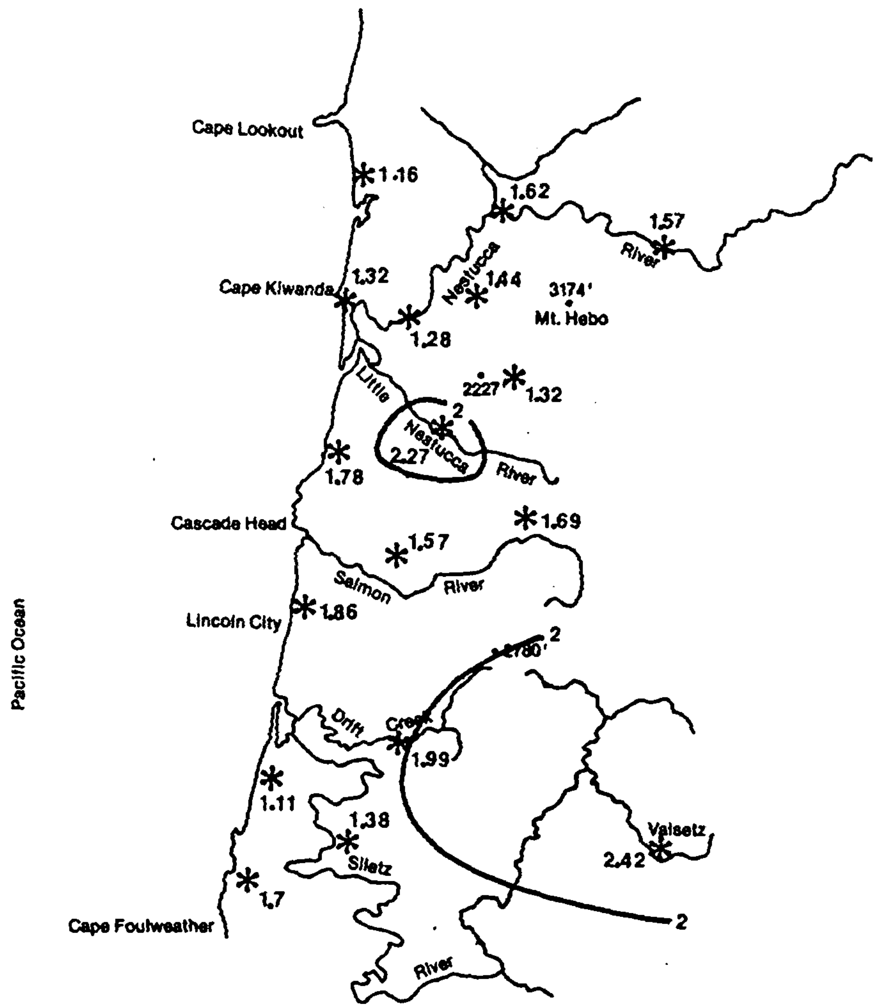


Figure 8. August, 1983 rainfall, north half, Siuslaw National Forest (courtesy J. Reim, hydrologist, Siuslaw National Forest).

AUGUST 1983 RAINFALL
South Half
Siuslaw National Forest

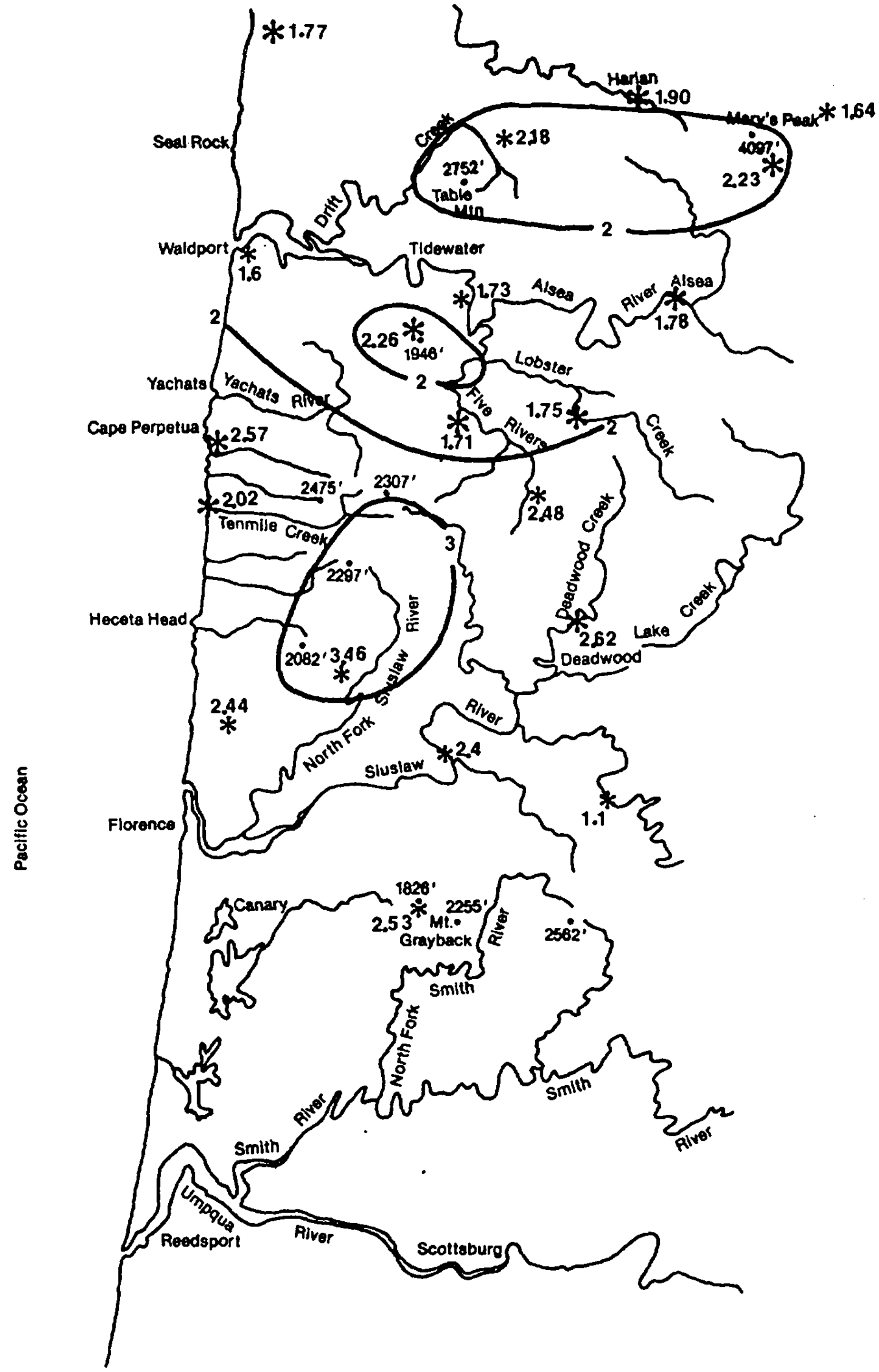


Figure 8 (continued). August, 1983 rainfall, South half, Siuslaw National Forest (courtesy J. Reim, hydrologist, Siuslaw National Forest).

NOVEMBER 1983 RAINFALL
North Half
Siuslaw National Forest

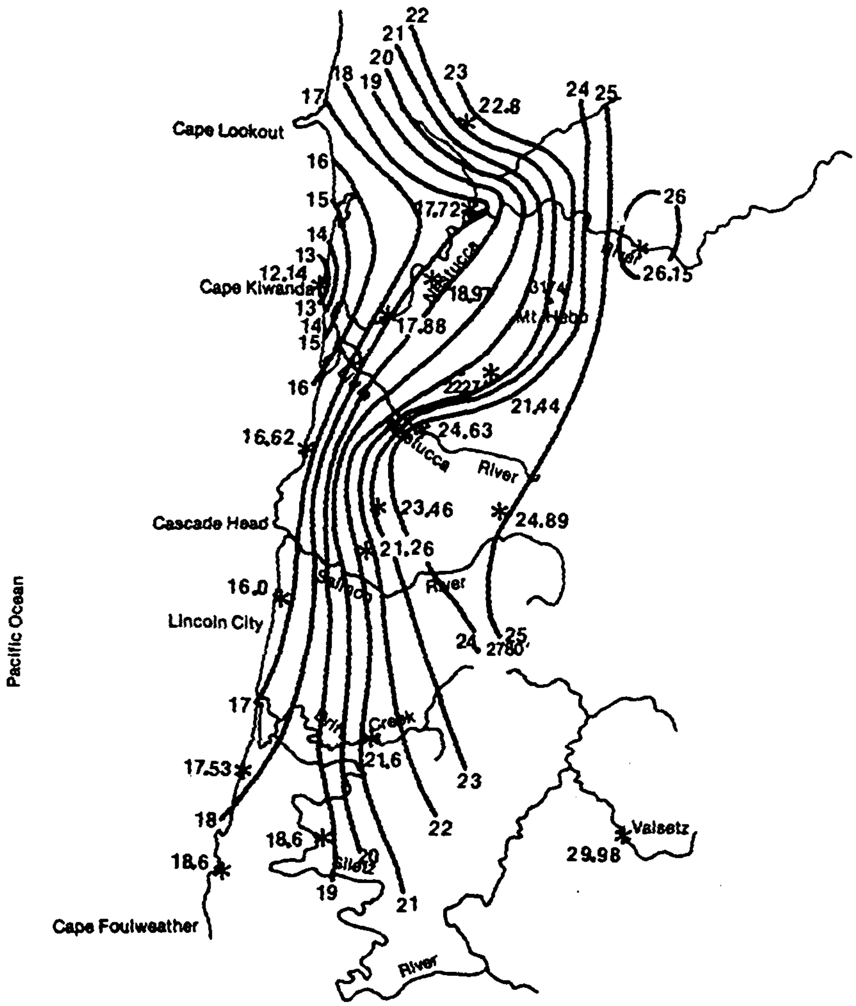


Figure 9. November, 1983 rainfall, North half, Siuslaw National Forest (courtesy J. Reim, hydrologist, Siuslaw National Forest).

NOVEMBER 1983 RAINFALL
South Half
Siuslaw National Forest

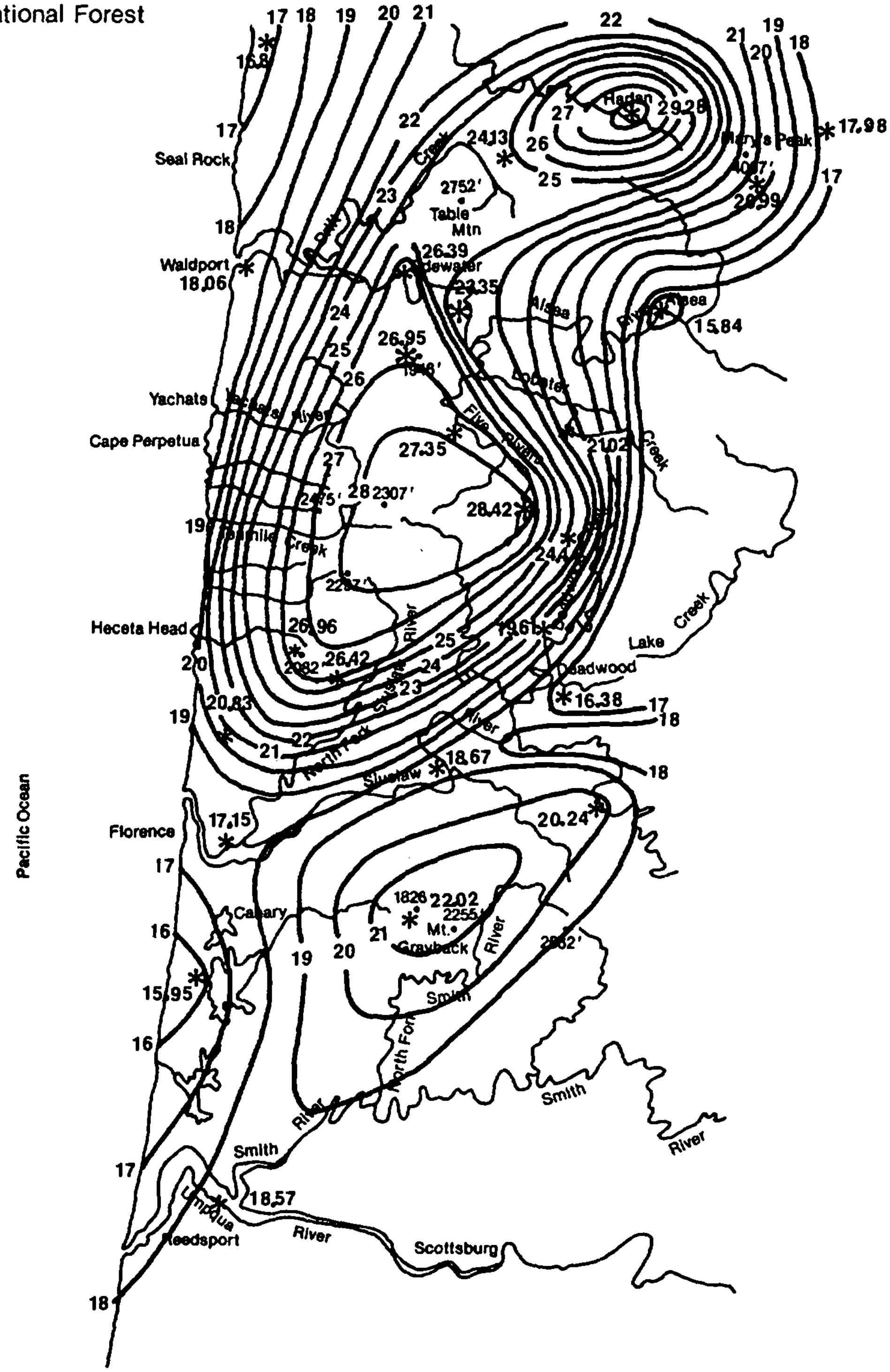


Figure 9 (continued). November, 1983 rainfall, South half, Siuslaw National Forest (courtesy J. Reim, hydrologist, Siuslaw National Forest).

GEOLOGY AND TOPOGRAPHY

Sedimentary and igneous bedrocks dominate the Siuslaw National Forest. Most of the area south of the Hebo District is composed of the Eocene Flournoy (Tyee) formation, layered arkosic sandstone and siltstone (Baldwin 1976; Badura et al. 1973). Other locally important sediments include: (1) the Alsea formation, massive tuffaceous siltstone and sandstone from Yachats to Siletz Bay; (2) the Yaquina formation along Yaquina Bay, sandstone alluvially deposited from Cascade volcanoes (3) the Nye formation, organic-rich mud and siltstone along Yaquina Bay; (4) the Nestucca formation, interbedded tuffaceous sandstone, and siltstone and basalt extrusives along the coast, including Cascade Head.

Major igneous bedrocks include: (1) the Siletz River volcanics, Paleocene and early Eocene submarine basalt extrusives which make up Mary's Peak, the Siletz Gorge, and high ridges to the north; (2) the Columbia River Basalt Group which forms Cape Foulweather, Otter Crest, and Depoe Bay; and (3) the Oligocene to Miocene Coast Range Intrusives which cap nearly all the major peaks between Mt. Hebo and Roman Nose (Baldwin 1976).

Topography is related to the weathering pattern of the various bedrock types and to widespread mass movement. Elevation varies from 4,097 feet at Mary's Peak to sea level. Areas of sandstone bedrock have maximum relief of about 1,500 feet and are characterized by short, steep slopes and dense dendritic drainage patterns. Sandstone layers generally dip to the west and form a pattern of gentle west-facing slopes and steep east-facing slopes (cuestaform lands) (Corliss 1973).

Areas of basalt bedrock are dissected in relation to the degree of faulting and fracturing of the bedrock (Corliss 1973). Slopes are generally long and smooth with lattice-dendritic drainage patterns. Erosion resistant intrusive igneous dikes and sills form ridges and cap major peaks.

Mass movements have modified most Coast Range topography. Soil creep, slump-earthflow, and debris avalanches are common (Swanston 1978). Old slumps and earthflows shaped large parts of the Hebo and Waldport Ranger Districts. Rapid, shallow-seated movements (debris avalanches) have been more active on the Alsea and Mapleton Ranger Districts (Dwight Barnett, Waldport Ranger District, personal communication).

SOILS

The following discussion on the general soils conditions of the Siuslaw National Forest is divided into four parts: (1) important soil series, (2) a summary of existing soil surveys, (3) initial soil-vegetation-productivity relationships, and (4) fire effects.

In a co-operative effort with the USDA Soil Conservation Service (SCS), soils will be described to SCS standards on all ecology intensive sample plots. Soils in intensive plots outside Lincoln County were described using standard SCS methods. The SCS, which is currently mapping the soils of Lincoln County, is installing sample soil pits on ecology intensive plots in that county. The SCS has mapped Lane and Douglas Counties (Dick Patching and Allan Terrell, USDA Soil Conservation Service, Newport, Oregon and Roseburg, Oregon personal communications).

Most of the soils on the forest are derived from sedimentary arkosic sandstones, shales, extrusive basalt, intrusive gabbro, diorite and nepheline syenite. Soils derived from sedimentary bedrock are most widespread on the forest. The clay content of these soils is dependent upon the amount of shale present in the parent material.

Soil physical properties are variable, depending on climate, landform and degree of weathering. Of the soils derived from igneous bedrock, those derived from basalt, gabbro or diorite, generally have higher base saturations than those derived from nepheline syenite (Corliss 1973).

Where colluvial and alluvial processes are common, upland soils tend to be well mixed, shallow, and stoney (e.g., the Slickrock, Digger and Blachly soil series). Deep clay soils (e.g., Honeygrove, Preacher and Bohannon series) are generally found on more stable sites. The soils of the Siuslaw tend to be more porous and less dense than soils with similar clay contents from other areas. This may be due to the soil churning effects of burrowing animals, high rates of root growth, decay, and windthrow (Corliss 1973).

In a soils mapping study of the Alsea Basin, Corliss (1973) identified soils from 29 different soil series and 1 variant from 4 soil orders: Mollisols (1 series), Spodosols (1 series), Inceptisols (23 series), and Ultisols (4 series, 1 variant).

The major soil associations in the Alsea Basin (Corliss 1973) include:

1. Bohannon-Slickrock Association

   Bohannon Series : gravelly loam 20 to 40 inches deep over arkosic sandstone. Soils are shallow,fine loamy, well-drained colluvium or residuums.

   Slickrock Series: gravelly clay loam over 48 inches deep over tuffaceous sandstone.

2. Honeygrove-Digger-Hatchery Association

   Honeygrove Series: clay over 60 inches deep over sandstone.

   Digger Series: gravelly loam 20 to 40 inches deep over sandstone.

   Hatchery Series: gravelly loam 20 to 40 inches deep over fractured basalt.

3. Klickitat Series: well drained moderately-deep, very gravelly clay loam 40 to 50 inches deep over basalt.

4. Skinner-Astoria-Fendall Association

Skinner Series: A cobbly clay loam 40 to 50 inches deep over basalt. Severe competition problems can develop on this soil type.

Astoria Series: clay 50 to 70 inches deep over siltstone.

Fendall Series: clay 20 to 40 inches deep over shale.

5. Knappa-Nehalem Association

Knappa Series: silty clay loam and silt loam over 60 inches deep.

Nehalem Series: silt loam, over 60 inches deep.

Youngberg and Ellington (1982) found similar soil series on the Mapleton Ranger District. Arkosic sandstone and siltstone and to a lesser extent, igneous parent materials are most common in the Mapleton area. Soils developed from sedimentary parent materials tend to be low in silica, more easily weathered and fertile. The Bohannon, Slickrock, and Honeygrove soil series are most widespread. In addition to these series, several isomesic (low annual temperature variation), skeletal soil series (eg., Millicoma) were commonly described on ecology intensive sampling of the rhododendron-dominated associations on the Mapleton Ranger District (Table 1).

Table 1. Soil series for plant associations of the Siuslaw National Forest.

Association	Number of Pits	Soil Series (Number of pits)
Sitka spruce/devil's club	3	Millicoma (1), Templeton (2)
Sitka spruce/fool's huckleberry - red huckleberry	14	Astoria (1), Desolation (1), Ecola (1), Necanicum (1), Salander (2), Skinner (2), Templeton (6)
Sitka spruce/Oregon oxalis	5	Desolation (1), Salander (1), Skinner (1), Templeton (2)
Sitka spruce/salal	4	Ascar (1), Lint (1), Necanicum (1), Salander (1)
Sitka spruce/salmonberry	2	Neskowin (1), Salander (1)
Sitka spruce/salmonberry-salal	3	Ferrelo (1), Formader (1), Neskowin (1)
Sitka spruce/swordfern	7	Salander (6), Templeton (1)
Western hemlock/devil's club	5	Bohannon (2), Braun (1), Digger (1), Slickrock (1),
Western hemlock/dwarf Oregon grape	8	Jory (1), Kilowan (1), Klickitat (1), Preacher (2), Slickrock (2) Remote (1)
Western hemlock/dwarf Oregon grape-salal	4	Digger (1), Klickitat (2), Preacher (1),
Western hemlock/evergreen huckleberry	12	Astoria (1), Blachly (1), Bohannon (1), Digger (1), Honeygrove (2) Jason (1), Marty (1), Millicoma (1), Preacher (4), Salander (1)
Western hemlock/Oregon oxalis	7	Desolation (1), McDuff (1), Preacher (3), Slickrock (2)
Western hemlock/rhododendron-dwarf Oregon grape	6	Digger (2), Jason (1), Kilowan (1), Marty (2), Milbury-Remote (1)
Western hemlock/rhododendron-evergreen huckleberry	11	Blachly (1), Digger (3), Jason (1), Marty (2), Preacher (1), Slickrock (1), Takenitch (1), Gardner (1)
Western hemlock/rhododendron-salal	9	Blachly (1), Digger (1), Marty (1), Preacher (2), Slickrock (2), Milbury (1)
Western hemlock/rhododendron/swordfern	18	Bohannon (1), Damewood (4), Digger (2), Klistan (1), Marty (2), Millicoma (4), Murtip (1), Slickrock (1), Takenitch (1), Remote (1)
Western hemlock/salal	4	Bohannon (1), Damewood (1), Honeygrove (1), Preacher (1)
Western hemlock/salmonberry	7	Millicoma (1), Necanicum (1), Preacher (1), Slickrock (2), Takenitch (1), Remote (1)
Western hemlock/salmonberry-salal	3	Digger (1), Preacher (1), Slickrock (1)
Western hemlock/salmonberry-vine maple	7	Blachly (1), Damewood (1), Digger (1), Preacher (2), Slickrock (2)
Western hemlock/swordfern	13	Digger (1), Hembre (2), Klistan (1), Marty (1), Necanicum (1), Neskowin (1), Remote (1), Slickrock (2), Takenitch (1), Meda (1), Milbury (1)
Western hemlock/vine maple-salal	17	Apt (1), Astoria (2), Blachly (5), Digger (1), Klickitat (2), Preacher (4), Slickrock (3), Takenitch (1), Remote (1)
Western hemlock/vine maple/swordfern	26	Apt (1), Blachly (3), Bohannon (4), Damewood (2), Digger (1), Kilowan (1), Klickitat (1), Millicoma (2), Preacher (4), Slickrock (6), Kirkendall (1)

Several other soil series were commonly described on Ecology sample plots installed throughout the forest (Table 1). These include:

1. Blachly series: Fine silty clay to silty clay loam over 60 inches over basalt.

2. Damewood series: Loamy, skeletal soils usually less than 30 inches deep over colluvial sandstone.

3. Marty series: Gravelly loam to 60 inches deep over quartz diorite.

4. Millicoma series: Isomesic loamy, skeletal soils less than 40 inches deep over colluvial sandstone.

5. Preacher series: Fine loam 50 to 70 inches deep over colluvial or residual sandstone.

6. Salander series: Isomesic silt loam, 60 to 70 inches deep over sedimentary colluvium.

7. Templeton series: Isomesic silt loam, 40 to 60 inches deep, over weathered siltstone and sandstone.

The soils of some parts of the Siuslaw National Forest have been examined by various researchers. Soils studies have been conducted in the Alsea Basin (Corliss 1973) and Mapleton Ranger District (Youngberg and Ellington 1982). There are no published studies of soils on the Waldport and Hebo Ranger Districts.

Corliss (1973) divided the Alsea Basin into three climatic subareas :the Alsea subarea (more inland), the Waldport subarea (at the coast) and the Tidewater subarea (between the Alsea and Waldport subareas). He hypothesized that differences in general soil characteristics observed for these three subareas are due to differences in average annual precipitation, amount of sunshine and average annual air temperature. These climatic factors control the amount of water available for leaching, rates of weathering and the temperatures at which soil chemical reactions take place. These major climatic factors also influence the kinds of vegetation that occupy sites and, thus, the kinds and amounts of organic matter available, the amount of surface protection and rates of nutrient cycling. Vegetation also ameliorates soil temperatures and leaching losses.

Soils of the Waldport subarea are commonly formed from shale parent material and are moderately fine to fine textured, high in organic matter and moderately well drained (Corliss 1973). The very low base saturation of these soils is thought to be caused by excessive leaching. Leaching is extreme due to high precipitation, high soil permeability, and good drainage. Litter layers are acidic and are often comprised of a thick organic mulch with layers of compacted duff. The cool, wet climate and slow decomposition allow duff to accumulate.

Soils of the Alsea subarea are generally ultisols. Lower precipitation, higher temperatures, higher evaporation, and fewer foggy days contribute to lower leaching rates and more rapid litter decomposition. Base saturation is generally higher than in the Waldport and Tidewater subareas.

The Tidewater climatic subarea is characterized by low annual fluctuations in air temperature, high precipitation, a relatively low number of fog and cloud free days, and moderate rates of evaporation. Soils are generally well leached Inceptisols.

Site quality appears to be loosely related to soil physical characteristics such as drainage and aeration, that influence moisture relations. Youngberg and Ellington (1982) report that site productivity is closely related to effective rooting depth and soil physical properties that influence water drainage and soil aeration on the Mapleton Ranger District. In southwestern Washington, Steinbrenner (1963) found that Douglas-fir site index increased in proportion to total soil depth. The relationships between total soil depth, effective rooting depth and plant association are complex (Table 2). Youngberg and Ellington (1982) postulated that productivity is related to water movement and soil depth. Corliss (1973) noted a correlation between the occurence of soil units and vegetation units. Similar vegetation tended to occur on areas which had the same soil characteristics. This was especially evident where soil water was limiting. Although the relationships between soil characteristics, plant associations and productivity are obscure, some general trends were evident from the analysis of intensive plot soils data.

With the exception of the salmonberry dominated associations, soils were deepest (40-55 inches) in the Sitka spruce zone plant associations. Effective rooting depths for these associations were also high, indicating generally low rock content. The fine textured, silty Salander and Templeton soil series were common in the Sitka spruce/swordfern association. This association also has the highest average soil depth (62 inches) and effective rooting depth (55 inches). The site index for Doulas-fir for this association (123) was high, but not significantly higher than those of the other Sitka spruce associations.

Shallow, skeletal soils consistently occur in the western hemlock/rhododendron-dwarf Oregon grape and western hemlock/rhododendron/swordfern associations. These two associations were the only ones with average total soil depths of less than 40 inches. Effective rooting depths for these associations are also very low, between 21 and 22 inches. These associations often occur on Digger, Millicoma and Marty skeletal soils. Youngberg and Ellington (1982) found rhododendron communities most often on Digger soils.

The lowest site quality occurs on southerly facing slopes dominated by salal, rhododendron, and evergreen huckleberry with Digger soils (Youngberg and Ellington 1982).

Table 2. Total Depth and Effective Rooting Depth for Soils of the Siuslaw National Forest.

Association	Number of Pits	Total Depth (Inches) Mean	SE[1]	Total Depth (Inches) Range	Effective Rooting Depth (Inches) Mean	SE	Effective Rooting Depth (Inches) Range
Sitka spruce/devil's club	3	56.7	8.3	40-65	40.0	12.6	18-61
Sitka spruce/fool's huckle-berry - red huckleberry	14	55.9	3.3	70-32	48.5	4.5	14-70
Sitka spruce/Oregon oxalis	5	58.4	4.8	42-70	51.8	5.7	32-65
Sitka spruce/salal	4	46.0	9.7	26-65	33.0	10.2	16-58
Sitka spruce/salmonberry	2	45.5	15.5	30-61	36.5	19.7	17-56
Sitka spruce/salmonberry-salal	3	30.0	4.6	22-38	25.6	2.7	21-31
Sitka spruce/swordfern	7	61.9	1.9	54-70	54.7	3.4	36-65
Western hemlock/devil's club	5	40.4	5.8	27-60	21.8	2.0	18-29
Western hemlock/dwarf Oregon grape	8	56.1	2.5	40-63	31.0	2.3	20-42
Western hemlock/dwarf Oregon grape-salal	4	48.0	9.4	20-60	31.0	9.6	6-52
Western hemlock/evergreen huckleberry	12	48.8	4.4	20-60	35.5	5.3	9-60
Western hemlock/Oregon oxalis	7	50.3	2.5	25-60	36.9	7.1	8-58
Western hemlock/rhododendron-dwarf Oregon grape	6	33.2	6.2	18-60	21.7	3.2	12-34
Western hemlock/rhododendron-evergreen huckleberry	11	49.8	5.1	17-75	31.5	5.1	11-58
Western hemlock/rhododendron-salal	9	52.1	4.7	24-65	37.6	6.3	13-59
Western hemlock/rhododendron/swordfern	18	39.8	3.8	18-71	22.1	3.5	6-61
Western hemlock/salal	4	45.0	8.7	30-60	36.9	10.4	15-56
Western hemlock/salmonberry	7	40.7	8.7	25-60	33.9	5.8	14-54
Western hemlock/salmonberry-salal	3	46.3	13.2	20-60	36.7	15.4	6-53
Western hemlock/salmonberry-vine maple	7	51.3	3.5	40-60	32.5	4.4	16-47
Western hemlock/swordfern	13	54.5	2.4	38-66	38.9	4.2	9-64
Western hemlock/vine maple-salal	17	57.9	1.1	45-60	45.0	2.4	23-58
Western hemlock/vine maple/swordfern	26	53.3	2.7	30-98	35.1	3.7	8-98

[1]Standard Error

The low productivity observed on rhododendron dominated sites may be related to the shallow, nutrient poor soils. Douglas-fir site index in the western hemlock/rhododendron types and the western hemlock/dwarf Oregon grape plant associations is generally 10 feet less than that in the other western hemlock plant associations. The lowest Douglas-fir site index is in the western hemlock/rhododendron-dwarf Oregon grape association,which also has the least effective rooting depth.

On some sites, productivity may be more closely tied to available water and slope position than soil depth. Although they had the low average soil and effective rooting depths, average site Douglas-fir index in the western hemlock/Devil's club and Sitka spruce/salmonberry-salal associations were among the highest (130 and 125, respectively).

Barnett (1984) described the effects of fire on soils in the Coast Range. The major impacts of slash fires are increased erosion and loss of soil nitrogen. Fire effects depend, in large part, on the physical characteristics and nitrogen availabitity of different soils. He developed three categories of fire sensitivity:

Sensitive - steep, south-to-west-facing, middle-to upper-slopes with total nitrogen capital generally less than 8,000 kg/ha. Hard burns will reduce site productivity in the next rotation. Typical soil series included Kilchis, Skinner, and Digger. Nearly all the western hemlock/rhododendron types and portions of the western hemlock/salal, western hemlock/dwarf Oregon grape, western hemlock/dwarf Oregon grape-salal, and western hemlock/evergreen huckleberry associations fall into this category.

Medium - Steep north slopes, broad ridges, steep lower slopes, and moderately steep south slopes with total nitrogen capital ranges from 6,000 to 16,000 kg/ha. Hard burns will produce losses of productivity after two rotations. Bohannon soils series is the most common. Most of the western hemlock/vine maple-salal and upper-slope portions of the western hemlock/swordfern, western hemlock/vine maple-swordfern, western hemlock/salmonberry, western hemlock/vine maple-salmonberry, western hemlock/salmonberry-salal, and Sitka spruce/salmonberry-salal associations fall into this category.

Resilient - gentle south slopes, all sites within one or two miles of the coast, and all other sites. Total nitrogen capital exceeds 16,000 kg/ha. A variety of deep, organic-rich soil series occur. Hard burns will not appreciably affect site productivity for at least the next two rotations. Nearly all of the Sitka spruce series, the western hemlock/oxalis and devil's club types, and the lower-slope portions of the western hemlock/salmonberry, western hemlock/swordfern, western hemlock/vine maple-salmonberry, and western hemlock/vine maple-swordfern associations fall into this category.

A Soil Resource Inventory (SRI) (Badura et al. 1974) with maps of SRI soil types has been compiled. The Forest is also implementing a Land Systems Inventory (LSI), a hierarchical system of geomorphic classification (Berry and Maxwell 1981). Lands fall into various categories based on climate, lithology and structure, topography, landform age, vegetation, and soils. The LSI is being developed through increasing refinement of the Soil Resource Inventory in combination with analysis of several other resource inventories. The LSI and plant association classification should work in harmony to provide better planning data bases at both the Forest and Ranger District levels.

VEGETATION OVERVIEW

Plant species distributions reflect a complex pattern of environmental gradients. Changes in temperature and available moisture obviously affect species composition since each species has a range and optimum for each environmental factor. Other, less obvious, factors affect species geography. Soil fertility, salt spray, disturbance, successional stage, seed source, pathogens, seed and seedling predation, and other factors influence plant distribution and abundance. Most of these factors are difficult to evaluate directly. Instead, their effects must be estimated in reverse through knowledge of plant species ecology (Table 3) and distribution. Some of the factors influencing plant geography will be discussed in later sections. The following is a brief description of some of the more obvious plant geographic patterns that seem to be related to climate.

Two major geographical trends in plant species follow: (1) the shift from strongly maritime conditions near the ocean to inland conditions over the first ridges and, (2) an increase in temperatures and evapotranspiration from north to south. A strong cline exists between near-ocean maritime conditions and interior conditions. The near-ocean, strongly maritime condition is more pronounced at the north end of the Forest and coincides with the rise from sea level to the first high ridges. Climatic conditions include frequent summer fog, relatively small annual temperature variation (Figure 6), minor summer plant moisture stress, and a steep gradient of annual precipitation from 80 inches or less on lowlands to over 100 inches on ridges only 4 or 5 miles away (Figure 7).

The Sitka spruce zone lies almost entirely within this strongly maritime climatic area, extending inland a short distance along rivers. Slope aspect in this zone has relatively minor effects on plant geography (Figure 10). Salmonberry, salal, and swordfern are the most common understory species. Salal and Sitka spruce are

Table 3. Comparison of autecological characteristics of important Coastal tree species[1].

	Shade Tolerance	Drought Tolerance	Fire Resistance	Root Rot Resistance[2]	Seed Crop Frequency	Palatability[3]	Windthrow Resistance
Big leaf maple	L *	M *	L *	H	H	M *	H
Douglas-fir	L	H	H	L	L	H	H
Noble fir	L	M	M	M *	M *	H	H
Lodgepole pine	L	H	M	M	H	L	M *
Red alder	L	L *	L *	H	H *	M *	M *
Sitka spruce	H	M	L	M	M *	L	L
Western hemlock	H	M	M	M	M	M *	L
Western redcedar	H	M	M	M	M	M	M

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[1]From Minore 1979; H=High, M=Medium, L=Low. * indicates characteristics not listed by Minore, estimated from field observations.

[2]*Phellinus weirii*.

[3]Palatability to deer.

salt spray tolerant. The Sitka spruce/salal association is common on wind-beaten headlands. Some of the highest forest productivity in the world has been measured in stands of Sitka spruce and western hemlock at Cascade Head (Fujimori 1971).

Conditions change inland over the first major ridges. While the climate is still generally maritime, temperatures fluctuate more; summer fog is not as common; and slopes are steeper and soils usually more well-drained. Sitka spruce is absent or very rare. Slope aspect has a more pronounced effect on species geography. On south-facing slopes with thin soils (Figure 11), vine maple, salal, salmonberry, swordfern, and (to the south) rhododendron are the most common species.

The second major plant geographical cline is from north to south. The climatic and soils conditions responsible are not clear, but probably include increasing summer air temperatures, increasing evapotranspiration, and steeper slopes with poorer soils, the result of changes in geology. At the south end of the Forest, particularly inland, species composition and plant associations are more similar to those of low elevation Cascades stands. Rhododendron, salal, dwarf Oregon grape and even dry-site species like madrone, poison oak, and hairy honeysuckle become important stand components--particularly on south facing slopes (Figure 12). At the north end of the Forest, species more typical of the cooler climates at higher elevations in the Cascades are common; including fool's huckleberry, queencup beadlily, Alaska huckleberry, and devil's club. This pattern indicates a substantially cooler climate to the north. A possible reason might be more clear weather and hot summer days at the south end, a trend not particularly evident in available climatic records.

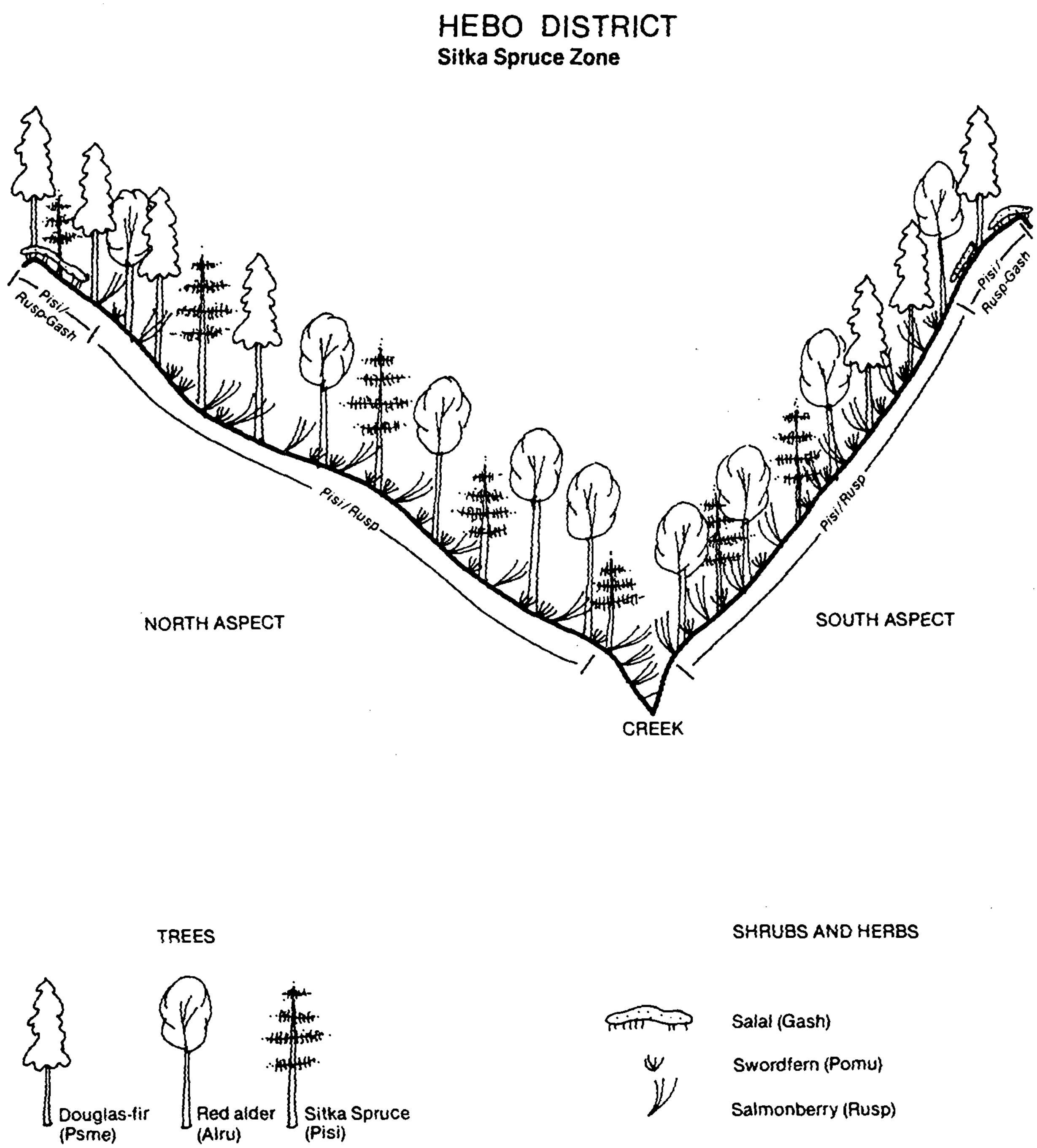

Figure 10. Typical pattern of community development on North and South slopes, Sitka spruce zone.

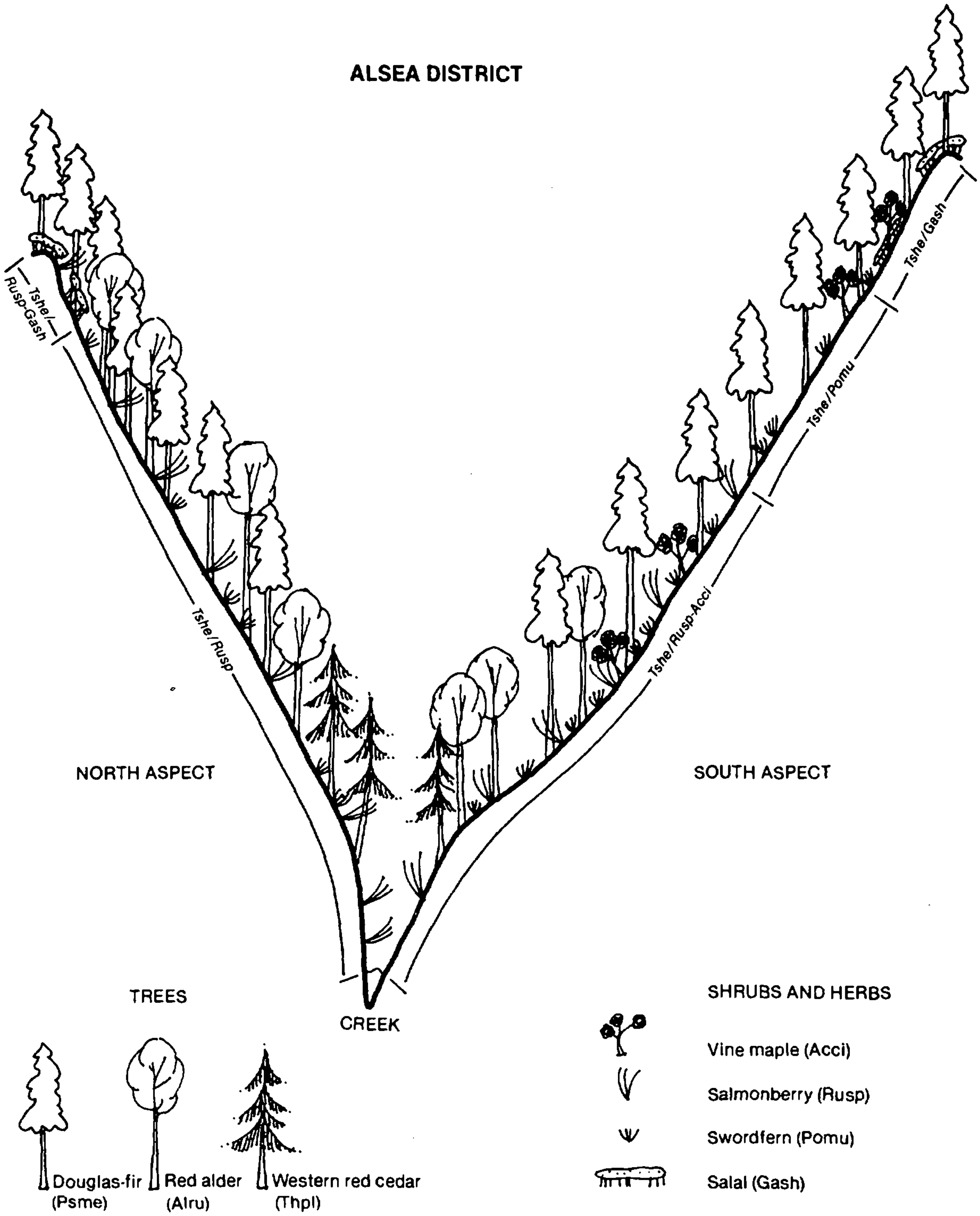

Figure 11. Typical pattern of community development on North and South slopes, western hemlock zone.

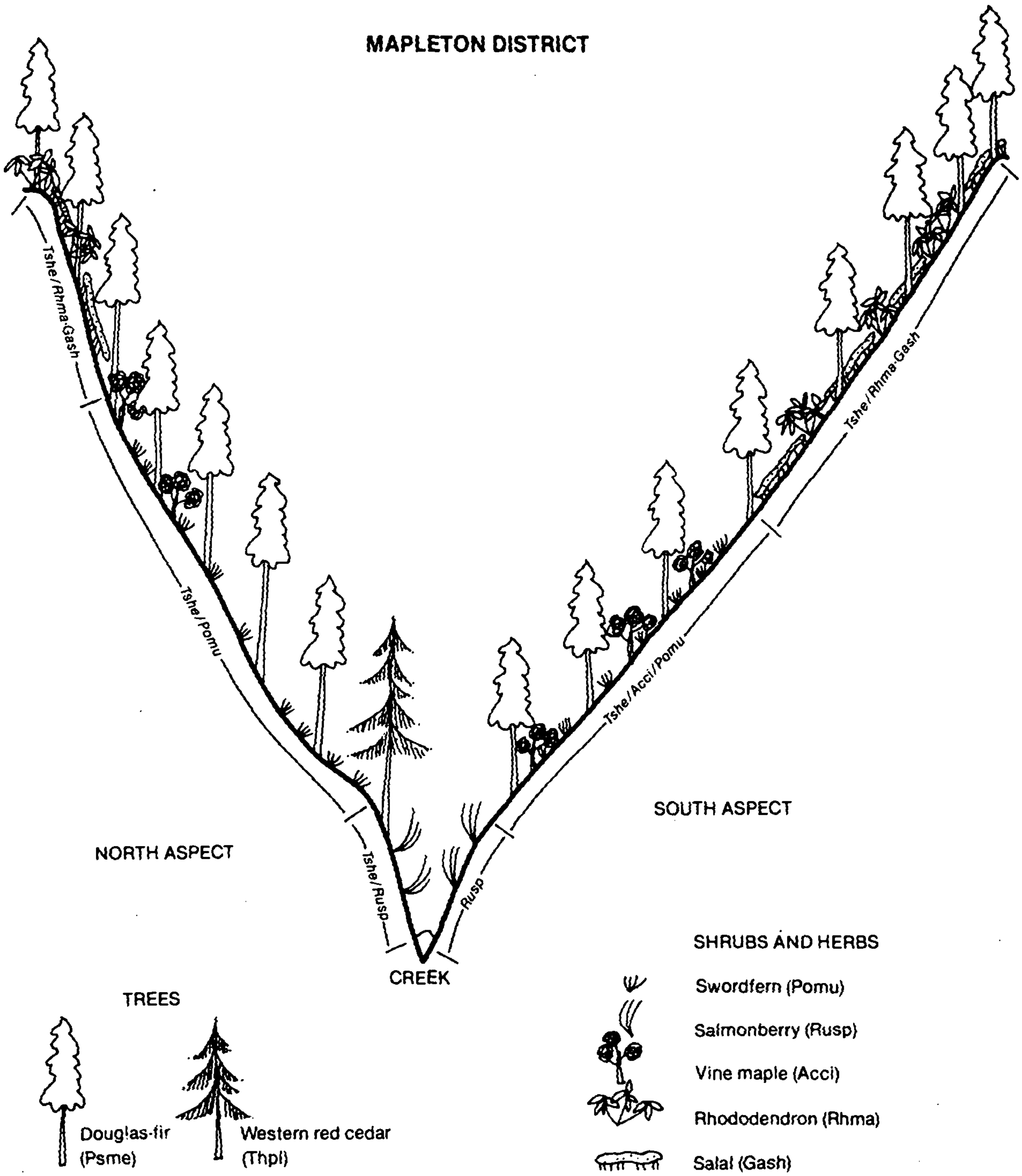

Figure 12. Typical pattern of community development on North and South slopes, western hemlock zone, South end of the Siuslaw National Forest.

NATURAL DISTURBANCE AND SUCCESSION

Natural distrubances and successional paths in the Central Oregon Coast Range differ from those of the Cascades. While most stands in the Cascades have not burned catastrophically for at least 200 years, few stands in the Coast Range are over 120 years old. Stands in the Oregon Cascades also experience more frequent low intensity fires (P. Teensma, personal communication; Means, 1980) compared to the Coast Range. Except for isolated patches, unburned old-growth stands are rare in the Oregon Coast Range (Juday, 1977). Juday (1977) lists several major fires since 1840 which are responsible for most of the current natural age classes:

Date	Location
1849	500,000 acres between the Siletz and Siuslaw Rivers
1868	Alsea Basin
1868	Coos Bay to north of the Umpqua River
1890	Nestucca Drainage
1902	Reburn of the 1890 Nestucca Burn
1910	Mount Hebo Burn
1933-1951	Tillamook Burns
1939	Smith River Burn
1951	Vincent Creek Burn 32,000 acres
1966	Oxbow Burn 43,000 acres

Areas that burned typically reburned within a few decades leaving charred and scattered surviving old trees. The pattern of reburn also eliminated relatively fire sensitive western hemlock and western redcedar from large areas. Fire frequency and intensity appear to have been lower in the coastal Sitka spruce zone.

Winds of hurricane force (over 74 mph) strike the Oregon Coast several times each winter (Badura et al., 1974) and occassionally exceed 100 mph at the top of Mt. Hebo. Blowdown resulting from these storms can be substantial. The Columbus Day storm (October 12, 1962) blew down 11 billion board feet of timber in Oregon and Washington, 98 percent of which was west of the Cascade Crest. Other major windstorms in Oregon and Washington occurred in November 1953, April 1957, February 1958, March 1963, January 1921, and January 1880 (Lynott and Cramer, 1966). Major windstorms have occurred since 1966. Those before 1950 are not well documented. In general, wind storms speed successional development by opening the canopy and releasing suppressed understory climax species (Dale et al., 1983).

Successional patterns have been documented for some coastal environments (Ness, 1973; Fonda, 1974; Alaback, 1982; Henderson, 1978). Long-term natural stand development depends on several factors including: disturbance type and intensity, disturbance frequency, seed source availability, and local environmental conditions. A typical sequence following an intense fire would be (1) herbaceous phase (0 to 5 years), (2) shrub phase (5 to 15 years), (3) Douglas- fir phase (15 to 500 years), (4) climax conifer. Succession modeling indicates that Douglas-fir continues to dominate stand structure as long as it survives (Dale and Hemstrom, 1983). After Douglas-fir density drops below 1 to 3 trees per acre, the stand goes through a rapid period of adjustment to climax composition and structure. Only one example of near climax conditions was found during reconnaissance sampling. Frequent fire has precluded successional development to old-growth over most of the Forest.

Seral development past age 5 is not documented by field data. Stands generally reach closed-canopy conditions by age 10 to 15. Cover of understory shrubs and herbs drops sharply as a function of reduced light and remains low until natural or prescribed thinning opens the canopy. By age 50, most stands have sufficiently open canopies to allow development of shrub and herb layers that persist into old-growth and, presumably, climax. The salmonberry associations often contrast with this gerneral pattern under natrual conditions. Competition by dense shrub layers during the first three years following disturbance often prevent establishment of a well-stocked conifer stand. Red alder is the only tree which regularly out strips salmonberry height growth. Consequently, the salmonberry associations often support stands of red alder with widely spaced conifers and a dense shrub understory. One possible consequence of natural seral development is powerful selective pressure for rapid juvenile height growth in conifers. On other sites, salal associations in particular, selective pressures would be less powerful for juvenile height growth and more for drought resistance. This suggests that selection of seed for planting stock should be stratified by plant association rather than elevation bands or District boundaries.

Many sites go through a red alder dominated stage following fire. Red alder seeds germinate and grow rapidly on exposed mineral soil in full sunlight. Three to five years following disturbance, alder begins rapid height growth which allows it to overtake and suppress conifers. During the next 100 to 150 years, shade tolerant conifers may accumulate in the understory and slowly break into the canopy. If no seed from shade tolerant conifers reach the stand, it eventually becomes a brushfield with scattered large Douglas-fir as the alder become senescent and die at about age 150 (figure 13). Eventually, shade tolerant conifer seed may reach the area or a new disturbance occurs. We have not observed clear examples of this path since very few stands are over 120 years old. The red alder stage may be important to long-term site fertility and checking the spread of Phellinus weirii root rot.

Biological disturbance, including insects and root rots, is an additional element in stand

SUCCESSIONAL PATHS

Western Hemlock/Salmonberry Association

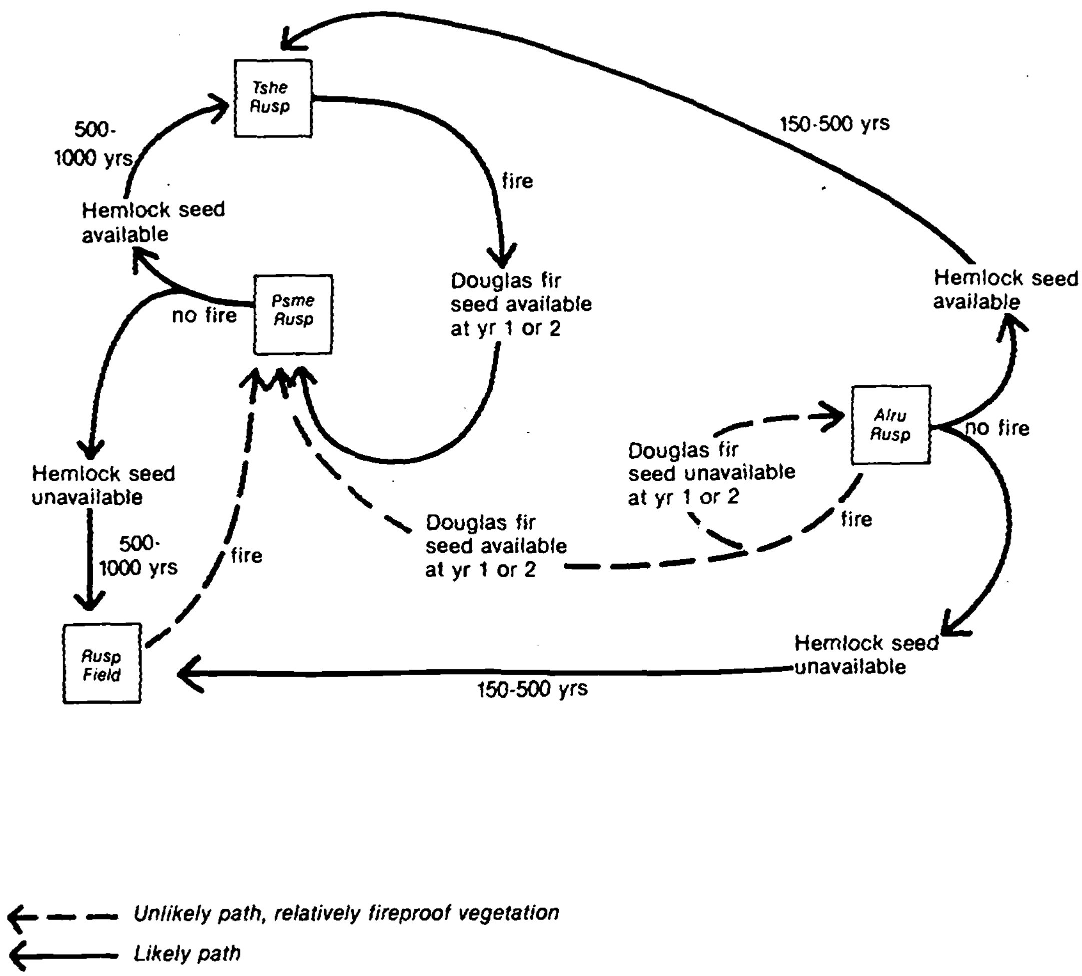

Figure 13. Successional paths in the western hemlock/salmonberry association.

development. The range of Sitka spruce may be substantially limited by Sitka spruce weevil (Overhulser et al., 1974), for example. Laminated root rot, Phellinus weirii, is a wide spread pathogen. Hardwood species are immune to Phellinus infection and a rotation of these species may be necessary before susceptable conifers can again occupy a site.

Stand structure is an important result of successional development. Successional sequences lasting more than 150 years in conifer stands allow large accumulations of standing live and standing and down dead trees. Large live and dead boles fulfill many important ecosystem functions including: wildlife habitat, long-term nutrient storage, sites for nitrogen fixation, and sources for large woody debris in streams that provide important energy bases and channel stability (Franklin et al., 1981; Maser et al., 1981). Conifer stands over 150 years old are not common outside the Mary's Peak watershed.

Live trees can grow to old-growth dimensions (e.g., 50 inches DBH) relatively quickly on high quality sites, but large dead woody debris accumulates more slowly. Alder dominated stands do not produce large amounts of decay-resistant woody debris, unless they are replaced by shade tolerant conifers in late succession. Likewise, managed stands do not develop large standing and down dead wood accumulations, unless management practices are designed to produce large dead wood (Brown 1985).

As a result of disturbance, competition, and successional patterns, salmonberry dominated communities have become widespread. Given a sufficiently long time period and a seed source for shade-tolerant conifers, many of these sites would probably develop into swordfern or oxalis communities. In fact, clearcut harvesting followed by slashburning, conifer planting, and release treatments may convert sites currently dominated by salmonberry to swordfern or oxalis types. There are a good many sites, however, where salmonberry will not be eliminated and will recover when the canopy opens past age 50. Most salmonberry sites in mature stands, between 90 and 140 years old, show no signs of conversion to other communities for at least the next century. By the standards in FSM 2060, these can be considered potential natural vegetation and called plant associations. Given the apparent pattern of catastrophic fire every 300 to 500 years, they can also be considered fire climax types (Daubenmire 1968).

MANAGEMENT CHARACTERISTICS

WILDLIFE HABITAT

Plant communities play an obvious role in animal habitat. Plant species composition and abundance determine the kinds and quality of food and shelter available. Seral communities vary from grasses and forbs (0 to 5 years following disturbance) to the old-growth forests (200 to 700 years following disturbance). The pattern of plant species composition during succession varies substantially among plant associations, resulting in different kinds and amounts of forage and cover. Many important animal habitat features, such as stand structure, are more closely related to disturbance history than to plant association. The rates at which an ecosystem acquires biomass and structure, however, are related to sitė productivity, and can be estimated from plant association.

Deer and elk use varies substantially among plant associations. Use is lowest in dense, shrubby salal and rhododendron stands (Table 4). A wall of nearly inpenetrable evergreen shrubs often limits access and use. Many sites lack suitable browse. The Sitka spruce associations are generally more extensively used by big game than western hemlock associations. Elk seemed to be most abundant in the western hemlock/salmonberry association and deer in the western hemlock/Oregon oxalis and swordfern associations. Some shrub species, especially red huckleberry and elderberry, were nearly always browsed.

The western hemlock/salmonberry-vine maple, western hemlock/devil's club, and western hemlock/vine maple/swordfern associations are prime mountain beaver habitat. Associations dominated by evergreen shrubs (rhododendron and evergreen huckleberry, in particular) are the poorest mountain beaver habitat. Silvicultural problems can be expected in associations with mountain beaver present in 50 percent or more of the plots (Table 4). Sitka spruce associations seem to support fewer mountain beaver colonies than similar western hemlock associations.

Snags are used by 100 wildlife species in western Oregon and Washington. At least 53 species (39 birds and 14 mammals) are cavity dependent (Neitro et al. 1985). Most of the variation in numbers of snags per acre among plant associations (Table 5) is a function of fire history and early stand establishment conditions. In general, the drier plant associations have higher numbers of snags, many of which are relatively small. Plant associations which lack intense early shrub development are more densely stocked with conifers. Many small snags result from suppression mortality in these stands. The moist, shrub-dominated associations typically develop fewer, larger snags. Most of the large snags (over 30 inches DBH) are charred remnants from fires that swept much of the Coast Range about 100 years ago.

We measured approximately 2,300 snags during the course of intensive sampling. Several important characteristics of the snag population in mature, natural stands emerge when all the snags are analyzed as a group without regard to plant association.

The tree species from which a snag develops has a loose relationship to use by cavity excavators.

Table 4. Wildlife habitat attributes by plant association for the Siuslaw National Forest.

Association	Number of Samples	Vegetative Cover: Canopy	Vegetative Cover: Tall Shrubs	Vegetative Cover: Herbs	Forage: Herb	Forage: Vine Maple	Forage: Oregon grape	Forage: Salal
		% X/SE	% X/SE	% X/SE	-- lbs/acre[1] - X /SE	X /SE	X/SE	X /SE
Sitka spruce/devil's club	18	74/ 3	50/ 5	69/ 5	1568/212	9/ 7		25/ 24
Sitka spruce/fool's huckle-berry - red huckleberry	30	75/ 3	43/ 4	41/ 4	816/113	7/ 6		25/ 23
Sitka spruce/Oregon oxalis	36	80/ 2	25/ 3	76/ 3	1931/177	10/ 9	9/ 9	
Sitka spruce/salal	21	79/ 3	30/ 6	41/ 7	525/150	1/ 1	55/37	843/379
Sitka spruce/salmonberry	33	76/ 3	60/ 4	64/ 4	1249/161	2/ 1		29/ 16
Sitka spruce/salmonberry-salal	19	76/ 3	54/ 5	33/ 5	975/215			55/11
Sitka spruce/swordfern	42	83/ 2	17/ 3	64/ 4	1391/172	6/ 4	4/ 4	15/ 6
Western hemlock/devil's club	18	77/ 2	46/ 6	73/ 4	1532/140	21/13	7/ 6	15/ 10
Western hemlock/dwarf Oregon grape	34	79/ 2	27/ 4	53/ 5	975/144	28/14	354/71	113/ 37
Western hemlock/dwarf Oregon grape-salal	24	74/ 3	32/ 5	26/ 4	697/197	64/36	590/124	614/134
Western hemlock/evergreen huckleberry	30	77/ 2	57/ 5	45/ 5	912/272	50/13	23/13	58/ 18
Western hemlock/Oregon oxalis	61	82/ 2	24/ 3	71/ 3	1630/ 138	15/ 5	27/11	22/ 9
Western hemlock/rhododendron-dwarf Oregon grape	16	78/ 2	71/ 7	27/ 8	392/188	36/21	254/93	77/ 35
Western hemlock/rhododendron-evergreen huckleberry	23	72/ 2	83/ 3	23/ 6	333/112	5/ 4	5/ 5	190/ 68
Western hemlock/rhododendron-salal	21	75/ 3	68/ 6	28/ 6	562/320		70/57	557/165
Western hemlock/rhododendron/swordfern	33	77/ 2	42/ 4	60/ 4	1196/139	18/10	59/33	27/ 22
Western hemlock/salal	42	76/ 2	35/ 5	31/ 4	708/188	12/11	27/12	769/172
Western hemlock/salmonberry	36	73/ 3	63/ 5	60/ 4	1462/125	1/ 1	1/ 1	3/ 2
Western hemlock/salmonberry-salal	15	73/ 3	58/15	34/ 5	855/229	18/18	77/40	421/151
Western hemlock/salmonberry-vine maple	43	66/ 3	69/ 3	64/ 3	1488/168	39/10	19/14	7/ 4
Western hemlock/swordfern	57	80/ 2	16/ 2	64/ 3	1391/151	1/ 1	11/ 4	64/ 29
Western hemlock/vine maple-salal	58	72/ 2	67/ 2	67/ 2	1737/100	79/18	13/ 7	19/ 10
Western hemlock/vine maple/swordfern	87	72/ 2	67/ 2	67/ 2	1725/126	72/17	12/ 9	17/ 19

[1] Green weight

Table 4. Wildlife habitat attributes of plant associations of the Siuslaw National Forest (continued).

Association	Forage: Rhododendron	Forage: Salmonberry	Wildlife Use: Pellet Elk	Wildlife Use: Presence Deer	Wildlife Use: Trail Freq.	Wildlife Use: Mountain Beaver	Wildlife Use: Thermal Cover[1]
	- lbs/acre[2] - X/SE	X/SE	%	%	%	%	% X/SE
Sitka spruce/devil's club		45/ 28	6	11	78	28	23/ 4
Sitka spruce/fool's huckleberry - red huckleberry		12/ 9	13	43	63	13	29/ 4
Sitka spruce/Oregon oxalis		63/ 30	11	72	78	11	25/ 3
Sitka spruce/salal		12/ 7	19	19	43	29	27/ 3
Sitka spruce/salmonberry		234/108	9	24	73	24	26/ 3
Sitka spruce/salmonberry-salal		55/ 11	16	11	79	11	35/ 5
Sitka spruce/swordfern		19/ 10	21	29	86	24	35/ 6
Western hemlock/devil's club		56/ 47	11	17	72	33	32/ 5
Western hemlock/dwarf Oregon grape		1/ 1	9	29	71	21	18/ 2
Western hemlock/dwarf Oregon grape-salal			13	21	71	17	16/ 4
Western hemlock/evergreen huckleberry		.		27	50	13	21/ 3
Western hemlock/Oregon oxalis		13/ 4	3	25	79	25	33/ 3
Western hemlock/rhododendron-dwarf Oregon grape	120/34				31		27/ 6
Western hemlock/rhododendron-evergreen huckleberry	119/39		4	4	30	13	17/ 3
Western hemlock/rhododendron-salal	171/81			5	38	5	24/ 4
Western hemlock/rhododendron/swordfern	78/27	10/ 10	6	3	70	21	26/ 5
Western hemlock/salal		6/ 4	12	19	52	26	22/ 3
Western hemlock/salmonberry		204/ 50	17	19	64	33	21/ 3
Western hemlock/salmonberry-salal		31/ 16	13	13	67	40	28/ 6
Western hemlock/salmonberry-vine maple		115/ 20	23	23	77	60	13/ 2
Western hemlock/swordfern		6/ 4	11	21	72	28	35/ 4
Western hemlock/vine maple-salal		2/ 1	3	17	41	17	9/ 1
Western hemlock/vine maple/swordfern		7/ 4	7	28	69	41	10/ 1

[1] Evergreen cover between 12 and 50 feet.

[2] Green Weight.

Table 5. Snags per acre by decay class for plant associations of the Siuslaw National Forest.

Association	Number of Samples	Snags per Acre — Decay Class 1	2	3	4	5	Over 30" DBH
		Mean/Standard Error					Mean
Sitka spruce/devil's club	3	1.2/ 0.9	3.1/ 0.9	3.6/ 3.2	5.4/ 1.3	1.5/ 0.5	13
Sitka spruce/fool's huckleberry - red huckleberry	13	2.6/ 0.7	9.0/ 3.8	15.8/ 4.9	4.9/ 1.2	2.3/ 0.7	21
Sitka spruce/Oregon oxalis	9	5.1/ 4.3	9.9/ 4.9	10.5/ 3.0	4.4/ 2.2	1.1/ 0.6	13
Sitka spruce/salal	7	4.6/ 4.0	6.2/ 3.1	4.5/ 1.6	3.1/ 1.6	0.5/ 0.3	12
Sitka spruce/salmonberry	5	4.5/ 4.3	24.8/16.5	3.4/ 2.9	0.3/ 0.2	2.0/ 1.6	20
Sitka spruce/salmonberry-salal	6	2.0/ 1.9	4.4/ 2.2	4.2/ 2.7	4.2/ 2.5	2.5/ 1.8	12
Sitka spruce/swordfern	8	2.2/ 1.5	7.7/ 3.1	6.6/ 3.0	1.3/ 0.4	0.5/ 0.2	11
Western hemlock/devil's club	7	2.8/ 2.1	8.1/ 5.3	10.3/ 3.9	1.6/ 0.6	1.4/ 0.5	15
Western hemlock/dwarf Oregon grape	6	2.5/ 3.0	1.1/ 1.1	7.0/ 4.6	3.6/ 2.1	0.8/ 0.4	10
Western hemlock/dwarf Oregon grape-salal	7	1.5/ 1.0	3.6/ 2.6	13.7/ 7.6	4.9/ 2.0	2.1/ 1.4	16
Western hemlock/evergreen huckleberry	8	2.9/ 2.7	10.6/ 5.0	12.7/ 3.8	2.1/ 1.4	0.8/ 0.5	10
Western hemlock/Oregon oxalis	9	8.8/ 7.3	5.4/ 2.1	11.4/ 4.0	4.4/ 1.4	1.7/ 0.6	16
Western hemlock/rhododendron-dwarf Oregon grape	4	1.3/ 0.8	5.0/ 5.0	7.4/ 5.0	6.2/ 4.2	3.7/ 1.3	8
Western hemlock/rhododendron-evergreen huckleberry	8	3.2/ 1.3	13.5/ 5.3	5.2/ 2.9	0.5/ 0.2	0.9/ 0.7	10
Western hemlock/rhododendron-salal	5	0.0/ -	4.4/ 2.0	4.2/ 2.1	3.7/ 1.9	1.6/ 1.0	8
Western hemlock/rhododendron/swordfern	12	1.3/ 0.8	4.3/ 1.6	4.9/ 1.4	7.8/ 3.6	1.6/ 0.6	8
Western hemlock/salal	13	4.3/ 1.7	14.4/ 4.5	20.5/ 5.1	8.0/ 3.2	3.7/ 1.8	29
Western hemlock/salmonberry	7	0.9/ 0.3	3.6/ 1.5	3.5/ 1.7	10.3/ 5.6	1.4/ 0.8	13
Western hemlock/salmonberry-salal	3	0.6/ 0.6	0.6/ 0.6	5.5/ 2.8	6.2/ 2.8	3.6/ 2.7	12
Western hemlock/salmonberry-vine maple	9	2.7/ 2.7	3.3/ 1.1	2.7/ 1.1	1.8/ 0.4	0.9/ 0.3	8
Western hemlock/swordfern	9	2.5/ 1.2	6.5/ 2.6	6.6/ 1.9	10.3/ 3.0	2.2/ 0.7	12
Western hemlock/vine maple-salal	11	1.0/ 0.5	3.1/ 1.2	5.6/ 1.9	4.9/ 1.7	5.4/ 1.4	13
Western hemlock/vine maple/swordfern	16	0.9/ 0.6	3.9/ 1.5	5.3/ 1.6	5.3/ 1.6	2.9/ 0.9	12

Nearly all snags in our samples were Douglas-fir, regardless of size or decay class (snag decay condition according to Neitro et al. 1985, Table 6). Western redcedar seems to be preferred for large cavities. All conifer species are used about equally by cavity excavators. Red alder seems to be relatively little used for cavity excavation (Table 7). These preferences may be due to decay rates. Alder decays quickly, offering transitory habitat for primary cavity excavators, while redcedar decays slowly, offering stable housing. Small snags developed from western hemlock, the result of suppression mortality, are not heavily used by cavity excavators. Douglas-fir snags are usually over 20 inches diameter and in decay classes 3 to 5.

Table 6. Physical characteristics of Douglas-fir snags by deterioration stage, Western Oregon (from Neitro et al. 1985)

Snag Characteristics	Stage of deterioration 1	2	3	4	5[1]
Limbs and branches	All present	Few limbs, no fine branches	Limb stubs only	Few or no stubs	None
Top	Pointed	Broken			
Diameter, top	- - - - Increasing at decreasing rate - - - -				
Height	- - - - Decreasing at decreasing rate - - - -				
Bark remaining	100% - - - - Variable - - - -				20%
Sapwood pres.	Intact - - - - Sloughing - - - -				Gone
Sapwood cond.	Sound, incipient decay, hard, original color	Advanced decay, fibrous, firm to soft, light brown	Fibrous, soft, light to reddish brown	Cubical, soft, reddish to dark brown	
Heartwood	Sound, hard, original color	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown	Advanced decay at base. Sloughing from upper bole, fibrous to cubical, soft, dark reddish brown	Sloughing, cubical soft, dark brown; or, fibrous, very soft dark reddish brown encased in hardened shell

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[1]Mostly remnant snags.

Table 7. Presence of cavities, decay class distribution, and diameter class distribution by snag species for Siuslaw National Forest snags.

Snag Species	n Snags	Cavity Size 0"-2"	2"-5"	5"+	Feeding Use	Snag Decay Class 1	2	3	4	5	Snag Diameter Class (inches) 0-20	21-30	31-40	41-60	60+
Douglas-fir	1718	48	39	31	89	4	14	21	38	22	24	19	24	30	3
Red alder	60	32	23	12	70	12	30	37	17	5	83	17			
Sitka spruce	142	39	27	22	72	16	20	17	39	9	25	15	25	27	9
Western hemlock	207	38	26	22	76	14	30	39	12	6	36	35	13	11	5
Western redcedar	36	39	31	39	83	6	25	42	25	3	17	22	22	33	6

Decay condition is strongly related to wildlife use in our sample. Most snags are relatively well decayed (Table 8). Decay class 1 and 2 snags are uncommon and are not heavily used for either feeding or cavity excavation. Many class 1 and 2 snags are relatively small, resulting from suppression-related mortality. The heaviest amount of wildlife use occurs in decay classes 3 and 4 snags. These are most often large, remnant Douglas-fir snags which provide stable habitat and food sources. Large Douglas-fir generally reach decay class 3 twenty years after mortality and may persist in decay classes 3 and 4 for an additional 100 years (Neitro et al. 1985). Decay class 5 snags are nearly always large and past the stage of optimum habitat for most cavity nesting animals. Average snag height decreases from 78 feet for class 1 snags to 17 feet for class 5 snags.

Snag diameter is also strongly related to wildlife use. Cavity presence increases substantially as a function of snag diameter (Table 9). The incidence of cavities in snags over 20 inches diameter is much higher than in smaller snags. Cavities are even more common in snags over 30 inches. Large cavities are most common in snags over 40 inches. Snag height is not strongly related to diameter.

Table 8. Snag species, cavity presence, diameter class distribution, and mean height by decay class for Siuslaw National Forest snags.

Decay class	n Snags	Cavity Size (inches) 0-2	2-5	5+	Feeding Use	Snag Diameter Class (inches) 0-20	21-30	31-40	41-60	60+	Snag Species Psme	Alru	Pisi	Tshe	Thpl	Height (feet) Mean/SE
Class 1	134	2	0	0	25	57	24	10	8	2	56	5	16	21	2	78/4
Class 2	365	27	23	14	80	50	26	14	9	1	67	5	8	17	3	56/2
Class 3	523	48	35	28	92	43	26	15	13	3	70	4	5	16	3	33/1
Class 4	809	64	50	40	96	11	13	31	41	4	80	1	7	3	1	28/1
Class 5	446	37	34	29	84	9	20	27	41	3	86	1	3	3	0.2	17/1

Table 9. Snag species, cavity presence, decay class, and mean height by diameter class for Siuslaw National Forest snags.

Diameter Class	n Snags	Cavity Size (inches) 0-2	2-5	5+	Feeding Use	Decay Class 1	2	3	4	5	Snag Species Psme	Alru	Pisi	Tshe	Thpl	Height (feet) Mean/SE
0" - 20"	608	24	16	7	76	13	30	37	14	7	69	8	6	12	1	34/1
21" - 30"	457	42	28	22	92	7	21	30	23	20	71	2	5	16	2	34/2
31" - 40"	515	54	45	34	92	3	10	15	49	25	81		7	5	2	33/1
41" - 60"	629	63	53	48	91	2	5	11	53	29	82		6	4	2	34/1
60" +	68	47	47	48	90	3	4	25	49	19	63		18	15	3	44/4

Down wood provides primary or secondary habitat for 150 terrestrial wildlife species (Bartels et al. 1985). In addition, down wood plays an important role in nutrient cycling processes in forest ecosystems (Bartels et al. 1985). Most of the variation in woody debris reflects fire history, rather than plant association (Table 10). A large part, generally between 15 and 25 tons per acre, of the down wood falls in decay classes 3 and 4 (decay condition according to Bartels et al. 1985, Table 11). In addition, up to 10 tons per acre is relatively undecayed in classes 1 and 2. A small amount of down wood in decay class 5 is usually present. The total amount of down wood ranges between 17 and 78 tons per acre by plant association. Average amounts of down wood in a couple of associations meet the minimum requirements for old-growth (T. Spies, Forestry Sciences Laboratory, Corvallis, Oregon, personal communication) even though very few of our sample plots fell in stands over 200 years old. Undoubtedly, all of the more productive plant associations could be managed to produce old-growth sizes and amounts of down wood in less than 200 years. Some of the other minimum structural attributes of old-growth might be absent in such stands (eg. a multi-layered canopy) unless specifically developed by management.

Management for specific structural characteristics should consider:

1. The potential of sites to produce structures of a given size within a specified time, eg. trees over 30 inches diameter in 50 years,

2. The number of structures at the start of the management period to allow for a sufficient number at the end of the period (allow for some loss),

3. The rate at which the structure decays. A Douglas-fir will grow to 30 inches diameter faster in the western hemlock/swordfern plant association than in the western hemlock/rhododendron-salal association but will require at least 20 years following mortality to reach decay class 3 in both associations.

STAND GROWTH AND PRODUCTIVITY

Our information on stand growth and productivity comes from a combination of reconnaissance and intensive plot data (see Methods section). Intensive plots are relatively expensive and time-consuming to install. Our sample sizes for most plant associations are relatively small (Table 12). All our data were collected from natural, relatively undisturbed natural stands. Stand volumes, periodic annual volume increment, and basal area are all strongly influenced by stocking which is, in turn, strongly influenced by early seral competitive interactions between shrubs and trees. Measures which depend on stocking levels in natural stands are not accurate indications of potential productivity under managed conditions. Height growth may be a more relevant general basis for comparison between plant associations.

Available site index curves may not be appropriate for the most productive sites on the Siuslaw National Forest. Thirty mature Douglas-fir (ages 90 to 120) and 30 Douglas-fir (ages 11 to 22) were selected for stem analysis and height growth reconstruction on the Alsea District to examine: 1) the fit of existing site index curves, and 2) the similarity of early height growth between trees in natural stands and those in managed stands.

The data indicate similar deviations in both natural and managed stands from the pattern suggested by King (1966) and McArdle et al. (1961) (Hemstrom and Logan 1985, Table 13, Figure 14). Douglas-fir height growth on the most productive sites (western hemlock/salmonberry and western hemlock/vine maple/swordfern associations) to age 80 seems substantially more rapid than predicted. After age 100, height growth dropped below predicted levels in most of the sampled trees. These patterns should be checked on a larger sample across the Forest. At present, the best available set of height growth/site index curves are those from King (1966) for Douglas-fir, Wiley (1978) for western hemlock, Hegyi et al. (1981) for Sitka spruce and western redcedar, and Worthington et al. (1960) for red alder.

Based on King's (1966) 50 year site index curves, the best sites for Douglas-fir growth in the western hemlock zone are the western hemlock/salmonberry-vine maple, western hemlock/devil's club, western hemlock/salmonberry, western hemlock/swordfern, and western hemlock/vine maple/swordfern associations, where mean site index ranges from 123 to 130 (Table 12). Douglas-fir site index averages are generally below 115 in rhododendron and dwarf Oregon grape associations. Douglas-fir site index averages between 118 and 122 in the remaining western hemlock associations. In general, Douglas-fir height growth in Sitka spruce associations is about the same as in comparable western hemlock associations. Both western hemlock and Sitka spruce appear to grow better in Sitka spruce associations than in western hemlock associations.

Current stand volume and gross periodic annual volume increment in natural stands are more strongly related to basal area, and probably early succesional competition levels, than to Douglas-fir site index. Current volume (gross) ranges from over 21,000 cubic feet per acre in the western hemlock/swordfern association to less than 13,000 cubic feet per acre in both the western hemlock/salmonberry-salal and western hemlock/rhododendron-evergreen huckleberry associations (Table 12). The salmonberry associations, which have high site indices for Douglas-fir, have relatively low current stand volumes, reflecting low stocking. The western hemlock/rhododendron associations, except western hemlock/rhododendron/swordfern, typically have relatively low stand basal areas and small quadratic mean diameters, reflecting low stocking and slower diameter growth rates.

Stand ages among p.a.'s are not variable, averaging between 90 and 135 years. This is the result of the massive fires during the last 150 years. On the average, trees tend to be younger in Sitka spruce associations than in western hemlock associations, perhaps due to slower stand establishment or more recent fires.

The economics of growing trees in various associations should be carefully examined. Sites in some associations, while highly productive for conifers, will be more costly to reforest due to shrub competition. Sites in other associations will be much easier and less expensive to reforest after harvest. Plant association maps being developed at both Ranger District and Forest levels will help managers evaluate the costs and benefit of growing trees at the site unit, drainage, Ranger District and Forest scale (see Plant Association Mapping).

Table 10. Attributes of down woody debris by decay class for Siuslaw National Forest plant associations.

Association	Number of Samples	Pieces per Acre By Decay Class 1	2	3	4	5
		Mean/Standard Error				
Sitka spruce/devil's club	3	1/ 1	34/14	39/ 6	51/21	12/ 5
Sitka spruce/fool's huckleberry - red huckleberry	13	4/ 1	13/ 3	31/ 6	28/ 5	28/ 5
Sitka spruce/Oregon oxalis	9	7/ 1	16/ 2	27/ 2	18/ 2	15/ 2
Sitka spruce/salal	7	4/ 1	13/ 2	28/ 6	28/ 8	31/ 5
Sitka spruce/salmonberry	5	5/ 2	12/ 3	16/ 2	9/ 2	5/ 2
Sitka spruce/salmonberry-salal	6	2/ 4	13/ 2	26/ 2	19/ 4	13/ 6
Sitka spruce/swordfern	8	3/ 1	18/ 3	23/ 7	19/ 5	15/ 5
Western hemlock/devil's club	7	4/ 2	29/ 4	27/ 5	25/ 5	2/ 1
Western hemlock/dwarf Oregon grape	6	1/ 0.4	6/ 2	26/ 13	21/ 4	7/ 3
Western hemlock/dwarf Oregon grape-salal	7	6/ 3	15/ 4	28/ 8	19/ 5	20/ 5
Western hemlock/evergreen huckleberry	8	2/ 1	12/ 4	24/ 5	20/ 4	18/ 4
Western hemlock/Oregon oxalis	9	3/ 1	14/ 4	16/ 5	22/ 4	12/ 4
Western hemlock/rhododendron-dwarf Oregon grape	4	3/ 2	15/ 3	22/ 5	23/ 3	39/15
Western hemlock/rhododendron-evergreen huckleberry	8	5/ 2	16/ 3	24/ 6	11/ 4	9/ 4
Western hemlock/rhododendron-salal	5		11/ 5	20/ 7	28/ 9	22/ 4
Western hemlock/rhododendron/swordfern	12	2/ 1	11/ 3	19/ 4	14/ 3	9/ 3
Western hemlock/salal	13	6/ 2	18/ 3	28/ 5	28/ 3	28/ 5
Western hemlock/salmonberry	7	4/ 2	10/ 4	19/ 4	20/ 6	12/ 3
Western hemlock/salmonberry-salal	3		14/ 1	18/ 1	18/ 5	10/ 3
Western hemlock/salmonberry-vine maple	9	1/ 1	8/ 4	21/ 5	17/ 3	10/ 2
Western hemlock/swordfern	9	7/ 2	21/ 6	19/ 5	20/ 5	19/ 5
Western hemlock/vine maple-salal	11	1/ 1	10/ 1	20/ 3	15/ 2	1/ 1
Western hemlock/vine maple/swordfern	16	1/ 1	8/ 2	15/ 2	18/ 2	20/ 14

Table 10. Tons down woody debris by decay class for plant associations of the Siuslaw National Forest (continued).

Association	Number of Samples	1	2	3	4	5	Total
		Mean / Standard Error					
Sitka spruce/devil's club	3	0.2/ 0.2	17/ 5	22/ 10	38/20	1/ 1	78
Sitka spruce/fool's huckleberry - red huckleberry	13	4/ 2	4/ 1	9/ 2	9/ 2	6/ 1	32
Sitka spruce/Oregon oxalis	9	5/ 1	7/ 1	9/ 2	7/ 2	2/ 0.3	30
Sitka spruce/salal	7	4/ 2	4/ 1	6/ 2	13/ 5	3/ 1	30
Sitka spruce/salmonberry	5	0.4/ 0 2	4/ 1	13/ 6	3/ 2	1/ 1	21
titka spruce/salmonberry-salal	6	0.1/ 0.1	20/12	27/13	11/ 5	3/ 1	61
Sitka spruce/swordfern	8	1/ 1	17/ 7	10/ 3	8/.3	2/ 1	38
Western hemlock/devil's club	7	2/ 1	24/ 7	13/ 3	11/ 3	2/ 1	21
Western hemlock/dwarf Oregon grape	6	0.1/ 0.1	1/ 1	9/ 4	6/ 3	1/ 1	17
Western hemlock/dwarf Oregon grape-salal	7	14/ 9	6/ 2	13/ 5	1.1/ 5	2/ 3	46
Western hemlock/evergreen huckleberry	8	3/ 2	4/ 2	6/ 2	9/ 3	4/ 4	26
Western hemlock/Oregon oxalis	9	2/ 1	6/ 2	8/ 3	11/ 4	1/ 1	28
Western hemlock/rhododendron-dwarf Oregon grape	4	4/ 4	5/ 1	6/ 4	5/ 1	3/ 1	23
Western hemlock/rhododendron-evergreen huckleberry	8	4/ 3	7/ 3	15/ 6	4/ 2	1/ 0.3	31
Western hemlock/rhododendron-salal	5		12/ 5	10/ 4	7/ 3	3/ 1	32
Western hemlock/rhododendron/swordfern	12	0.2/ 0.1	13/ 3	5/ 1	4/ 2	1/ 0.3	23
Western hemlock/salal	13	4/ 2	5/ 1	4/ 1	14/ 4	5/ 1	32
Western hemlock/salmonberry	7	4/ 3	5/ 2	9/ 3	10/ 7	1/ 0.4	29
Western hemlock/salmonberry-salal	3		5/ 2	6/ 2	17/ 5	1/ 1	29
Western hemlock/salmonberry-vine maple	9	0.5/ 0.1	3/ 2	15/ 3	11/5	1/ 0.3	31
Western hemlock/swordfern	9	3/ 1	9/ 3	7/ 3	4/ 1	2/ 1	25
Western hemlock/vine maple-salal	11	1/ 1	4/ 1	7/ 2	7/ 1	3/ 1	22
Western hemlock/vine maple/swordfern	16	2/ 1	10/ 3	9/ 2	10/ 2	3/ 1	34

Table 11. Physical characteristics of Douglas-fir logs by deterioration stage, (from Bartels et al. 1985)

Log Characteristics	Stage of deterioration 1	2	3	4	5
Bark	Intact	Intact	Trace	Absent	Absent
Twigs <1.8 in	Present	Absent	Absent	Absent	Absent
Texture	Intact	Intact to partly soft	Hard, large pieces	Small, soft, blocky pieces	Soft and powdery
Shape	Round	round	round	round to oval	oval
Color of wood	Original color	original color	original color to faded	light brown to faded brown or yellowish	faded to light yellow or gray
Portion of log	log elevated on support points	log elevated on support points but sagging slightly	log sagging near ground	all of log on ground	all of log on ground

Table 12. Stand productivity by plant association for the Siuslaw National Forest.

Association	Douglas-fir[1] Age 50	Douglas-fir[2] Age 100	Western Hemlock[3]	Sitka Spruce[4]	Western Red Cedar[5]	Red Alder[6]
	Mean[7]/Standard Error[8]/Number of Observations					
Sitka spruce/devil's club	116/2/21	179/3/33		170/7/10		
Sitka spruce/fool's huckleberry - red huckleberry	114/3/26	151/3/35	108/3/26	175/4/35		
Sitka spruce/Oregon oxalis	121/3/38	160/3/40	116/3/31	169/5/31		117/0/1
Sitka spruce/salal	122/2/29	164/3/32	119/4/15	164/5/21		
Sitka spruce/salmonberry	122/2/34	163/3/35	119/0/1	174/5/22		
Sitka spruce/salmonberry-salal	125/2/21	168/4/19	100/3/6	155/6/16		
Sitka spruce/swordfern	123/3/34	169/2/36	123/6/13	161/3/35		
Western hemlock/devil's club	130/2/37	178/3/43	114/4/12			
Western hemlock/dwarf Oregon grape	115/3/48	163/3/51			138/0/1	
Western hemlock/dwarf Oregon grape-salal	113/2/38	156/2/47	115/4/14			
Western hemlock/evergreen huckleberry	118/3/45	160/4/53	117/5/6			
Western hemlock/Oregon oxalis	122/2/83	167/2/86	109/4/16	170/1/2	158/0/1	121/2/2
Western hemlock/rhododendron-dwarf Oregon grape	100/3/27	138/4/29	98/17/2			
Western hemlock/rhododendron-evergreen huckleberry	113/2/45	156/4/48	81/0/1			
Western hemlock/rhododendron-salal	113/4/35	158/4/39				
Western hemlock/rhododendron/swordfern	111/3/51	156/3/83	85/3/3		113/0/1	
Western hemlock/salal	121/2/73	162/2/91	112/3/20	147/5/4		
Western hemlock/salmonberry	123/2/47	172/3/56	110/3/10		101/0/1	
Western hemlock/salmonberry-salal	123/3/25	165/3/41	90/0/1	139/0/1	86/0/1	
Western hemlock/salmonberry-vine maple	130/2/54	178/2/65	95/9/4			
Western hemlock/swordfern	124/1/75	167/2/82	114/3/24	139/9/3	120/0/1	
Western hemlock/vine maple-salal	123/2/76	169/2/100				
Western hemlock/vine maple/swordfern	126/1/91	179/1/156				

1 King (1966) 50-year site index.
2 McArdle et al. (1961) 100-year site index.
3 Wiley (1978) 50-year site index.
4 Hegyi et al. (1979) 50-year site index.
5 Hegyi et al. (1979) 50-year site index.
6 Worthington et al. (1960) 50-year site index.
7 Pooled means from reconnaissance and intensive sample plots.
8 Pooled standard errors from reconnaissance and intensive sample plots.

Table 12. Stand productivity by plant association for the Siuslaw National Forest (continued).

Association	Number of Plots	Quadratic Mean Diameter Mean/SE[1]	Stand Density Index Mean/SE	Gross Total Cubic Volume Ft^3/Acre Mean/SE	Gross Periodic Annual Increment Ft^3/Acre/Yr Mean/SE
Sitka spruce/devil's club	3	38/ 5	305/66	15269/2975	147/31
Sitka spruce/fool's huckleberry - red huckleberry	13	26/ 2	447/33	19812/1450	246/32
Sitka spruce/Oregon oxalis	10	22/ 2	433/29	17170/1401	293/53
Sitka spruce/salal	7	27/0.4	369/38	17424/1978	162/15
Sitka spruce/salmonberry	6	27/ 3	296/25	13528/1570	185/28
Sitka spruce/salmonberry-salal	6	21/ 3	417/40	14951/1104	244/27
Sitka spruce/swordfern	8	25/ 1	413/36	16646/1622	280/58
Western hemlock/devil's club	7	26/ 2	406/57	18075/1914	174/29
Western hemlock/dwarf Oregon grape	6	29/ 4	427/33	19612/2601	148/29
Western hemlock/dwarf Oregon grape-salal	7	24/ 3	453/65	19986/2447	154/38
Western hemlock/evergreen huckleberry	8	20/ 2	398/39	15025/2153	174/24
Western hemlock/Oregon oxalis	9	23/ 3	446/28	17269/1394	215/23
Western hemlock/rhododendron-dwarf Oregon grape	4	19/ 2	405/29	13879/1999	169/42
Western hemlock/rhododendron-evergreen huckleberry	8	19/ 1	360/14	12833/ 847	162/22
Western hemlock/rhododendron-salal	5	24/ 3	317/19	13744/1970	160/28
Western hemlock/rhododendron/swordfern	12	28/ 2	422/21	16586/1164	188/26
Western hemlock/salal	13	21/ 1	423/28	16470/1184	221/16
Western hemlock/salmonberry	7	25/ 4	334/25	14122/1482	191/35
Western hemlock/salmonberry-salal	3	26/ 5	309/77	12860/3865	122/ 5
Western hemlock/salmonberry-vine maple	9	29/ 3	298/34	13510/1443	142/22
Western hemlock/swordfern	9	21/ 2	533/36	21600/1894	228/32
Western hemlock/vine maple-salal	11	33/ 2	354/21	17441/ 794	154/15
Western hemlock/vine maple/swordfern	16	33/ 2	323/25	16492/ 123	134/12

[1] Standard Error

Table 12. Stand productivity by plant association for the Siuslaw National Forest (continued).

Association	Number of Intensive Plots	Basal Area (square feet) Douglas-fir Mean/SE[1]/n	Western Hemlock Mean/SE/n	Sitka Spruce Mean/SE/n	Red Alder Mean/SE/n	Total Basal Area (ft) Mean/SE
Sitka spruce/devil's club	3	97/44/ 3	4/ 5/ 3	189/52/ 3	8/14/1	299/57
Sitka spruce/fool's huckle-berry - red huckleberry	13	37/12/13	144/28/13	174/28/13	9/ 5/6	363/21
Sitka spruce/Oregon oxalis	10	65/16/10	136/27/10	98/23/10	31/16/6	331/16
Sitka spruce/salal	7	161/45/ 7	59/16/ 7	92/38/ 7		313/31
Sitka spruce/salmonberry	6	108/40/ 6	31/10/ 6	97/33/ 6	5/ 5/2	249/14
Sitka spruce/salmonberry-salal	6	91/17/ 6	89/36/ 6	108/56/ 6	7/ 7/1	311/27
Sitka spruce/swordfern	8	86/44/ 8	76/30/ 8	157/49/ 8	4/11/1	335/29
Western hemlock/devil s club	7	215/19/ 7	82/27/ 7	5/ 3/ 7	5/ 6/2	329/36
Western hemlock/dwarf Oregon grape	6	340/47/ 6	5/ 3/ 6		19/23/2	371/38
Western hemlock/dwarf Oregon grape-salal	7	248/37/ 7	98/17/ 7	1/ 1/ 7	.	355/46
Western hemlock/evergreen huckleberry	8	208/32/ 8	45/19/ 8	1/ 1/ 8	9/12/2	291/31
Western hemlock/Oregon oxalis	9	212/27/ 9	87/31/ 9	3/ 3/ 9	17/21/4	347/20
Western hemlock/rhododendron-dwarf Oregon grape	4	262/42/ 4	22/19/ 4		3/ 7/1	293/38
Western hemlock/rhododendron-evergreen huckleberry	8	228/18/ 8	5/ 3/ 8		2/ 3/2	262/13
Western hemlock/rhododendron-salal	5	235/28/ 5	5/ 5/ 5		2/ 4/1	258/24
Western hemlock/rhododendron/swordfern	12	275/24/12	21/ 6/12		17/10/6	330/20
Western hemlock/salal	13	244/29/13	63/25/13	5/ 3/13	2/ 3/2	321/19
Western hemlock/salmonberry	7	168/46/ 7	70/33/ 7	2/ 1/ 7	27/21/4	275/24
Western hemlock/salmonberry-salal	3	208/68/ 3	3/ 3/ 3	3/ 3/ 3	27/28/2	256/62
Western hemlock/salmonberry-vine maple	9	209/31/ 9	22/31/ 9	3/ 3/ 8	8/ 3/6	251/26
Western hemlock/swordfern	9	186/44/ 9	193/36/ 9	6/ 4/ 9		401/31
Western hemlock/vine maple-salal	11	319/14/11			3/ 5/2	322/14
Western hemlock/vine maple/swordfern	16	269/22/16	1/0.8/16		10/12/5	290/18

[1] Standard Error

Table 12. Stand productivity by plant association for the Siuslaw National Forest (continued).

Association	Number of Plots	Growth Basal Area: Douglas-fir Mean/SE[1]/n	Growth Basal Area: Western Hemlock Mean/SE/n	Growth Basal Area: Sitka Spruce Mean/SE/n	Age (Douglas-fir or Sitka Spruce) Mean/SE/n
Sitka spruce/devil s club	3	399/ 30/ 3		666/749/ 3	89/ 6/ 3
Sitka spruce/fool's huckleberry - red huckleberry	13	46/ 29/ 8	558/ 79/12	747/ 56/13	106/11/13
Sitka spruce/Oregon oxalis	10	580/123/ 8	601/116/ 9	875/139/10	87/ 7/10
Sitka spruce/salal	7	429/ 58/ 6	394/ 78/ 5	484/ 31/ 5	88/ 4/ 5
Sitka spruce/salmonberry	6	396/ 63/ 5	318/ / 1	567/114/ 5	91/ 6/ 5
Sitka spruce/salmonberry-salal	6	498/ 48/ 4	540/ 84/ 5	632/148/ 5	113/27/ 5
Sitka spruce/swordfern	8	509/ 54/ 5	743/317/ 5	913/258/ 5	82/ 9/ 7
Western hemlock/devil s club	7	510/103/ 7	379/ 54/ 5		108/ 4/ 7
Western hemlock/dwarf Oregon grape	6	538/65/ 6			155/35/ 6
Western hemlock/dwarf Oregon grape-salal	7	502/ 76/ 7	345/ 80/ 4		139/25/ 7
Western hemlock/evergreen huckleberry	8	458/166/ 7	510/ 69/ 2		111/34/ 7
Western hemlock/Oregon oxalis	9	558/ 44/ 9	387/ 56/ 5	799/ 0 / 1	106/21/ 9
Western hemlock/rhododendron-dwarf Oregon grape	4	398/ 94/ 4	401/ 0 /1		108/ 8/ 4
Western hemlock/rhododendron-evergreen huckleberry	8	406/ 45/ 8	518/ 0 / 1		103/ 6/ 8
Western hemlock/rhododendron-salal	5	429/ 50/ 5			108/ 9/ 5
Western hemlock/rhododendron/swordfern	12	504/ 43/12	995/219/ 3		139/14/12
Western hemlock/salal	13	4[illegible]8/ 39/13	378/ 54/ 6	560/122/ 2	94/ 7/13
Western hemlock/salmonberry	7	528/ 65/ 7	463/ 88/ 3		118/16/ 7
Western hemlock/salmonberry-salal	3	341/ 40/ 3		868/ 0 / 1	87/16/ 3
Western hemlock/salmonberry-vine maple	9	421/ 42/ 9	999/557/ 2		117/11/ 9
Western hemlock/swordfern	9	591/ 69/ 9	674/187/ 6	1033/150/ 2	107/14/ 9
Western hemlock/vine maple-salal	11	452/ 20/11			135/20/11
Western hemlock/vine maple/swordfern	16	412/ 32/16			124/10/16

[1] Standard Error

Table 13. Deviations of actual heights of stem sectioned Douglas-fir trees from predicted heights using King (1966) site index curves and the heights of the sectioned trees at: 1) age 100, 2) age of top damage or, 3) total tree age when cut if less than 100 years.

		Breast Height Age											
		10	20	30	40	50	60	70	80	90	100	110	120
Site	Tree	Deviation from King (1966) in feet											
Minister	1	-0.1	-0.2	0.5	2.3	2.0	5.1	3.3	3.6	2.2	-0.2	-5.5	-10.0
	2	11.5	14.8	17.1	14.3	14.0	11.4	8.7	5.7	1.1	-2.3	-8.3	-10.3
	3	-3.0	-2.6	-1.8	2.9	8.0	9.2	8.2	8.0	4.9	-0.1	-4.3	-8.4
	4	-0.1	2.3	5.5	6.3	9.6	9.9	8.8	6.4	1.9	-3.0	-7.8	-13.2
	5	-10.5	-7.9	-13.9	-12.1	-6.0	-4.4	-0.5					
Deadwood	1	6.4	5.0	4.1	3.4	5.6	7.7	7.8	5.0	1.8	-0.6	-1.8	-2.2
	2	-7.6	-7.3	-9.4	-3.6	3.0	2.7	3.2	4.7	3.9	-0.3	-7.3	-13.7
	3	0.9	-0.7	-3.5	-0.4	2.0	5.5	8.3	6.1	5.5	-0.4	-8.5	-14.4
	4	4.6	3.1	0.9	-0.4	1.3	2.5	1.3	-1.6				
	5	0.7	4.6	-7.2	-10.5	0.0	-0.6	-0.7					
Fleece	1	5.7	8.8	9.1	12.7	13.9	14.9	11.3	9.2	5.4	-0.9	-7.9	-13.9
	2	5.5	8.3	8.5	10.7	13.0	13.9	11.7	8.1	4.2	-2.1	-9.1	-15.1
	3	14.6	7.1	7.9	11.5	15.0	16.0	12.6	9.3	5.2	-0.9	-5.9	-8.2
	4	4.4	1.4	2.1	2.1	4.0	5.0	5.3	4.0	4.1	-1.0	-3.6	
	5	9.0	9.5	2.8	3.9	9.5	11.0	11.3	7.8	3.3	-1.0	-3.3	-4.9
Crab	1	6.9	4.7	0.8	-1.9	-1.0	-0.8	-0.7	-1.4				
	2	-7.5	-11.7	-13.2	-19.1	-14.5	-8.8	-5.2	-1.9	-0.9	-2.0		
	3	-6.1	-9.0	-12.4	-8.6	-7.0	-7.7	-3.2	-2.1	-2.6	-2.8	-4.3	
	4	-1.1	-4.8	-2.9	-3.6	-1.4	0.6	3.4	3.7	2.5	-1.0	-4.4	
	5	-1.9	-2.3	-0.4	-1.1	3.0	5.7	7.9	5.8	-0.2			
Trenholm	1	-5.9	-11.5	-3.2	-1.7	-0.4	-1.6	-3.1	-0.7	1.5	-0.8	-3.2	
	2	3.6	-4.6	-0.6	-6.4	-6.3	-3.9	-0.2	5.5	-0.5			
	3	-5.9	-18.8	-12.7	-15.2	-15.9	-15.7	-9.5	-3.5	-2.5	-2.4	-4.4	
	4	2.6	1.8	-1.8	-2.4	-1.7	3.5	5.5	5.0	1.8	-0.9	1.2	
	5	1.9	0.8	-1.6	0.6	-2.7	-2.0	-0.7	1.0	0.4	-3.8	-8.1	
Trenholm-Carns	1	10.4	6.6	10.0	11.1	7.5	4.8	2.8	3.2	1.0	-1.8	-2.3	
	2	-9.3	-14.6	-10.6	-5.5	-2.6	1.8	1.7	0.6	-0.7	-2.0		
	3	-5.6	-9.8	-15.4	-17.2	-17.0	-10.8	-7.3	-0.8	1.1	-1.2		
	4	7.7	6.6	4.1	-0.4	0.0	0.4	3.0	2.7	2.6	-0.3	-2.6	
	5	-7.1	-8.9	-8.3	-5.5	-2.0	0.8	3.3	1.1	-1.4			
Mean		0.8	-0.9	-1.5	-1.0	1.1	2.5	3.3	3.4	1.6	-1.4	-5.1	-10.4
Std. Dev.		6.7	8.1	8.1	8.6	8.4	7.6	5.7	3.7	2.4	1.0	2.7	4.2
Sample Size		30	30	30	30	30	30	30	28	26	23	20	11
Std. Error		1.2	1.5	1.5	1.6	1.5	1.4	1.0	0.7	0.5	0.2	0.6	1.2

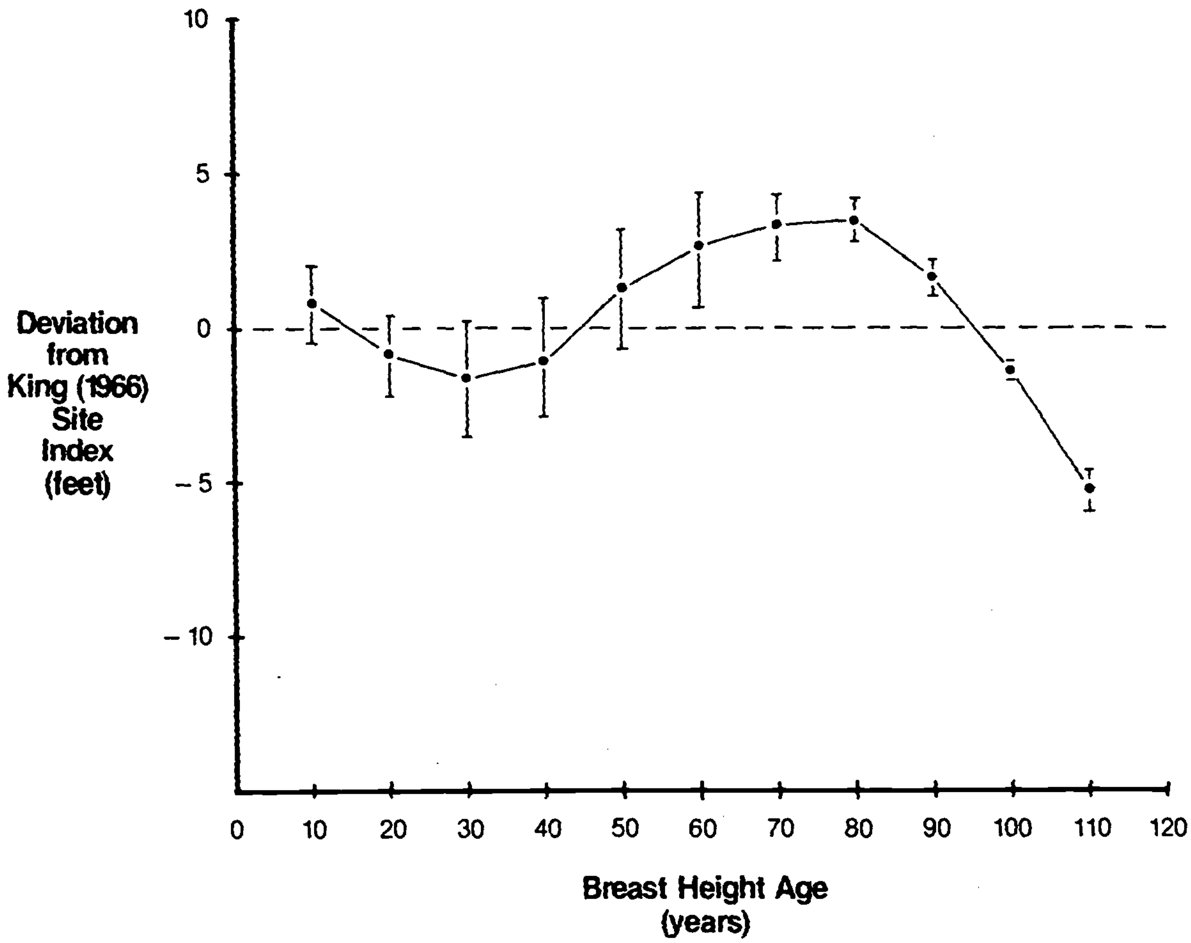

Figure 14. Deviations of actual height from predicted height (King, 1966) in a sample of Douglas-fir from Alsea District, Siuslaw National Forest.

EARLY SERAL DEVELOPMENT

Early seral competition between trees and shrubs influences species composition and the rate of canopy closure. The difficulty and costs of conifer regeneration in managed stands and the availability of forage and cover for wildlife depend to a large degree on the pattern and speed of early successional development. In the past, competitive conditions could not easily be predicted before timber harvest. This occasionally resulted in unneccessary treatments or unanticipated suppression-related conifer seedling mortality following timber harvest. Justification for optimization of treatments has been difficult due to the lack of tools to predict shrub competition.

In anticipation of plant association classification and clarification of probable relationship between shrub growth rates and plant associations, Ranger Districts began collecting data that would allow plot stratification by plant association on reforestation survey plots. Tremendous numbers of reforestation survey exams are taken on all clearcuts at 1, 3, and 5 years (plus supplemental additional exams in some areas) following harvest. Crop tree height, percent cover, and height of several important shrubs and herbs, selected site physical factors, animal browse, and treatments are recorded for each plot. Currently, plots taken from 1981 through 1985 on the Mapleton and Waldport Ranger Districts can be stratified and examined by plant association. Results presented here reflect a first-approximation analysis, for silvicultural purposes. Plant response estimates will be improved as information from other Ranger Districts becomes available and additional plot information accumulates. More information regarding the plot design and sampling procedures can be obtained from Ranger District Silviculturists.

A key to early seral communities was developed from estimates of species response to disturbance. Response estimates assumed that major indicator species are not eliminated by harvesting and slash burning. Most species used in the key sprout from underground parts following disturbance. Those which increase rapidly following disturbance, salmonberry for example, sprout vigorously from rootstocks and rhizomes (Barber 1976) and may also seed into disturbed areas. The key was conservative. Reforestation survey plots in which plant association was unclear were not assigned a plant association code. Identifying plant associations in older plantations in which management treatments have produced a tight conifer canopy is much more difficult.

Reforestation survey data sets from Mapleton and Waldport Ranger Districts were stratified into groups of similar plant associations. Measurements of average maximum crop tree height, average shrub height, and percent cover of important shrubs and herbs were analyzed as a function of time since harvest for several important species. The resulting picture of vegetative development in the first 5 years following harvest should prove useful to both silviculturists and wildlife biologists.

Many reforestation survey plots fell in areas which had either been treated to reduce shrub growth or planted more than once with conifer seedlings. Plots which had not been treated were used to estimate development of shrub cover and height over time. Plots which had not been replanted were used to estimate conifer height growth over time. These two restrictions may have biased the results. Shrubs are normally treated in areas where shrub height growth is rapid. This bias probably produces slight under-estimates of average shrub height growth.

Elimination of sites which had been replanted may produce a similar bias in estimating conifer height growth. The highest conifer growth rates seem to occur on moist sites which also support rapid shrub growth. Seedling mortality may be high in these areas and replanting is fairly common. Replanting is an expensive operation and not performed on a large scale. The bias introduced by eliminating replanted areas has probably caused slightly underestimated juvenile conifer height growth on salmonberry dominated sites.

Although other shrub species compete with conifer seedlings on some sites, salmonberry is most often the cause of seedling mortality. Significant salmonberry competition develops in only a few plant associations (Tables 14 and 15). Salmonberry reaches maximum early seral development in the Sitka spruce/salmonberry, Sitka spruce/salmonberry-salal, western hemlock/salmonberry, western hemlock/salmonberry-salal, and western hemlock/salmonberry-vine maple associations. Average salmonberry height increases rapidly after logging to more than 2 feet in the first year and 2.5 to 4 feet by the end of the third year (Figures 15 and 16). Surviving conifers lag behind until age three and generally outstrip salmonberry height growth by 3 feet or more by age five. A relatively high percentage of plots lack crop trees at age three and five in the salmonberry types, indicating mortality among smaller trees. The most severe competition occurs in a subset of the salmonberry group. These sites could be located on the ground from plot grids and analyzed to increase silviculturists' abilities to predict competitive development. Other groups of plant associations generally lack important competitive interactions between conifers and shrubs (Figures 17 through 20) with some notable local exceptions (eg. snowbrush ceanothus and vine maple).

Development of vegetative cover over time follows different routes depending on plant association. In general, the same species of shrubs and herbs which dominate mature and old-growth forests usually re-establish dominance by three years after harvest. The recovery process during the first five years following clearcutting and burning proceeds rapidly. During the first year, several species of opportunistic invaders may

Table 14. Height growth crop trees[1] by plant association group for the Siuslaw National Forest. Data taken from reforestation survey plots sampled from 1981 to 1984.

Location/Plant Association Group	Average Maximum Crop Tree Height											
	Year 1				Year 3				Year 5			
	mean	n	90% CI		mean	n	90% CI		mean	n	90% CI	
Mapleton District												
Sitka spruce/salal	-	2	-	-	-	-	-	-	6.1	7	-	-
Sitka spruce/salmonberry	1.5	22	1.4	1.6	4.0	15	3.4	4.6	6.4	18	5.3	7.5
Sitka spruce/swordfern	1.2	9	-	-	2.9	13	2.4	3.4	7.1	10	6.3	7.9
Western hemlock/salal	1.5	274	1.4	1.6	3.5	249	3.2	3.6	6.4	552	6.2	6.6
Western hemlock/salmonberry	1.6	248	1.5	1.7	4.1	245	3.9	4.3	6.6	394	6.4	6.8
Western hemlock/swordfern	1.7	179	1.6	1.8	3.9	187	3.6	4.2	6.1	329	5.9	6.3
Western hemlock/rhododendron	1.6	77	1.5	1.7	3.0	37	2.7	3.3	5.2	147	4.9	5.5
Waldport District												
Sitka spruce/salal	1.4	57	1.3	1.5	4.2	44	3.8	4.6	6.7	189	6.4	7.0
Sitka spruce/salmonberry	1.7	21	1.5	1.9	4.1	14	3.4	4.8	7.4	37	6.7	8.1
Sitka spruce/swordfern	-	4	-	-	4.7	8	-	-	5.8	25	5.3	6.3
Western hemlock/salal	1.4	171	1.2	1.6	3.5	165	3.2	3.7	5.9	332	5.7	6.1
Western hemlock/salmonberry	1.6	211	1.5	1.7	3.6	190	3.4	3.8	6.3	245	6.0	6.6
Western hemlock/swordfern	1.5	73	1.4	1.6	3.3	46	3.0	3.6	6.2	127	5.8	6.6
Western hemlock/rhododendron	1.4	4	-	-	-	3	-	-	-	1	-	-

[1]Average height of the tallest crop trees in sample plots where crop trees existed. Means not calculated for sample size less than 5. 90% confidence interval not calculated for sample size less than 10.

Table 15. Height growth of salmonberry by plant association group for the Siuslaw National Forest. Mean not calculated for sample sizes less than 5. Confidence interval not calculated for sample size less than 10.

Location/Plant Association Group	Average Salmonberry Height											
	Year 1				Year 3				Year 5			
	mean	n	90% CI		mean	n	90% CI		mean	n	90% CI	
Mapleton District												
Sitka spruce/salal	-	2	-	-	-	2	-	-	1.6	9	-	-
Sitka spruce/salmonberry	2.1	22	1.7	2.5	3.9	16	3.5	4.3	3.8	12	3.5	4.1
Sitka spruce/swordfern	1.6	8	-	-	0.9	10	0.3	1.5	1.6	7	-	-
Western hemlock/salal	0.3	353	0.2	0.4	0.5	358	0.4	0.6	0.4	795	0.3	0.5
Western hemlock/salmonberry	2.7	313	2.6	2.8	3.8	405	3.7	3.9	4.6	599	4.5	4.7
Western hemlock/swordfern	0.6	217	0.5	0.7	0.8	253	0.7	0.9	1.2	490	1.1	1.3
Western hemlock/rhododendron	0.2	93	0.1	0.3	0.5	51	0.3	0.7	0.3	209	0.2	0.4
Waldport District												
Sitka spruce/salal	0.9	57	0.8	1.0	1.1	47	0.8	1.4	0.5	27	0.3	0.7
Sitka spruce/salmonberry	3.0	20	2.3	3.7	3.3	20	2.9	3.7	3.9	9	-	-
Sitka spruce/swordfern	-	4	-	-	1.6	7	-	-	1.0	6	-	-
Western hemlock/salal	0.6	212	0.5	0.7	0.7	243	0.6	0.8	0.9	157	0.8	1.0
Western hemlock/salmonberry	2.7	181	2.6	2.8	2.6	334	2.5	2.7	3.5	148	3.3	3.7
Western hemlock/swordfern	0.8	84	0.6	1.0	0.9	74	0.7	1.1	1.7	45	1.3	2.1
Western hemlock/rhododendron	0.1	7	-	-	0.5	4	-	-	-	0	-	-

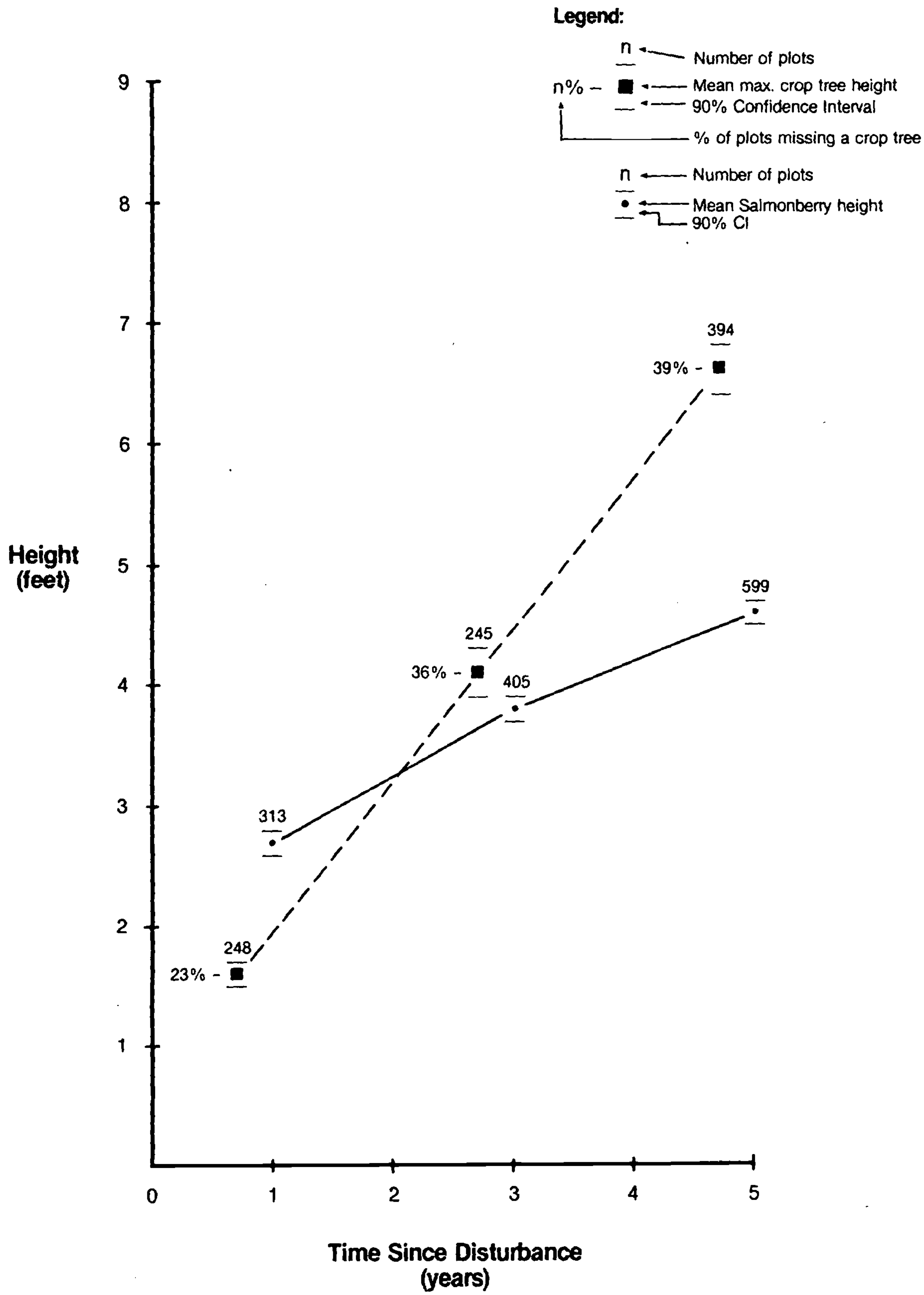

Figure 15. Early seral height growth of salmonberry and conifers in the western hemlock/salmonberry plant association, Mapleton Ranger District, Siuslaw National Forest.

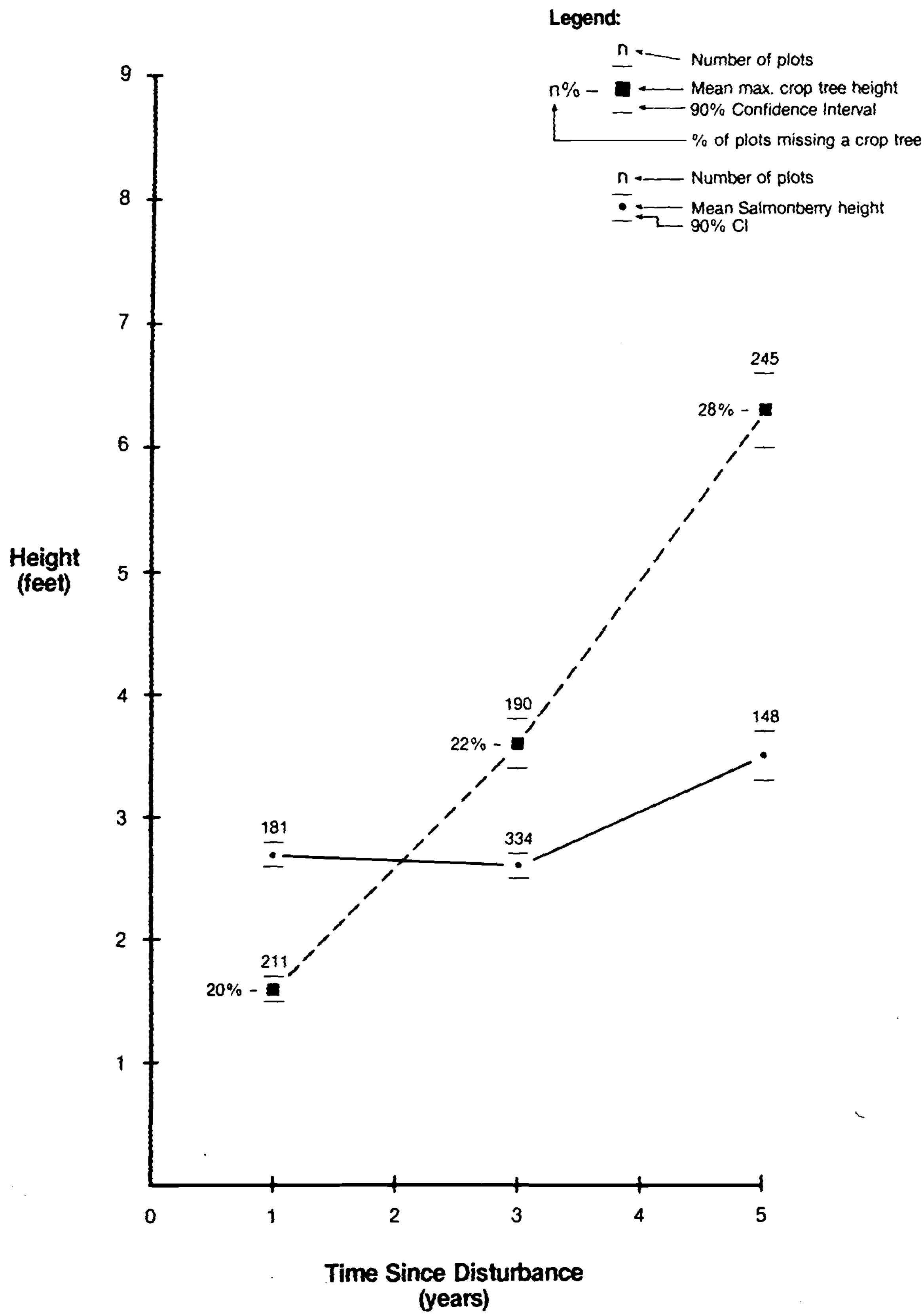

Figure 16. Early seral height growth of salmonberry and conifers in the western hemlock/salmonberry plant association, Waldport Ranger District, Siuslaw National Forest.

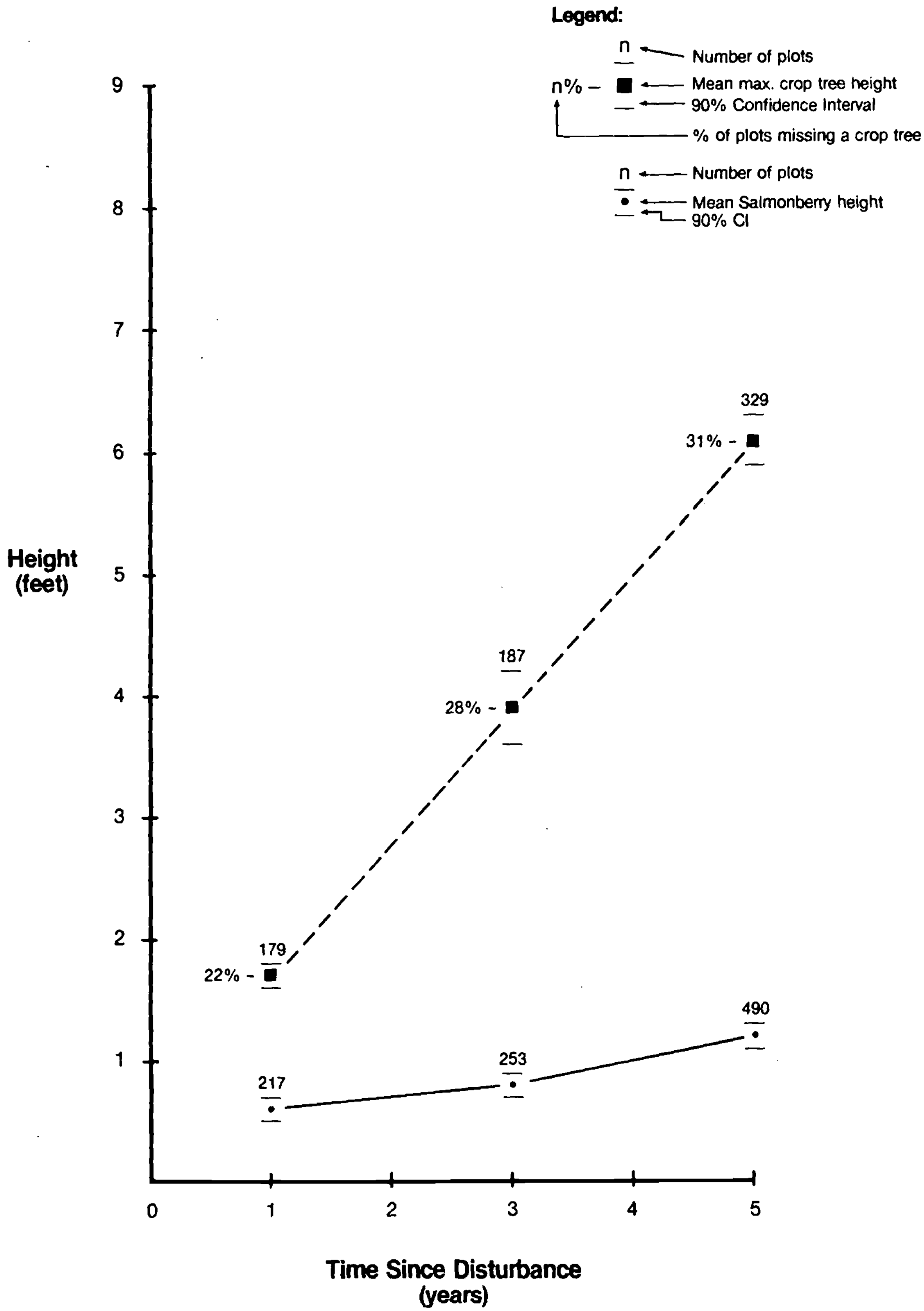

Figure 17. Early seral height growth of salmonberry and conifers in the western hemlock/swordfern plant association, Mapleton Ranger District, Siuslaw National Forest.

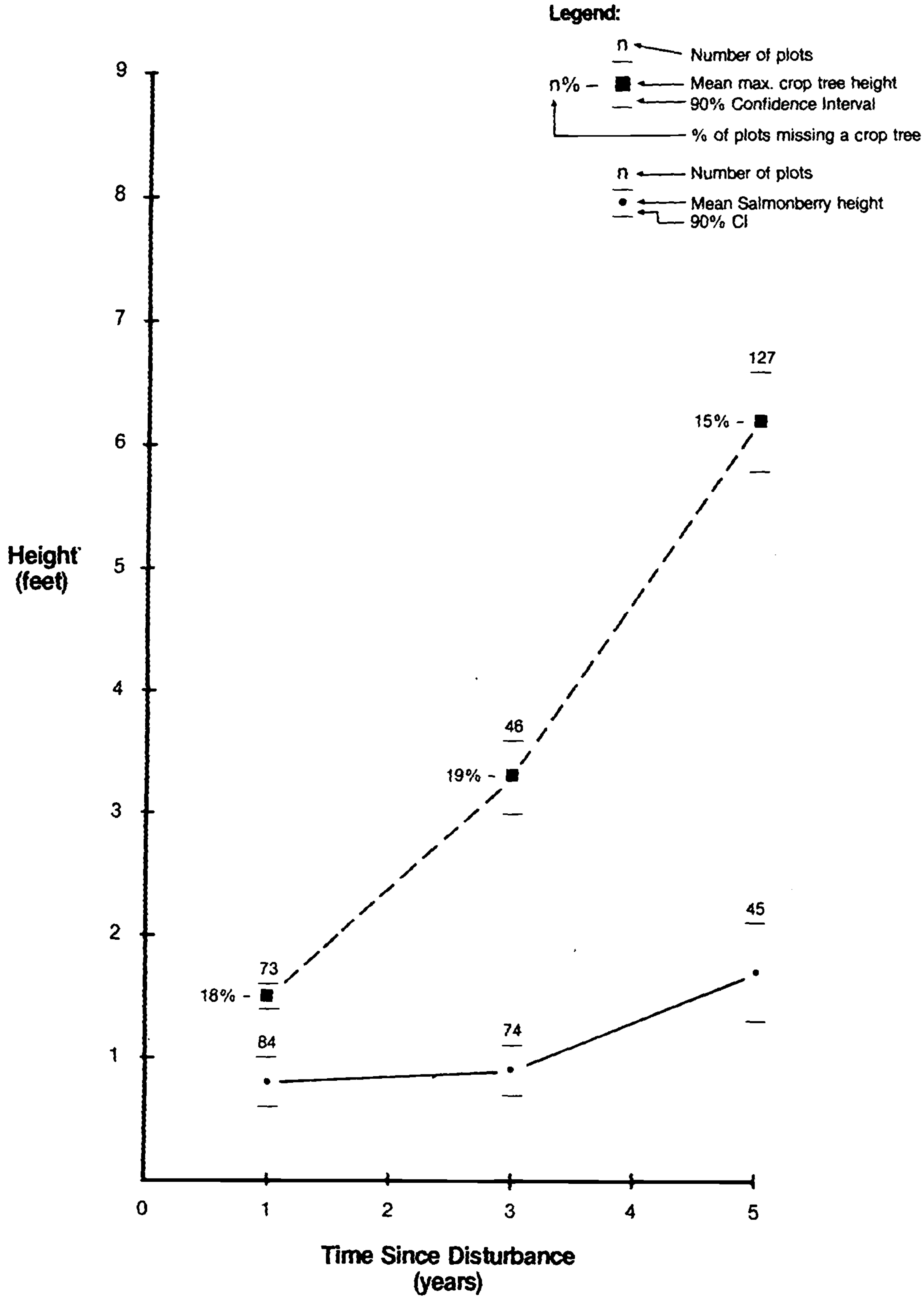

Figure 18. Early seral height growth of salmonberry and conifers in the western hemlock/swordfern plant association, Waldport Ranger District, Siuslaw National Forest.

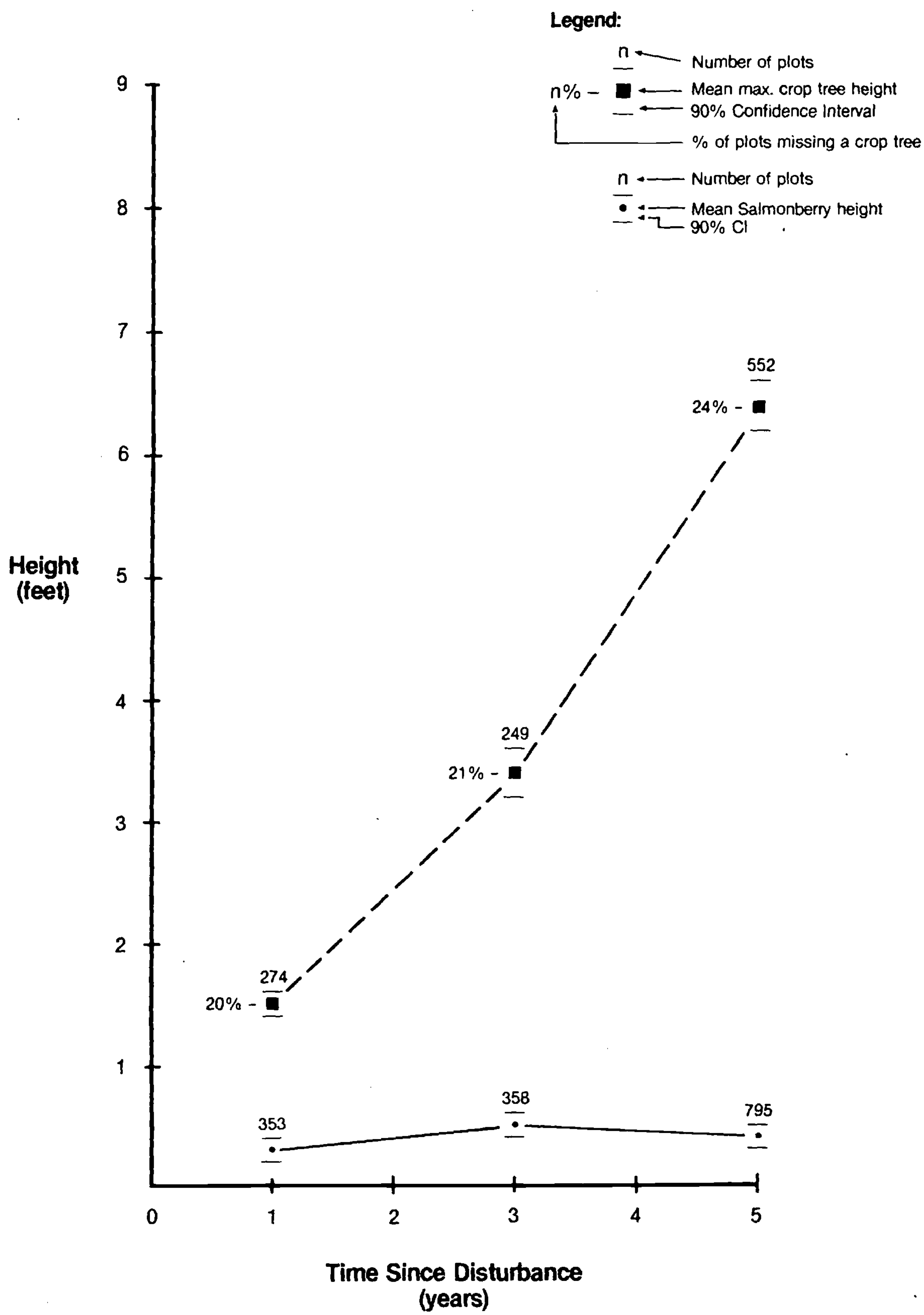

Figure 19. Early seral height growth of salmonberry and conifers in the western hemlock/salal plant association, Mapleton Ranger District, Siuslaw National Forest.

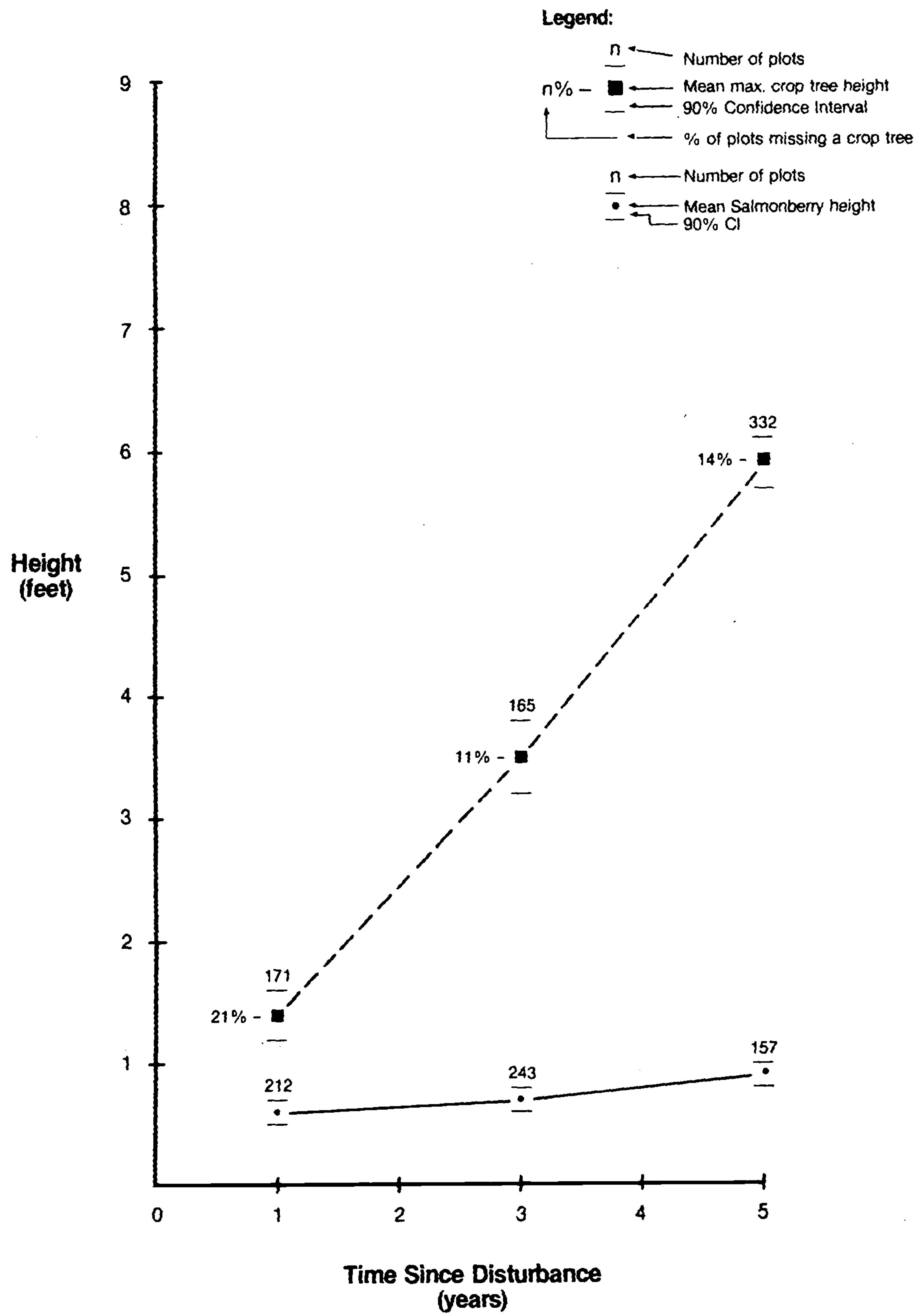

Figure 20. Early seral height growth of salmonberry and conifers in the western hemlock/salal plant association, Waldport Ranger District, Siuslaw National Forest.

become established. By the third year following disturbance, most shrubs are at least as abundant as in mature forests (Figures 21 through 23). Some species of shrubs, salmonberry and thimbleberry in particular, are more abundant than those in mature forests by the fifth year following disturbance. Salal and vine maple increase following harvest but are not as opportunistic. Swordfern lags behind in cover development and by five years following disturbance averages about 10 percent less cover than in typical mature stands. Bracken fern is the most common species in the early seral stages of salal-dominated associations.

Grazing and browsing animals also have a substantial effect on early seral development. Deer, elk, and mountain beaver all forage in early seral stands. In some locations, these species may eat enough developing conifer seedlings to delay stand establishment and tip the competitive balance between trees and shrubs in favor of the shrubs.

Wildlife biologists should find the reforestation data set analysis useful for estimating the kind and rates of forage and cover development for wildlife habitat models. Height growth estimates for species other than salmonberry and conifers could be easily developed. Used in conjunction with a map of plant associations and stand conditions, the information would greatly aid the analysis of current conditions and trends for wildlife habitat on a watershed, Ranger District, and Forest basis.

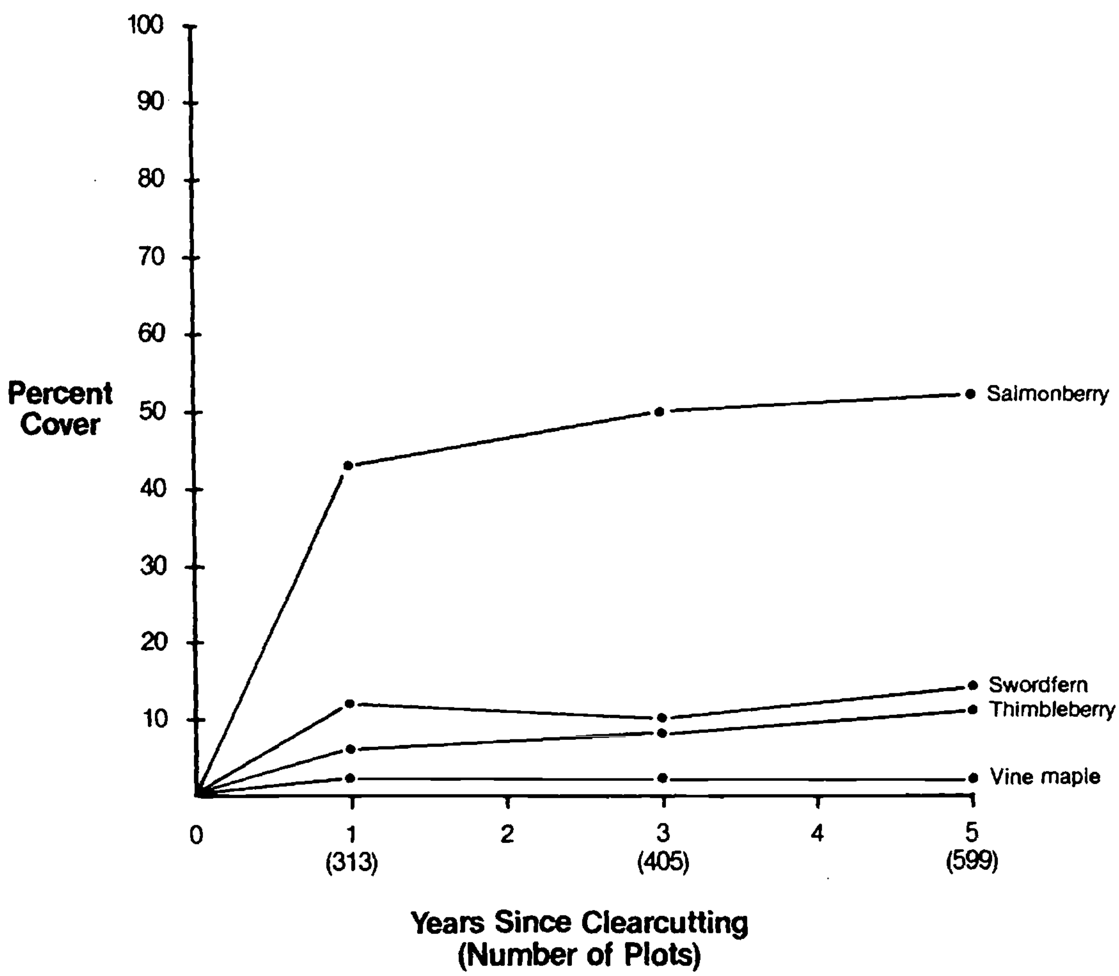

Figure 21. Early seral cover development of selected shrub and herb species, western hemlock/salmonberry association, Mapleton Ranger District, Siuslaw National Forest.

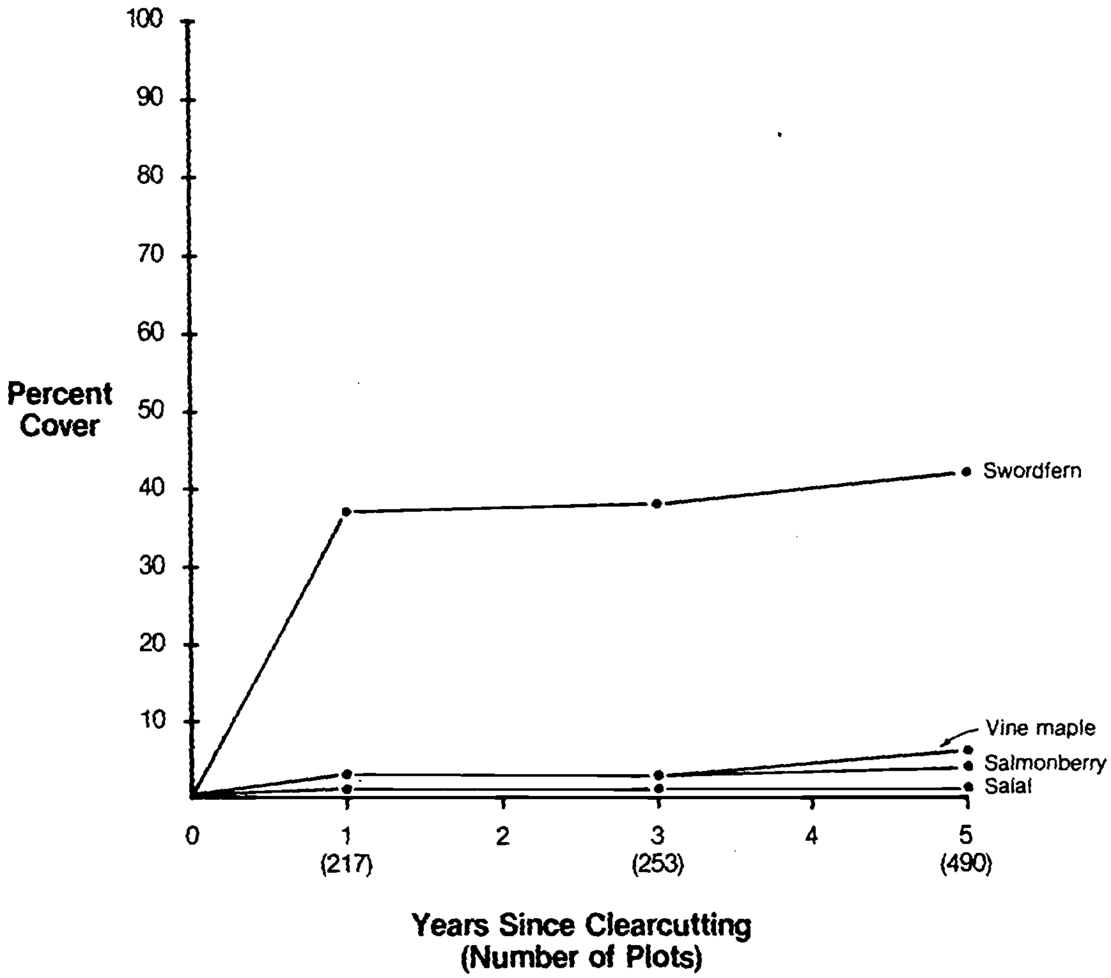

Figure 22. Early seral cover development of selected shrub and herb species, western hemlock/swordfern association, Mapleton Ranger District, Siuslaw National Forest.

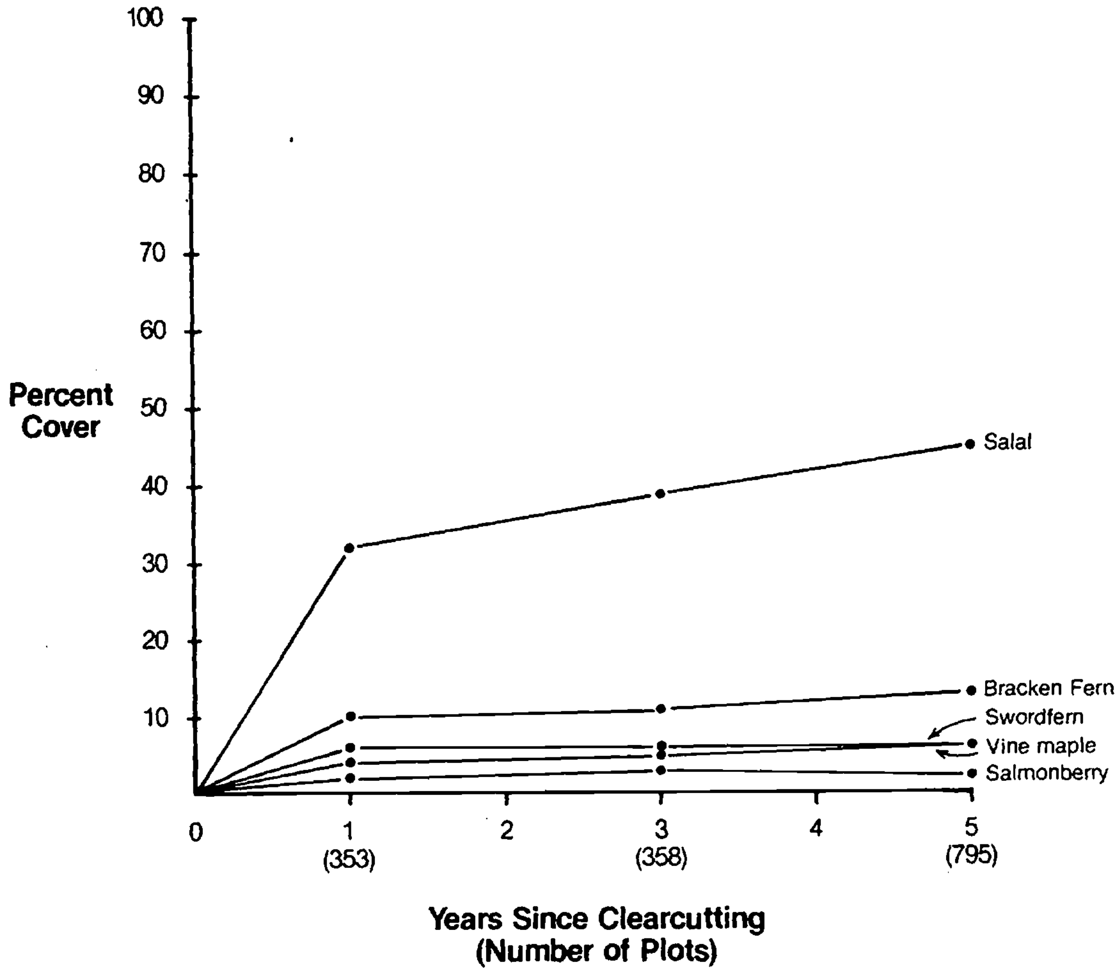

Figure 23. Early seral cover development of selected shrub and herb species, western hemlock/salal association, Mapleton Ranger District, Siuslaw National Forest.

PLANT ASSOCIATION MAPPING

Forest Resources Inventory, planned for contract sampling during FY87, is being stratified by a combination of stand types and plant association groups. Plant associations were grouped based upon similarity of conifer site potential, wildlife forage potential, and general silvicultural characteristics. Plant association groups and stand types were mapped on 1:12000 aerial photographs for the entire Forest during the period from July 1985 to the end of April 1986. By mid-summer, 1986, maps of plant association groups, tabulations of acres by mapping unit, and files of stand attributes should be available for Forest use.

These maps will be stored and manipulated with a Geographic Information System. Ranger District field people and managers are constantly refining this first-approximation map set in the course of field work and project planning. Plant association and stand maps can be combined with assessments of responses to treatments and rates of vegetative change to greatly enhance planning at the Forest and project levels. It should be possible to generate estimates of treatment costs, response benefits, and future vegetative conditions on a local basis to:

1. Estimate current conditions and future trends of forage and animal habitat conditions,

2. Assess the costs and benefits of silvicultural treatments in terms of vegetative conditions and timber production,

3. Evaluate the need for fire as a site preparation method over large areas,

4. Allocate harvest levels to areas of ground based on local measures of site productivity.

This first set of plant association group and stand maps currently being developed will not usually be sufficiently accurate for project use, but will become accurate to the finest scales necessary as they are updated and corrected during project field work. A consistent, periodic method of updating maps based on field inspection must be developed in order for the map bases to remain useful.

KEY TO PLANT ASSOCIATIONS

This key applies to forest stands over 50 years old.

The steps in using the key are:

1. Select an area representative of the stand as a whole. Avoid sites where the vegetation or topography are changing over a short distance.

2. Identify and list tree, shrub, and herb species. Estimate the cover to the nearest 1 percent up to 10 percent and to the nearest 10 percent thereafter.

3. Work through the keys (step by step) to a preliminary identification and ecoclass code.

4. Review the association description to verify the identification.

5. Only after verification, note the management implications for the association.

It is important to follow these steps rigorously. Misidentification may lead to the wrong management implications.

The associations are abstractions based upon plot data taken throughout the Forest. In each case, plots were grouped according to plant community similarity and used as the basis for an abstraction process. Few stands will exactly match average stand conditions in the association descriptions.

Variation in vegetation across the landscape is continuous. There are many ecotonal areas which will not fit neatly into any particular association. Such areas should be managed in the same manner as the most similar association. In most cases, similar associations have similar management properties.

This key and guide should be used in the field to aid proper identification of associations. Questions concerning identification should be addressed in the field where species composition and cover can be easily and correctly evaluated.

There are only about 30 common herb and shrub species used in the key and association descriptions. Table 16 contains the abbreviations, scientific and common names used in this guide.

The ecoclass code following the plant association name in both the key and guide should be used whenever ecoclass is to be entered in the TRI system.

Series Key

Page

1. Canopy cover less than 10 percent. Non-forest, to be described in later guides.
1. Canopy cover greater than 10 percent . . . .(2)

2. Noble fir greater than 10 percent of the canopy. Noble fir community 107
2. Noble fir minor or absent . . . .(3)

3. Sitka spruce over 2 percent in regeneration layer or over 10 percent in canopy. Sitka spruce series, Key A 56
3. Sitka spruce minor or absent . . . .(4)

4. Western hemlock over 2 percent in regeneration layer or 10 percent in canopy. Western hemlock series, Key B 57
4. Western hemlock and Sitka spruce absent . . . .(5)

5. Within the local zone of Sitka spruce; usually less than 5 miles from ocean, elevation usually less than 1,000 feet. Sitka spruce series. Key A 56
5. Outside local zone of Sitka spruce occurence. Western hemlock series. Key B 57

Key A. Sitka Spruce Series

		Page
1.	Devil's club cover greater than 5 percent. PISI/OPHO CSS6-21	61
1.	Devil's club minor or absent . . . .(2)	
2.	Salmonberry cover greater than 10 percent . . . .(3)	
2.	Salmonberry minor or absent . . . .(4)	
3.	Salal or evergreen huckleberry cover greater than 10 percent. PISI/RUSP-GASH CSS5-22	71
3.	Salal and evergreen huckleberry minor or absent. PISI/RUSP CSS5-21	69
4.	Salal cover greater than 20 percent. PISI/GASH CSS3-21	67
4.	Salal minor or absent . . . .(5)	
5.	Oregon oxalis cover greater than 20 percent. PISI/OXOR CSF3-21	65
5.	Oregon oxalis minor or absent . . . .(6)	
6.	Fool's huckleberry cover greater than 5 percent. PISI/MEFE-VAPA CSS2-21.	63
6.	Fool's huckleberry minor or absent . . . .(7)	
7.	Swordfern cover greater than 20 percent. PISI/POMU CSF1-21	73
7.	Swordfern minor or absent. Sparse understory, return to step 1 and use releative cover instead of percent cover.	

Key B. Western Hemlock Series

Page

1. Rhododendron cover over 5 percent . . . . (2)
1. Rhododendron minor or absent . . . . (6)

2. Evergreen huckleberry cover over 20 percent. TSHE/RHMA-VAOV2 CHS3-24. 87
2. Evergreen huckleberry minor or absent . . . . (3)

3. Salal cover over 10 percent. TSHE/RHMA-GASH CHS3-22. 89
3. Salal minor or absent . . . . (4)

4. Dwarf Oregon grape cover over 5 percent. TSHE/RHMA-BENE CHS3-21. 85
4. Dwarf Oregon grape minor or absent. . . . . (5)

5. Rhododendron cover over 15 percent. TSHE/RHMA/POMU CHS3-23 91
5. Rhododendron cover less than 15 percent . . . . (6)

6. Devil's club cover over 5 percent. TSHE/OPHO CHS5-21 75
6. Devil's club minor or absent . . . . (7)

7. Salmonberry cover over 10 percent . . . . (8)
7. Salmonberry minor or absent . . . . (10)

8. Salal cover over 10 percent. TSHE/RUSP-GASH CHS4-23. 97
8. Salal minor or absent . . . . (9)

9. Vine maple cover over 20 percent. TSHE/RUSP-ACCI CHS4-22 99
9. Vine maple minor or absent. TSHE/RUSP CHS4-21. 95

10. Salal cover over 20 percent . . . . (11)
10. Salal minor or absent . . . . (13)

11. Dwarf Oregon grape cover over 10 percent. TSHE/BENE-GASH CHS1-22 79
11. Dwarf Oregon grape minor or absent . . . . (12)

12. Vine maple cover over 20 percent. TSHE/ACCI-GASH CHS2-21 103
12. Vine maple minor or absent. TSHE/GASH CHS1-23. 93

13. Oregon oxalis cover over 20 percent. TSHE/OXOR CHF1-21 83
13. Oregon oxalis minor or absent . . . . (14)

14. Evergreen huckleberry cover over 10 percent. TSHE/VAOV2 CHS6-10 81
14. Evergreen huckleberry minor or absent . . . . (15)

15. Dwarf Oregon grape cover over 5 percent. TSHE/BENE CHS1-21 77
15. Dwarf Oregon grape minor or absent . . . . (16)

16. Vine maple cover over 20 percent. TSHE/ACCI/POMU CHS2-22 105
16. Vine maple minor or absent . . . . (17)

17. Swordfern cover over 20 percent. TSHE/POMU CHF1-22 101
17. Swordfern minor or absent. Sparse understory, return to step 1 and use relative cover instead of percent cover.

Table 16. List of TRI abbreviations, scientific, and common names of trees, shrubs, and herbs used in the key and association discriptions[1]. Species used in the key are indicated with a *.

TREES

TRI CODES	SCIENTIFIC NAME	COMMON NAME	INDICATION[2]
ABPR *	Abies procera	Noble fir	
ACMA	Acer macrophyllum	Bigleaf maple	
ALRU	Alnus rubra	Red alder	disturbance
ARME	Arbutus menziesii	Madrone	warm, dry
CACH	Castanopis chrysophylla	Chinquapin	warm, dry
PISI *	Picea sitchensis	Sitka spruce	coastal fog
PICO	Pinus contorta	Lodgepole pine	
PSME	Pseudotsuga menziesii	Douglas-fir	
TABR	Taxus brevifolia	Pacific yew	
THPL	Thuja plicata	Western redcedar	
TSHE *	Tsuga heterophylla	Western hemlock	

SHRUBS

TRI CODES	SCIENTIFIC NAME	COMMON NAME	INDICATION
ACCI *	Acer circinatum	Vine maple	
BENE *	Berberis nervosa	Dwarf Oregon grape	warm
CACH	Castanopsis chrysophylla	Chinquapin	warm, dry
CEVE	Ceanothus velutinus	Snowbrush	disturbance
COCO	Corylus cornuta	California hazel	warm
CONU	Cornus nuttallii	Pacific dogwood	warm
GASH *	Gaultheria shallon	Salal	
HODI	Holodiscus discolor	Ocean-spray	
MEFE *	Menziesia ferruginea	Fool's huckleberry	cool
MYCA	Myrica californica	Pacific bayberry	coast dunes
OPHO *	Oplopanax horridum	Devil's club	wet
RHMA *	Rhododendron macrophyllum	Rhododendron	dry
RHDI	Rhus diversiloba	Poison oak	hot, dry
RHPU	Phmnus purshiana	Cascara	
RILA	Ribes lacustre	Prickly currant	
ROGY	Rosa gymnocarpa	Baldhip rose	warm, dry
RUPA	Rubus parviflorus	Thimbleberry	
RUSP *	Rubus spectabilis	Salmonberry	warm, wet
RUUR	Rubus ursinus	Trailing blackberry	warm
SARA	Sambucus racemosa	Red elderberry	
SYMO	Symphoricarpos mollis	Snowberry (trailing)	warm, dry
VAAL	Vaccinium alaskaense	Alaska huckleberry	cool
VAME	Vaccinium membranaceum	Big huckleberry	cool-cold
VAOV2 *	Vaccinium ovatum	Evergreen huckleberry	
VAPA	Vaccinium parvifolium	Red huckleberry	warm

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[1]Keyed to "Northwest Plant Names and Symbols for Ecosystem Inventory and Analysis," USDA Forest Service General Technical Report PNW-46, Fourth Edition, 1976, and "Flora of the Pacific Northwest," Hitchcock and Cronquist, 1973.

[2]Environmental indication is strong when several similar species are present and their cover is high. Opposite indications should be weighed by number of indicators present and their percent cover.

Table 16. List of TRI abbreviations, scientific, and common names of trees, shrubs, and herbs used in the key and association discriptions[1] (continued).

HERBS AND GRASSES

TRI CODE	SCIENTIFIC NAME	COMMON NAME	INDICATION
ADBI	Adenocaulon bicolor	Pathfinder	
ADPE	Adiantum pedatum	Maidenhair fern	wet
ANDE	Anemone deltoidea	Three-leaved anemone	
AQFO	Aquilegia formosa	Sitka columbine	
ARCA3	Aralia californica	California aralia	
ASCA3	Asarum caudatum	Wild ginger	moist
ATFI	Athyrium filix-femina	Ladyfern	moist, wet
BLSP	Blechnum spicant	Deerfern	moist
CABU2	Calypso bulbosa	Calypso orchid	
CAOB	Carex obnupta	Slough sedge	wet
CLUN	Clintonia uniflora	Queencup beadlily	cool
COLA	Coptis laciniata	Goldthread	
COMA3	Corallorhiza maculata	Coral-root	
COCA	Cornus canadensis	Dogwood bunchberry	cool
DIFO	Dicentra formosa	Pacific bleeding heart	moist
DIHO	Disporum hookeri	Fairybells	
DIPU	Digitalis purpurea	Foxglove	
DRAU2	Dryopteris austriaca	Mountain woodfern	
EQUIS	Equisetum spp.	Horsetail	moist
FRAGA	Fragaria spp.	Strawberry	
FECA	Festuca californica	California fescue	
GAOR	Galium oreganum	Oregon bedstraw	
GATR	Galium triflorum	Sweetscented bedstraw	
GOOB	Goodyera oblongifolia	Rattlesnake plantain	
GYDR	Gymnocarpium dryopteris	Oak fern	moist
HIAL	Hieracium albiflorum	White hawkweed	
LUCA2	Luzula campestris	Field woodrush	
LYAM	Lysichitum americanum	American yellow skunk cabbage	wet
MADI2	Maianthemum dilatatum	False lily-of-the-valley	
MOSI	Montia sibirica	Siberian montia	
OSCH	Osmorhiza chilensis	Sweet cicely	
OXOR *	Oxalis oregana	Oregon oxalis	
POMU *	Polystichum munitum	Western swordfern	
POGL4	Polypodium glycyrrhiza	Licorice fern	
PTAQ	Pteridium aquilinum	Bracken fern	disturbance
PYPI	Pyrola picta	White vein pyrola	
PYAS	Pyrola asarifolia	Alpine pyrola	
STAM	Streptopus amplexifolius	Clasping leaved tweisted stalk	
STME2	Stachys mexicana	Mexican betony	
SMRA	Smilacina racemosa	Feather solomonplume, False solomonseal	moist
SMST	Smilacina stellata	Starry solomonplume, False solomonseal	moist
TIUN	Tiarella unifoliata	Coolwort foamflower	moist
TOME	Tolmiea menziesii	Pig-a-back plant	
TRLA2	Trientalis latifolia	Western starflower	
TROV	Trillium ovatum	Pacific trillium	
VAHE	Vancouveria hexandra	Inside-out-flower	moist, warm
VIGL	Viola glabella	Pioneer violet	moist
VISE	Viola sempervirens	Redwoods violet	

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[1]Keyed to "Northwest Plant Names and Symbols for Ecosystem Inventory and Analysis," USDA Forest Service General Technical Report PNW-46, Fourth Edition, 1976, and "Flora of the Pacific Northwest," Hitchcock and Cronquist, 1973.

Sitka spruce/devil's club
PISI/OPHO — COAST CSS6-21

<u>Floristic Characteristics</u>

Douglas-fir, western hemlock, and Sitka spruce dominate the canopy layer. Both western hemlock and Sitka spruce regenerate in many stands. Red alder is often present in the canopy, occasionally as the dominant species.

Devil's club is always present, averaging 23 percent cover. Fool's huckleberry, salmonberry, red huckleberry, salal, and vine maple are common. Total shrub cover averages 53 percent.

The diverse herb layer usually includes swordfern, fairybells, deerfern, mountain woodfern, ladyfern, Oregon oxalis, Siberian montia, false lily-of-the-valley, Mexican betony, field woodrush, sweetscented bedstraw, and Pacific trillium. Several other species may be present. Total herb cover averages 69 percent.

<u>Environmental Characteristics</u>

The Sitka spruce/devil's club association indicates very moist soils and strong maritime climatic influences, regardless of slope position or aspect. Effective rooting depth averages 40 inches (Table 2) and soil moisture is abundant through the year. On steep slopes, this association may indicate seeps or impeded drainage. On gentle terrain it occurs where water accumulates from poorly drained areas upslope. American yellow skunkcabbage, if present, indicates swampy conditions. Fourteen out of 15 of our sample plots were from Hebo Ranger District.

<u>Productivity and Management Characteristics</u>

This association, while not widespread, presents some unique management considerations. Since the soils are moist throughout the year, compaction and erosion may be serious following disturbance. Building roads through the association will require careful planning for stability and drainage. This association frequently occurs near streams and has important hydrologic functions, including regulation of sediment and input of organic matter. Many natural stands possess snag, down wood, and live tree structural characteristics of old-growth by age 100. Management for old-growth characteristics would be comparatively easy.

Douglas-fir site index averages 116, (50-year base, Table 12). Sitka spruce grows as well as or better than Douglas-fir. In addition, Sitka soils better than Douglas-fir. Red alder grows and regenerates very well.

Stand basal area averages 281 square feet per acre, lower than normal for the Sitka spruce series (Table 12). Natural stands have developed under intense early competition from salmonberry and red alder and are generally widely spaced. Competition from salmonberry and red alder will usually be severe following clearcutting. Sitka spruce/devil's club sites are difficult to burn. Most sites are resilient to fire effects (Barnett 1984).

Given relatively high use by deer, elk, and mountain beaver, and general proximity to water sources or streams, the Sitka spruce/devil's club association is often valuable as wildlife habitat (Table 4).

Comparisons

The Sitka spruce/devil's club association occurs along the Pacific Coast well into Alaska. The Waldport Ranger District represents the southern limit of its distribution. It has been described on the Olympic National Forest in Washington (Henderson and Peter 1982), in British Columbia and in southeast Alaska (Alaback 1980 and Martin et al. 1985). The type has not been previously described in Oregon, though it is increasingly common north of the Hebo Ranger District.

The Sitka spruce/devil's club-salmonberry/dogwood bunchberry association occurs on alluvial floodplains in Southeast Alaska (Alaback 1980). Alaback suggests that the productivity of this association is much lower than that of similar stands on the Oregon Coast because of the shorter growing seasons and glacially formed or boggy soil conditions.[1]

A Sitka spruce/ devil's club association occurs in near-ocean habitats that experience frequent floods on the Chatham area of the Tongass National Forest (Martin et al. 1985). This association, which lacks Douglas-fir as a major overstory component, is floristically quite different from the Sitka spruce/devil's club association on the Siuslaw National Forest.

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[1] Personal communication, Paul Alaback, Research Ecologist, Juneau, AK

Sitka spruce/fool's huckleberry-red huckleberry
PISI/MEFE-VAPA — COAST CSS2-21

Floristic Characteristics

Western hemlock and Douglas-fir dominate the canopy, usually accompanied by Sitka spruce. Red alder may occur in the canopy but is not usually the dominant species. Western hemlock is the major regenerating species; Sitka spruce is usually present.

Several shrubs often occur, but fool's huckleberry and red huckleberry are most common. Salal, salmonberry, and trailing blackberry are often present, but not abundant. Alaska huckleberry, a species common at high elevations in the Cascades and north into Alaska, may be abundant.

Swordfern and deerfern are nearly always present. Other common herbs include Oregon oxalis, Siberian montia, false lily-of-the-valley, fairybells, field woodrush, sweetscented bedstraw, Pacific trillium, and redwoods violet.

Environmental Characteristics

This association occurs on benches and gentle, lower and middle slopes on Hebo and Waldport Ranger Districts. Soils are moist and relatively development in clearcuts, mostly salmonberry,

should not be as intense as in the salmonberry associations. Sites are generally resilient to fire effects (Barnett 1984).

This association has the highest potential for developing old-growth Sitka spruce stands. Many 90-year-old stands have scattered trees over 50 inches DBH. Management for large dead wood could produce levels of snags and down wood comparable to Douglas-fir old-growth in a relatively short time. Deer and elk use of natural stands is usually heavy, possibly because of abundant red huckleberry, a favored browse species. Mountain beaver populations range from low to moderate (Table 4).

Comparisons

The Sitka spruce/fool's huckleberry-red huckleberry association has not been described outside the Siuslaw National Forest but is probably increasingly common north of the Forest in the Coast Range. Plant communities dominated by Sitka spruce and fool's huckleberry are common in Southeast Alaska (Martin et al. 1985).
well-drained, averaging 56 inches total depth and 49 inches effective rooting depth (Table 2). Soil series varied in our sample plots, but those

having relatively high coarse fragment contents were most common.

Maritime climatic influences are important, including frequent fog. This association is in the transition between the western hemlock and Sitka spruce climatic zones. Coastal fog and other marine influences are probably not as pronounced as in other Sitka spruce associations. But, since the fool's huckleberry association drops out quickly to the south and increases into Southeast Alaska, it probably indicates a generally cooler climate than most of the other Sitka spruce types.

Productivity and Management Characteristics

Douglas-fir grows moderately well. Site index averages 114 (50 year base, Table 12). Douglas-fir site index is lower in this association than in any other Sitka spruce association, possibly a reflection of a cooler climate. Sitka spruce grows extremely well, site index averages 175 (100 year base). Western hemlock and red alder also grow well. Shrub

Floristic Characteristics

Sitka spruce, western hemlock, and Douglas-fir usually dominate the canopy layer. Western hemlock and Sitka spruce comprise the regeneration layer, if any is present. Red alder is the major canopy species in some stands.

Fool's huckleberry, red huckleberry, salmonberry, and elderberry occur in the relatively sparse shrub layer. Total shrub cover averages 31 percent.

A rich Oregon oxalis carpet characterizes the herb layer. Swordfern is usually abundant. Other common herbs include false lily-of-the-valley, Mexican betony, ladyfern, deerfern, mountain woodfern, fairybells, California fescue, field woodrush, and Pacific trillium.

Environmental Characteristics

This association is the coastal complement of the western hemlock/Oregon oxalis association. It occurs on well-watered, well-drained benches, alluvial flats, and toe slopes. Soils are not as wet as in the Sitka spruce/devil's club or salmonberry associations and are generally rich. Soil depth and effective rooting depth are about the same as in the Sitka spruce/swordfern association and generally deeper than in other Sitka spruce associations (Table 2). Nearly all our samples of this association are from Hebo Ranger District. As in the other Sitka spruce associations, the climate is strongly maritime, including frequent summer fog and fairly uniform temperatures.

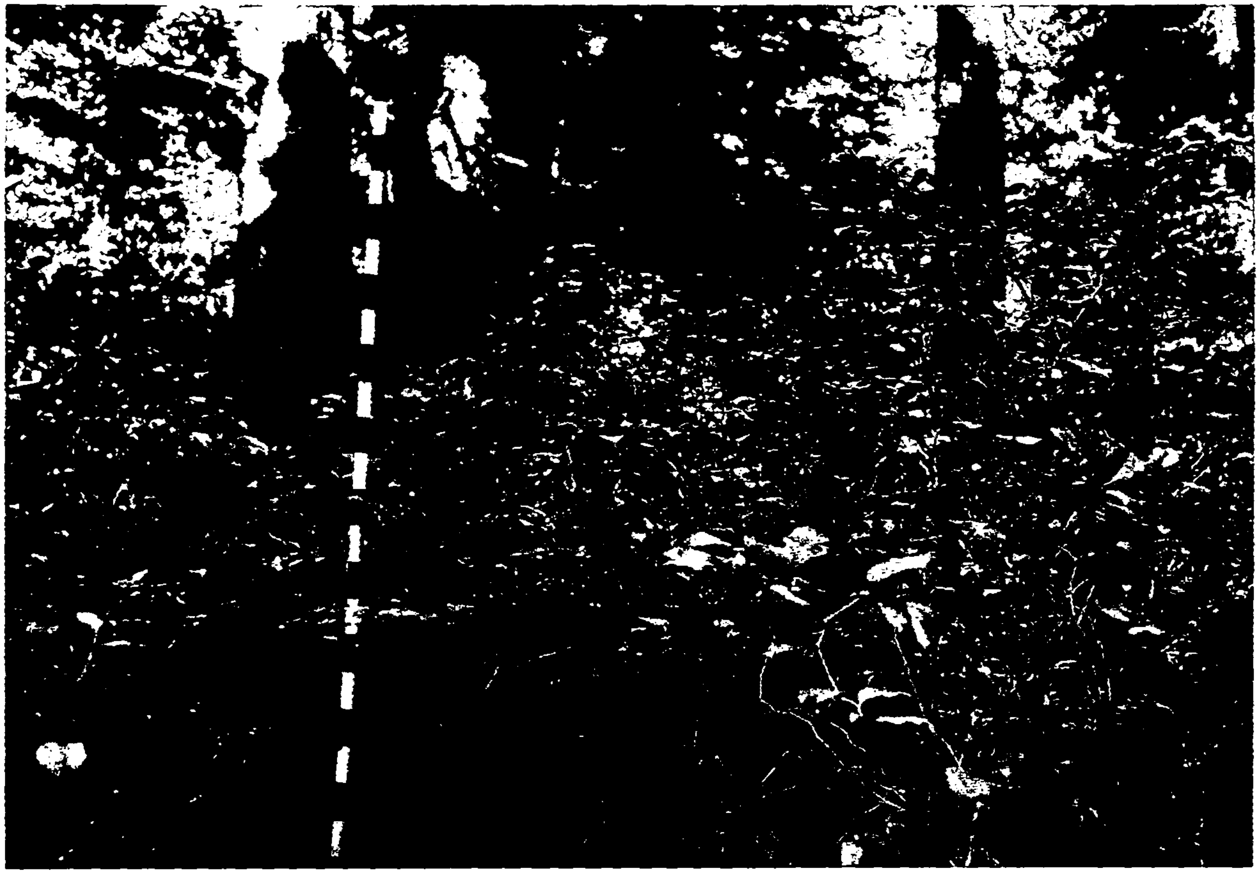
Productivity and Management Characteristics

Douglas-fir, Sitka spruce, western hemlock, western redcedar, and red alder all grow well in this association. Douglas-fir site index averages 121 (50 year base, Table 12). Stand basal area averages 327 square feet per acre (Table 12). Available data indicate relatively low levels of shrub development in early succession. Red alder is an important species on many sites and grows rapidly. Other than red alder competition, browsing by deer, elk, mountain beaver and other animals may be the greatest detriment to full stocking. Sitka spruce should be considered for planting since it has excellent diameter, height, and stand volume growth patterns. Spruce weevil may limit spruce success in some areas, particularly outside the coastal fog zone. Most sites are resilient to fire effects (Barnett 1984).

Wildlife use in the Sitka spruce/Oregon oxalis type is often high. Many sites are on shaded north aspects, where they may provide relief from summer heat for deer and elk. Open vegetative conditions may also encourage deer and elk use. Mountain beaver populations are low to moderate (Table 4). Rapid tree growth allows relatively early development of old-growth structures. When the Sitka spruce/Oregon oxalis type occurs in riparian zones, most often on raised alluvial terraces, it plays an important role in input of woody debris to streams. Most stands are visually attractive and would be good locations for trails.

Comparisons

Sitka spruce/Oregon oxalis communities occur along the immediate coast from central Oregon north into British Columbia. They are most prominent along alluvial flats and terraces. Henderson and Peter (1982) described a similar association, in which western hemlock plays a larger role, on the Olympic National Forest in Washington on low elevation flats and terraces. Douglas-fir site index is very similar to that in the Siuslaw National Forest Sitka spruce/Oregon oxalis association.



Floristic Characteristics

Sitka spruce, western hemlock, and Douglas-fir are the major canopy components. Western hemlock and Sitka spruce regenerate in many stands. Red alder frequently occurs in the canopy, usually in small amounts.

Dense salal thickets (averaging 53 percent cover) are typical. Red huckleberry and salmonberry are nearly always present. A few other shrubs, including fools' huckleberry and trailing blackberry, are common in small amounts.

Only swordfern contributes much cover to the herb layer, but it may be minor or absent. A few other herbs occur in trace amounts. Total herb cover averages 32 percent.

Environmental Characteristics

This association occurs near the ocean on well-drained, moderately shallow soils, often in the salt-spray zone. Several of our sample plots were on stabilized sand dunes. Sites range from steep to nearly flat and tend to be southwest-facing. As is the case in most of the coastal strip, summer fog is more frequent and temperatures more uniform than farther inland. Our sample plots were from Waldport and Hebo Ranger Districts and Oregon Dunes National Recreation Area (NRA). Over half our plots were from the Waldport Ranger District.

Productivity and Management Characteristics

Conifers grow moderately well on sites in this association. Douglas-fir site index averages 122 (50 year base, Table 12). Sitka spruce does not appear to grow as well as Douglas-fir, possibly due to low summer soil moisture. More inland examples of this association should probably be managed for Douglas-fir or a mix of Douglas-fir and Sitka spruce. Red alder does not grow as well here as in the salmonberry and swordfern associations. Management for alder may require planting to insure adequate stocking. Basal area of natural stands averages 329, higher than in most other Sitka spruce associations (Table 12). This may be due to less intense early seral competition.

Salmonberry height averages about 1 foot by the fifth year following harvest (Table 15). As a result, costs of stand establishment should be significantly lower than in the salmonberry associations. Although burning may be necessary to reduce fuels, it is probably not necessary for competition reduction on most sites. Sites are either resilient or moderately sensitive to fire effects, depending on soil depth and slope (Barnett 1984).

The Sitka spruce/salal association is not generally found in riparian situations and does not usually contribute significantly to woody debris in streams. Wildlife use can be high on coastal headlands where this and other Sitka spruce associations are used for hiding cover adjacent to open meadows. Mountain beaver populations are low to moderate (Table 4). Stands that have been thinned may have a dense salal layer that restricts deer and elk use.

Comparisons

The Sitka spruce/salal association is common on well-drained soils near the ocean. It occurs south to the southern range of Sitka spruce and north into British Columbia, but has not been described outside the Siuslaw National Forest.

Floristic Characteristics

The canopy in this association ranges from nearly pure Sitka spruce, Douglas-fir, and western hemlock to nearly pure red alder. Conifer regeneration under mature stands, usually either Sitka spruce or western hemlock, may be very sparse or absent. In cases where Sitka spruce and western hemlock are absent from the canopy and regeneration layer, successional development after the alder canopy falls apart is unclear. Physical factors such as proximity to the ocean, elevation (generally less than 1,000 feet except on Mt. Hebo) and the distribution of Sitka spruce in the area will have to guide classification of such sites into the Sitka spruce or western hemlock series.

Dense salmonberry characterizes the shrub layer. Red huckleberry, vine maple, and fool's huckleberry are usually present, along with a few other shrubs.

The herb layer consists of swordfern and Oregon oxalis on most sites, usually accompanied by several other herbs; including, fairybells, deerfern, ladyfern, Siberian montia, false lily-of-the-valley, Mexican betony, field woodrush, sweetscented bedstraw, and Pacific trillium.

Environmental Characteristics

The Sitka spruce/salmonberry association indicates abundant soil moisture with adequate drainage and strong maritime climatic influences. Salmonberry communities often dominate lower slopes and alluvial flats and may extend to ridgetops. Soils are usually moderately deep (Table 2), developed from upslope colluvial materials, and rich in organic matter.

The Sitka spruce/salmonberry association occurs on the Hebo Ranger District from sea level to over 1,500 feet elevation on both gentle and steep terrain. On the Waldport Ranger District it rarely occurs above 1,000 feet elevation and is generally found on gentle topography. Two of our samples were from the north end of the Mapleton Ranger District.

Productivity and Management Characteristics

Douglas-fir, Sitka spruce, western hemlock, red alder and salmonberry grow very well in this association (Tables 12, 14, and 15). Douglas-fir site index averages 122 (50 year base) and Sitka spruce averages 174 (100 year base, Table 12). Basal area in natural stands averages only 247 square feet per acre due, at least in part, to intense competition in early succession (Table 12).

Competition between trees and shrubs following clearcutting is more severe than in any other Siuslaw National Forest association. Salmonberry responds rapidly following canopy removal, often reaching 3 to 4 feet in height by three years following harvest (Table 15). By 8 years after clearcutting, untreated sites are often dense mixtures of alder and salmonberry. Rapid conifer establishment is essential for successful regeneration. Once conifers become established, their growth is usually excellent. Most sites are resilient to fire effects (Barnett 1984), but will be difficult to burn for site preparation. Moist soils increase erosion and compaction hazards. Proximity to streams may also complicate aerial application of herbicides.

High conifer growth rates allow rapid development of old-growth live structural features. Old-growth characteristics could be produced substantially before 200 years by implementing appropriate management techniques. In addition, this association usually occurs on lower slopes and near streams and provides important riparian habitat and is a source of woody debris for streams. Mountain beaver populations are often high. Deer and elk use is heavy in some natural stands and openings.

Comparisons

Sitka spruce/salmonberry communities become increasingly common along the Pacific Coast north of the Mapleton Ranger District into Washington. However, this association has not been described outside of the Siuslaw National Forest.

Floristic Characterics

Sitka spruce, western hemlock, and Douglas-fir usually dominate the canopy. Western hemlock and (less frequently) Sitka spruce form the regenerating layer, if any is present. Red alder occurs but is not often the major species.

The dense shrub layer averages 72 percent cover. Salmonberry and salal are the major species. Red huckleberry, fool's huckleberry, and evergreen huckleberry are common. Vine maple may be abundant.

Swordfern cover averages 26 percent. The herb layer is otherwise sparse, with small amounts of Siberian montia, mountain woodfern, deerfern, and Pacific trillium.

Environmental Characteristics

This association occurs along ridges or topographic rises usually below 1,000 feet elevation near the coast. Soils are well-drained and relatively thin (Table 2). Maritime climatic influences are strong with frequent summer fog and relatively uniform temperature conditions (Figure 2). Sites are topographically somewhat drier than in the Sitka spruce/salmonberry association but less well-drained than in the Sitka spruce/salal association.

Productivity and Management Characteristics

Douglas-fir, Sitka spruce, western hemlock and red alder grow well. Douglas-fir site index averages 125 (50 year base), highest of the Sitka spruce associations (Table 12). Sitka spruce also grows very well and, although susceptible to spruce weevil, should be considered for management.

Basal area in natural stands averages 312 square feet per acre, substantially higher than in the Sitka spruce/salmonberry association (Table 12). This may be due to less intense early seral competition from shrubs and red alder. Salmonberry competition following clearcutting can be severe, but not generally as intense as in the Sitka spruce/salmonberry association. The presence of salal indicates drier sites, in which salmonberry does not grow as rapidly. In any case, planted seedling should be quickly established to lessen shrub competition problems. Most sites are resilient to fire effects. Those with thin soils may be moderately sensitive to fire effects (Barnett 1984).

Rapid conifer growth rates allow quick establishment of large wildlife habitat structures. This association is not usually found under riparian conditions and is not an important source of woody debris in streams. Mountain beaver populations are low to moderate (Table 4). Deer and elk use is usually light in natural stands.

Comparisons

Sitka spruce/salmonberry-salal communities are scattered along the Oregon Coast, but this association has not been described outside of the Siuslaw National Forest.

Floristic Characteristics

Sitka spruce, western hemlock, and Douglas-fir usually dominate the canopy. Western redcedar is also common. Red alder is frequently present and may dominate the canopy. Western hemlock and Sitka spruce form the regeneration layer, if any is present.

Red huckleberry, fool's huckleberry, and salmonberry are the most common shrubs. Salal and evergreen huckleberry are frequent codominants. Total shrub cover is usually low, averaging 24 percent.

Swordfern is usually abundant, averaging 55 percent cover. Several other herbs may be present in small amounts, including: Siberian montia, false lily-of-the-valley, Oregon oxalis, ladyfern, deerfern, fairybells, sweetscented bedstraw, Pacific trillium, and redwoods violet.

Environmental Characteristics

The Sitka spruce/swordfern association occupies middle and lower slopes and benches in the Sitka spruce zone. It often lies just above the lower slope break into salmonberry communities or on shaded northerly-facing slopes. Soils are deep and rich in organic matter. Average soil depth and effective rooting depth are greater than in any other Sitka spruce association (Table 2). In fact, the Sitka spruce/swordfern association had deeper soils, on average, than any other forested plant association sampled. Soil coarse fragment contents are consistently low. All but one of the seven descriptions of soil pits on intensive plots fell into the Salander soil series (Table 1).

Productivity and Management Characteristics

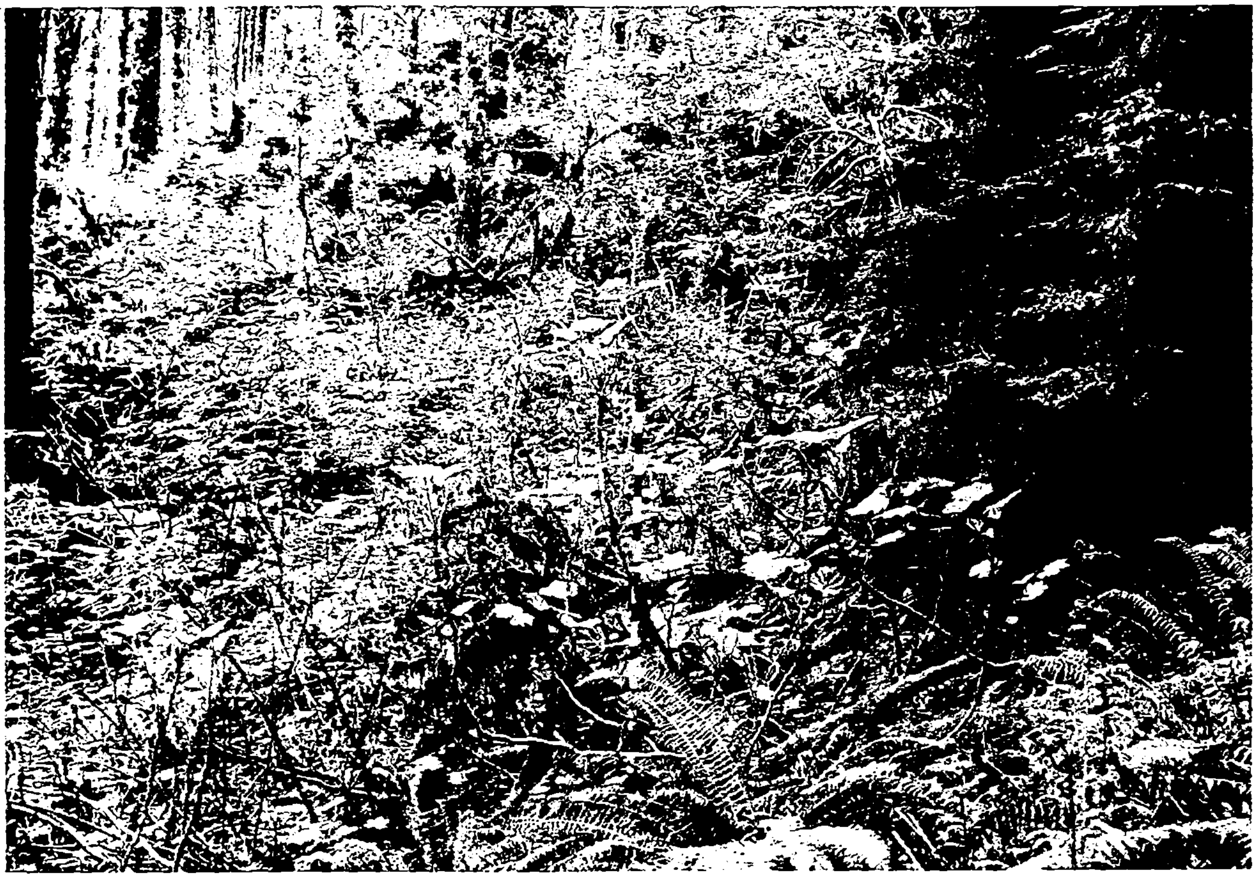
Sitka spruce, Douglas-fir, western hemlock, red alder and western redcedar all grow well. Douglas-fir site index averages 123 (50 year base, Table 12). Sitka spruce may be a good choice for management, especially where deer and elk damage is likely. Basal area in natural stands averages 316 square feet per acre (Table 12).

Shrub competition can develop to moderate levels following clearcutting but not to the extent typical of the salmonberry associations (Tables 14 and 15). In many cases, swordfern is the major early seral understory species and the shrub layer is relatively sparse. A substantial red alder canopy can develop and is the main competitor with conifers on many sites. Damage from animal browse may be substantial. Sites are generally resilient to fire effects (Barnett 1984).

As in the rest of the Sitka spruce associations, large structures necessary for old-growth habitat can be produced relatively quickly. Swordfern communities occasionally occur on raised alluvial terraces and, in such cases, are especially important deer and elk habitat. Swordfern sites on upper slopes may be heavily used, although in a less predictable fashion. Most stands are visually attractive and would be suitable for trail locations. Mountain beaver populations range from moderate to high (Table 4).

Comparisons

The Sitka spruce/swordfern association is fairly common north of the Siuslaw National Forest to British Columbia. Henderson and Peter (1982) described a floristically similar association on the Olympic National Forest in Washington. They reported much higher site indicies for Douglas-fir and Sitka spruce than those of the Siuslaw National Forest Sitka spruce/Oregon oxalis association.



Floristic Characteristics

Douglas-fir and western hemlock dominate the canopy. Many stands contain substantial amounts of western redcedar or red alder. If a regeneration layer is present, western hemlock and, to a smaller degree, western redcedar are the major species,

Devil's club is always important in the diverse shrub layer. Vine maple, salmonberry, red huckleberry, and fool's huckleberry may be abundant. Total shrub cover averages 56 percent.

Oregon oxalis and swordfern are the major herb species. Other wet site indicating herbs are usually present; especially, lady fern, maidenhair fern, Mexican betony, and mountain woodfern. Several other herbs are common: deerfern, Siberian montia, sweetscented bedstraw, and Pacific trillium. Total herb cover averages 74 percent.

Environmental Characteristics

The western hemlock/devil's club association is relatively common on the Hebo Ranger District in poorly drained, concave or seepy topography, usually on northerly-facing slopes or near streams. Soils tend to be relatively shallow and moist, if not saturated, throughout the year. Soil depth averaged 40 inches (22 inches effective rooting depth) on our intensive plots (Table 2). Elevations vary from near sea level to over 1,800 feet on Mt. Hebo. This association is much less common on the Alsea and Waldport Ranger Districts and rare on the Mapleton Ranger District.

Productivity and Management Characteristics

Douglas-fir site index averages 130 (50 year base, Table 12), better than any other plant association except western hemlock/salmonberry-vine maple. Basal area of natural stands averages 298 square feet per acre (Table 12). Many stands are relatively poorly stocked with conifers, probably due to intense competition during early succession. Where the type is extensive, species more tolerant of saturated soils, particularly western redcedar, should be considered for planting.

Alder and salmonberry will develop quickly on most sites after clearcutting. If salmonberry cover exceeds 10 percent, severe shrub competition can be expected following clearcutting. Salmonberry and conifer height growth during the first 5 years should be similar to that in the western hemlock/salmonberry association (Tables 14 and 15). Vine maple and thimbleberry may be important competitors in some young stands.

Soils are moist all year long and pose special engineering problems. Soil compaction or erosion may be severe. Extensive heavy equipment travel should be avoided. In addition, these sites are often associated with water sources and there may be significant hydrologic and stream sedimentation impacts following disturbance. Wildlife habitat values may be high, especially in riparian areas. Use by elk and deer does not seem particularly high in upland devil's club sites. Evidence of mountain beaver was recorded in a third of our sample plots (Table 4).

Comparisons

The western hemlock/devil's club association becomes more common north along the coast into Washington, British Columbia (Krajina 1965), and Southeast Alaska. It has been described in the Cascades from the Willamette National Forest in the south to the north Cascades in Washington. Throughout its range, it indicates saturated soils and relatively high tree growth rates.

Martin et al. (1985) described western hemlock/devil's club associations in Southeast Alaska. One association is most often found on moist, disturbed sites such as alluvial fans and floodplains. The overstory is dominated by western hemlock rather than Douglas-fir and the rich herb layer is dominated by oak-fern and woodfern rather than Oregon oxalis and swordfern. The other associations occur on cool sites at higher elevations and are dominated by *Vaccinium spp.* and devil's club.

Similar plant communities exist in the northern Washington Cascades. The productivity potential and floristic characteristics of the western hemlock/devil's club association on the Mount Baker-Snoqualmie National Forest (Henderson and Peter 1984 and 1985) are very similar to the western hemlock/devil's club association on the Siuslaw National Forest. A similar herb-rich western hemlock/devil's club association is common at Mount Rainier National Park. The western hemlock/devils club association becomes less common south in the Washington and Oregon Cascades.

The floristic characteristics of the western hemlock/devils club/Oregon oxalis association on the Mount Hood National Forest (Halverson et al. 1985) are similar to those of the western hemlock/devil's club association on the Siuslaw National Forest, but productivity is much lower on the Mount Hood National Forest.

The western hemlock/devil's club/swordfern association on the Gifford Pinchot National Forest (Topik et al. 1985) is the most herb rich of the devil's club associations. Except for the dominance of swordfern, this association is floristically very different from the western hemlock/devil's club association on the Siuslaw National Forest.

South of the McKenzie River, on the Willamette National Forest (Hemstrom et. al 1985), western hemlock/devil's club communities occur in isolated wet spots. A western hemlock/devil's club association occurs on wet habitats and fluvial and alluvial soils on the Olympic National Forest (Henderson and Peter 1981b and 1982). Although less productive than the corresponding type on the Siuslaw National Forest, both associations are floristically similar.

Western hemlock/dwarf Oregon grape
TSHE/BENE — COAST CHS1-21

Floristic Characteristics

Douglas-fir is the most abundant species in the overstory of mature stands. Western hemlock is codominant in many stands and is the major regenerating species. Western redcedar, a minor climax species, may also be codominant in some stands. Bigleaf maple is more common than red alder.

Dwarf Oregon grape is the major understory shrub, usually in association with salal. Vine maple may also be abundant. Several other shrubs occur consistenly including: trailing blackberry, red huckleberry, baldhip rose, California hazel, and ocean-spray. Total shrub cover averages 45 percent.

As with many of the other western hemlock associations, swordfern dominates the herb layer. Other common herbs which occur consistently in smaller amounts include: Siberian montia, Oregon oxalis, fairybells, California fescue, sweetscented bedstraw, western starflower, Pacific trillium, and redwoods violet. Total herb cover, most of which is swordfern, averages 50 percent.

Environmental Characteristics

The western hemlock/dwarf Oregon grape association commonly occurs at upper elevations on east-, south-, and west-facing middle- to upper-slopes with well-drained soils. Bedrock was exposed at the surface in one-third of the sample plots. Soils are either shallow or relatively deep but rocky, with low effective rooting depths (averaging 31 inches, Table 2). Preacher and Slickrock series were the most commonly described series in our intensive sample plots (Table 1). The majority of the intensive samples were from the Corvallis watershed on the Alsea Ranger District.

Productivity and Management Characteristics

Conifer and red alder growth is relatively poor. Douglas-fir site index averaged 113 (50 year base) in our sample plots (Table 12). Summer drought may limit tree growth. Seedling survival may be limited by competitiom from bigleaf maple, vine maple, and Ceanothus spp. in clearcuts. Natural red alder regeneration is typically poor.

Moderate and hot burns may cause significant soil degradation on unfavorable soil conditions and topographic positions in the the western hemlock/dwarf Oregon grape association. Most sites are moderately sensitive or sensitive to fire effects (Barnett 1984). Burning will also aid the germination and establishment of Ceanothus spp. from seed stored in the soil.

Deer and elk use is relatively low (Table 4). Since this association is widespread in the Corvallis watershed, which contains a substantial share of the Forest's old-growth, old-growth values are often high. The type as a whole, however, does not produce old-growth quickly. The western hemlock/dwarf Oregon grape type is uncommon in riparian areas. It is relatively poor mountain beaver habitat.

Comparisons

The western hemlock/dwarf Oregon grape association is common on mesic sites in the Oregon and southern Washington Cascades. It becomes less common north of Mt. Rainier in Washington.

Although floristically similar, the Cascadian western hemlock/dwarf Oregon grape associations are less productive than those of the Coast Range and Olympic Mountains. This association is often found on the poorer soils and drier sites (Halverson et al. 1985) or on warm sites in the cool portion of the western hemlock zone in the North Cascades (Henderson and Peter 1981a).

The western hemlock/dwarf Oregon grape association is highly variable on the Mt. Baker-Snoqualmie National Forest (Henderson and Peter 1981a, 1981d, 1984 and 1985). The shrub and herb layers are sparse and cool site indicating shrubs such as thin-leaf huckleberry are common in small amounts. Vine maple and swordfern are poorly represented. Site index for Douglas-fir varies from 117 to 134 (100 year base).

The western hemlock/dwarf Oregon grape association on the Gifford Pinchot National Forest (Topik et al. 1985) has a similar complement of shrubs. It lacks the large amounts of vine maple, Oregon oxalis and swordfern that are common on the Siuslaw National Forest.

The western hemlock/dwarf Oregon grape association described by Halverson et al. (1985) for the Mt. Hood National Forest has a depauperate understory dominated by dwarf Oregon grape. It is the least productive of the Cascade western hemlock/dwarf Oregon grape associations and least like that of the Siuslaw National Forest. The more productive and floristically more diverse western hemlock/dwarf Oregon grape/swordfern association described for the Mt. Hood is very similar to the western hemlock/dwarf Oregon grape association on the Siuslaw National Forest.

The western hemlock/dwarf Oregon grape association on the Willamette National Forest (Hemstrom et al. 1985) has a very diverse herb layer but lacks the large amounts of swordfern characteristic of the Siuslaw National Forest ssociation. Site index for Douglas-fir is high for the Cascades (140, 100 year index), but is nowhere near that of the Siuslaw National Forest (163, 100 year base).

There are three western hemlock/dwarf Oregon grape associations described for the Olympic National Forest (Henderson and Peter 1981b, 1981c and 1982). The western hemlock/swordfern/dwarf Oregon grape association is the only one in which productivity is similar to the western hemlock/dwarf Oregon grape association on the Siuslaw National Forest. However, it lacks the well developed, diverse shrub layer of the Siuslaw National Forest type.

In the Siskiyou province of Southwestern Oregon, this association occurs on the most moist sites east of the Coast Range crest and is often accompanied by large amounts of rhododendron (Smith et al. 1985). The understory is the most diverse of the western hemlock plant associations in the Siskiyou province. The overstory, which generally includes tan oak and western red cedar, is more diverse than that found on the Siuslaw National Forest.

Floristic Characteristics

Douglas-fir dominates the canopy in most stands. Many sites have small amounts of mature and regenerating western hemlock and western redcedar. Red alder, bigleaf maple or golden chinquapin may be present in smaller amounts in some stands.

The shrub layer is mostly comprised of dwarf Oregon grape and salal. Vine maple or evergreen huckleberry may be abundant. Red huckleberry is common in most stands. Various other shrubs, especially Pacific dogwood, baldhip rose, trailing blackberry, and ocean-spray may be present in small amounts.

The herb layer is characterized by large amounts of swordfern. Several other herbs occur in most stands: sweetscented bedstraw, western starflower, redwoods violet, Pacific trillium, fairybells, and California fescue. Total herb cover, which is mostly swordfern, averages 33 percent.

Environmental Characteristics

The western hemlock/salal-dwarf Oregon grape association is found in environments similar to those on which the western hemlock/dwarf Oregon grape association occurs. It is most common at upper elevations (average 1,385 feet) in the Alsea Ranger District, particularly in the Corvallis watershed.

Sites tend to be more northerly facing and soils less stoney than in the western hemlock/dwarf Oregon grape association, but shallower than in the western hemlock/salal association. The Klickitat soil series was most common on the few intensive plots installed in this association (Table 1). Given the similarity of site and vegetation, some western hemlock/dwarf Oregon grape-salal stands may be western hemlock/dwarf Oregon grape sites where large amounts of salal have developed in response to open canopy conditions.

Productivity and Management Characteristics

Conifer growth is relatively poor. Douglas-fir site index averages 113 (50 year base, Table 12). Stand basal area is relatively high, averaging 320 square feet per acre (Table 12). Natural regeneration of red alder is usually spotty. Shrub competition in the early seral stages after disturbance is not particularly intense in this association.

Given the typical thin soils, past fire history, and their usual drier, ridgetop topographic positions, western hemlock/dwarf Oregon grape-salal sites are often sensitive to fire effects (Barnett 1984).

Deer and elk use is relatively low in natural stands. The robust thickets of salal which develop following thinning restrict big game travel and further limit use. Mountain beaver are not usually abundant (Table 4). This association is most common in the Corvallis watershed, which contains a large share of the Forest's old-growth habitat.

Comparisons

Communities dominated by salal and dwarf Oregon grape are common in the Oregon Cascades, the southern Washington Cascades, and drier parts of the Coast Range, north to the Olympic Mountains and Vancouver Island. This association is not common in the Siuslaw National Forest. It is more abundant east of the Forest boundary, but has not been described in the Willamette Valley.

Similar associations are widespread on the Willamette (Hemstrom et al. 1985), Gifford Pinchot (Topik et al. 1985) and Mt. Hood (Halverson et al. 1985) National Forests. Shrub density is far lower and herb diversity higher in the Cascades. Salal and swordfern are less important components of the Cascadian associations. Site index for Douglas-fir is 15 to 30 feet lower in the Cascades, decreasing from a high of 141 (100 year base) on the Willamette National Forest to 126 (100 year base) on the Gifford Pinchot National Forest.

The western hemlock/salal-dwarf Oregon grape and western hemlock/swordfern/salal associations described on the Olympic National Forest (D. Peter, personal communication) are similar to the Siuslaw National Forest western hemlock/dwarf Oregon grape-salal association. The more productive western hemlock/swordfern/salal association on the Olympic National Forest has a well developed herbaceous layer and a dense shrub layer (including dwarf Oregon grape) similar to the western hemlock/dwarf Oregon grape-salal association on the Siuslaw National Forest.

The Olympic National Forest western hemlock/salal-dwarf Oregon grape association is less rich and lacks the swordfern dominated herb layer of the Siuslaw National Forest association.

Floristic Characteristics

Douglas-fir dominates the canopy. Western hemlock and western redcedar may occur in the canopy and regeneration layers. About one-third of our sample plots contained red alder, rarely as the dominant species. Bigleaf maple may be present.

Several shrub species comprise the dense shrub layer. Evergeen huckleberry is always present and averages 21 percent cover. Other common shrubs include: salal, red huckleberry, vine maple, dwarf Oregon grape and small amounts of salmonberry. The shrub layer is typically dense, averaging 73 percent cover.

Swordfern dominates the herb layer with an average cover of 43 percent. Sweetscented bedstraw, Pacific trillium, deerfern, Oregon oxalis, and Siberian montia may also be present, but in small amounts.

Environmental Characteristics

The evergreen huckleberry association occurs most often on steep, south- or west-facing upper-slopes and ridges. Sites are generally drier than those of the western hemlock/ salal association. Soil moisture is less abundant than in the western hemlock/swordfern association but more abundant than in rhododendron associations.

Soil depth averages 48 inches with 36 inches of effective rooting depth (Table 2). This association occurs on a variety of soil series, but Preacher and Honeygrove are most common (Table 1). Seventy-seven percent of our sample plots were from the Mapleton Ranger District.

Productivity and Management Characteristics

Douglas-fir site index averages 118 (50 year base, Table, 12) and stand basal area averages 306 square feet per acre (Table 12). Natural red alder regeneration is gernerally poor. Red alder growth is relatively slow.

Shrub competition in clearcuts is slight. Moderate and hot slash fires should be avoided since many sites are on upper slopes with relatively poor soils, possibly with low nitrogen levels. Most sites are moderately sensitive to fire effects (Barnett 1984).

Wildlife habitat and riparian values are relatively low. Mountain beaver are uncommon (Table 4).

Comparisons

The western hemlock/evergreen huckleberry association is widespread on the Mapleton Ranger District and may be common south of the Siuslaw National Forest. The western hemlock/western redcedar association on the Siskiyou National Forest (Atzet and Wheeler, 1984) has a more diverse overstory but is otherwise floristically similar.

Floristic Characteristics

Douglas-fir usually dominates the canopy. Western hemlock is present in the canopy of most stands and in the regeneration layer of many stands. Western redcedar may be abundant. Red alder was present in 35 percent of our sample plots, occasionally as the major canopy species.

The shrub layer is usually sparse. Red huckleberry and salmonberry are present in small amounts in many stands. Total shrub cover averages30 percent.

Oregon oxalis forms a luxurious carpet except in heavily shaded stands. Swordfern cover averages 44 percent. Fairybells, Siberian montia, ladyfern, deerfern, Pacific trillium, and sweetscented bedstraw commonly occur. Total herb cover averages 71 percent.

Environmental Characteristics

The western hemlock/Oregon oxalis association occurs on moist, shaded upper slopes and benches or alluvial terraces. Soils depth averages 50 inches with 37 inches of effective rooting depth (Table 2). Preacher and Slickrock were the major soil series in our intensive sample plots. The western hemlock/Oregon oxalis association is most common on the Hebo and Waldport Ranger Districts.

Productivity and Management Characteristics

Douglas-fir site index averages 122 (50 year base) in the western hemlock/Oregon oxalis association (Table 12). Most natural stands are well stocked with conifers. Basal area averages 333 square feet per acre (Table 12). If salmonberry cover in a natural stand exceeds 10 percent, shrub competition following stand disturbance could be intense. Red alder often regenerates prolifically and grows exceptionally well once established. Oregon oxalis sites are generally resilient to fire effects (Barnett 1984).

Where the western hemlock/Oregon oxalis association occurs near streams, it can be an important component of riparian vegetation. Most Oregon oxalis communities are not immediately adjacent to streams. Their most important contribution is usually woody debris. The parklike Oregon oxalis communities, especially in older stands, are visually appealing.
Deer and elk use can be high on some Oregon oxalis

sites, probably more for thermal cover than hiding cover. Mountain beaver are common to abundant (Table 4).

Comparisons

The western hemlock/Oregon oxalis association occurs widely in the Cascades, Olympic Mountains, and Coast Range from southern Oregon into British Columbia. In most cases it indicates fertile soils, high precipitation, and excellent growing sites.

Western hemlock/Oregon oxalis associations with rich herb layers are common in the Cascades. The western hemlock/swordfern-Oregon oxalis association on the Gifford Pinchot National Forest (Topik et al. 1985) has the greatest variety of herb species, but cover values are low. Swordfern cover averages half the amount typical on the Siuslaw National Forest. Douglas-fir site index is similar: 174 on the Siuslaw National Forest and 162 on the Gifford Pinchot National Forest (100 year base).

This similarity in site index values does not hold for the western hemlock/swordfern-Oregon oxalis association on the Mount Hood National Forest (Halverson et al. 1985). In fact, Douglas-fir site index (154, 100 year base) is lower than in any other Cascades western hemlock/Oregon oxalis association. The Mt. Hood association may occur on slightly drier sites than the other Cascadian western hemlock/Oregon oxalis associations.

The western hemlock/Oregon oxalis association becomes less common farther south in the Cascades. It has not been described south of the Willamette National Forest. The western hemlock /Oregon oxalis associations on the Willamette National Forest (Dyrness et al. 1974 and Hemstrom et al. 1985) are almost as productive (Douglas-fir site index 168, 100 year base) as the Siuslaw National Forest western hemlock/Oregon oxalis association. The floristics and environmental conditions occurs essentially the same as on thisSiuslaw National Forest.

Henderson and Peter (1981b, 1981c and 1982) described western hemlock/Oregon oxalis and western hemlock/swordfern-Oregon oxalis association on the Olympic National Forest. The species composition of the western hemlock/swordfern-Oregon oxalis association is most like the western hemlock/Oregon oxalis association on the Siuslaw National Forest. The shrub layer is less dense and fewer species are represented. Unlike Oregon oxalis stands on the Siuslaw National Forest, western hemlock is far more abundant than Douglas-fir and site index for Douglas-fir is very low (131, 100 year base). The other Oregon oxalis type on the Olympic National Forest is more moist and productive (mean Douglas-fir site index 181, 100 year base) but has a different understory species composition.

Western hemlock/rhododendron-dwarf Oregon grape

TSHE/RHMA-BENE — COAST CHS3-21

Floristic Characteristics

Douglas-fir and western hemlock dominate the canopy. Western redcedar may also be present. Conifer regeneration is usually sparse. Bigleaf maple is the major hardwood and occurred on one-third of our sample plots.

The dense shrub layer is diverse. Dwarf Oregon grape and rhododendron are usually accompanied by salal, red huckleberry, vine maple, evergreen huckleberry, trailing blackberry, and ocean-spray. Total shrub cover averages 80 percent.

Swordfern dominates the herb layer, averaging 32 percent cover. Other herb species occur in small amounts.

Environmental Characteristics

This association usually occurs on ridges and southerly-facing, steep, upper-slopes on the Mapleton Ranger District. It is most common on the south half of the Ranger District, particularly in the Smith-Umpqua block. Average effective rooting depth is lower than in any other association (Table 2). Digger and Marty were the most common soil series in our intensive sample plots (Table 1). Plant moisture stress in summer is high enough to substantially slow conifer growth. The presence of poison oak, hairy honeysuckle, tall Oregon grape and madrone indicates particularly dry sites.

Soil nitrogen appears to be low enough on many sites to cause chlorosis. Youngberg and Ellington (1982) found that available nitrogen was lower on rhododendron dominated sites than on other sites on the Mapleton Ranger District. Lower soil nitrogen may be the result of frequent, hot, natural fires and a general absence of nitrogen fixing species during early succession.

Productivity and Management Characteristics

Conifer and red alder growth is slower than in any other association described in this guide (Table 12). Douglas-fir site index averages 100 (50 year base). Natural stands tend to be open (average basal area 266 square feet per acre, Table 12) with relatively low diameter growth rates. Summer moisture stress and poor soil nitrogen levels are probably responsible for reduced growth. Red alder regenerates poorly. Management for red alder would be difficult.

Early seral competition is moderate. Because Douglas-fir grows relatively slowly, salal, rhododendron, Ceanothus spp., and bigleaf maple may gain a competitive advantage. Quickly established, vigorous seedlings should keep ahead of shrubs.

Most sites are sensitive to fire effects (Barnett 1984). Slash burning should be done over moist fuels on cool days, if at all. The risks of fire becoming intense enough to cause significant nitrogen loss are high. Indirect watershed values may be high since many western hemlock/rhododendron-dwarf Oregon grape communities occur on steep headwalls with thin soils.

Deer and elk use is light. The dense shrub layer, steep slopes, and poor quality forage do not provide high quality habitat. Mountain beaver are virtually absent (Table 4).

Comparisons

Western hemlock/rhododendron-dwarf Oregon grape communities are common in the Oregon Cascades and in the Coast Range south of the Siuslaw River.

Dyrness et al. (1974) described this assocition at low to mid-elevations on deep, non-rocky soils in the central Cascades. In contrast, it occurs on rocky, shallow soils on the Siuslaw National Forest. The western hemlock/rhododendron-dwarf Oregon grape associations described on the Mt. Hood (Halverson et al. 1985) and Willamette National Forests (Hemstrom et al. 1985) are floristically similar to each other but lack the shrub diversity found on the Siuslaw National Forest. However, the Willamette and Siuslaw National Forests' site index for Douglas-fir is significantly higher.

Floristic Characteristics

Douglas-fir dominates the canopy. Western redcedar and western hemlock are present in about one-third of the stands. Western hemlock is the major regenerating species when regeneration is present. Bigleaf maple is present in many stands.

The shrub layer is a dense tangle of shrubs including: rhododendron, evergreen huckleberry, salal, vine maple, dwarf Oregon grape, trailing blackberry, red huckleberry, and ocean-spray. Total shrub cover averages over 90 percent.

Swordfern is often the only noticeable herb although Pacific trillium and a few other species may be present. The dense shrub layer prevents the establishment of most herbs.

Environmental Characteristics

This association occurs on dry sites with either steep, excessively-drained or deep clay soils. While soils averaged nearly 50 inches deep in our sample plots, effective rooting depth was only 32 inches (Table 2). Digger and Marty were the most common soil series (Table 1). Summer drought develops early. Canopies and adjacent young stands are often thin and chloritic, indicating nitrogen deficient soils.

This association is most common on steep, low elevation ridges and slopes on the Mapleton Ranger District. A similar community with an even more diverse and dense shrub layer occurs on stabilized sand dunes in the nearby Oregon Dunes National Recreation Area.

Productivity and Management Characteristics

Douglas-fir site index is among the lowest of all Siuslaw National Forest plant associations, averaging 113 (50 year base, Table 12). Relatively slow tree growth is probably the result of summer drought and infertile soils. Natural stands tend to be poorly-stocked (average basal area 264 square feet per acre, Table 12). Red alder regenerates and grows relatively poorly.

Most sites are moderately sensitive or sensitive to fire effects (Barnett 1984). As in the other western hemlock/rhododendron associations, moderate and hot slash fires can cause soil damage and nutrient loss. Fire will also stimulate germination of Ceanothus spp. seed which may be stored in the soil. Ceanothus spp. and bigleaf maple may pose competition problems on some sites. Removal of Ceanothus spp. should be carefully weighed against the advantages of nitrogen fixation. In most cases, healthy conifer seedlings will survive and eventually over-top Ceanothus spp..

Indirect watershed values may be high, since many rhododendron-evergreen huckleberry communities occur on steep headwalls with thin soils. Deer and elk use is low due to the shrub density and relatively poor quality forage. Mountain beaver are rarely present (Table 4).

Comparisons

Evergreen huckleberry is rare in the Central and Northern Oregon Cascades. It is most abundant on ridgetops and dry slopes or on stabilized sand dunes in the Coast Range. The western hemlock /rhododendron-evergreen huckleberry association has not been described outside the Siuslaw National Forest.

Floristic Characteristics

Douglas-fir dominates the canopy. Western hemlock is scattered in both the overstory and regeneration layers of some stands. Red alder is rare. Bigleaf maple is the most common hardwood.

Rhododendron and salal dominate the profuse shrub layer. Vine maple, dwarf Oregon grape, evergreen huckleberry, and red huckleberry are common. Rhododendron dominates some sites to the near exclusion of other species. Total shrub cover averages 51 percent.

Herbs other than swordfern are not abundant. Swordfern varies from absent to 70 percent cover. Trace amounts of Pacific trillium, Oregon oxalis, and a few other herbs may be present. Total herb cover (including swordfern) averages 27 percent.

Environmental Characteristics

The western hemlock/rhododendron-salal association is rare outside the Mapleton Ranger District. It occurs on warm, well-drained slopes and ridges. While a variety of soils series were found in the sample plots, Preacher and Slickrock were the most common (Table 1). Soils tend to be deeper than in other rhododendron associations (average depth 52 inches, effective depth 38 inches, Table 2), but most sites are topographically dry. A few sample plots were on northerly-facing slopes or had better soils and substantially higher Douglas-fir site indices. Nitrogen appears to be limiting on some sites and the canopy may be chlorotic.

Productivity and Management Characteristics

Conifers and red alder grow more slowly in the western hemlock/rhododendron-salal association than in most others (Table 12). Although a few sites with better soils and northerly aspects have Douglas-fir site indices of 122 or greater, site index generally falls between 85 and 115 (50 year base, Table 12). Basal area averages 266 square feet per acre (Table 12). The abundance of dry site-indicating species (poison oak, hairy honeysuckle, tall Oregon grape or madrone) is inversely proportional to site index.

On some sites Ceanothus spp. and bigleaf maple competition may be severe following harvest and burning. If planting is delayed or seedling establishment is slow, significant competition problems may develop.

As in all rhododendron types, moderate and hot slash fires can cause soil degradation and promote the establishment of Ceanothus spp. Chlorotic canopies in many stands probably reflect low nitrogen availability. Nitrogen fixers such as Ceanothus spp. should help recharge the soil nitrogen pool. Low soil nitrogen levels are often due to frequent, hot fires in the past. Most sites are moderately sensitive or sensitive to fire effects (Barnett 1984).

Western hemlock/rhododendron-salal communities do not occur in riparian areas. Indirect effects on stream water quality may be significant when this association occurs on steep headwalls on south aspects.

Deer and elk use is low in natural stands (Table 4). Bear seemed noticably more abundant at the south end of the Forest where rhododendron communities are common. The large bear populations may be more a result of lower rates of human use than plant community. Mountain beaver are rarely present.

Comparisons

Western hemlock/rhododendron-salal associations are much more common in the Oregon Cascades and south and east of the Siuslaw National Forest in the Coast Range.

Western hemlock/rhododendron-salal associations are found on the Willamette (Dyrness et al. 1974 and Hemstrom et al. 1985) and Mt. Hood (Halverson et al. 1985) National Forests. These associations are floristically similar to one another and much less productive than the Siuslaw National Forest western hemlock/rhododendron-salal association. In fact, these associations are among the least productive of the western hemlock associations on these Forests. The western hemlock/rhododendron-salal associations in the Cascades generally have a more diverse herb layer and lack the large amounts of swordfern found on the Siuslaw National Forest. They also have a more diverse shrub layer in which dwarf Oregon grape is common. Rhododendron and salal covers are generally higher than on the Siuslaw National Forest.

The understory species composition of the western hemlock-Port Orford cedar/rhododendron association of the Siskiyou province (Smith et al. 1985) is similar to the western hemlock/rhododendron-salal association of the Siuslaw National Forest. This association occurs on upper slopes and ridgetops with fairly deep soils. The canopy is more diverse than on the Siuslaw National Forest, and often includes western hemlock, Douglas-fir, Port Orford cedar, western white pine and tan oak.

Floristic Characteristics

Douglas-fir dominates the canopy, often in association with western hemlock and western redcedar. Western hemlock is the major regenerating species, often accompanied by western redcedar. Bigleaf maple is present in nearly half the stands. Red alder is not as common.

Rhododendron and vine maple dominate the diverse shrub layer. Shrub cover averages 45 percent and usually includes red huckleberry, salal, vine maple, dwarf Oregon grape, evergreen huckleberry and rhododendron.

Swordfern cover averages 53 percent. Several other herbs, including: sweetscented bedstraw, Pacific trillium, and fairybells may be present in small amounts.

Environmental Characteristics

The western hemlock/rhododendron/swordfern association is the most moist of the rhododendron-dominated associations. It occurs on steep, well-drained, northerly-facing middle- to lower-slopes at the south end of the Forest. It intergrades with the western hemlock/swordfern and western hemlock/vine maple/swordfern associations as soil moisture increases. Low rhododendron cover and high vine maple and swordfern cover indicate more moist soils and greater site productivity.

Soils averaged 40 inches deep with 22 inches effective rooting depth (Table 2). Poor soils may be offset to some extent by sub-irrigation from upslope water sources. Soil series varied in our sample plots. Millicoma, Damewood, Digger, and Marty (all either skeletal or clay-rich) were the most common. (Table 1).

Productivity and Management Characteristics

Douglas-fir site index is low, averaging 111 (50 year base, Table 12). Site index increases as rhododendron cover drops and vine maple cover increases. The appropriate management characteristics for stands with only small amounts of rhododendron and high vine maple cover may be those of the western hemlock/vine maple/swordfern association. Red alder regenerates and grows better than in other rhododendron types but is not as productive as in western hemlock/swordfern or western hemlock/salmonberry associations.

Bigleaf maple and vine maple may resprout and grow quickly in clearcuts. Ceanothus spp. may occasionally be a strong competitor, particularly following slash burning. The rhododendron/swordfern association often indicates thin, unstable soils. Soils in this type are not as susceptable to degradation and nutrient loss from moderate fires as those in other rhododendron associations.

Use by deer and elk is heavier than in other, shrubbier rhododendron associations, but is still relatively low. Other wildlife habitat values are also low (Table 4). It rarely occurs in riparian areas. Mountain beaver populations may be large in the most moist stands of this association, especially where swordfern, a favorite mountain beaver food, is abundant.

Comparisons

Rhododendron is uncommon in the Coast Range north of the divide between the Siuslaw and Alsea River Drainages. It appears again in rainshadow areas of the Olympic Mountains and Vancouver Island. Rhododendron is common in the southern Coast Range. It is common in the Cascades south of the Columbia Gorge. A western hemlock/rhododendron/ swordfern association has not been described outside the Siuslaw National Forest.

Floristic Characteristics

Douglas-fir dominates the canopy. Western hemlock is present in the regeneration and canopy layers on most sites. Small amounts of western redcedar may be present. Red alder occurs on some sites, rarely as the dominant species. Bigleaf maple and golden chinquapin are occasionally present.

Salal is usually dense. Vine maple, dwarf Oregon grape, red huckleberry, and trailing blackberry occur in small amounts. Salmonberry and thimbleberry may be present on moist sites. Total shrub cover averages over 70 percent.

Swordfern dominates the herb layer. Bracken fern is often abundant in stands which have been thinned or recently disturbed. Trace amounts of a few other herbs occur, including: sweetscented bedstraw, fairybells, and Pacific trillium. Stands with particularly heavy salal cover have usually been disturbed and, except for swordfern, lack an appreciable herb layer.

Environmental Characteristics

The western hemlock/salal association is most prominent on south- or west-facing upper slopes and ridges. It also occurs on upper-slope slump faces and flats. Soils are moderately deep and well-drained. Soil series in our sample plots varied substantially and included Honeygrove clay-rich soils (Table 1). Summer moisture stress is probably higher in the salal association than in lower-slope associations.

Productivity and Management Characteristics

Douglas-fir grows moderately well. Site index averages 121 (50 year base, Table 12). Trees may be abnormally short due to frequent wind damage. Basal area averages 315 square feet per acre (Table 12). Red alder is not as common or productive in salal types as in swordfern or salmonberry types. Red alder stand establishment, in *Phellinus weirii* infected areas for example, may require planting. Salmonberry averages less than 1 foot tall five years after clearcutting (Tables 19 and 20). Slash burning to reduce competition should not generally be necessary. In fact, due to soils and topographic location, the salal type is susceptible to significant nutrient losses from burning. Fire effects are generally moderate but sites with thin soils are sensitive to fire (Barnett 1984).

Salal communities are not common in riparian zones. They may occur at the top of headwalls and contribute indirectly to water quality through slope stability. Deer and elk use in natural stands is low. Salal responds rapidly to stand thinning and often becomes so dense that it reduces deer and elk use. Mountain beaver are not usually abundant (Table 4).

Comparisons

Western hemlock/salal associations are common in the Cascades and Coast Range of Oregon and Washington. Cascades varieties of this association are not as densely shrubby nor are the salal thickets as tall. Many salal types in the Cascades also include rhododendron and large amounts of vine maple.

As with the western hemlock/swordfern associations on the Siuslaw National Forest, the presence of large quantitites of vine maple indicates higher productivity. Therefore, we have recognized a western hemlock/vine maple-salal association. The western hemlock/salal associations described from the central Oregon Cascades (Dyrness et al 1974, Hemstrom et al. 1985) and Mt. Rainier National Park (Franklin et al. 1979) are more like the western hemlock/vine maple-salal association.

This association is the most common plant association on the White River Ranger District of the Mt. Baker-Snoqualmie National Forest in northern Washington (Henderson and Peter 1981). Similar associations occur elsewhere on the Forest. Douglas-fir site index is much lower (ranging from 96-128, 100 year base) than on the Siuslaw National Forest.

The western hemlock/salal association described by Topik et al. (1985) for the Gifford Pinchot National Forest has the same complement of shrubs as found on the Siuslaw National Forest, but the herb layer is more diverse and productivity much lower.

The western hemlock/salal association on the Olympic National Forest (Henderson and Peter 1981b, 1981c, and 1982) is floristically similar to the Siuslaw National Forest western hemlock/salal association but lacks large amounts of swordfern and productivity is much lower.

Atzet and Wheeler (1984) described a western hemlock/salal association on dry sites or shallow soils on the Siskiyou National Forest. With the exception of the more diverse tree and shrub layers and constant presence of beargrass, the species composition is similar to that on the Siuslaw National Forest.

Floristic Characteristics

Depending on disturbance history, Douglas-fir dominates the canopy in some stands, red alder in others. Western hemlock is the major regenerating species in stands which have regeneration. Many stands are nearly pure red alder with scattered, larger Douglas-fir and western hemlock. The successional development of red alder stands that lack western hemlock is unclear, since red alder typically senesces at 100-150 years of age and Douglas-fir does not regenerate under a canopy. The climatic and environmental nature of the stands suggests that western hemlock would be the climax if seed sources were not eliminated by disturbance. Tolerant conifer seed sources are not completely lacking from most stands.

Salmonberry cover averages 51 percent. Other important shrub species include: fool's huckleberry, red elderberry, and red huckleberry. Total shrub cover averages 74 percent.

The dense shrub layer generally inhibits the development of herbaceous vegetation. Oregon oxalis, Mexican betony, Siberian montia, false lily-of-the-valley, swordfern, deerfern, maidenhair fern, fairybells, field woodrush, and sweetscented bedstraw are present in small amounts in most stands. Swordfern averages over 44 percent cover. Oregon oxalis may be abundant.

Environmental Characteristics

The western hemlock/salmonberry association occurs on well-watered sites. Soils are moist much of the year, but are not as wet or poorly drained as in the devil's club associations. Soils in our sample plots were mostly in the Slickrock or Preacher series (Table 1). They are moderately shallow, averaging 40 inches total depth and 34 inches effective rooting depth (Table 2). Soil fertility is enhanced by the large inputs of nitrogen and organic matter during red alder dominated seral stages. In addition, intense burrowing by mountain beaver churns the soil, increasing aeration, and organic matter incorporation.

This association most often occurs on middle and lower slope positions on north or northeast aspects. Slope steepness varies from flat to over 60 percent. Salmonberry usually occurs along watercourses and continues upslope until a slope break changes subsurface water abundance. At the north end of the Forest, salmonberry communities may extend nearly to the ridgetops.

Productivity and Management Characteristics

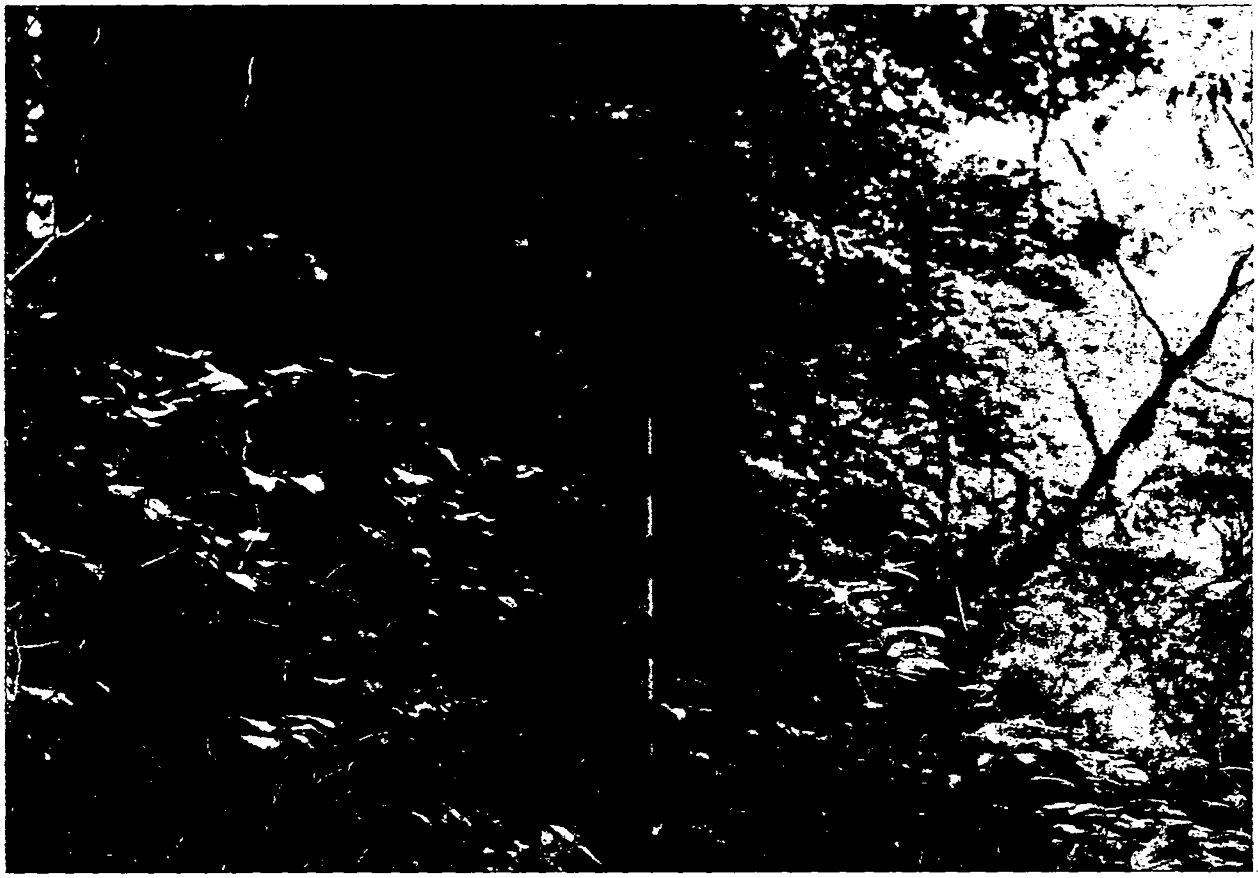
Conifer and red alder growth are excellent in the western hemlock/salmonberry association. Douglas-fir site index averages 123 (50 year base, Table 12) due to favorable moisture relations and, apparently, good soil fertility. Basal area and, consequently, stand volume are relatively low in the salmonberry association due to early seral competition.

The same factors which promote favorable tree growth also complicate conifer management by enhancing shrub growth. Salmonberry and alder compete vigorously in clearcuts. Salmonberry averages between 2.5 and 4 feet tall at the end of the third year (Tables 14 and 15). The typical lower slope position and abundant green fuel of these sites can impede slash burning, which is often important in slowing salmonberry growth. Red alder often begins to grow rapidly by year 5, usually over-topping associated conifers. There is probably a subset of the salmonberry type where competition is even more severe (Frazier 1986). The proximity to streams and ground water mean that erosion and vegetation management activities may impact water quality. According to the characteristics established by Barnett (1984), the western hemlock/salmonberry association is generally resilient to fire.

Deer and elk use may be high on salmonberry dominated sites near streams and on some northerly facing slopes which are cool in the summer. Since trees attain large size quickly and the vegetation is relatively fire resistant, there are often large nest trees and cavity filled snags in natural stands. Large live trees and dead wood could be quickly produced, if desired, to develop old-growth habitat features. Mountain beaver are common (Table 4).

Comparisons

Salmonberry-dominated stands are widespread in the Oregon and Washington Coast Ranges and Olympic Mountains. Western hemlock/salmonberry communities are commonly found along streams and in other open areas. They are often considered to be disturbance climax or seral communities. Western hemlock/salmonberry plant communities do not occur in the Cascades.



Floristic Characteristics

Douglas-fir and western hemlock, usually mixed with red alder, dominate the canopy in most stands. Conifer regeneration is uncommon but may include western hemlock and western redcedar.

The shrub layer is a dense mix of salmonberry and salal supplemented by minor amounts of red huckleberry, vine maple, dwarf Oregon grape, and evergreen huckleberry. Total shrub cover averages 84 percent.

Swordfern is the only abundant herb. Siberian montia, field woodrush, and Pacific trillium are common. Total herb cover averages 32 percent.

Environmental Characteristics

The western hemlock/salmonberry-salal association occurs where the western hemlock/salmonberry and western hemlock/salal associations intermingle in hummocky topography or near ridges. Soils are moderately thin and rocky, averaging 46 inches deep with 37 inches of effective rooting depth (Table 2). The environment is wet during winter, but not quite as dry as the western hemlock/salal association in the summer. Most western hemlock/salmonberry-salal sites are on south- or west-facing slopes or ridges. This association is most common on the Waldport Ranger District.

Productivity and Management Characteristics

Summer moisture stress and ridgetop exposure to wind keep conifer growth rates slightly below those found in the most productive associations (Table 12). Douglas-fir site index averages 123 (50 year base). Natural stands are often sparsely stocked, probably due to shrub competition in early succession. Basal area averages 267 square feet per acre (Table 12). Both salal and salmonberry respond vigorously to canopy removal. Salal does not compete intensely with conifers. Salmonberry probably does not respond as rapidly in this association as in the salmonberry association. Fire effects are generally moderate, according to the criteria established by Barnett (1984).

Since the salmonberry-salal association occurs on upper slopes and ridges, it does not often directly influence riparian systems or water quality. Large live trees and habitat features of old-growth are produced less quickly than in the more productive associations. Deer and elk use is relatively low. Mountain beaver were present in 40 percent of the sample plots (Table 4).

Comparisons

The western hemlock/salmonberry-salal association is common on ridges on the Waldport Ranger District within five to ten miles of the ocean. This association is rarely found further south and inland. It has not been described outside of the Siuslaw National Forest.

Floristic Characteristics

Douglas-fir and/or red alder dominate the canopy. Western hemlock occurs in the canopy of about one-third of the stands and occasionally occurs in the regeneration layer. Red alder was the major canopy species in about two-thirds of our sample plots.

Salmonberry and vine maple codominate in the shrub layer. Small amounts of red huckleberry occur in most stands. Salal, California hazel, cascara buckthorn, red elderberry, and a few other shrubs may be present.

Except for swordfern, which averages 48 percent cover, the herb layer is usually sparse. Oregon oxalis, Siberian montia, ladyfern, and deerfern may occur. Total herb cover averages 62 percent.

Environmental Characteristics

The western hemlock/salmonberry-vine maple association represents the more inland end of the salmonberry spectrum. It occurs on warmer, slightly drier sites than the western hemlock/salmonberry association. Slope and aspect vary. Soils are typically deep and rich in organic material. Soil moisture is abundant. As in the western hemlock/salmonberry association, Preacher and Slickrock soil series are the most common (Table 1). Fifty percent of our plots were from the Alsea Ranger District, reflecting an inland geographic distribution.

Productivity and Management Characteristics

Douglas-fir finds an optimum environment in this association. Site index averages 130 (50 year base, Table 12), higher than in any other association except western hemlock/devil's club. Red alder also grows very well. Natural stand volume is relatively low in spite of rapid height growth. This may be due to relatively low stocking, a function of intense early seral shrub competition.

Early succession usually involves rapid shrub response and intense competition among salmonberry, vine maple, red alder and conifers. Salmonberry height growth patterns should closely follow those for the western hemlock/salmonberry association (Tables 15 and 16). Five years following disturbance, alder often begins to dominate the stand, suppressing both shrubs and conifers. Salmonberry-vine maple sites on lower slopes develop green biomass quickly and can be difficult to burn, but are generally resilient to fire (Barnett 1984).

Animal use is often heavy in all successional stages. Mountain beaver were present in more of our plots in this association than on any other plant association (Table 4). Deer and elk use is frequently heavy. The salmonberry-vine maple association is often adjacent to streams and makes important contributions to woody debris in streams, the food base of aquatic systems, and sediment regulation.

Comparisons

This association is similar to the western hemlock/salmonberry association but indicates drier conditions. It has not been described outside the Siuslaw National Forest.

Floristic Characteristic

Douglas-fir usually dominates the canopy, commonly associated with western hemlock and western redcedar. While both western hemlock and western redcedar may be present in the regeneration layer, western hemlock is more common. Red alder may be the major canopy species. Bigleaf maple may be present.

Although the shrub layer is generally sparse, red huckleberry, salal, salmonberry, vine maple, and fool's huckleberry may be present. Total shrub cover averages only 22 percent.

Swordfern is the major herb. Many other species may be present in small amounts including: Siberian montia, Oregon oxalis, deerfern, fairybells, Pacific trillium, redwoods violet, and sweetscented bedstraw. Total herb cover averages 65 percent.

Environmental Characteristics

The western hemlock/swordfern association is common throughout the Forest. It occurs on steep middle and lower slopes or, less often, on benches and alluvial flats. Soils are well-drained but receive continuous subsurface moisture from upslope. Soils are usually deep and rich in organic matter. Soil series varied in our intensive sample plots (Table 1).

Productivity and Management Characteristics

Douglas-fir site index averages 124 (50 year base, Table 12). Natural stands are usually well stocked (basal area averages 332 square feet per acre) with dense canopies. Red alder regenerates and grows very well on most sites following disturbance. Where salmonberry cover is over 10 percent, competition can be substantial following harvest of natural stands. Salmonberry growth rates are substantially lower than in salmonberry associations (Table 15, Figures 17 and 18). Vigorous conifer seedlings can usually outgrow competing vegetation, except red alder, without release treatments. Swordfern sites are generally resilient to fire effects (Barnett 1984).

When swordfern associations occur near streams, they may be important sources of woody debris. Like the western hemlock/Oregon oxalis association, swordfern associations are visually pleasing, especially with stands of large trees. Old-growth structural features develop rapidly in the swordfern type. Deer and elk use is generally moderate, mostly for thermal cover. Mountain beaver are common (Table 4).

Comparisons

Western hemlock/swordfern associations are common on moist, productive sites in the Olympic Mountains, the Coast Range from the Siskiyou National Forest to British Columbia and the western Cascades from Mt. Rainier through the Willamette National Forest. This association was first described in the Alsea Basin (Corliss and Dyrness 1965).

With few exceptions, swordfern communities in the Cascades include moderate amounts of vine maple. In the coast range, sites with large amounts of vine maple tend to be more productive and were split into the western hemlock/vine maple/swordfern association.

The most similar of the Cascade associations was described by Dyrness et al. (1974) and Hemstrom et al. (1985) for the central Oregon Cascades and Willamette National Forest. They described both western hemlock/swordfern and western hemlock/vine maple/swordfern associations. The western hemlock/swordfern association on the Willamette National Forest has moderate amounts of vine maple and nearly identical productivity (Hemstrom et al. 1985). A western hemlock/swordfern association with very small amounts of vine maple and slightly lower Douglas-fir site index occurs on the White River Ranger District of the Mt.Baker-Snoqualmie National Forest (Henderson and Peter 1981d).

The western hemlock/swordfern association found on the Siskiyou National Forest (Smith et al. 1985) is floristically similar to the Siuslaw National Forest association.

Floristic Characteristics

Douglas-fir dominates the canopy in most stands. Western hemlock and western redcedar are occasionally present. The canopy is relatively open compared to other western hemlock associations. Regeneration is spotty or absent. Red alder or bigleaf maple are occasionally important canopy components.

This association is characterized by dense thickets of vine maple and salal. Total shrub cover averages nearly 100 percent. A few other shrub species are common, including: red huckleberry, trailing blackberry, and evergreen huckleberry.

Where the understory is nearly totally occupied by shrubs, the herb layer may be nearly nonexistant. Where a herb layer develops beneath the tangle of shrubs, swordfern is usually the dominant species. Swordfern cover is variable and can be as high as 50 percent. Pacific trillium and sweetscented bedstraw are the only other common herbs.

Environmental Characteristics

The western hemlock/salal and western hemlock/vine maple-salal associations are environmentally similar. Both occur on well-drained mid- to upper slopes and ridges. The western hemlock/vine maple-salal association is usually found on lower, more well watered sites topographically below the salal association.

Average soil depth in the western hemlock/vine maple-salal association is 10 inches deeper than in the western hemlock/salal association (Table 2). Blachly, Preacher, and Slickrock are the most common soil series (Table 1). The western hemlock/vine maple-salal association is most common on Alsea and Mapleton Ranger Districts.

Productivity and Management Characteristics

Douglas-fir grows very well. Site index averages 123 (50 year base, Table 12). This is higher than in the western hemlock/salal association and probably reflects better soil conditions and more available water during summer. Stand basal area averages 295 square feet per acre (Table 12). Red alder is not usually important in natural stands. Red alder stand establishment will usually require planting. Shrub competition following disturbance will be moderate, mainly from vine maple. Fire effects are ususally moderate but may be variable. Sites with deep soils will be resilient to fire effects and those with shallow soils more sensitive (Barnett 1984).

Western hemlock/vine maple-salal communities do not usually occur in either riparian areas or on steep headwalls. Management activities will have small direct effects on stream water quality. Deer and elk occasionally find hiding cover in western hemlock/vine maple-salal stands but the often inpenatrable shrub layer restricts movement. Mountain beaver use is reduced as salal cover increases (Table 4).

Comparisons

Western hemlock/salal communities are common in the Cascades and Coast Ranges. Most investigators have not recognized a separate vine maple-salal association within these communities. In the Oregon Coast Range,the western hemlock/vine maple-salal association occurs on geographically different sites and appears to indicate higher productivity than the western hemlock/salal association.

Corliss and Dyrness (1965) described a Douglas-fir/vine maple-salal seral community in the Alsea area. Dyrness et al. (1974) also described a similar, less herb rich seral community in the central Oregon Cascades.

A western hemlock/swordfern/salal association, similar to the western hemlock/vine maple-salal association, occurs on the Soleduck Ranger District of the Olympic National Forest (Henderson and Peters 1982). Swordfern is a major component of this plant association but productivity is much lower.

Franklin et al. (1979) also reported poor growth for the floristically similar western hemlock/salal association which occurs on hot, dry, low elevation sites in Mt. Rainier National Park.

A diverse, species rich western hemlock/salal association occurs on the Willamette National Forest (Hemstrom et al. 1985). Although site index for Douglas fir (144, 100 year base) is the highest of the Cascades western hemlock/salal associations, it is considerably lower than that for the western hemlock/vine maple-salal assciation on the Siuslaw National Forest (169, 100 year base). Salal extends into the Pacific silver fir zone on warm, dry sites on the Willamette National Forest (Hemstrom et al. 1985).

Floristic Characteristics

Douglas-fir usually dominates the canopy. Western hemlock and western redcedar are common. Western hemlock regeneration was present in 22 percent of our sample plots. Red alder may be the dominant species. Bigleaf maple is frequently present.

Vine maple is always present, averaging 52 percent cover. Red huckleberry, salal, and salmonberry are common in small amounts. Total shrub cover averages 70 percent.

Swordfern dominates the herb layer, averaging 61 percent cover. Oregon oxalis, Siberian montia, sweetscented bedstraw, and Pacific trillium are present in most stands with less than 10 percent cover each.

Environmental Characteristics

The western hemlock/vine maple/swordfern association is similar in many respects to the western hemlock/swordfern association. The vine maple/swordfern association is most common on relatively warm, well-drained middle and lower slopes. Soils are generally deep with relatively high percentages of coarse fragments. Slickrock, Preacher, Bohannon, and Blachly were the most common soil series in our intensive plots (Table 1). The vine maple/swordfern association is most common on Alsea Ranger District and least common on Hebo Ranger District.

Productivity and Management Characteristics

Douglas-fir seems to grow slightly better in the western hemlock/vine maple/swordfern association (mean site index 126, 50 year base, Table 12) than in the swordfern association. Temperature conditions may be more favorable in the western hemlock/vine maple/swordfern type. Conifer stands are relatively well-stocked (average basal area 292 square feet per acre). Red alder grows very well.

Competition from shrubs and red alder after clearcutting can be severe. Red alder can be abundant 5 to 8 years after clearcutting. Small amounts of salmonberry can, in combination with vine maple, quickly resprout and form a dense shrub thicket soon after disturbance. Salmonberry growth rates should be similar to those in the western hemlock/swordfern association (Tables 17 and 18). On the whole, the western hemlock/

vine maple/swordfern type should not present competition problems as severe as salmonberry types. Sites are either moderately impacted be fire or resilient (Barnett 1984).

Deer and elk use is moderately high. The dense shrub layer provides good hiding cover. This association is prime mountain beaver habitat. Mountain beaver were present in over 40% of our plots (Table 4).

This association often occurs on steep slopes and headwalls with moist soils and high erosion potential. It also occurs on well-drained alluvial terraces where it is an important part of the riparian ecosystem.

Comparisons

Western hemlock/vine maple/swordfern communities are common in the Cascades and Coast Range. They have been described in the Olympic Mountains (Henderson and Peter 1981b, 1981c and 1982), throughout the Oregon and Washington Cascades (Henderson and Peter 1981d, Topik et al. 1985, Halverson et al.1985 and Hemstrom et al. 1985) and the Coast Range. Most investigators have placed them with the western hemlock/swordfern association, arguing that vine maple is a response to canopy opening and disturbance. In some cases, this appears to be true, but there seem to be significant geographic distribution and productivity differences between the two associations in the Coast Range.

Most of the western hemlock/swordfern associations which have been described in the Cascades are floristically similar to the western hemlock/vine maple/swordfern association on the Siuslaw National Forest but are generally less productive. Comparable productivity values were reported for a similar association on the Mt. Baker-Snoqualmie National Forest (Henderson and Peter 1984 and 1985).

Noble Fir Communities

A substantial stand of noble fir lies on the north- and east-facing slopes at the top of Mary's Peak. This plant community appears to be a relict from past climatic conditions when noble fir was probably more wide spread in the Coast Range. It consists of noble fir and Douglas-fir in combination with understory species common in the Pacific silver fir zone of the Cascades. Noble fir, while not extremely shade tolerant, seems to be regenerating in canopy openings caused by windthrow from frequent, intense wind storms. Similar remnant patches occur on the highest mountain tops north of Mary's Peak. Just north of the Columbia River there are substantial stands of noble fir in the Willipa Hills. We do not have a sufficient sample of noble fir dominated communities to develop floristic descriptions or assign a plant association name.

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APPENDIX

VEGETATIVE AND ENVIRONMENTAL TABLES BY ASSOCIATION

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS
Mean Cover is the Average of Canopy Cover on Those Plots in Which the Species Occurred
Constancy is the Percent of Plots in Which the Species Occurred

Association	TSHE/OPHO	TSHE/RUSP	TSHE/RUSP -ACCI	TSHE/RUSP -GASH	TSHE/OXOR	TSHE/POMU	TSHE/ACCI /POMU	TSHE/GASH
Number of Plots	10	30	34	13	52	49	77	29
	Cover/Constancy							
Tree Species 1/								
ACMAM	---	31/13	15/15	---	13/10	14/18	19/26	5/10
ACMAR	---	4/3	1/3	---	---	3/4	4/1	---
ALRUM	11/64	28/70	30/59	8/69	10/35	18/41	10/35	4/31
ALRUR	3/9	2/7	4/6	---	2/2	3/4	1/1	3/7
CONUM	---	---	---	---	---	---	---	40/7
CACHM	---	---	---	---	---	---	---	2/14
MYCAM	---	---	---	---	---	---	---	---
PICOM	---	---	---	---	---	---	---	---
PICOR	---	---	---	---	---	---	---	---
PISIM	---	1/20	---	1/15	1/8	2/10	3/5	1/3
PISIR	---	1/7	---	---	1/6	1/2	---	---
PSMEM	50/100	41/93	55/97	58/85	48/96	48/96	62/100	64/100
PSMER	1/9	1/10	1/9	---	1/2	3/6	---	1/17
TABRM	---	50/3	---	---	15/8	---	---	---
TABRR	---	---	---	---	2/2	---	---	---
THPLM	28/36	12/40	14/15	19/15	25/40	17/47	15/23	10/21
THPLR	1/9	2/13	1/3	2/15	2/13	3/16	6/4	---
TSHEM	34/73	27/67	13/32	28/54	42/81	40/71	16/39	21/41
TSHER	3/55	5/43	1/9	1/23	12/58	8/55	3/22	13/38
Mean Canopy Cover	75/100	74/100	66/100	65/92	82/100	79/98	71/99	73/100
Mean Regeneration Cover	3/73	6/40	2/26	4/54	11/63	7/84	7/31	6/66
Shrub Species								
ACCI	30/55	8/23	48/100	30/38	38/42	5/41	52/100	10/59
BENE	2/45	2/17	2/18	5/31	3/29	3/33	2/36	4/48
COCO2	4/9	9/10	12/44	20/15	8/2	13/20	8/23	3/14
CONU	---	---	---	---	---	---	---	12/7
GASH	3/55	2/33	2/44	24/100	4/31	5/65	3/60	49/100
HODI	---	6/7	4/9	3/23	3/8	7/14	5/12	11/4
LOCI	---	---	---	---	---	---	---	---
MEFE	2/45	5/50	1/3	4/31	5/33	3/39	2/8	9/10
MYCA	---	---	---	---	---	---	---	---
OPHO	24/100	1/10	---	---	1/13	1/2	1/1	1/7
RHDI	---	10/7	---	---	---	11/8	3/5	8/3
RHMA	---	3/7	---	---	50/2	3/4	3/3	2/14
RHPU	1/9	4/17	2/38	5/31	3/4	4/8	4/25	2/24
RIBR	---	8/7	---	---	1/4	---	---	---
ROGY	---	---	1/3	3/8	1/10	1/4	2/10	3/41
RUPA	1/27	7/30	1/24	6/38	1/13	1/20	2/19	2/31
RUSP	16/64	51/100	27/100	25/100	4/63	4/63	3/53	4/24
RUUR	2/36	2/10	2/35	2/23	1/13	2/33	2/35	3/72
SAMBU	---	3/13	---	6/15	---	1/2	8/1	---
SARA	1/18	12/43	4/35	2/15	2/19	4/6	2/17	1/3
VAAL	2/18	2/13	2/3	---	1/4	---	---	---
VAOV2	---	4/23	5/15	7/31	4/6	3/29	5/26	6/24
VAPA	5/100	7/73	5/88	14/85	5/87	5/88	9/90	9/86
WHMO	---	1/3	1/3	1/8	---	---	---	3/7
Mean Shrub Cover	56/100	71/100	82/100	84/100	30/100	22/100	72/100	73/100

1/ "m" after the species represents mature trees.
"r" after the species represents regenerating trees (less than 12 feet tall).

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	TSHE/OPHO	TSHE/RUSP	TSHE/RUSP -ACCI	TSHE/RUSP -GASH	TSHE/OXOR	TSHE/POMU	TSHE/ACCI /POMU	TSHE/GASH
Number of Plots	10	30	34	13	52	49	77	29
	Cover/Constancy							
Herb Species								
ACRU	1/9	1/7	1/3	---	1/4	---	1/6	1/7
ACTR	2/9	--	---	---	2/8	---	1/3	3/10
ADBI	---	1/3	---	---	2/6	3/2	1/3	
ADPE	2/18	2/10	1/9	---	---	2/2	1/12	1/3
ANDE	---	---	---	---	1/2	2/4	1/3	1/7
ASCA3	1/9	2/7	1/21	---	1/13	1/10	2/14	1/3
ATFI	3/36	2/47	1/56	1/15	2/44	2/27	1/29	1/7
BLSP	2/64	2/53	1/59	2/38	2/52	3/47	2/36	2/17
BROMU	1/18	2/17	2/18	---	1/12	1/10	2/10	1/7
BRVU	2/36	2/3	1/6	---	1/15	3/12	1/1	4/17
CAREX	1/9	3/23	1/18	1/15	2/6	---	1/12	1/10
CAOB	2/9	---	1/3	---	1/2	1/8	1/1	
CABU2	---	---	---	---	---	---	---	
CLUN	---	---	---	---	---	---	---	
DIFO	1/27	1/23	2/35	1/23	2/25	1/24	1/30	1/3
DIHO	1/45	1/47	1/35	1/38	1/73	1/65	1/36	1/38
DRAU2	2/18	2/27	2/12	2/15	1/37	1/12	2/13	1/10
FECA	2/18	3/17	2/26	2/15	1/27	2/8	1/27	6/24
FEOC	1/9	2/3	1/3	---	---	---	1/3	1/3
FESU	---	--	---	---	1/12	1/2	1/1	1/10
GATR	2/73	2/60	1/85	1/69	2/62	1/55	1/87	1/55
HIAL	---	---	---	---	1/2	---	---	1/7
LUCA2	1/45	1/53	2/44	1/54	1/31	1/33	1/29	1/17
LUZUL	1/9	1/10	1/3	---	1/8	2/8	1/3	1/7
LYAM	---	1/3	2/3	1/8	1/4	---	---	
MADI2	2/45	5/43	3/35	1/8	2/37	1/22	1/19	2/28
MAOR	---	2/20	2/24	---	---	2/12	2/9	
MOSI	2/91	3/73	2/91	1/62	2/77	2/76	2/65	1/24
OXOR	29/82	15/80	6/62	2/38	39/100	5/57	3/53	3/24
POGL4	---	2/13	1/6	---	1/4	---	1/3	
POMU	51/100	44/97	48/100	29/100	44/100	58/100	61/100	20/90
PTAQ	6/27	2/17	1/9	3/23	2/15	2/12	1/9	14/55
SMST	1/9	1/7	1/3	---	2/12	3/4	1/9	1/17
STAM	1/9	1/7	1/6	---	1/8	---	---	1/3
STME2	2/55	3/70	2/41	1/8	2/37	1/22	2/21	1/14
SYRE	---	---	1/3	---	---	---	---	2/7
TITR	3/27	4/10	1/6	---	1/12	2/10	1/3	
TOME	1/9	4/27	13/18	1/8	2/6	1/2	1/6	
TRLA2	---	1/3	1/3	1/23	2/6	1/4	1/19	2/31
TROV	1/55	1/37	1/35	1/46	1/75	1/73	1/75	1/34
VAHE	---	1/3	---	---	1/2	2/6	2/10	1/17
VIGL	---	2/10	1/3	---	1/2	1/2	---	1/3
VISE	1/9	1/23	1/18	1/38	2/23	1/43	1/18	8/38
Mean Herb Cover	74/100	60/100	62/100	32/100	71/100	65/100	65/100	34/97
Mean Moss Cover	32/91	26/93	17/100	14/100	32/94	17/98	15/97	29/93

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	TSHE/ACCI -GASH	TSHE/BENE -GASH	TSHE/BENE	TSHE/VAOV2	TSHE/RHMA /POMU	TSHE/RHMA -GASH	TSHE/RHMA -BENE	TSHE/RHMA -VAOV2
Number of Plots	48	18	31	22	25	16	12	15
	Cover/Constancy							
Tree Species 1/								
ACMAM	17/10	3/33	18/35	30/22	11/48	11/38	13/33	5/40
ACMAR	---	---	4/10	---	---	---	---	
ALRUM	10/21	6/33	9/23	9/26	7/20	13/25	3/8	9/27
ALRUR	2/6	1/6	---	2/4	---	---	---	5/7
CONUM	7/2	---	---	---	---	---	20/8	
CACHM	3/2	4/6	---	---	---	3/6	---	5/7
MYCAM	---	---	---	---	---	1/6	---	
PICOM	---	---	---	---	---	---	---	
PICOR	---	---	---	---	---	---	---	
PISIM	1/4	---	---	2/4	---	---	---	
PISIR	1/4	1/6	1/3	---	---	---	---	
PSMEM	65/96	62/100	57/100	56/100	57/100	70/100	68/100	63/93
PSMER	6/4	2/11	1/6	1/4	---	---	---	1/7
TABRM	19/6	6/11	2/13	1/4	2/4	---	4/17	7/13
TABRR	---	1/6	---	---	---	---	---	
THPLM	6/17	13/33	14/26	29/52	12/48	10/6	14/25	6/33
THPLR	2/2	1/11	3/13	9/17	3/16	1/6	3/25	1/7
TSHEM	11/19	8/44	43/52	15/70	24/60	13/44	28/42	16/27
TSHER	2/17	13/33	5/45	3/22	3/32	5/38	5/8	2/27
Mean Canopy Cover	67/98	71/100	78/100	77/100	77/100	78/100	78/100	71/100
Mean Regeneration Cover	4/25	9/56	5/74	9/30	3/48	15/50	5/25	2/33
Shrub Species								
ACCI	55/100	15/56	26/45	41/74	18/64	15/69	39/58	30/67
BENE	3/29	23/100	16/100	6/43	3/76	4/69	11/100	3/47
COCO2	8/29	12/22	6/29	4/30	8/20	7/25	2/8	8/27
CONU	10/2	24/17	6/6	10/4	10/4	---	---	22/13
GASH	35/100	40/100	5/81	9/87	4/52	29/94	5/83	16/73
HODI	9/19	11/83	6/29	6/22	7/20	4/38	10/33	10/47
LOCI	---	---	1/3	---	---	---	4/8	3/20
MEFE	---	---	3/23	2/9	---	---	---	---
MYCA	---	---	---	---	---	---	---	---
OPHO	---	---	---	---	---	---	---	---
RHDI	5/15	---	2/13	5/9	7/24	32/13	---	10/13
RHMA	4/4	5/6	---	---	16/100	35/100	49/100	38/100
RHPU	6/42	15/6	6/6	2/22	4/8	5/25	3/17	3/20
RIBR	1/2	1/6	---	1/4	---	---	---	---
ROGY	2/23	3/39	2/39	2/13	---	2/6	2/8	1/20
RUPA	2/8	2/22	1/23	3/22	3/8	20/13	---	2/13
RUSP	3/33	4/22	2/16	4/39	3/36	2/6	2/8	3/33
RUUR	2/65	16/50	2/35	1/48	2/32	2/56	2/50	2/53
SAMBU	1/2	---	---	---	2/8	---	---	---
SARA	1/2	2/11	1/6	1/9	1/8	---	---	---
VAAL	---	---	3/6	---	---	---	---	---
VAOV2	12/46	23/17	12/13	21/100	5/56	6/75	7/75	41/100
VAPA	7/92	10/78	8/65	7/83	7/84	7/81	5/92	4/80
WHMO	---	---	---	1/4	1/4	1/6	2/17	2/7
Mean Shrub Cover	103/100	95/100	45/100	73/100	45/100	85/100	81/100	106/100

1/ "m" after the species represents mature trees.
"r" after the species represents regenerating trees (less than 12 feet tall).

Appendix (Continued)

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	TSHE/ACCI -GASH	TSHE/BENE -GASH	TSHE/BENE	TSHE/VAOV2	TSHE/RHMA /POMU	TSHE/RHMA -GASH	TSHE/RHMA -BENE	TSHE/RHMA -VAOV2
Number of Plots	48	18	31	22	25	16	12	15
	Cover/Constancy							
Herb Species								
ACRU	1/6	---	---	---	1/8	---	---	1/7
ACTR	---	2/39	7/23	---	---	---	3/8	1/7
ADBI	1/4	2/28	2/26	---	---	---	2/8	---
ADPE	---	---	2/3	1/13	1/20	---	2/17	1/7
ANDE	2/8	2/28	1/19	---	2/8	---	---	---
ASCA3	2/8	1/6	---	1/4	1/4	2/6	---	---
ATFI	1/6	7/17	2/16	2/9	2/16	1/19	---	1/7
BLSP	2/21	1/6	2/26	2/39	2/32	2/25	---	2/13
BROMU	2/4	2/28	4/13	1/4	2/8	---	---	---
BRVU	2/10	1/11	2/19	2/4	---	1/6	---	1/7
CAREX	1/6	---	2/10	---	1/8	---	---	---
CAOB	1/2	---	---	---	---	---	---	---
CABU2	---	1/11	---	---	---	---	1/8	1/7
CLUN	---	---	---	---	---	---	---	---
DIFO	1/13	1/17	1/10	1/9	1/32	1/6	2/8	2/7
DIHO	1/21	1/61	1/48	1/17	1/36	1/13	1/17	1/13
DRAU2	---	1/6	1/10	1/4	1/4	---	---	1/7
FECA	1/19	2/44	2/55	1/9	---	---	---	---
FEOC	1/2	1/17	2/10	1/4	---	---	1/25	1/20
FESU	1/2	----	---	---	---	---	1/8	---
GATR	1/48	1/78	2/68	1/61	2/48	2/25	2/25	1/27
HIAL	1/2	1/6	---	---	---	---	1/8	1/20
LUCA2	1/8	2/11	1/26	1/13	1/12	1/6	---	---
LUZUL	1/2	---	---	2/4	1/12	---	---	---
LYAM	---	---	---	---	---	---	---	---
MADI2	1/13	3/6	2/26	---	1/4	2/13	---	1/7
MAOR	---	---	1/10	1/17	3/4	2/6	---	1/7
MOSI	2/23	1/28	2/52	2/39	2/36	1/19	2/17	2/13
OXOR	2/25	9/28	11/42	8/52	6/64	5/31	2/42	3/20
POGL4	1/2	---	---	---	1/4	1/6	---	---
POMU	27/100	24/100	39/100	43/100	53/100	24/100	32/92	19/93
PTAQ	3/25	4/28	1/29	---	---	2/44	---	2/20
SMST	2/4	1/6	2/6	---	---	---	1/8	1/13
STAM	---	1/6	---	---	---	---	---	---
STME2	---	---	1/16	2/13	1/8	---	1/8	---
SYRE	---	2/11	1/13	---	1/8	---	---	1/7
TITR	---	2/11	1/3	---	---	---	---	---
TOME	---	---	---	1/4	1/4	---	---	---
TRLA2	1/15	1/50	1/42	1/30	2/28	2/13	2/17	1/20
TROV	1/73	1/61	1/71	2/78	2/64	2/50	2/92	1/47
VAHE	1/8	2/8	1/23	2/9	3/24	3/6	1/33	---
VIGL	---	---	1/3	---	---	---	---	---
VISE	1/23	2/44	1/45	1/22	1/12	2/13	2/25	1/27
Mean Herb Cover	31/98	33/100	50/100	47/100	57/100	27/100	32/100	21/93
Mean Moss Cover	18/100	13/94	16/100	12/96	12/100	11/94	29/100	16/93

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	PISI/OPHO	PISI/RUSP	PISI/RUSP -GASH	PISI/GASH	PISI/OXOR	PISI/POMU	PISI/MEFE -VAPA
Number of Plots	16	28	13	14	26	34	17
	Cover/Constancy						
Tree Species 1/							
ACMAM	---	---	---	1/7	---	33/9	---
ACMAR	---	---	---	---	---	---	---
ALRUM	11/33	1/3	6/31	5/57	18/31	11/44	4/12
ALRUR	1/7	---	---	1/14	---	1/6	---
CONUM	---	25/69	---	---	---	---	---
CACHM	---	2/3	---	---	---	---	---
MYCAM	---	---	---	---	---	---	---
PICOM	---	---	---	---	---	---	---
PICOR	---	---	---	---	---	---	---
PISIM	15/93	25/93	26/100	31/93	28/96	29/97	26/53
PISIR	1/53	4/41	2/15	2/50	2/42	6/32	1/12
PSMEM	43/87	47/79	33/85	43/71	28/77	44/74	34/88
PSMER	---	---	1/8	---	---	1/3	1/12
TABRM	---	---	40/8	---	35/4	---	---
TABRR	---	---	---	---	---	---	---
THPLM	12/33	---	18/23	7/36	5/15	12/47	6/29
THPLR	1/7	---	---	---	1/4	---	1/12
TSHEM	36/100	18/72	25/100	28/93	35/96	27/91	44/94
TSHER	4/73	3/45	5/69	5/71	7/81	4/65	11/88
Mean Canopy Cover	77/100	77/100	76/100	80/100	79/100	83/100	72/100
Mean Regeneration Cover	8/80	3/55	5/77	5/93	7/88	4/74	10/94
Shrub Species							
ACCI	13/47	17/62	24/23	8/7	23/23	21/29	22/18
BENE	1/7	3/14	---	7/21	10/4	2/12	2/18
COCO2	---	---	---	---	---	7/3	---
CONU	---	---	---	---	1/4	---	---
GASH	3/40	4/31	22/100	53/100	2/15	3/59	6/71
HODI	---	3/14	2/8	3/21	---	3/3	---
LOCI	---	---	---	---	---	---	---
MEFE	9/100	6/62	6/62	3/57	9/85	3/76	11/100
MYCA	---	---	---	---	---	---	---
OPHO	23/100	2/7	---	---	2/35	2/3	2/6
RHDI	---	---	---	---	---	---	---
RHMA	---	---	---	---	---	---	---
RHPU	1/20	10/10	3/31	4/21	2/12	1/24	1/6
RIBR	1/7	3/17	---	---	1/4	1/6	---
ROGY	---	1/7	---	---	---	2/3	1/6
RUPA	2/20	3/21	2/15	1/29	1/4	4/6	---
RUSP	10/93	42/100	20/100	5/79	4/69	4/76	3/65
RUUR	---	2/17	1/23	1/50	---	2/15	1/41
SAMBU	---	---	---	---	---	---	---
SARA	3/47	4/38	3/15	1/7	7/42	2/32	1/12
VAAL	5/40	5/7	8/15	---	6/35	1/3	23/35
VAOV2	---	7/28	8/46	3/29	1/4	4/53	2/6
VAPA	9/100	8/93	9/92	15/93	12/92	10/94	20/100
WHMO	---	3/7	---	---	---	---	1/6
Mean Shrub Cover	53/100	69/100	72/100	90/100	31/100	24/100	49/100

1/ "m" after the species represents mature trees.
"r" after the species represents regenerating trees (less than 12 feet tall).

PLANT SPECIES COMPOSITION OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	PISI/OPHO	PISI/RUSP	PISI/RUSP -GASH	PISI/GASH	PISI/OXOR	PISI/POMU	PISI/MEFE -VAPA
Number of Plots	16	28	13	14	26	34	17
	Cover/Constancy						
Herb Species							
ACRU	---	1/7	---	---	1/4	1/15	1/6
ACTR	---	---	---	---	8/4	---	1/6
ADBI	---	---	---	---	2/4	---	---
ADPE	---	1/3	---	---	---	---	---
ANDE	1/7	2/3	---	---	---	---	---
ASCA3	1/7	1/7	---	---	2/8	1/9	1/6
ATFI	2/73	2/55	3/23	1/21	3/65	2/50	2/18
BLSP	3/80	3/62	3/85	2/36	3/73	3/76	5/94
BROMU	1/13	1/3	---	5/14	3/27	2/12	1/6
BRVU	1/13	1/14	1/8	---	8/27	4/9	3/12
CAREX	1/7	15/3	5/8	---	3/8	1/6	1/6
CAOB	---	---	---	---	---	---	---
CABU2	---	---	---	---	---	---	---
CLUN	1/13	1/3	---	---	2/15	1/3	1/29
DIFO	1/20	1/21	---	---	2/4	1/21	1/6
DIHO	2/87	1/76	1/84	1/29	2/81	1/68	1/47
DRAU2	1/87	1/34	1/54	---	2/54	1/29	1/24
FECA	1/20	1/21	2/8	1/7	1/46	2/21	1/18
FEOC	1/7	---	---	---	1/12	1/3	---
FESU	1/7	1/3	---	---	---	1/3	---
GATR	2/40	1/52	1/38	1/36	1/50	2/56	1/41
HIAL	1/7	---	---	1/7	1/8	---	2/6
LUCA2	1/73	1/55	1/15	2/14	1/54	1/38	1/47
LUZUL	1/20	1/10	3/8	2/7	1/8	1/3	---
LYAM	1/7	2/10	2/8	---	1/4	---	---
MADI2	2/60	2/45	1/23	1/21	4/73	4/50	8/41
MAOR	---	2/21	---	---	2/8	1/6	---
MOSI	2/73	2/86	2/62	2/57	4/92	2/85	2/59
OXOR	29/93	20/66	4/23	4/14	38/100	6/50	10/59
POGL4	4/7	1/7	1/15	1/7	2/4	---	1/12
POMU	45/100	42/100	26/100	29/93	34/100	55/100	17/100
PTAQ	1/20	3/14	1/15	1/36	1/19	2/15	2/12
SMST	2/7	1/10	---	---	1/12	1/6	5/12
STAM	1/33	1/3	1/8	1/7	1/19	1/3	1/18
STME2	2/53	7/48	1/8	---	5/73	3/35	---
SYRE	---	---	---	---	---	---	---
TITR	2/40	1/10	1/15	---	2/23	2/6	1/24
TOME	2/7	4/21	1/8	---	6/15	1/15	---
TRLA2	---	2/14	---	3/7	1/4	1/6	---
TROV	1/67	1/55	1/62	1/36	1/69	1/59	1/71
VAHE	1/13	1/3	---	---	---	1/3	---
VIGL	---	1/3	---	---	---	---	---
VISE	1/13	2/28	1/8	5/21	5/23	2/47	2/41
Mean Herb Cover	69/100	61/100	31/100	32/93	77/100	63/100	35/100
Mean Moss Cover	35/93	35/100	33/100	20/100	34/96	19/100	40/100

Appendix

ENVIRONMENTAL SUMMARY OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	TSHE/OPHO	TSHE/RUSP	TSHE/RUSP -ACCI	TSHE/RUSP -GASH	TSHE/OXOR	TSHE/POMU	TSHE/ACCI /POMU	TSHE/GASH
Number of Plots	10	30	34	13	52	49	77	29
	Percent of Plots							
Aspect (quadrant)								
NE (0-90)	50	30	24	--	29	24	17	21
SE (90-180)	--	33	35	38	17	16	26	14
SW (180-270)	30	13	18	31	17	33	27	48
NW (270-360)	20	23	24	31	37	27	27	17
Elevation (feet)								
0-500	--	17	18	23	4	8	14	3
500-1000	40	53	44	38	42	41	56	24
1000-1500	40	23	29	15	37	31	22	48
1500+	20	7	9	23	17	6	9	21
Slope (percent)								
0-20	40	17	26	15	23	8	14	24
20-40	10	37	26	23	21	14	13	17
40-60	10	17	24	15	31	22	23	28
60+	40	30	24	46	25	55	48	28
District								
Hebo	60	37	12	8	54	24	12	34
Waldport	20	27	24	46	25	39	27	21
Alsea	20	3	50	23	13	12	40	31
Mapleton	--	33	15	23	8	24	21	14
Dunes NRA	--	--	--	--	--	--	--	--

Association	TSHE/ACCI -GASH	TSHE/BENE -GASH	TSHE/BENE	TSHE/VAOV2	TSHE/RHMA /POMU	TSHE/RHMA -GASH	TSHE/RHMA -BENE	TSHE/RHMA -VAOV2
Number of Plots	48	18	31	22	25	16	12	15
	Percent of Plots							
Aspect (quadrant)								
NE (0-90)	2	18	10	14	28	6	17	13
SE (90-180)	19	18	32	27	20	25	17	20
SW (180-270)	42	35	45	36	40	44	42	47
NW (270-360)	37	29	13	23	12	25	25	20
Elevation (feet)								
0-500	10	--	6	27	24	--	--	7
500-1000	46	24	16	45	32	38	--	73
1000-1500	33	47	42	27	32	38	58	13
1500+	10	29	35	--	12	19	42	7
Slope (percent)								
0-20	19	12	6	14	8	19	8	27
20-40	35	18	13	23	4	6	25	--
40-60	17	29	32	32	8	19	8	7
60+	29	41	48	32	80	50	58	67
District								
Hebo	6	6	23	--	--	--	--	--
Waldport	4	6	13	9	4	--	--	--
Alsea	60	71	52	9	4	--	--	--
Mapleton	29	18	13	82	92	100	100	100
Dunes NRA	--	--	--	--	--	--	--	--

Appendix (Continued)

ENVIRONMENTAL SUMMARY OF SIUSLAW NATIONAL FOREST PLANT ASSOCIATIONS

Association	PISI/OPHO	PISI/RUSP	PISI/RUSP -GASH	PISI/GASH	PISI/OXOR	PISI/POMU	PISI/MEFE -VAPA
Number of Plots	16	28	13	14	26	34	17
				Percent of Plots			
Aspect (quadrant)							
NE (0-90)	33	25	--	14	38	24	6
SE (90-180)	27	21	31	29	19	18	29
SW (180-270)	13	11	31	14	31	38	47
NW (270-360)	27	43	38	43	12	21	18
Elevation (feet)							
0-500	20	46	38	29	15	44	18
500-1000	53	32	54	50	31	38	53
1000-1500	27	11	8	21	42	12	35
1500+	--	11	--	--	--	6	6
Slope (percent)							
0-20	20	39	31	35	46	12	29
20-40	20	11	15	14	19	24	41
40-60	27	7	23	28	15	29	12
60+	33	43	23	21	19	32	18
District							
Hebo	93	54	62	29	81	29	76
Waldport	7	39	23	64	19	68	24
Alsea	--	--	--	--	--	--	--
Mapleton	--	7	--	--	--	--	--
Dunes NRA	--	--	8	7	--	3	--