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Title: PLANT COMMUNITIES IN THE OLD-GROWTH FORESTS OF NORTH COASTAL OREGON

Abstract approved: _____
Dr. Charles E. Poulton

This study was conducted in the old-growth forests of Clatsop, Tillamook, and Lincoln counties, Oregon. The three objectives of the research were to describe and classify the near-climax plant communities found within the forests, to relate the associes described by a previous study to the forest communities characterized by the present study, and to relate the present elk distribution to the distribution of plant communities identified.

Vegetation, soils, and physiographic data were collected from a large number of timbered stands of variable sizes scattered throughout the area bounded on the north by Youngs River and on the south by the Siletz River. Sampling was stratified within each tract to obtain homogeneous vegetation-soil sampling locations. Vegetation data, recorded from 137 locations, formed the basis for the plant community classification. Society tables were used for a

phytosociological synthesis of vegetation data.

Eleven plant communities were identified within the timbered areas studied. All were within what might be termed a broad Tsuga heterophylla forest association. Plant species useful for identifying community stands were used in naming the eleven plant communities:

Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina

Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/Blechnum spicant

Tsuga heterophylla-Abies amabilis/Gaultheria shallon/Tiarella unifoliata

Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana

Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Cornus canadensis

Tsuga heterophylla-Vaccinium ovalifolium/Polystichum munitum

Tsuga heterophylla/Acer circinatum/Cryptogramma crispa

Tsuga heterophylla/Berberis nervosa/Trientalis latifolia

Tsuga heterophylla/Polystichum munitum-Adiantum pedatum

Tsuga heterophylla/Vaccinium membranaceum/Xerophyllum tenax

Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa

A dichotomous key was prepared to facilitate the identification of community stands in the field. Field tests in new locations were not conducted to determine the accuracy of the key, but data from

individual stands were used to key locations into the proper community without difficulty.

Stands of associes previously described on logged and burned forest lands are compared with those of the near-climax plant communities identified.

The present elk distribution of the area is related to a north to south geographic change in the amount of "coastal-habitat". The relative importance of communities to deer and elk is compared. Suggestions are made for the utility of the phytosociological classification of this important forested area.

Plant Communities in the Old-Growth Forests of North Coastal Oregon

by

William Wester Hines

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PLANT COMMUNITIES IN THE OLD-GROWTH FORESTS OF NORTH COASTAL OREGON

INTRODUCTION

Demands of an increasing human population continue to reduce the amount of nonarable lands available for the sustained yield management of our renewable land resources. Simultaneously, existing supplies of the same resources are being harvested at accelerated rates. As resource needs continue to increase, so must the intensity of renewable resource management, but intensive use or management for a single purpose does not guarantee that the resources will be used wisely. Instead, ill-advised practices and misuses could inadvertently occur when trying to meet rising resource needs. Land-use and management decisions should be based upon an ecological understanding of the resource; otherwise, resources might become irrepairably altered to the detriment of future societies.

Recent changes in the intensity of western Oregon forest management has already begun to affect the productivity of the big game ranges. The forest industry largely controls the forest lands for wood fiber production and its management can in large measure control and regulate the quantity and quality of Columbian black-tailed deer, (Odocoileus hemionus columbianus Richardson), and Roosevelt elk, (Cervus canadensis roosevelti Merriam) habitat in the State.

Rapid forest regeneration, shorter tree-growth cycles, stand stocking control, fertilization, and fire control are beginning to change the character and composition of recently logged areas and to affect the rapidity with which seral vegetation develops after logging. How do such practices affect the suitability of areas as game habitat? What alternative practices are acceptable and where would their use produce the desired response? Where should intensively managed key areas be established for the winter control of elk distribution and animal nutrition? These are but a few management questions facing biologists that can be best answered from an ecological understanding of the forest environment.

The Oregon Game Commission has undertaken, in cooperation with Oregon State University, two previous plant community studies. The first was a segment of an ecological study of black-tailed deer in the north coast Tillamook Burn area and the second a similarly designed study of Roosevelt elk in Coos and Douglas counties of southwestern Oregon. The more extensive Coos area investigation described and characterized forest associations in climax or near climax stands. Secondary plant succession was also described for selected habitat-types and the relationship of seral vegetation patterns was related to the distribution of elk use.

The present study is an extension of the earlier investigation of seral plant communities in the deer habitat of the Tillamook Burn.

The initial study characterized the seral communities, determined soil-vegetation relationships, and discussed the character of likely habitat-types occurring within the Burn. The present investigation was designed to study the soil-vegetation relationships in the relatively undisturbed, near-climax forests within and surrounding the Burn.

The study had the following objectives:

(1) Describe and characterize the plant communities in the high seral forests located in and adjacent to the Tillamook Burn.

(2) Relate the various associes described by the initial study (Bailey and Poulton, 1968) to the forest communities characterized by the present study.

(3) Relate the present Roosevelt elk distribution to the distribution of the plant communities identified.

The study area included all forest lands from the Oregon Coast Range summit westward to the Pacific Ocean and from the Youngs River drainage in Clatsop County south through Tillamook County to the Siletz River drainage in northern Lincoln County (Figure 1).

The taxonomic nomenclature of grass species follows Hitchcock (1950). The five volumes of Hitchcock et al. (1955, 1959, 1961, 1964, 1969) have been referred to for the remaining higher plants.

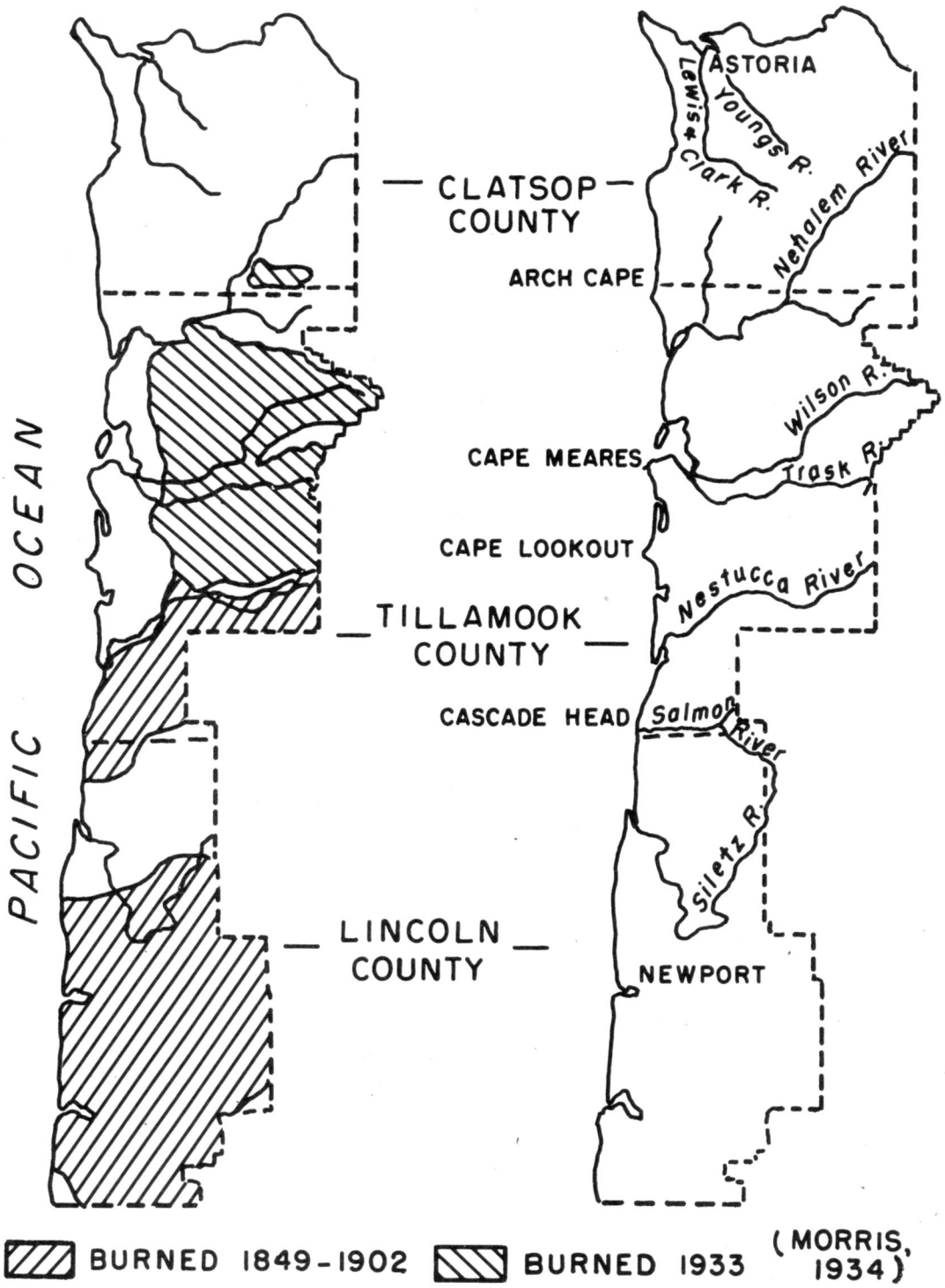

Figure 1. Map of the three-county study area showing the major river drainages and distribution of previous wildfires.

DESCRIPTION OF STUDY AREA

Geology and Physiography

The Oregon Coast Range is a broad irregular group of highly dissected hills that have developed from tertiary formations fractured by numerous igneous intrusions (Washburne, 1914). The summit parallels the coastline some 25 to 35 miles to the east.

The Astoria geologic formation covers a broad area extending southward from Astoria in northwestern Clatsop County. Here, massive beds of fine-grained sandstone grading upward into shale are overlaid by coarse-grained micaceous sandstone.

Columbia basalt intrusions, beginning at Neahkahnie Mountain and appearing frequently throughout the northwestern portion of Clatsop County, have produced such promontories as Onion Peak, Sugarloaf, North Saddle, Humbug, and Nicolai mountains (Peck, 1961).

The Nestucca formation occurs southward into the lower Nehalem Valley where interbedded tuffaceous and shaly siltstone and claystone along with basaltic sandstone predominate (Baldwin, 1959).

A complex of the sedimentary Nestucca formation and the Tillamook volcanic series has been mapped by Peck (1961) from the Upper Trask River area south through the Nestucca River drainage to approximately the Salmon River highway. Scattered inclusions of

coarse-grained granophyric gabbro and diorite occur from Mount Hebo southward through the Little Nestucca drainage towards Valsetz (Peck, 1961).

South of the Salmon River, the Siletz River volcanic series predominates to the Siletz River, the southern boundary of the present study area. The series consists chiefly of ferromagnesiun lava flows but includes flow breccias, pyroclastic rocks, and small amounts of sedimentary beds. Dark greenish gray asphanitic to porphyritic basalt rock predominates in the flows (Snavely and Baldwin, 1948).

The extreme southern portion of the study area occurs within the northern extension of the Tyee sandstone formation encountered and described by Bailey (1966) in his Coos County studies. The sandstone is medium to coarse grained and highly micaceous. In Lincoln County the sandstone is white in color because of the presence of andesitic or dacitic tuff (Washburne, 1914).

Climate

The study area is under the predominating influence of an oceanic climate, whose degree of influence varies considerably from place to place, especially with changes in elevation and distance inland from the coast. The climate is largely controlled by the North Pacific Drift and the prevailing westerly winds (Heusser, 1960). Warm, moist offshore winds, moving towards the "Aleutian Low"

during the winter, cross the coastline and rise abruptly as they approach the Oregon Coast Range. Cooler air aloft causes vigorous condensation and heavy rains, especially west of the Coast Range crest. Unlike the southern portion of the Range, numerous peaks and ridges rise to an elevation of approximately 3,000 feet in the north coastal area where annual precipitation amounts are the highest in the State. Weather records indicate that the northeastern portion of Lincoln County receives 200 inches of rainfall annually (Figure 2).

During the late spring and summer months, offshore currents moving under the influence of the North Pacific High, move southward toward low pressure areas that develop over the warmer continent (Heusser, 1960). Summer fog banks commonly move across the coastline and extend eastward into all lowlands and river drainages as much as 20 miles or more. Fog intensity and inland penetration are inversely related to maximum interior daytime temperatures except during periods when onshore winds prevent marine air from approaching the coast. Fog dissipation usually occurs by midmorning in areas of deepest penetration but cloudy skies commonly persist throughout the day along coastal sections.

As depicted in Figure 3, the coastal edge of the study area has an extremely oceanic climate with infrequent snowfall and few days of sub-freezing temperatures.

At Glenora on the eastern edge of the area near the Coast

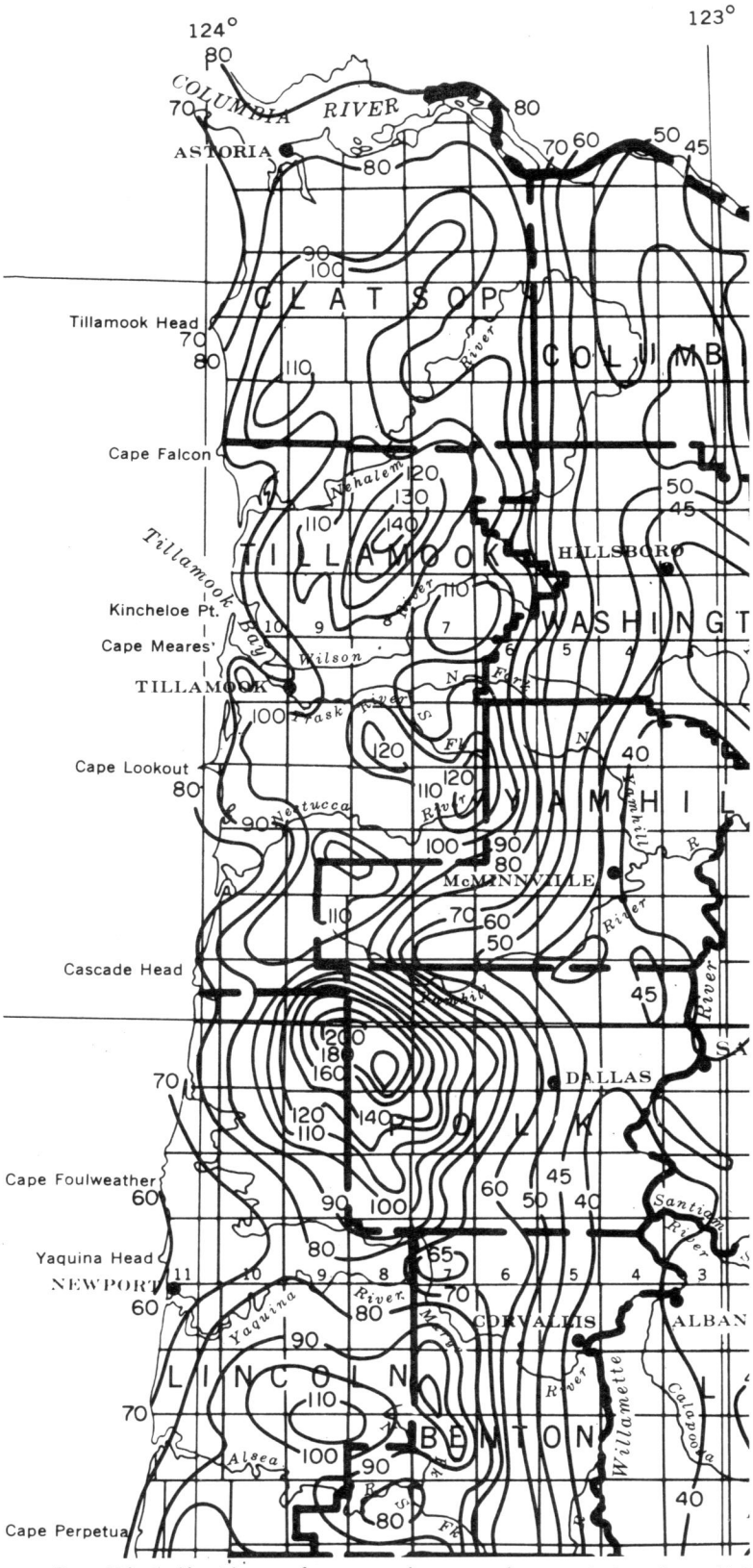

Figure 2. Distribution of normal annual precipitation (1930-1957) within the study area (U.S.D.A., 1964).

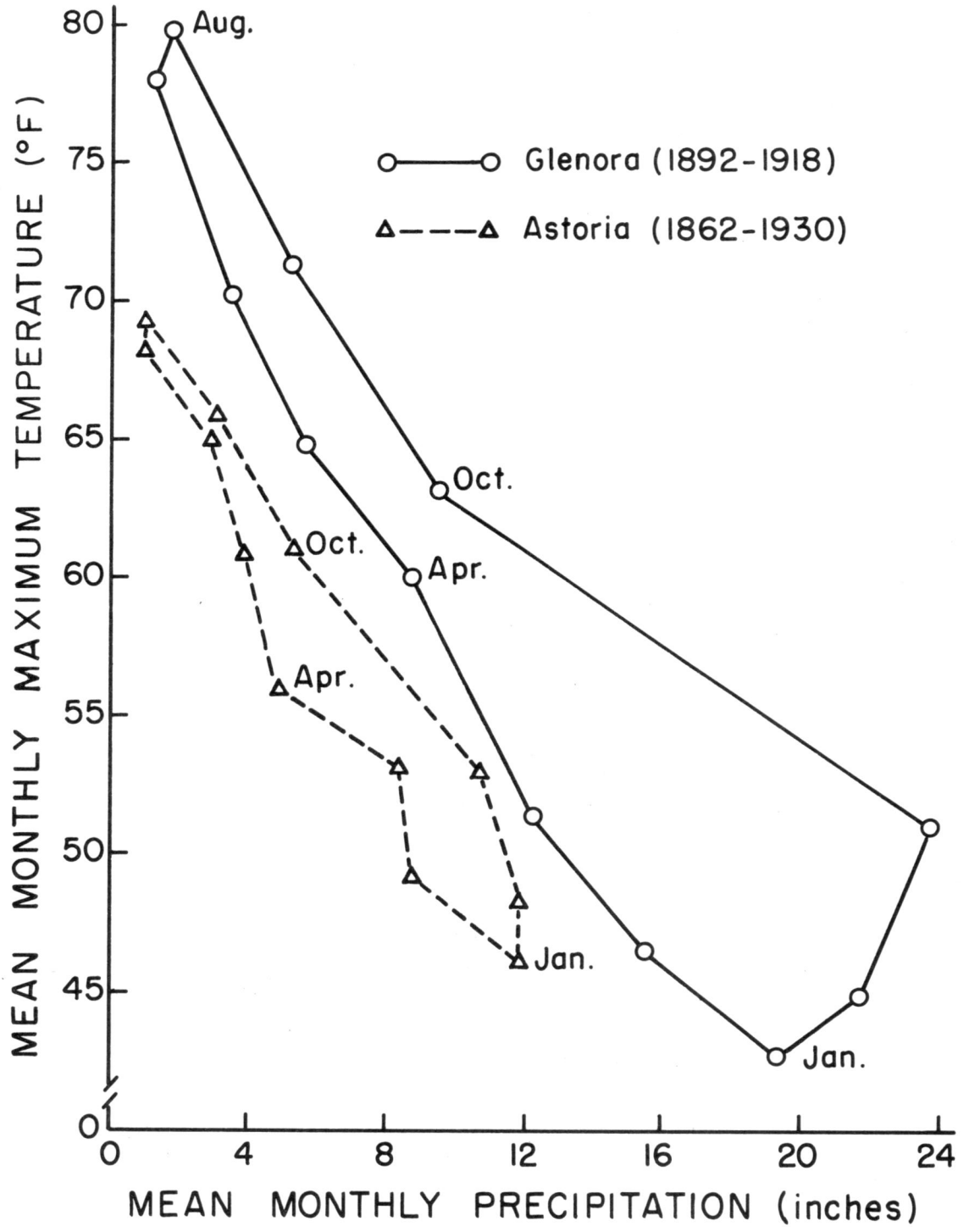

Figure 3. A hythergraph comparing mean monthly maximum temperatures and precipitation for the eastern (Glenora) and western (Astoria) portions of the study area (U.S.W.B., 1936).

Range summit, the oceanic influence has been moderated. Maximum temperatures, snowfall, and rainfall are increased and minimum temperatures, humidity, and growing season lengths are less (Figure 3).

Vegetation

According to Franklin and Dyrness (1969) the study area includes portions of two vegetation zones. The Picea sitchensis zone occurs on the extreme western portion of the area. It is only a few kilometers in breadth except where it fingers inland into river valleys. It is usually restricted to coastal areas less than 150 meters in elevation, but where mountains rise abruptly from the coastline, the zone may extend to 600 meters in elevation where fog and low clouds are frequent during the drier part of the year (Franklin and Dyrness, 1969). Picea sitchensis, Tsuga heterophylla, and Thuja plicata are the most common stand dominants in forested areas. Pseudotsuga menziesii, Abies amabilis and Abies grandis are less frequently found. Becking (1954) and Schmidt (1957) suggest the Pseudotsuga menziesii is not a component of numerous stands within the coastal fog belt because the climate had discouraged fires, a necessary prerequisite for Pseudotsuga menziesii establishment before man's logging activities began opening the canopy.

The Tsuga heterophylla zone is recognized as the most extensive vegetation zone in western Oregon (Franklin and Dyrness, 1969).

Here, because of the frequency of past fires, Pseudotsuga menziesii is the subclimax dominant over much of the range. Other commonly occurring species include Tsuga heterophylla, Thuja plicata, Abies grandis, and Picea sitchensis near the coast. Taxus brevifolia is a common subordinate species but most other hardwood species are scarce in mature undisturbed stands. Table 1 gives the distribution of timber-types in 1933 before most of the area was logged.

All areas sampled by the present investigation fall within the Picea sitchensis and Tsuga heterophylla zones identified by Franklin and Dyrness (1969) or the fog and mountainous climatic subregions recognized by Becking (1954).

Fire and Logging History

Prior to the 1933 Tillamook fire, documentation of the timing and extent of earlier wildfires was scanty. It is commonly believed that many were deliberately started or inadvertently extended by Indians and whites to remove undergrowth and/or maintain pastures for wild game and domestic ruminants.

Perhaps the most complete reconstruction of the Coast Range fire history was made by Morris (1934). Though the exact dates and sizes of many fires could not be agreed upon, the fact remains that large fires have occurred frequently since the arrival of the white settlers in about 1849. The location and distribution of the

Table 1. Distribution of timber types in the year 1933 before most of the study area was logged.*

Cover Type	Acreage by Forest Cover Types					
	Clatsop		Tillamook		Lincoln	
	Total	Percent	Total	Percent	Total	Percent
Nonforest	48,090	9.2	74,858	10.0	62,082	9.7
Forest						
Pseudotsuga menziesii	97,540	18.6	144,760	20.1	301,384	47.2
Tsuga heterophylla	153,605	29.2	80,650	11.3	39,825	6.3
Picea sitchensis	22,190	4.2	37,268	5.2	26,379	4.1
Thuja plicata	3,035	0.6	2,172	0.3	1,949	0.7
Abies amabilis & *procera*	8,265	1.6	1,550	0.2	2,040	0.3
Hardwood, alder, maple	8,485	1.6	73,190	10.2	11,784	17.6
Seedlings & saplings	38,375	7.3	21,658	3.0	8,623	1.4
Old cutovers	7,370	1.4	1,488	0.2	1,370	0.2
Cutovers (1920-1933)	105,295	20.0	45,205	6.2	23,308	3.6
Deforested burns	32,690	6.2	239,049	33.1	55,205	8.6
Other	535	0.1	1,769	0.2	4,661	0.7
Total acres	525,475		723,629		638,610	

*U.S.F.S. 1934

larger burns are schematically outlined in Figure 1 from locations supplied by Morris (1934).

The Nestucca fire, occurring sometime during the 1840's, started near the headwaters of the Nestucca River and covered approximately 380,000 acres. The southern periphery extended as far south as Cascade Head and the Salmon River drainage (Morris, 1934; Munger, 1944). Subsequent reburns by settlers inhabiting the bottomlands along the Nestucca River near Hebo, discouraged the establishment of coniferous forests so that today, much of that area lacks well-stocked commercial forests.

Beginning in 1933, a series of four Tillamook fires destroyed approximately 365,000 acres of old-growth timber immediately north of the northern boundary of the Nestucca fire. Collectively, the Nestucca and Tillamook fires extended from the Coast Range summit westward to within sight of the tidal areas, covering more than 1,000 square miles in the central and southern portions of the present study area.

Within the area, "islands" of old-growth timber escaped the crown fires that swept the areas. Fire scars on decadent Pseudotsuga menziesii indicate that many remnant stands were affected by ground fires either before or during the crown fires. Apparently no recent and extensive crown fires have occurred in the western half of Clatsop County.

Prior to 1933, most logging activities were adjacent to tidal areas in the northern part of the study area. Cutting did not accelerate in Tillamook County until after the 1939 Tillamook fire (Table 2). Significant removals of timber from Lincoln County began after World War II.

Table 2. History of acres logged in Clatsop, Tillamook, and Lincoln counties. (O. S. B. F. 1947-1967).

Logging period (years)	Acres Logged by County		
	Clatsop	Tillamook	Lincoln
Pre-1920	7,370	1,488	1,370
1920-1933	105,295	45,205	23,308
1934-1946	*	*	*
1947-1957	107,450	209,376	119,945
1958-1967	69,702**	91,688**	80,630**
Total Acres Logged	289,817	347,747	235,253
Total Forest Acres	474,000	648,000	571,000

* Acreage Figures Unavailable
** State and Private Acreage Only

PREVIOUS STUDIES

Within Study Area

Vegetation

Neiland (1958) conducted studies in a large old-growth remnant forest situated near the center of the Tillamook Burn in Tillamook County. The same area was intensively studied at the beginning of the present investigation, followed by studies which ranged westward radiating north and south along the coast. Neiland (1958) sampled vegetation on opposing slopes in the forest and adjacent Burn to compare the occurrence of species in the two habitats. No attempts were made to subdivide and interpret data in terms of differences in the plant communities present.

Working in the same major drainage as Neiland (1958), Bailey and Poulton (1968) have described eight seral plant communities that have developed following the 1945 fire. Their key for community identification lists the following associes present:

(1) Vaccinium parvifolium/Gaultheria shallon

(2) Rubus parviflorus/Trientalis latifolia

(3) Pteridium aquilinum/Lotus crassifolius

(4) Acer circinatum/Polystichum munitum

(5) Alnus rubra/Polystichum munitum

(6) Alnus rubra/Rubus parviflorus

(7) Acer macrophyllum/Alnus rubra

(8) Acer macrophylum/Symphoricarpos mollis

Dirks-Edmunds (1947) and Macnab (1958) conducted studies on Saddleback Mountain on the south side of the Salmon River drainage in northeastern Lincoln County, situated in the southern portion of the present study area. Both studies, located at approximately 1,500 feet elevation reported the presence of old-growth timber stands dominated by Pseudotsuga menziesii with Tsuga heterophylla occupying a subordinate position. The species list by each author shows a scattering of Abies procera in both areas but an absence of Vaccinium ovalifolium in the Macnab (1958) area.

Soils

The earliest soil survey in the study area was conducted in the Astoria area where 147,000 acres were mapped in the western and northern portions of the County. Mapping was limited to areas along drainages and the coast possessing agricultural potential (Torgerson et al., 1949).

Astoria soils, developing from weathering sandstone and shale, were found on the hills and uplands where they occupy 60 percent of the total area surveyed. Their distribution extends south on lands dominated by Picea sitchensis and Tsuga heterophylla to the

Necanicum River, the southern boundary of the survey area (Torgenson et al., 1949).

The soil survey of the Tillamook Burn area by Swanson (1957), near the location where the present study was initiated, described the Astoria, Trask, Hembre, and Kilchis soils as predominating in the area.

Westward towards the coast, a Tillamook area survey found that the Astoria and Hembre soils occupied most of the forested, hilly, and mountainous areas adjacent to the bottomlands along the rivers and coast (Bowlsby, 1964).

Most recently Meurisse and Youngberg (1971) conducted a soil-vegetation survey on the 12,000-acre Tillamook Tree Farm east of Garibaldi and the 14,000-acre Munson Falls Tree Farm southeast of Tillamook. Unlike the Tillamook area survey, all of the Tree Farm mapping was restricted to commercial forest lands. The present investigation also studied forest plant communities scattered throughout the two private forests.

The Meurisse and Youngberg (1971) survey indicated that Astoria soils occupied approximately 40 percent of the two tree farms while Hembre soils occupied an additional 25 percent. Klickitat soils, similar to those mapped by Corliss and Dyrness (1963), some 70 miles south along the coast, also occupied 24 percent of the Tillamook area tree farm acreage.

Other Pertinent Studies

Two noteworthy studies have been completed in the central and south coast areas of Oregon. Corliss and Dyrness (1963) recognized ten understory plant communities in mapping the Alsea River watershed:

Gaultheria shallon

Holodiscus discolor-Gaultheria shallon

Acer circinatum-Gaultheria shallon

Gaultheria shallon-Polystichum munitum

Acer circinatum-Polystichum munitum

Polystichum munitum

Rubus spectabilis-Polystichum munitum

Polystichum munitum-Oxalis oregana

Pteridium aquilinum-Gaultheria shallon

Gaultheria shallon-Pteridium aquilinum

The survey was designed to provide information for the land manager's use when prescribing management alternatives. The classification disregarded the seral status of the communities encountered. Areas which have been frequently burned support a community dominated by *Pteridium aquilinum*. The authors indicate that the community could be the seral equivalent of a number of others varying from the *Acer circinatum* to the *Gaultheria shallon* (Corliss

and Dyrness, 1961).

One of the most intensive studies undertaken in the Oregon Coast Range was conducted by Bailey (1966) in the south coast vegetation of Coos and Douglas counties, located approximately 100 miles south of the southern end of the present study area. Though more intensive, his approach was similar to that of the present investigation. Analysis of quantitative plot data taken from tentatively identified stands showed that five major forest associations were present in his 265,000 acre study area. Two indicative understory species were used to name each association:

Thuja/Adiantum-Athyrium

Tsuga/Polystichum/Oxalis

Tsuga/Acer/Berberis

Tsuga-Pseudotsuga/Rhododendron/Berberis

Pseudotsuga/Holodiscus/Gaultheria

A shrub layer is practically non-existent in the Adiantum-Athyrium association. Most stands of the association occur on steep slopes near the bottom of the larger canyons where Polystichum munitum and Oxalis oregana dominate the herb layer. The presence of extremely moist, stony soils is characteristic of the community.

The most widely distributed and variable community studied by Bailey (1966) was the Polystichum/Oxalis community. The shrub layer is characteristically dominated by Acer circinatum or Tsuga

reproduction. Oxalis oregana and Polystichum munitum dominate the herb layer and Tiarella trifoliata is considered as an indicator species. Stands are commonly found on lower and middle slopes having deep and relatively stone-free profiles (Bailey, 1966).

Stands of the climax Acer/Berberis association are dominated by Tsuga heterophylla. A low shrub cover occurs under the dense forest canopy but Acer circinatum thrives in the lightspots. Dominance of the herb layer is shared by Berberis nervosa and Polystichum munitum. Stands occur on a variety of slope gradients either in the middle or lower slope position. Soils underlying stands are mostly stone-free and have a clay or clay loam texture.

Climax stands of Rhododendron/Berberis association are dominated by either Tsuga heterophylla or Pseudotsuga menziesii. Low cover of Rhododendron macrophyllum and Berberis nervosa occur in the densely shaded environment but Rhododendron dominates where lightspots occur. The low-constancy saprophyte Allotropa virgata displays high fidelity for the association. Stands most commonly occur on the upper slopes and ridges with south-facing exposures.

In relatively dry areas, Pseudotsuga menziesii is the climax overstory-dominant in the Holodiscus/Gaultheria association. Holodiscus discolor dominates the shrub layer and Gaultheria shallon and Berberis nervosa share dominance in the ground layer. Stands usually occur on south slopes where soils are stony and show a high clay

content in the B horizons (Bailey, 1966).

Three studies conducted predominantly beyond the Oregon Coast Range are reviewed because they also developed classifications of forest vegetation in the Pacific Northwest. An early investigation of Spilsbury and Smith (1947) developed a biological method of forest site type determination. These authors correlated the occurrence of vegetation differences with tree growth and have developed a key to recognize site differences using plant species as phytometers of the environment. Individual species are not restricted to any one plant community; some occur in all site types and others display greater fidelity. Changes in species form, vigor, and abundance from site to site are important criteria for discrimination.

Five forest site types, ranging from the most to the least productive were recognized by Spilsbury and Smith:

SITE TYPE	DOMINANTS	IMPORTANT SPECIES
Polystichum	Achyls t. Polystichum m.	Fatsia h. Luzula sp. Asplenium c. Montia s. Tiarella l. Struthiopteris s.
Polystichum-Gaultheria	Polystichum m. Gaultheria s. Berberis n.	Chimaphila a. Rosa g. Corallorhiza sp.
Gaultheria	Gaultheria s. Berberis n.	Listera n. Boschniakia s. Allotropa m.

SITE TYPE	DOMINANTS	IMPORTANT SPECIES
Gaultheria-Parmelia	Gaultheria s. Berberis n.	Lupinus sp. Arctostaphylos u. Parmelia e.
Gaultheria-Usnea	Gaultheria s.	Usnea b.

Becking (1954) separated the plant communities of the Pseudotsuga menziesii region into the major Polystichum munitum and Gaultheria shallon forest type groups based upon principles of Braun-Blanquet phytosociology. The presence of indicator species or distinctive groups of species was used to characterize the forest types.

The Polystichum munitum dominated group is characterized by deep loamy soils having good moisture seepage, brown-earth development, and a high site index of 172 for Pseudotsuga menziesii.

The group dominated by Gaultheria shallon has well-drained sandy to gravelly soils that hold relatively little summer moisture. Podsol soil development occurs at all elevations where a medium to low site index (120-150) is characteristic of the Gaultheria group.

The Polystichum and Gaultheria types are represented in all four of Becking's physiographic subregions by one or more associations.

Becking (1954) recognizes 14 forest types within the two forest type groups. From his list of indicator species for each type, vegetation representative of the following Becking types is found within

the present study area:

Polystichum munitum-Pseudotsuga menziesii group

Asarum caudatum
Fog belt
Typical
Montane
Subalpine

Gaultheria shallon-Pseudotsuga menziesii group
Fog belt
Lowland
Montane

Franklin (1966) studied the old-growth forest communities and soils in the Abies amabilis and Tsuga mertensiana zones of the Washington Cascade Range where Abies amabilis is a major tree species. Since balsam fir is present in some stands of the present study, the 12 associations listed by Franklin as in the Abies amabilis zone follow:

Mount Ranier Province

A. amabilis/Gaultheria
A. amabilis/Vacc. alaskaense
A. amabilis/Berberis
A. amabilis/Xerophyllum/Lithosol
A. amabilis/T. heterophylla/Vacc. membranaceum*
A. amabilis/Streptopus
A. amabilis/Oxalis
A. amabilis/Oplopanax*
A. amabilis/Menziesia*

Mount Adams Province

A. amabilis/Achlys
A. amabilis/Tiarella
A. amabilis/Vacc. ovalifolium

* Also present in Mount Adams province

TERMINOLOGY

The presentation contains several specialized terms which have been widely used by previous studies but which lack an internationally-accepted definition. Without clarification, a reader can become quickly confused.

The plant community is an abstraction of aggregations of plants with a relatively uniform physiognomy and species composition which reoccurs across the landscape under relatively uniform environmental conditions. The definition for vegetation-type is synonymous with that for plant community.

A stand is a concrete example or unit of the abstract plant community as it occurs in the landscape.

Presence refers to the occurrence of plant species in a plant community or stand and presence percentage is the occurrence of a species in a number of stands, expressed as a percentage of the total stands.

Prominence indicates the apparent importance of species in terms of the aspect of the community or its stature relative to other species present.

Fidelity is a qualitative characteristic of plant species used to link its occurrence to specific plant communities.

Character species are those displaying high fidelity for specific

plant communities.

Differential species are those which are used to subdivide a group, the parts of which are linked by character species.

Indicator species are those with a high presence percentage in particular communities and absent or occurring with a low presence percentage in others.

METHODS

General

The fourth and most intensive reconnaissance method outlined by Poulton (1962) was adopted for use by the present study. Poulton states that the technique is adequate for characterizing vegetation and developing tentative classifications but he cautioned that the method is not a substitute for statistically sound quantitative plot studies. Each approach has a place; and if properly applied, each will complement the other.

The relative speed with which stand data could be collected, permitted coverage of a wide area and a large number of stands to be examined. Only one visit was made to each location because of the scattered occurrence of uncut timber tracts in the area and the isolated nature of most stands.

Since field work commenced in July and terminated in October, 1964, some of the delicate and short-lived plant species were missed by one-vistitation sampling. A complete characterization of all plant species endogenous to each stand was sacrificed for extended sampling to reveal information on community distributions within the study area. The assumption was made that the more important differentiating characteristics of each phytosociological class would be present

in the data collected. From a practical standpoint, classifications must rely on features that can be observed at most times of the year.

Study Areas

Public land management agencies and timber holding companies in the area were interviewed in order to obtain information on the locations of scattered old-growth timber areas that might be suitable for study. Potential areas had to be large enough to insure that environmental differences in adjacent logged areas did not appreciably influence vegetation growth or species composition within the timber. Priority was given to suitable areas occurring in the vicinity of the Tillamook Burn in Tillamook County. At the outset, vegetation stands located in the only large old-growth forest within the Burn were studied if their understory vegetation had not been disturbed by fire or salvage logging activities. As familiarity with the vegetation increased and similarities and differences became evident, particularly common stands were bypassed in favor of others possessing different floristics or physiographic characteristics.

Once the old-growth areas within the Burn had been thoroughly studied, additional tracts scattered around the periphery of the Burn were investigated. As the summer progressed timbered areas as far north as the Youngs River in northern Clatsop County and as far south as the Siletz River drainage in northern Lincoln County were

studied. Sampling was not extended into areas drained by tributaries of either the Columbia or Willamette rivers.

Sampling Locations

Within the timber, a search for areas of homogeneous vegetation was made by traversing the terrain in a general tacking manner at obliques to the contour. No area less than 100 yards from the timber edge was considered for study. Areas where "blow-down" or insect kill created openings in the forest canopy were either avoided or sampled separately. When areas free from recent disturbance and exhibiting a high degree of homogeneity in species composition and prominence were located, data were collected separately from uniform portions of the topography supporting that stand. The physiography of stands was described by the categories given in Appendix I.

Vegetation Sampling

When a sampling location was selected, the boundaries of a 50 by 75 foot rectangular plot for describing the tree stand density by size classes were established using 1/8 inch polyethylene coated nylon core line. Even though a plotless method of making vegetation cover estimates was used, the distinct boundaries of the stand-density plot were helpful in estimating cover values for low-growing plant species.

The multiple-layered vegetation within the stand was separated

into three strata based upon the height of the species present:

Stratum	Height range (feet)
Ground layer	0-3
Shrub layer	3-35
Tree layer	35+

Prominence and cover ratings were assigned to all species in each stratum to provide a vertical cross-section of species layers within communities. The five prominence-rating classes developed by Anderson and Poulton (1958) are outlined in Appendix II.

Cover estimates were made for all species within each layer by using the following eight-class system described by Daubenmire (1959). Cover is defined as that area of the ground that would be covered by projecting an imaginary vertical line to the ground from the periphery of the plants at their most extended dimension Daubenmire (1959). The following summarizes the classes used for making cover estimates:

Class	Cover Range (Percent)	Class Interval (Percent)
1	0-1	0.5
2	1-5	3.0
3	5-10	7.5
4	10-25	17.5
5	25-50	37.5
6	50-75	62.5
7	75-95	85.0
8	95-100	97.5

These values provide an index to the total impact of each plant species, and like prominence data, are useful in describing the physiognomy of stands.

Age and Size Class Data

Clues to the eventual species composition of the climax tree layer were obtained by examining the relative age structure of woody plants within a 50 to 75 foot plot established at each location. The ability of species to thrive and perpetuate themselves was described by placing all shrub and tree species into classes based upon their size, vigor, and apparent age (Appendix II).

Tree stand density and species composition were described by the enumeration of dead and living individuals into several DBH size classes. Where trunk decomposition was nearly complete, bark surrounding the stump either above or just below the ground surface usually identified the species previously occupying the location. Pseudotsuga menziesii was further separated into "old-growth" and "second-growth" trees by differences in the bark characteristics and DBH size.

Under the dense overstory canopies, height alone was not a good criterion for judging the age of subordinate individuals. Increment borings and cross section samples were collected from most stands and aged by growth ring counts using a variable power binocular

microscope. Cross sections of species with indistinct growth patterns were polished and stained to accentuate annual growth rings.

Estimates of maximum stand age were obtained by growth ring counts on stumps present in logging units immediately adjacent to the timbered areas studied.

Soils

With few exceptions, a soil profile description was made within each vegetation stand sampled using the procedures outlined by the Soil Survey Manual (1951).

Uniform microrelief was a prerequisite for selecting the pit location within the 50 by 75 foot tree density plot. Pits were dug to a maximum depth of 50 inches if progress was not halted by large rocks.

The general profile description included the solum depth, relative age, origin, and type of parent material present. The horizons of each profile were identified and their structure, amount of coarse fragments greater than 1/2 inch in diameter, and root penetration were determined.

Because of the poorly lighted and wet conditions beneath the canopy, a pint sample of each horizon was collected and taken to the laboratory to complete the profile descriptions.

All samples were passed through a series of screens to obtain a dry weight estimate of the proportion of coarse fragments in each

horizon. Three size classes of soil separates were recognized: (1) less than 2 mm diameter, (2) 2 mm to 1/4 inch diameter, (3) 1/4 to 1/2 inch diameter.

The Boyucous hydrometer method of soil texture analysis was used to determine the texture of 323 horizons (Day, 1965). The high organic content of the remaining upper horizons prohibited their oxidation so that a "spit and feel" method of texture determination was relied upon, using samples of known texture as controls.

The pH of a saturated soil paste from each horizon was measured by a Beckman glass electrode pH meter.

Interpretations

The large number of stands studied required that the vegetation data first be separated into four groups, based upon species composition in the tree or canopy layer of each stand. The presence of Abies amabilis, Picea sitchensis, Abies procera, and Tsuga heterophylla, in that order, determined into which group a stand was initially placed. A society table was developed from the stands in each overstory group. The tables were developed to organize, synthesize, and display data into units having similar ecology. Species presence, cover, and fidelity were used to arrange species within stand groupings, in combining or separating subgroupings, and in arranging stands within established plant community groupings.

In constructing society tables, consideration was first given to the presence and absence of species in stands. Stand data containing the same species or similar combinations of species were placed together. This preliminary arrangement combined stands having similar patterns of species presence.

The species list for each preliminary group in each tree layer grouping, was entered on the left vertical margin of the society table under the appropriate tree, shrub, or herb category. Stand numbers were listed at the top of the table columns.

Species ordination was first made by species presence then by species cover. Taxa were arranged vertically under the appropriate life-form heading so that those having high presence were ordered above those of lower presence. Next, species were arranged, through many revisions, on the basis of similar distribution and cover patterns.

Individual stands of each plant community were questioned or challenged as belonging to other phytosociological groupings. Soils and physical site factor data were especially important in challenging stands that had comparatively few species present because of dense shade beneath closed canopies.

Following the final revisions within each of the four overstory groupings, individual stands containing a low cover value for the tree species identifying each group were scrutinized to determine if

their physiognomy justified placing them in another overstory group. Again, physiographic and soils data were important in making decisions.

In the final analysis, communities could not be differentiated by the presence or absence of one or even a few species. Species expressing high fidelity for a particular community were usually inconspicuous and/or low in presence. Species having high presence and/or prominence, when considered alone, had little diagnostic value because they also occupied a similar position in stands of other communities. The presence and relative importance of species in groups having similar requirements were most important in separating both individual and groups of stands.

A shorthand description of some of the character and differentiating species is used to identify plant communities. The descriptors were formed from plant symbols (Garrison, et al., 1967) for the plants important to the identification of the community. Where species were absent from the plant list, species binomials were prepared by combining the first two letters of the genus and species name.

RESULTS

Eleven plant communities were identified by the present study. The number of stands grouped into each classification unit varied from 4 to 21, giving an 11.8 stand average. A listing of communities that were identified and the descriptors used to identify them are given in Table 3. Comparison of the presence percentage and mean cover percentage of each species found in the communities are given in Tables 4 and 5, respectively. A listing of all species encountered is given in Appendix III.

Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina Community

Stands of the Tshe-Pisi/Opho/Atfif community (Figure 4) are generally found inland from those of the Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/Blechnum spicant, where the former extends to 1300 feet elevation in the western portions of the mid-interior areas (Table 6). Most of the 21 stands studied are located south of the Nehalem River drainage.

Stands of the community are found on all aspects and slope lengths to 400 yards (Appendix IV). Seventy-two percent occur on slope gradients of 30 percent or less but none were found on gradients greater than 70 percent. Stands show no affinity for particular types of microrelief. Pit and mound relief is more common than in stands

Table 3. A listing of the eleven plant communities identified and the shorthand descriptor for each community.

Plant Community	Stands examined	Descriptor
Tsuga heterophylla-Picea sitchensis/ Oplopanax horridum/ Athyrium filix-femina	21	Tshe -Pisi/ Opho/ Atfif
Tsuga heterophylla-Picea sitchensis/ Gaultheria shallon/ Blechnum spicant	20	Tshe-Pisi/ Gash/ Blsp
Tsuga heterophylla-Abies amabilis/ Gaultheria shallon/ Tiarella unifoliata	8	Tshe-Abam/ Gash/ Tiun
Tsuga heterophylla-Abies amabilis/ Vaccinium ovalifolium/ Oxalis oregana	13	Tshe-Abam/ Vaov/ Oxor
Tsuga heterophylla-Abies amabilis/ Rhododendron macrophyllum/ Cornus canadensis	4	Tshe-Abam/ Rhma/ Coca
Tsuga heterophylla/ Vaccinium ovalifolium/ Polystichum munitum	7	Tshe/ Vaov/ Pomu
Tsuga heterophylla/ Acer circinatum/ Cryptogramma crispa	8	Tshe/ Acci/ Crcr
Tsuga heterophylla/ Berberis nervosa/ Trientalis latifolia	7	Tshe/ Bene/ Trla2
Tsuga heterophylla/ Polystichum munitum-Adiantum pedatum	7	Tshe/ Pomu-Adpe
Tsuga heterophylla/ Vaccinium membranaceum/ Xerophyllum tenax	21	Tshe/ Vame/ Xete
Tsuga heterophylla-Abies procera/ Vaccinium membranaceum/ Cryptogramma crispa	21	Tshe-Abpr/ Vame/ Crcr
Total Stands	137	

Table 4. A summary of the presence percentage of each plant species occurring within plant community stands.

Plant species	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tium	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
Plant Community											
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
TREES											
Tsuga heterophylla	100	100	100	100	100	100	100	100	100	90	81
Thuja plicata	19	29	75	38	50	43	50	43	23	5	29
Pseudotsuga menziesii	57	5			50	100	100	100	100	95	100
Picea sitchensis	76	48	25	15							
Abies procera										10	76
Alnus rubra	10	5						4			
Abies amabilis			100	100	100						10
Acer macrophyllum									14		
Total Shrub Species	(5)	(5)	(4)	(4)	(4)	(3)	(3)	(4)	(4)	(4)	(5)
SHRUBS											
Vaccinium parvifolium	90	100	88	77	25	86	88	100	100	90	60
Menziesia ferruginea	71	90	75	62	25	57	13		43	14	33
Berberis nervosa	5		75	38	25	86	88	100		100	24
Acer circinatum	57		13			43	88	100	43	86	48
Oplopanax horridum	52		13	15		43	25		43	5	24
Gaultheria shallon	19	100	100		75	100		100		81	
Vaccinium ovalifolium	90	71	88	92	100	100		14	43	57	95
Rubus spectabilis	62	48	25	38		29	13		43		
Rosa gymnocarpa			13			14	63	86		71	10
Taxus brevifolia			75			14	50	86		71	5
Rubus ursinus						29	38	57		29	
Vaccinium membranaceum					100					57	95
Rubus nivalis		5									5
Symphoricarpos mollis										5	
Amelanchier alnifolia										5	
Pachistima myrsinites										5	
Arctostaphylos uva-ursi										5	
Holodiscus discolor										5	
Ceanothus sanguineus										5	
Cornus nuttallii										5	
Sorbus sitchensis											10
Rhododendron macrophyllum					75						
Sambucus racemosa		5		8							
Rubus parviflorus	5										
Vaccinium ovatum		19									
Total Shrub Species	(9)	(8)	(10)	(7)	(7)	(11)	(9)	(8)	(6)	(18)	(11)

Table 4. Continued

Plant species	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tium	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
Plant Community											
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
HERBS											
Polystichum munitum	95	95	75	92	25	100	100	100	100	86	24
Oxalis oregana	90	67	38	92	25	100	100	29	100	24	48
Viola sempervirens	57	29	100	89	50	57	100	57	23	86	57
Coptis laciniata	48	38	75	92	25	57	75	43	57	57	62
Trillium ovatum	71	38	75	46	50	86	75	71	23	52	67
Smilacina sessilifolia	33	5	38	23	50	29	75	43	71	62	90
Cryptogams	95	95	100	85	100	86	75	100	71	95	86
Disporum smithii	76	56	25	38	50	86		29	100	57	62
Clintonia uniflora	33	33	88	62	100	57	38	14		38	86
Maianthemum bifolium	71	57	75	85	25	43	50		43	10	71
Blechnum spicant	95	95	88	100	50	100	38	14	86	5	29
Montia sibirica	52	19	13	46	25	29	63		86		14
Listeria cordata		5	50	38	25		50	14	23	43	52
Achlys triphylla	5					43	50	43	57	90	95
Cryptogramma crispa			38	8	100		63	14	14	62	95
Vancouveria hexandra			50	54			50	14	23	57	57
Goodyera oblongifolia	5		13	8			13	57		43	19
Viola glabella	5		13	15	25	29		29		24	
Galium triflorum	19	5		8			50	29	57	5	
Dryopteris dilatata		10		31	25		13	14	43		10
Luzula parviflora	43	14	13	23			13		43		5
Trientalis latifolia	5	14					50	86	14	52	
Streptopus curvipes	19	19	13	31		14					5
Corallorhiza maculata					25		38	57		86	19
Linnaea borealis			13		50			14		67	10
Sanicula crassicaulis			13	8		14	25			24	
Hieracium albiflorum			25	8			25	14		5	
Actaea rubra	5		13	8		14	13				
Chimaphila menziesii					25			29		62	33
Cornus canadensis			13		75					24	43
Athyrium filix-femina	76	24							57		5
Adiantum pedatum						29		14	43		
Tiarella unifoliata	5	5	63	46							
Stachys mexicana	19	5					13		23		
Monotropa uniflora		5						57		38	
Asarum caudatum	10								14	5	

Table 4. Continued

Plant species	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tium	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pamu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
Plant Community											
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
HERBS											
Trisetum cernuum	10								14		5
Festuca rubra			25	23							
Xerophyllum tenax			25							86	
Corallorhiza mertensiana									23	10	33
Frageria vesca			38								24
Bromus sp.			13	23							
Lilium columbianum										10	
Hypopitys lanuginosa										10	
Penstemon sp.										5	
Elymus sp.				31							
Poa sp.	5										
Dicentra formosa	5										
Pteridium aquilinum	5										
Mimulus sp.	5										
Epilobium sp.						13					
Carex sp.								14			
Tiarella trifoliata		10									
Adenocaulon bicolor				8							
Total Herb Species	(28)	(22)	(28)	(28)	(19)	(17)	(25)	(24)	(25)	(31)	(27)
Total No. Species	(42)	(35)	(42)	(39)	(30)	(31)	(37)	(36)	(35)	(53)	(43)

Table 5. A summary of the mean cover of plant species within plant community stands.

Plant species	Plant Community: Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
TREES											
Tsuga heterophylla	57	83	43	60	39	65	49	54	76	51	42
Thuja plicata	6	4	18	3	14	8	8	9	4	T	2
Pseudotsuga menziesii	20	T			2	25	33	38	26	46	24
Picea sitchensis	13	6	1	T							
Abies procera										T	19
Alnus rubra	2	T						1			
Abies amabilis			13	26	23						8
Acer macrophyllum									1		
Total tree species	(5)	(5)	(4)	(4)	(4)	(3)	(3)	(4)	(4)	(4)	(5)
SHRUBS											
Vaccinium parvifolium	14	18	7	3	2	14	3	7	5	12	2
Menziesia ferruginea	10	8	2	3	1	4	T		2	T	1
Berberis nervosa	2		8	5	T	14	17	47		40	8
Acer circinatum	10		1			5	27	30	5	25	5
Oplopanax horridum	7		T	T		2	1		2	T	2
Gaultheria shallon	4	42	14		29	27		27		30	
Vaccinium ovalifolium	15	19	21	12		12		1	2		
Rubus spectabilis	6	1	T	1		1	T		1		
Rosa gymnocarpa			T			T	3	1		3	1
Taxus brevifolia			2			T	9	14		12	1
Rubus ursinus		T				2		1		2	
Vaccinium membranaceum					51*					7*	32*
Rubus nivalis							T				T
Symphoricarpos mollis										T	
Amelanchier alnifolia										T	
Pachistima myrsinites										T	
Arctostaphylos uva-ursi										T	
Holodiscus discolor										T	
Ceanothus sanguineus										T	
Cornus nuttallii										T	
Sorbus sitchensis											1
Rhododendron macrophyllum					47						
Sambucus racemosa		T		T							
Rubus parviflorus	T										
Vaccinium ovatum		3									
Total shrub species	(9)	(8)	(10)	(7)	(7)	(11)	(9)	(8)	(6)	(18)	(11)

Table 5. Continued

Plant Community											
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
Plant species	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
HERBS											
Polystichum munitum	49	20	4	17	1	48	38	25	59	9	1
Oxalis oregana	50	10	3	67	1	43	62	9	92	1	19
Viola sempervirens	6	1	8	10	1	2	2	1	1	4	2
Coptis laciniata	2	1	6	6	1	2	1	1	1	1	4
Trillium ovatum	2	1	2	1	2	3	1	1	T	1	2
Smilacina sessilifolia	2		1	1	3	1	6	1	1	1	13
Cryptogams	68	48	58	45	44	20	33	43	55	32	25
Disporum smithii	3	1	T	1	1	3		1	2	2	3
Clintonia uniflora	2	1	11	3	6	1	1	T		1	17
Maianthemum bifolium	11	1	6	4	1	3	1		1	T	4
Blechnum spicant	13	37	7	7	3	10	1	T	2	T	1
Montia sibirica	2	3	1	8	T	1	2		15		T
Listeria cordata		T	1	1	T		1	T	1	T	1
Achlys triphylla	T					8	10	2	2	21	16
Cryptogramma crispa			13	T	8		3	3	T	16	27
Vancouveria hexandra			2	3			1	T	1	3	5
Goodyera oblongifolia	T		T	T			T	1		T	T
Viola glabella	T		T	T	1	2		T		1	
Galium triflorum	T	T		T			1	1	1	T	
Dryopteris dilatata		T		1	1		T	T	T		T
Luzula parviflora	1	T	T	1			T		1		T
Trientalis latifolia	T	T					1	2	T	1	
Streptopus curvipes	T	T	T	T		T					T
Corallorhiza maculata					T		1	1		1	T
Linnaea borealis			T		2			T		3	T
Sanicula crassicaulis		T	2	T		T	T			T	
Hieracium albiflorum			T	T			T	T		T	
Actaea rubra	T		T	T		T	T				
Chimaphila menziesii					T			1		1	T
Cornus canadensis			T		3					T	2
Athyrium filix-femina	2	T							T		T
Adiantum pedatum						3		T	1		
Tiarella unifoliata	T	T	4	4							
Stachys mexicana	T	T					T		T		
Monotropa uniflora		T						1		T	
Asarum caudatum	T								T		T

Table 5. Continued

Plant species	Plant Community										
Number stands examined	21	20	8	13	4	7	8	7	7	21	21
	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
HERBS											
Trisetum cernuum	1								T		T
Festuca rubra			T	1							
Xerophyllum tenax			3							22	
Corallorhiza mertensiana									T	T	T
Frageria vesca			1								1
Bromus sp.			T	1							
Lilium columbianum										T	
Hypopitys languinosa										T	
Penstemon sp.										T	
Elymus sp.				1							
Poa sp.	T										
Dicentra formosa	T										
Pteridium aquilinum	T										
Mimulus sp.	T										
Epilobium sp.							T				
Carex sp.									T		
Tiarella trifoliata		T									
Adenocaulon bicolor				T							
Total Herb species	(28)	(22)	(28)	(28)	(19)	(17)	(25)	(24)	(25)	(31)	(27)
Total Species	(42)	(35)	(42)	(39)	(30)	(31)	(37)	(36)	(35)	(53)	(43)

* Includes Vaccinium ovalifolium.

Figure 4. A representative stand of the Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina community.

Figure 5. A stand of the Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/Blechnum spicant community.

Table 6. Percent distribution of stands by plant community within the study area.

Study Area Segment[1]	Plant Community										
	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe-Vame/Xete	Tshe-Abpr/Vame/Crcr
South Interior					100	72	13	28			14
Central Interior							62	58		100	72
North Interior											
South mid-Interior	62	10				14	25				
Central mid-Interior	24							14	100		14
North mid-Interior	14			46							
South direct											
Central direct		79				14					
North direct		11	100	54							

[1] North - Youngs River south to Nehalem River
Central - Nehalem River south to Nestucca River
South - Nestucca River south to Siletz River
Direct - Lower one-third of major river drainages
mid-Interior - middle one-third of major river drainages
Interior - Upper one-third of major river drainages

of Tshe-Pisi/Gash/Blsp community.

Soils associated with the community have originated predominantly from marine sediments, being relatively stone-free throughout their 36 to 48 inch depths (Table 7). Profiles examined were typical of Astoria soils mapped in the same area by Meurisse and Youngberg (1971). The three stands occurring on basalt soils are in proximity to stands of the Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community in an area southeast of Tillamook Head. The associated Hembre soils are as deep and stone-free as are the more predominant Astoria soils.

Tsuga heterophylla has the highest presence and cover of any tree species present in the canopy (Table 8). Picea sitchensis reaches its highest presence in the community where stem density plots contained a mean of 2.2 living Picea sitchensis, or approximately 25 trees per acre, larger than one inch DBH (Table 9).

The density of mature to decadent Pseudotsuga menziesii is greater in stands of more inland communities than in the Tshe-Pisi/Gash/Blsp community which borders the coast.

Thuja plicata has a mean maximum DBH of 98 inches, the largest statistic encountered for that species in stands of any community (Table 10).

Tsuga heterophylla is the only tree layer species having seedling, sapling, and pole-size regeneration in the ground and shrub

Table 7 . Percentage distribution of plant community stands by soil differences.

Soil Series	Plant Community										
	Tshe-Pisi/ Opho/ Atfif	Tshe-Pisi/ Gash/ Blsp	Tshe-Abam/ Gash/ Tium	Tshe-Abam/ Vaov/ Oxor	Tshe-Abam/ Rhma/ Coca	Tshe/ Vaov/ Pomu	Tshe/ Acci/ Crcr	Tshe/ Bene / Trla2	Tshe/ Pomu-Adpe	Tshe/ Vame/ Xete	Tshe-Abpr/ Vame/ Crcr
Trask		6									
Astoria	88	88		27		29			20	5	
Kilchis				10				33		25	5
Klickitat			83	36	50	42	40	67	40	50	26
Hembre	12	6	17	27	50	29	60		40	20	69

Table 8. Descriptive statistics for the Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	57	38	8-98	4	3-5
Picea sitchensis	76	13	38	0-38	3	0-4
Pseudotsuga menziesii	57	20	0	0-63	0	0-4
Thuja plicata	19	6	0	0-63	0	0-4
Alnus rubra	10	2	0	0-38	0	0-4
SHRUBS						
Vaccinium parvifolium	90	14	18	0-38	4	0-5
Vaccinium ovalifolium	90	15	3	0-38	3	0-5
Menziesia ferruginea	71	10	18	0-38	4	0-4
Rubus spectabilis	62	6	3	0-38	2	0-4
Acer circinatum	57	10	0	0-38	0	0-4
Oplopanax horridum	52	7	0	0-63	0	0-4
Gaultheria shallon	19	4	0	0-38	0	0-5
Berberis nervosa	5	2	0	0-38	0	0-3
Rubus parviflorus	5	T	0	0-1	0	0-2
HERBS						
Cryptogams	95	68	85	0-98	3	0-5
Polystichum munitum	95	49	63	0-98	5	0-5
Blechnum spicant	95	13	3	0-63	3	0-5
Oxalis oregana	90	50	38	0-98	3	0-4
Disporum smithii	76	3	3	0-8	2	0-3
Athyrium filix-femina	76	2	3	0-8	2	0-3
Trillium ovatum	71	2	3	0-3	2	0-3
Maianthemum bifolium	71	11	18	0-38	3	0-3
Viola sempervirens	57	6	0	0-63	0	0-3
Montia sibirica	52	2	0	0-18	0	0-3
Coptis laciniata	48	2	0	0-8	0	0-3
Luzula parviflora	43	1	0	0-3	0	0-2
Clintonia uniflora	33	2	0	0-18	0	0-3
Smilacina sessilifolia	33	2	0	0-18	0	0-3
Streptopus curvipes	19	T	0	0-3	0	0-2
Stachys mexicana	19	T	0	0-3	0	0-2
Galium triflorum	19	T	0	0-3	0	0-2
Trisetum cernuum	10	1	0	0-8	0	0-2
Asarum caudatum	10	T	0	0-1	0	0-1
Poa sp.	5	T	0	0-3	0	0-2
Goodyera oblongifolia	5	T	0	0-1	0	0-2
Tiarella unifoliata	5	T	0	0.8	0	0-3
Viola glabella	5	T	0	0-3	0	0-2
Actaea rubra	5	T	0	0-3	0	0-2
Dicentra formosa	5	T	0	0-3	0	0-2
Pteridium aguilinum	5	T	0	0-1	0	0-2
Mimulus sp.	5	T	0	0-8	0	0-3
Achlys triphylla	5	T	0	0-1	0	0-1
Trientalis latifolia	5	T	0	0-1	0	0-2

Table 9 . Mean tree stem density larger than one inch DBH within macroplots.[1]

Tree Species	Plant Community										
	Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
Tsuga heterophylla											
Alive	12.6	20.4	15.5	13.4	9.0	21.3	11.5	7.3	13.0	13.2	13.1
Dead	7.0	12.2	12.8	13.2	2.0	4.7	2.3	1.7	4.4	1.4	4.6
A/D Ratio[2]	1.8/1.0	1.7/1.0	1.2/1.0	1.0/1.0	4.5/1.0	4.5/1.0	5.0/1.0	3.3/1.0	3.0/1.0	9.4/1.0	2.8/1.0
Thuja plicata											
Alive	0.9	0.2	4.8	0.2	4.5	0.6	0.5	1.3	0.4	0.4	0.6
Dead	0.1	0.3	1.3	2.0	2.5	0.4	-	0.3	-	0.2	-
A/D Ratio	9.0/1.0	1.0/1.5	3.7/1.0	1.0/20.0	1.8/1.0	1.5/1.0	-	4.3/1.0	-	2.0/1.0	-
Pseudotsuga menziesii											
Alive	1.4	-			0.3	1.3	1.8	2.3	1.4	3.2	2.5
Dead	2.2	0.7			2.0	3.3	2.8	2.5	2.2	5.3	4.2
A/D Ratio	1.0/1.6	-			1.0/6.7	1.0/2.5	1.0/1.6	1.0/1.0	1.0/1.6	1.0/1.7	1.0/1.7
Abies amabilis											
Alive			4.5	4.3	14.8						
Dead			1.3	1.6	2.5						
A/D Ratio			3.5/1.0	2.7/1.0	5.9/1.0						
Picea sitchensis											
Alive	2.2	0.8	0.3								
Dead	1.6	-	0.1								
A/D Ratio	1.4/1.0	-	3.0/1.0								
Taxus brevifolia											
Alive			0.7					4.0		2.1	
Dead								2.5		1.1	
A/D Ratio								1.6/1.0		1.9/1.0	
Abies procera											
Alive										T	3.6
Dead										-	1.4
A/D Ratio										-	2.6/1.0

[1] To convert density figures to stems per acre, multiply each density by (11.6).

[2] The A/D ratio gives the alive/dead tree ratio.

Table 10. Mean minimum and maximum alive and dead tree sizes (DBH-inches) within community stands.

Tree Species	Plant Community																					
	Tshe-Pisi/ Opho/ Atfif		Tshe-Pisi/ Gash/ Blsp		Tshe-Abam/ Gash/ Tium		Tshe-Abam/ Vaov/ Oxor		Tshe-Abam/ Rhma/ Coca		Tshe/Vaov/Pomu		Tshe/Bene/ Trla2		Tshe/ Acci/Crcr		Tshe/Pomu-Adpe		Tshe-Vame/Xete		Tshe-Abpr/Vame/Crcr	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tsuga heterophylla																						
Alive	5.5	31.6(14)	4.5	39.2(18)	2.0	38.0(6)	3.2	40.9(11)	1.8	36.5(4)	1.9	44.0(7)	8.8	29.6(5)	3.5	36.0(4)	5.2	42.6(4)	1.7	33.4(18)	2.6	39.2(18)
Dead	4.9	20.4(14)	5.5	34.2(18)	3.2	35.7(6)	3.3	36.9(11)	9.8	18.8(4)	6.3	36.0(6)	3.0	5.7(3)	3.0	13.0(4)	2.8	18.6(5)	3.8	8.8(10)	4.9	14.8(12)
Thuja plicata																						
Alive	32.0	98.5(2)	6.0	57.3(3)	11.0	49.5(4)	33.0	82.7(4)	6.0	30.5(2)	26.0	66.7(3)	10.5	23.5(2)	5.0	43.0(1)	18.0	52.0(2)	2.0	8.0(1)	21.0	22.3(5)
Dead	4.0	7.0(1)	36.0	54.0(4)	1.3	8.0(4)	12.0	40.0(1)	8.0	13.5(2)	9.0	21.0(1)	18.0	36.0(1)					1.0	6.0(1)		
Pseudotsuga menziesii																						
Alive	33.1	41.5(8)									43.6	53.2(4)	52.8	58.1(6)	45.0	68.3(4)	46.0	77.4(5)	39.1	49.3(17)	43.1	55.3(13)
Dead	39.0	55.2(9)	16.0	77.2(4)					21.0	47.0(2)	34.5	49.8(6)	24.4	50.6(5)	21.0	56.3(3)	38.5	57.8(4)	20.0	42.7(18)	21.8	41.9(16)
Abies procera																						
Alive																					25.2	43.9(13)
Dead																					15.5	29.0(9)
Abies amabilis																						
Alive					8.4	23.4(5)	4.3	18.6(10)	3.0	44.5(4)												
Dead					6.7	12.0(5)	1.6	31.5(6)	6.8	26.8(4)												
Picea sitchensis																						
Alive	18.6	39.9(12)	30.0	58.2(8)	58.0	69.0(1)																
Dead	11.0	46.6(8)			32.0	32.0(1)																
Taxus brevifolia																						
Alive					1.0	6.0(1)							2.7	13.3(3)					1.8	9.4(5)		
Dead													1.0	13.0(2)					2.6	6.6(5)		

( ) Indicates the number of stand plots having minimum and maximum measurem ents for averaging.

layers. Eighty-one percent of the stands contain Tsuga heterophylla seedlings in the ground layer while saplings are also present in 76 percent of the 21 stands sampled.

Picea sitchensis seedlings were only observed at 29 percent of the locations, being found primarily on rotting "nurse" logs. Sapling and pole-size individuals were not observed under the canopy. Perpetuation of the species probably depends upon the development of natural openings in the canopy by wind-thrown or dying groups of individuals forming the tree canopy.

The three ericads Vaccinium ovalifolium, Vaccinium parvifolium, or Menziesia ferruginea individually dominate or share prominence in the shrub layer (Table 8). Unlike the Tshe-Pisi/Gash/Blsp community, Galtheria shallon is only present in 19 percent of all stands. In contrast, Oplopanax horridum, a moisture-loving species, reaches its highest presence and cover suggesting that the Tshe-Pisi/Opho/Atfif community is one of the more mesic communities studied.

Rubus spectabilis also reaches its highest presence and cover in the community. Ample rootstock is present to permit the species to quickly dominate stands following logging.

Collectively, the cryptogams provide a 68 percent mean forest floor carpet, the highest cryptogam cover observed in stands of any community. A vigorous covering of three-foot Polystichum munitum covers approximately one-half the ground layer surface where Oxalis

oregana occupies many of the interspaces between ferns.

Another fern Athyrium filix-femina provides relatively little cover but its 76 percent presence makes it a character species, particularly when its presence is considered along with other species also having character value. Except for Luzula parviflora, no other herb had indicator value for the community.

Stands of the Tshe-Pisi/Opho/ Atfif community can be recognized by the presence of Picea sitchensis, Oplopanax horridum, Rubus spectabilis and Athyrium filix-femina. The complete absence of Abies amabilis and only an occasional presence of Gaultheria shallon with a five percent cover helps confirm identification of the community.

Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/ Blechnum spicant Community

Seventy-nine percent of all Picea sitchensis/Gaultheria shallon/ Blechnum spicant stands (Figure 5) were located between the Nehalem and Nestucca Rivers in the western one-third of the study area. All locations were below 900 feet elevation on a full range of slope gradients occurring most prominently in the upper one-third slope position (Appendix IV).

Ninety-four percent of the soil profiles associated with stands of the community have formed from marine sediments. With two exceptions, coarse fragments are either nonexistent or contribute

little towards the makeup of these predominantly residual soils. Most profiles were greater than 36 inches deep and 88 percent of all sedimentary profiles examined were identified as the widely distributed Astoria soil series (Appendix V).

Charcoal was evident in 35 percent of the soil profiles examined, suggesting that fire has had relatively little influence on plant succession in this relatively mesic community where summer fog banks shroud stands much of the summer.

Tsuga heterophylla dominates the canopy in all Tshe-Pisi/Gash/Blsp stands and the presence of Pseudotsuga menziesii, either as living trees or as dead remnants, is found in only five percent of the stands (Table 11). Picea sitchensis occurs in approximately one-half of the stands (Table 11). Aging studies showed that living Picea sitchensis in the tree canopy are of relatively uniform age and that they became established at approximately the same time as the dominant Tsuga heterophylla. Picea sitchensis seedlings were only found in ten percent of the stands and no sapling-sized individuals were observed. Picea sitchensis, unlike Tsuga heterophylla seems incapable of reproducing itself under the dense shade of the tree canopy, but Picea sitchensis seedlings, saplings, and pole-sized individuals were observed in the unsampled lightspots created by openings in the forest canopy.

The low presence of Thuja plicata is characteristic of most

Table 11. Descriptive statistics for the Tsuga heterophylla-Picea sitchensis/ Gaultheria shallon/ Blechnum spicant community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	83	85	63-98	5	4-5
Picea sitchensis	48	6	8	0-63	3	0-4
Thuja plicata	29	4	0	0-38	3	0-4
Pseudotsuga menziesii	5	T	0	0-3	0	0-3
Alnus rubra	5	T	0	0-3	0	0-3
SHRUBS						
Gaultheria shallon	100	42	38	1-98	4	1-5
Vaccinium parvifolium	100	18	18	3-38	3	2-4
Menziesia ferruginea	90	8	3	0-18	3	0-4
Vaccinium ovalifolium	71	19	38	0-85	3	0-5
Rubus spectabilis	48	1	0	0-3	0	0-3
Vaccinium ovatum	19	3	0	0-38	0	0-4
Rubus ursinus	5	T	0	0-1	0	0-1
Sambucus racemosa	5	T	0	0-3	0	0-2
HERBS						
Cryptogams	95	48	63	0-98	3	0-5
Blechnum spicant	95	37	63	0-85	4	0-5
Polystichum munitum	95	20	3	0-85	3	0-5
Oxalis oregana	67	10	0	0-85	2	0-4
Maianthemum bifolium	57	1	0	0-8	0	0-3
Disporum smithii	57	1	0	0-3	0	0-3
Trillium ovatum	38	1	0	0-3	0	0-2
Coptis laciniata	38	1	0	0-3	0	0-3
Clintonia uniflora	33	1	0	0-8	0	0-2
Viola semperivirens	29	1	0	0-3	0	0-3
Athyrium filix-femina	24	T	0	0-3	0	0-2
Montia sibirica	19	3	0	0-63	0	0-3
Streptopus curvipes	19	T	0	0-3	0	0-2
Luzula parviflora	14	T	0	0-3	0	0-2
Trientalis latifolia	14	T	0	0-1	0	0-2
Dryopteris dilatata	10	T	0	0-3	0	0-2
Tiarella trifoliata	10	T	0	0-1	0	0-2
Monotropa uniflora	5	T	0	0-3	0	0-2
Galium triflorum	5	T	0	0-3	0	0-2
Stachys mexicana	5	T	0	0-1	0	0-2
Listeria cordata	5	T	0	0-1	0	0-2
Smilacina sessilifolia	5	T	0	0-1	0	0-2
Tiarella unifoliata	5	T	0	0-1	0	0-2

communities studied. The occurrence of occasional decadent individuals indicates that this long-lived species is relatively resistant to fire. Growth ring counts on stumps in logged areas adjacent to stands revealed that some of the Thuja giants are more than 500 years old to a hollow center.

Shrub layer prominence is usually shared by Gaultheria shallon, Vaccinium parvifolium, and occasionally Vaccinium ovalifolium. Gaultheria shallon has a mean cover of 42 percent (Table 11) and a modal height of two feet. Particular stands have a dense four to six-foot high Gaultheria shallon and Vaccinium ovalifolium shrub cover. Menziesia ferruginea, though it occurs in 10 of the 11 communities described, has its highest presence and cover in the Tshe-Pisi/Gash/Blsp community. Rubus spectabilis, a shrub layer subordinate, occupies only one percent of the area, but in adjacent logged areas it is usually the dominant shrub.

Vaccinium ovatum displays high fidelity for the community, especially for stands on Cape Meares that are located adjacent to old stabilized sand dunes having excessively well-drained Netarts soils. It is most commonly found growing on small hummocks where the microsite soil drainage is apparently at a maximum.

Though Blechnum spicant is present in 10 of the 11 communities described, cover values are highest in the Tshe-Pisi/Gash/Blsp community where cover values exceed those of Polystichum munitum.

Except for the cryptogams and Oxalis oregana, no other herb layer plant species has a mean cover value greater than one percent and none occur with sufficient fidelity to have value as a character species.

Tusga heterophylla-Abies amabilis/Gaultheria shallon/ Tiarella unifoliata Community

All stands of the Tshe-Abam/Gash/Tiun community (Figure 6) were located in the 2100 to 3000 foot elevation range in the vicinity of Onion Peak in the upper Elk, Arch Cape, and Coal Creek drainages. The area is approximately four miles inland from the coastal community of Arch Cape, being within the direct coastal subunit (Table 4). Stands of the community probably occurred on other promontories in western Clatsop County before most of the area was logged.

The Onion Peak area is within the summer fog belt belt where warm summer temperatures and periods of low humidity are rare. No fire scars were found on the bark of decadent trees or snags and only 50 percent of the soil profiles examined showed evidence of charcoal. The coastal environment may have discouraged the wildfires that were so common in the Pseudotsuga menziesii stands across the North Fork Nehalem River to the east. Stands of the community show a strong preference for moderately steep to excessively steep slopes near the tops of ridges leading to Onion Peak. Large igneous

Figure 6. A typical example of the Tsuga heterophylla-Abies amabilis/Gaultheria shallon/Tiarella unifoliata community.

Figure 7. View of a near-climax stand of the Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community.

rocks 20 feet or more in diameter are numerous, particularly near the ridge tops (Figure 6). Areas of active sheet erosion are common on the steeper slopes. Unlike the Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community, stands are found on the rugged ridge tops where they show no preference for particular types of microrelief (Appendix IV).

All soils are formed from basic igneous materials from the Columbia River basalt intrusion that formed Onion Peak (Peck, 1961). Eighty-three percent of all soils examined showed strong evidence of developing from colluvium.

With one exception, all soil profiles examined were classed as Klickitat soils (Table 7). The modal depth of the solum was 24 to 36 inches which is about 12 inches shallower than similar soils in Tillamook County. Surprisingly, the amounts of coarse fragment in the profiles are much less than the amounts found in the Klickitat soils of the Tsuga heterophylla/Vaccinium membranaceum/Xerophyllum tenax community.

Tsuga heterophylla and Thuja plicata share prominence in most stands where Thuja plicata reaches the highest presence and canopy coverage of all communities studied. Pseudotsuga menziesii is not present nor is there any evidence, in the form of bark in snag pockets, to suggest that the species was once present (Table 6).

Abies amabilis is present at all locations where it has a mean

canopy cover of 13 percent. Aging studies showed that mature Abies and Tsuga individuals are approximately the same age, being between 226 and 259 years old (Table 12). Scattered decadent-appearing Tsuga heterophylla of unknown age are also present.

Picea sitchensis, exceeding 60 inches DBH, is present in one stand but the understory of all stands is devoid of Picea sitchensis reproduction.

Abies amabilis seedlings are abundant in 75 percent of the stands examined but unlike Tshe-Abam/Vaov/Oxor stands, sapling-sized individuals are present in 37 percent of the stands. The presence of rocky areas apparently keeps the canopy open, permitting side-light to enter stands and encourage seedling survival. Despite the presence of permanent openings, conifers beneath the canopy exhibit slow growth for extended periods. Two and six inch DBH Tsuga heterophylla were aged at 98 and 259 years old. Suppressed Abies amabilis are less abundant, suggesting that they may not be as shade tolerant as Tsuga heterophylla.

The presence of Gaultheria shallon, Taxus brevifolia, Rosa gymnocarpa, and Acer circinatum in the shrub layer separates the community from the Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community (Table 13).

Ground layer species having character value in the Tshe-Abam/Gash/Tiun community include Tiarella unifoliata, Xerophyllum tenax,

Table 12. Percentage distribution of Abies amabilis and Tsuga heterophylla ages by DBH sizes classes in Abies amabilis communities.

DBH (inches)	Percentage Distribution Abies amabilis Age (years)									
	1-20	21-40	41-60	61-80	81-100	101-150	151-200	201-250	251-300	300+
1-2		50		50						
3-4		50	50							
5-6					100					
7-8										
9-10					100					
11-20				20	10	30	20	10	10	
21-30					50	50				
31-40										
41+										

DBH (inches)	Percentage Distribution Tsuga heterophylla age (years)									
	1-20	21-40	41-60	61-80	81-100	101-150	151-200	201-250	251-300	300+
1-2		38	38	12	12					
3-4			50	50						
5-6				40	20	20			20	
7-8			33			67				
9-10			25	25	13		25	12		
11-20				33		33	13	21		
21-30			33		33	34				
31-40							50			50
41+										

Table 13. Descriptive statistics for the Tsuga heterophylla-Abies amabilis/Gaultheria shallon/Tiarella unifoliata community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	43	63	8-85	4	3-5
Abies amabilis	100	13	8	3-63	3	3-5
Thuja plicata	75	18	3	0-63	4	0-4
Picea sitchensis	25	1	0	0-8	0	0-3
SHRUBS						
Gaultheria shallon	100	14	8	1-63	3	2-5
Vaccinium parvifolium	88	7	3	0-18	2	0-4
Vaccinium ovalifolium	88	21	18	0-85	4	0-5
Berberis nervosa	75	8	8	0-18	3	0-4
Menziesia ferruginea	75	2	3	0-8	2	0-3
Taxus brevifolia	75	2	3	0-8	3	0-3
Rubus spectabilis	25	T	0	0-3	0	0-2
Acer circinatum	13	1	0	0-8	0	0-3
Rosa gymnocarpa	13	T	0	0-1	0	0-2
Oplopanax horridum	13	T	0	0-3	0	0-2
HERBS						
Cryptogams	100	58	38	38-98	4	3-5
Viola sempervirens	100	8	8	3-18	3	2-3
Blechnum spicant	88	7	8	0-18	3	0-3
Clintonia uniflora	88	11	8	0-38	3	0-3
Maianthemum bifolium	75	6	8	0-18	3	0-3
Polystichum munitum	75	4	3	0-8	3	0-3
Trillium ovatum	75	2	3	0-3	2	0-2
Coptis laciniata	75	6	3	0-8	2	0-3
Tiarella unifoliata	63	4	0	0-18	0	0-3
Vancouveria hexandra	50	2	0	0-8	0	0-3
Listeria cordata	50	1	0	0-3	2	0-2
Oxalis oregana	38	3	0	0-6	0	0-4
Frageria vesca	38	1	0	0-3	0	0-2
Cryptogramma crispa	38	13	0	0-63	0	0-4
Smilacina sessilifolia	38	1	0	0-8	0	0-3
Disporum smithii	25	T	0	0-3	0	0-2
Hieracium albiflorum	25	T	0	0-1	0	0-2
Festuca rubra	25	T	0	0-3	0	0-2
Xerophyllum tenax	25	3	0	0-18	0	0-4
Actaea rubra	13	T	0	0-1	0	0-2
Montia sibirica	13	1	0	0-1	0	0-2
Sanicula crassicaulis	13	2	0	0-18	0	0-3
Viola glabella	13	T	0	0-3	0	0-2
Linnaea borealis	13	T	0	0-3	0	0-3
Cornus canadensis	13	T	0	0-3	0	0-3
Bromus sp.	13	T	0	0-1	0	0-2
Streptopus curvipes	13	T	0	0-3	0	0-2
Luzula parviflora	13	T	0	0-3	0	0-2
Goodyera oblongifolia	13	T	0	0-1	0	0-2

Fragaria vesca, Linnaea borealis, and Cornus canadensis. Several are characteristically found in the understory of the high elevation interior area stands of the Tshe-Abpr/Vame/Crcr community.

Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/ Oxalis oregana Community

All 13 stands of the Tshe-Abam/Vaov/Oxor community (Figure 7) were located within the triangle formed by U.S. Highways 26, 101, and State Highway 53. More specifically, all stands were found in the vicinity of Onion Peak, Kidder Butte, and Ice Box Canyon.

The community shows a preference for the cool north and east slopes where more than 75 percent of the stands developed on slopes greater than 50 percent (Appendix IV). Stands were never found on the top slope position. Instead, they show a preference for areas with concave microrelief having slopes scattered with moss-covered basalt boulders.

Seventy-five percent of the soils associated with the community have developed from basalt parent material. Ninety-two percent of the profiles examined have had their development strongly influenced by colluvium. Approximately one-half of the stands developed on deep, stony Klickitat and shallow porous Kilchis soils (Table 7). The remainder developed on deep relatively stone-free Hembre and Astoria soils (Appendix V).

Unlike most other communities, none of the 13 Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana stands contain Pseudotsuga menziesii nor any evidence that it once was a component of the overstory (Table 14). Large decadent Tsuga heterophylla are common with a few individuals being more than 300 years old. A cross-section of the Tsuga heterophylla age-size relationship in the Abies amabilis community is given in Table 12. No evidence of fire scars was found in 90 percent of the stands examined, suggesting that the vegetation is in a near-climax condition.

Abies amabilis is present in all stands where it has a mean canopy cover of 26 percent. Increment borings revealed that the species is present in most age classes (Table 12). Many of the largest individuals are present as dead snags (Table 9). Abies amabilis seedlings are present in 83 percent of the stands but saplings are scarce in the shrub stratum.

An occasional Picea sitchensis is found in the canopy of the Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community but the species is more commonly found on decaying "nurse" logs of undetermined species, awaiting growth opportunities that accompany openings in the forest canopy.

Vaccinium ovalifolium has the highest presence and cover of any species in the shrub stratum. The presence of Oplopanax horridum, Rubus spectabilis, and Menziesia ferruginea indicate a mesic

Table 14. Descriptive statistics for the Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/Oxalis oregana community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	60	85	18-85	5	3-5
Abies amabilis	100	26	8	3-63	3	2-5
Thuja plicata	38	3	0	0-8	0	0-3
Picea sitchensis	15	T	0	0-3	0	0-2
SHRUBS						
Vaccinium ovalifolium	92	12	3	0-63	3	0-5
Vaccinium parvifolium	77	3	3	0-8	3	0-4
Menziesii ferruginea	62	3	3	0-8	0	0-3
Berberis nervosa	38	5	0	0-18	0	0-5
Rubus spectabilis	38	1	0	0-3	0	0-3
Oplopanax horridum	15	T	0	0-3	0	0-3
Sambucus racemosa	8	T	0	0-1	0	0-2
HERBS						
Blechnum spicant	100	7	3	1-18	2	2-3
Coptis laciniata	92	6	8	0-18	3	0-3
Oxalis oregana	92	67	85	0-85	5	0-5
Polystichum munitum	92	17	18	0-63	3	0-5
Viola sempervirens	85	10	18	0-38	2	0-3
Maianthemum bifolium	85	4	3	0-18	2	0-3
Cryptogams	85	45	63	0-98	3	0-5
Clintonia uniflora	62	3	3	0-18	2	0-3
Vancouveria hexandra	54	3	3	0-18	2	0-3
Trillium ovatum	46	1	0	0-3	0	0-2
Montia sibirica	46	8	0	0-38	0	0-3
Tiarella unifoliata	46	4	0	0-18	0	0-3
Listeria cordata	38	1	0	0-3	0	0-2
Disporum smithii	38	1	0	0-3	0	0-2
Streptopus curvipes	31	T	0	0-3	0	0-2
Dryopteris dilatata	31	1	0	0-3	0	0-2
Elymus sp.	31	1	0	0-3	0	0-2
Smilacina sessilifolia	23	1	0	0-3	0	0-2
Bromus sp.	23	1	0	0-3	0	0-3
Festuca rubra	23	1	0	0-8	0	0-3
Luzula parviflora	23	1	0	0-3	0	0-2
Viola glabella	15	T	0	0-3	0	0-2
Actaea rubra	8	T	0	0-1	0	0-2
Goodyera oblongifolia	8	T	0	0-3	0	0-2
Hieracium albiflorum	8	T	0	0-1	0	0-2
Galium triflorum	8	T	0	0-3	0	0-2
Sanicula crassicaulis	8	T	0	0-8	0	0-2
Cryptogramma crispa	8	T	0	0-8	0	0-2
Adenocaulon bicolor	8	T	0	0-3	0	0-2

understory environment. Collectively, all shrubs cover less than 25 percent of the surface (Table 14). None of the seven shrub species present have community indicator value but the absence of Gaultheria shallon helps separate the community from the Tsuga heterophylla-Abies amabilis/Gaultheria shallon/Tiarella unifoliata community.

The ground layer is largely carpeted by Oxalis oregana and cryptogams with Polystichum munitum and Blechnum spicant occurring individually or in small clumps. Maianthemum bifolium, Streptopus curvipes and grasses attain their highest presence and cover in this community (Tables 4 and 5).

Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Cornus canadensis Community

Stands of the Tshe-Abam/Rhma/Coca community (Figure 8) were only encountered in the southern interior portion of the study area between Stott and Saddleback Mountain at elevations ranging from 2,200 to 2,700 feet above sea level. The four stands occur in the upper two-thirds and top slope positions with one stand located on each of the principal exposures (Appendix IV).

Slopes supporting stands have rock-free gradients of less than 50 percent. All soils vary from 36 to 48 inches in depth and are of basalt origin. Properties of the soil horizons are within the range of variation observed in the Tillamook area Hembre and Klickitat

Figure 8. The typical character of the understory vegetation in stands of the Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Cornus canadensis community.

Figure 9. A stand of high-seral Tsuga heterophylla/Vaccinium ovalifolium/Polystichum munitum community.

soils. One-half of the soils supporting Tshe-Abam/Rhma/Coca stands were classified into each of these two series (Table 7).

Tsuga heterophylla and Abies amabilis share prominence in the canopy (Table 15). Thuja plicata is present in only about half of the stands. Pseudotsuga menziesii occurs as scattered individuals and Abies procera is absent from all four stands. From numerous remains, it is obvious that Pseudotsuga was once an important component of the overstory (Table 9). Today Abies amabilis, with a mean maximum DBH of 44 inches and Tsuga heterophylla with mean diameters of 37 inches tower above a dense tree layer of younger Abies amabilis and Tsuga heterophylla that reaches a height of about 70 feet above the ground (Table 10).

Aging studies showed that Abies amabilis, like Tsuga heterophylla, has an amazing ability to survive long periods under a tree canopy in a stunted growth form. Abies amabilis between one and three inches DBH, were found to be between 102 and 115 years old. Sectioning showed that the species has the ability to greatly accelerate growth once the canopy opens and growth conditions become more favorable.

All stands have an abundance of Abies amabilis and Tsuga heterophylla seedling, sapling, and pole-size reproduction. More than 18 percent of the shrub layer cover is occupied by each species. Seedlings of each species occupy three percent of the ground surface

Table 15. Descriptive statistics for the Tsuga heterophylla-Abies amabilis/ Rhododendron macrophyllum/ Cornus canadensis community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	39	18	18-86	4	4-5
Abies amabilis	100	23	18	18-38	4	3-4
Thuja plicata	50	14	0	0-38	4	0-4
Pseudotsuga menziesii	50	2	3	0-3	3	0-3
SHRUBS						
Vaccinium membranaceum & Vaccinium ovalifolium	100	51	38	18-85	3	3-5
Rhododendron macrophyllum	75	47	63	0-63	5	0-5
Gaultheria shallon	75	29	38	0-63	3	0-3
Vaccinium parvifolium	25	2	0	0-8	0	0-3
Menziesia ferruginea	25	1	0	0-3	0	0-2
Berberis nervosa	25	T	0	0-1	0	0-2
HERBS						
Cryptogams	100	44	38	38-63	5	5
Cryptogramma crispa	100	8	8	8	3	2-3
Clintonia uniflora	100	6	8	3-8	3	2-3
Cornus canadensis	75	3	3	0-8	2	0-3
Blechnum spicant	50	3	0	0-8	0	0-3
Smilacina sessilifolia	50	3	0	0-8	0	0-3
Trillium ovatum	50	2	3	0-3	0	0-3
Linnaea borealis	50	2	3	0-3	2	0-2
Disporum smithii	50	1	0	0-3	0	0-2
Viola sempervirens	50	1	0	0-3	2	0-2
Maianthemum bifolium	25	1	0	0-3	0	0-2
Dryopteris dilatata	25	1	0	0-3	0	0-2
Coptis laciniata	25	1	0	0-3	0	0-3
Oxalis oregana	25	1	0	0-3	0	0-2
Viola glabella	25	1	0	0-3	0	0-2
Polystichum munitum	25	1	0	0-3	0	0-2
Chimaphila menziesii	25	T	0	0-1	0	0-1
Montia sibirica	25	T	0	0-1	0	0-2
Corallorhiza maculata	25	T	0	0-1	0	0-2
Listeria cordata	25	T	0	0-1	0	0-2

in all stands.

In the shrub layer, Rhododendron macrophyllum either dominates or shares prominence with Vaccinium membranaceum and Vaccinium ovalifolium. The subordinate Gaultheria shallon is the only other shrub species having a high mean cover and presence value (Table 15). Acer circinatum is totally absent. Perhaps its position is being occupied by Rhododendron macrophyllum.

Polystichum munitum only occurs in 25 percent of all stands where it has a small low-vigor growth form. Cornus canadensis, Linnaea borealis, and Abies amabilis seedlings all help identify stands.

Stands were sampled after the fall rains began and several species are known to have matured and disappeared while studies were in progress. Perhaps this partially explains the relatively species-poor condition of stands.

Tsuga heterophylla/Vaccinium ovalifolium/ Polystichum munitum Community

The Tshe/Vaov/Pomu community (Figure 9) is found between 300 and 2,000 feet elevations where 86 percent of the stands are located in the upper two-thirds of major river drainages south of the Nestucca River. The community is most common on the warmer exposures where all sampling locations were found on slopes ranging

between 200 and 400 yards in length. The community occupies sites on moderate slope gradients having few rocks on the surface (Appendix IV).

Seventy-one percent of all soils have developed from basalt parent material and two-thirds of them show evidence of developing in the presence of colluvium. Fifty-nine percent of the basalt profiles were identified as well-drained Klickitat soils having as much as 60 percent of some horizons composed of coarse fragments (Table 7). All stands occurring on basalt soils are located in the upper tributaries of the Siletz River. The sedimentary soils are essentially stone-free and formed from residuum. Stands associated with Astoria soils are found between Cape Meares and the upper Little Nestucca River drainage.

The tree layer of the Tshe/Vaov/Pomu community is dominated by Tsuga heterophylla. Tsuga reaches its highest stem density and largest mean maximum DBH in this community (Tables 9 and 10). The oldest observed Tsuga heterophylla was 382 years of age.

Only 14 percent of the stands show evidence of fire scars on Pseudotsuga menziesii or their snags but charcoal was found in 71 percent of the soil profiles, suggesting that fires occurred prior to the establishment of most existing stands.

The remnant Pseudotsuga menziesii scattered throughout the stands ranged from 237 to 533 years of age. All locations contain

three times as many dead Pseudotsuga remnants as living individuals. As these decadent individuals die, they are being replaced by Tsuga heterophylla which has previously become established under the Pseudotsuga canopy.

Thuja plicata is present in some stands of all communities studied but in the Tshe/Vaov/Pomu community as in most others, its presence is less than 50 percent. Stands have a mean density of 0.6 living trees per plot, or approximately seven per acre (Table 9). One Thuja plicata seedling and no saplings were found, suggesting that if the species is capable of reproducing itself, in these high-seral communities, it does so very slowly. All locations contain all sizes and ages of Tsuga heterophylla reproduction. Many flat crowned individuals, less than two inches DBH are more than 100 years old.

The community has a high presence and cover of Gaultheria shallon, Berberis nervosa, Vaccinium ovalifolium, and Menziesia ferruginea (Table 16). The presence of Acer circinatum, Oplopanax horridum, Rosa gymnocarpa, Taxus brevifola, and Berberis nervosa and the absence of Picea sitchensis separates the community from the Tshe-Pisi/Gash/Blsp community which also has Gaultheria shallon as an understory dominant (Table 4).

The character of the herb layer is similar to that of the Tshe-Pisi/Opho/Atfif community where three-foot Polystichum munitum dominates and Oxalis oregana occupies most of the interspaces in

Table 16. Descriptive statistics for the Tsuga heterophylla/Vaccinium ovalifolium/Polystichum munitum community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	65	85	38-85	4	4-5
Pseudotsuga menziesii	100	25	38	3-63	3	3-4
Thuja plicata	43	8	0	0-38	3	0-4
SHRUBS						
Gaultheria shallon	100	27	18	3-85	4	2-5
Vaccinium ovalifolium	100	12	8	3-38	3	2-4
Vaccinium parvifolium	86	14	8	0-38	4	0-4
Berberis nervosa	86	14	18	0-38	4	0-4
Menziesia ferruginea	57	4	0	0-18	3	0-3
Acer circinatum	43	5	0	0-18	0	0-4
Oplopanax horridum	43	2	0	0-8	2	0-4
Rubus ursinus	29	2	0	0-8	0	0-2
Rubus spectabilis	29	1	0	0-3	0	0-2
Rosa gymnocarpa	14	T	0	0-3	0	0-2
Taxus brevifolia	14	T	0	0-3	0	0-2
HERBS						
Polystichum munitum	100	48	63	8-85	5	3-5
Oxalis oregana	100	43	85	8-85	3	2-4
Blechnum spicant	100	10	3	1-38	2	1-4
Cryptogams	86	20	8	0-63	3	0-3
Disporum smithii	86	3	3	0-3	2	0-2
Trillium ovatum	86	3	3	0-3	2	0-2
Coptis laciniata	57	2	3	0-3	2	0-2
Clintonia uniflora	57	1	0	0-3	2	0-2
Viola sempervirens	57	2	3	0-8	2	0-3
Achlys triphylla	43	8	0	0-38	0	0-3
Maianthemum bifolium	43	3	0	0-18	0	0-3
Montia sibirica	29	1	0	0-3	0	0-2
Viola glabella	29	2	0	0-8	0	0-3
Smilacina sessilifolia	29	1	0	0-3	0	0-2
Adiantum pedatum	29	3	0	0-18	0	0-2
Sanicula crassicaulis	14	T	0	0-3	0	0-2
Streptopus curvipes	14	T	0	0-3	0	0-2
Actaea rubra	14	T	0	0-3	0	0-2

stands. The presence of either Achyls triphylla or Adiantum pedatum in stands of the Tsuga heterophylla/Vaccinium ovalifolium/Polystichum munitum vegetation type helps to separate stands of the two communities.

Tsuga heterophylla/Acer circinatum/ Cryptogramma crispa Community

Concrete examples of the Tshe/Acci/Crcr community (Figure 10) were found between 1,200 and 2,400 feet elevation where 75 percent of the eight stands are located in the upper one-third of major river drainages south of the Nehalem River.

Eighty-seven percent of all stands are found on slopes longer than 200 yards having as much as 85 percent slope gradients. Stands occupy all slope positions except the bottom areas. They show no preference for particular aspects (Appendix IV).

All soils underlying Tshe/Acci/Crcr stands have developed from basalt parent material. Unlike the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community, the soil surface is essentially free from a rock cover. Sixty percent of the profiles examined were classed as the deep relatively stone-free Hembre soil (Table 7). The remainder were characteristic of the Klickitat soils described by Meurisse and Youngberg (1971).

Tsuga heterophylla and Pseudotsuga menziesii share prominence

Figure 10. A representative stand of the Tsuga heterophylla/Acer circinatum/Cryptogramma crispa community.

Figure 11. A stand of the relatively xeric Tsuga heterophylla/Berberis nervosa Trientalis latifolia community.

in the tree layer where the density and size of each is similar to that of other communities outside the coastal fog zone. Thuja plicata is present in 50 percent of the stands where it occurs at a mean density of six individuals per acre (Table 9).

Numerous similarities exist between the Tshe/Acci/Crcr and the Tshe/Bene/Trla2 community, particularly regarding their physiography and understory vegetation. Both communities are only found on soils of basalt origin found south of the Nehalem River where they are almost exclusively found in the upper one-third of drainages that extend to the crest of the Coast Range.

Acer circinatum, Taxus brevifolia, Rosa gymnocarpa, Berberis nervosa, and Vaccinium parvifolium all have high presence in the shrub layer of each community (Table 17). However, stands of the Tshe/Acci/Crcr community lacks a Gaultheria shallon cover which has a mean cover of 27 percent in all stands of the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community.

The shrubs Rubus spectabilis, Oplopanax horridum, and Menziesia ferruginea are only found in the Tsuga heterophylla/Acer circinatum/Cryptogramma crispa community stands where the soils are deeper and where summer moisture is apparently more abundant.

The character of the ground layer vegetation also indicates a mesic environment. The cover and stature of Polystichum munitum are greater in Tshe/Acci/Crcr stands. Oxalis oregana, another

Table 17. Descriptive statistics for the Tsuga heterophylla/Acer circinatum/cryptogramma crispa community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	49	85	8-85	4	3-5
Pseudotsuga menziesii	100	33	38	18-38	4	3-5
Thuja plicata	50	8	0	0-38	0	0-4
SHRUBS						
Acer circinatum	88	27	18	0-85	5	0-5
Berberis nervosa	88	17	18	0-38	3	0-5
Vaccinium parvifolium	88	3	3	0-8	2	0-4
Rosa gymnocarpa	63	3	3	0-8	3	0-3
Taxus brevifolia	50	9	0	0-63	0	0-4
Rubus nivalis	38	T	0	0-1	0	0-2
Oplopanax horridum	25	1	0	0-8	0	0-4
Menziesia ferruginea	13	T	0	0-3	0	0-2
Rubus spectabilis	13	T	0	0-1	0	0-1
HERBS						
Oxalis oregana	100	62	63	38-98	3	2-5
Polystichum munitum	100	38	18	3-85	5	3-5
Viola sempervirens	100	2	3	1-3	2	1-3
Cryptogams	75	33	63	0-63	3	0-4
Smilacina sessilifolia	75	6	18	0-18	3	0-3
Trillium ovatum	75	1	3	0-3	2	0-2
Coptis laciniata	75	1	3	0-3	2	0-3
Cryptogramma crispa	63	3	3	0-8	2	0-3
Montia sibirica	63	2	3	0-3	2	0-2
Achlys triphylla	50	10	0	0-63	0	0-5
Listeria cordata	50	1	3	0-3	0	0-3
Maianthemum bifolium	50	1	0	0-3	2	0-2
Vancouveria hexandra	50	1	0	0-3	0	0-3
Galium triflorum	50	1	0	0-3	0	0-2
Trientalis latifolia	50	1	0	0-3	2	0-2
Clintonia uniflora	38	1	0	0-8	0	0-2
Corallorhiza maculata	38	1	0	0-3	0	0-2
Blechnum spicant	38	1	0	0-3	0	0-2
Sanicula crassicaulis	25	T	0	0-3	0	0-2
Hieracium albiflorum	25	T	0	0-1	0	0-2
Dryopteris dilatata	13	T	0	0-1	0	0-1
Goodyera oblongifolia	13	T	0	0-3	0	0-2
Luzula parviflora	13	T	0	0-1	0	0-2
Actaea rubra	13	T	0	0-1	0	0-2
Epilobium sp.	13	T	0	0-1	0	0-2
Stachys mexicana	13	T	0	0-1	0	0-2

species having high moisture requirements, blankets most of the interspaces between Polystichum munitum in all the Tsuga heterophylla/Acer circinatum/Cryptogramma crispa stands while the presence and cover of Oxalis are greatly reduced in examples of the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community.

Tsuga heterophylla/Berberis nervosa/ Trientalis latifolia Community

Eighty-six percent of the seven Tshe/Bene/Trla2 stands (Figure 11) were found in the upper one-third of river drainages that extend to the summit of the Coast Range. All stands were located south of the Wilson River but the wide distribution of logged and burned areas having similar physiography suggests that the community was once widely distributed northward into the Kilchis River drainage.

The community was found on south and west exposures at the middle and upper one-third positions on slopes ranging from 100 to 500 yards in length. Stands show a preference for moderately steep gradients having a relatively rocky cover that usually does not exceed 20 percent of the surface area (Appendix IV).

All soils associated with the community have developed from basalt parent material. Separation of horizon soil particles showed that 41 to 60 percent of the dry weight of most horizons was composed of sand-sized and larger particles, making the profiles exceptionally

well-drained. The character of coarse fragments indicate that profile development has been strongly influenced by colluvium. Two-thirds of the soils underlying stands of the community were identified as Klickitat soils while the remaining profiles were classed as Kilchis soils, the lithosolic equivalent of the Hembre series (Appendix V).

Tsuga heterophylla and Pseudotsuga menziesii are present in all stands where they usually shared prominence (Table 18). The stand density of Tsuga heterophylla was the lowest of all communities studied and the mean maximum DBH measurement was also the smallest encountered for the species (Table 10).

Thuja plicata has a relative high presence percentage in Tshe/Bene/Trla2 stands. Other communities containing Taxus brevifolia and Rosa gymnocarpa also have a relatively high presence percentage.

Tsuga heterophylla is the only conifer having all age classes of individuals present. Only one Thuja plicata seedling was recorded in the seven stands studied.

Charcoal was found only in 17 percent of the profiles examined. Fire scars are absent on all old-growth Pseudotsuga menziesii, indicating that ground fires have not influenced the understory vegetation development.

Taxus brevifolia reaches maximum prominence in stands of the community where it has a mean density of 46 living stems per plot larger than one inch DBH (Table 9). All size classes to a mean

Table 18. Descriptive statistics for the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	54	85	8-98	4	3-5
Pseudotsuga menziesii	100	38	38	8-63	4	3-5
Thuja plicata	43	9	0	0-38	0	0-4
Alnus rubra	14	1	0	0-8	0	0-3
SHRUBS						
Berberis nervosa	100	47	38	8-85	4	3-5
Acer circinatum	100	30	38	3-85	4	3-4
Gaultheria shallon	100	27	8	1-85	3	2-4
Vaccinium parvifolium	100	7	8	1-18	3	2-4
Taxus brevifolia	86	14	8	0-63	3	0-4
Rosa gymnocarpa	86	1	3	0-3	2	0-2
Rubus ursinus	57	1	1	0-3	2	0-2
Vaccinium ovalifolium	14	1	0	0-3	0	0-2
HERBS						
Cryptogams	100	43	63	3-63	3	2-5
Polystichum munitum	100	25	38	3-63	3	3-5
Trientalis latifolia	86	2	1	0-8	2	0-3
Trillium ovatum	71	1	1	0-3	2	0-2
Goodyera oblongifolia	57	1	1	0-3	0	0-3
Viola sempervirens	57	1	3	0-3	0	0-3
Monotropa uniflora	57	1	1	0-3	2	0-2
Corallorhiza maculata	57	1	1	0-3	0	0-3
Coptis laciniata	43	1	0	0-3	0	0-2
Smilacina sessilifolia	43	1	0	0-3	0	0-2
Achlys triphylla	43	2	0	0-8	0	0-3
Disporum smithii	29	1	0	0-3	0	0-2
Oxalis oregana	29	9	0	0-63	0	0-3
Galium triflorum	29	1	0	0-3	0	0-3
Viola glabella	29	T	0	0-1	0	0-2
Chimaphila menziesii	29	1	0	0-3	0	0-2
Linnaea borealis	14	T	0	0-3	0	0-2
Clintonia uniflora	14	T	0	0-1	0	0-2
Vancouveria hexandra	14	T	0	0-3	0	0-2
Adiantum pedatum	14	T	0	0-3	0	0-2
Blechnum spicant	14	T	0	0-3	0	0-2
Dryopteris dilatata	14	T	0	0-1	0	0-1
Cryptogramma crispa	14	3	0	0-18	0	0-3
Hieracium albiflorum	14	T	0	0-1	0	0-2
Listeria cordata	14	T	0	0-1	0	0-2

maximum diameter of 13 inches DBH were present. Growth-ring counts showed all age classes to be present with the decadent individuals showing more than 200 years of growth surrounding their decayed centers (Figure 12).

Berberis nervosa, Acer circinatum, Gaultheria shallon, Vaccinium parvifolium, and Taxus brevifolia all have high presence and mean cover values in the shrub layer (Table 18). Rosa gymnocarpa has its highest presence of 86 percent in the community but its mean cover is only one percent. Rubus ursinus also reaches its highest presence in the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community where it occupies a subordinate position in the shrub layer.

Rubus spectabilis, Oplopanax horridum, and Menziesia ferruginea, three shrubs with high moisture requirements, were not found in stands of the community. Their absence helps confirm identification of the community.

The ground layer is largely covered by cryptogams interspersed with Polystichum munitum of low stature whose stunting is in contrast to its luxuriant growth form in stands of fog belt communities.

Monotropa uniflora, Corallorhiza maculata, and Goodyera oblongifolia are the only three ground layer species having differentiating value when their occurrence is considered along with those of

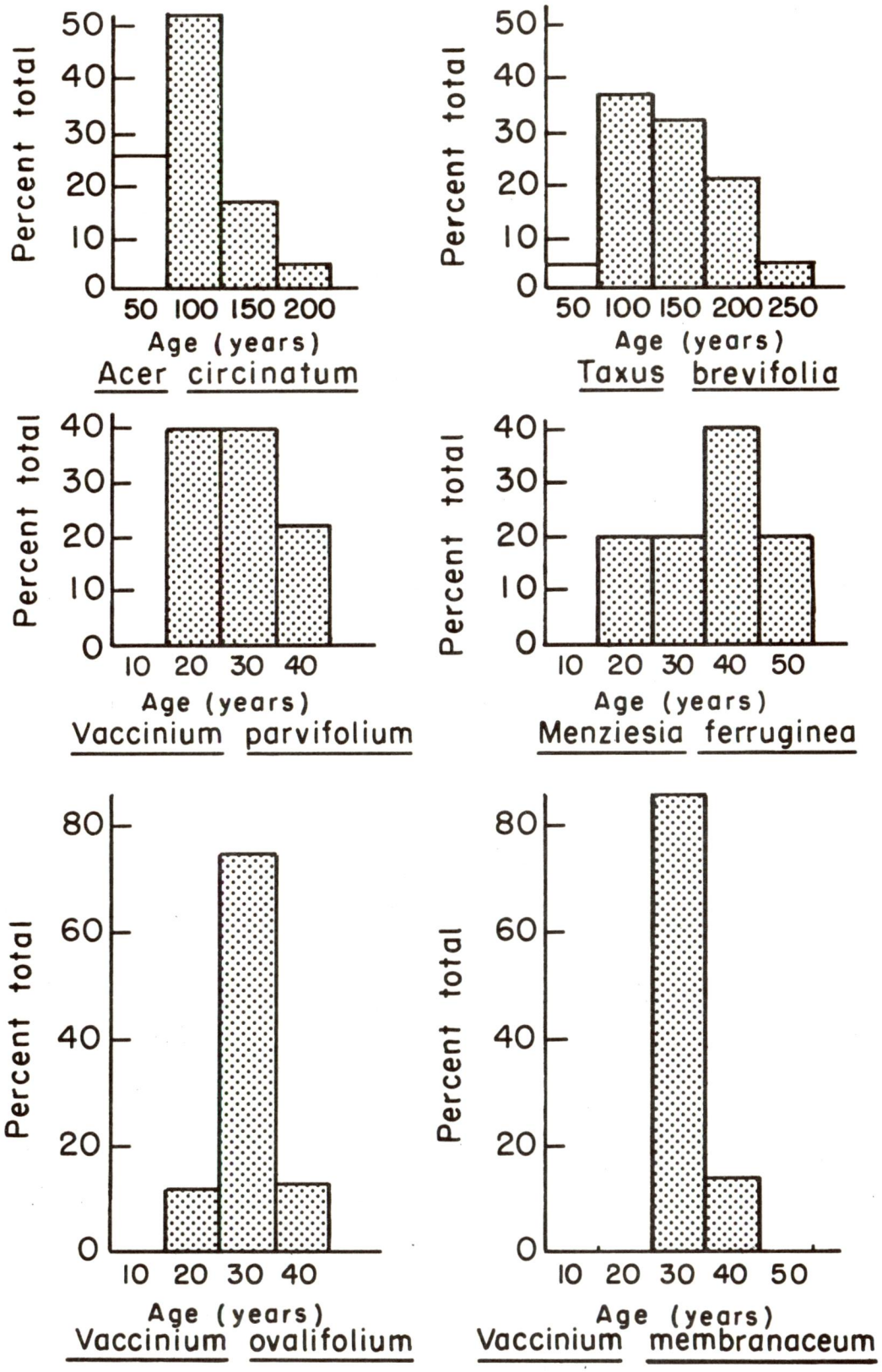

Figure 12. Age distribution of mature and decadent individuals of various shrub species.

certain shrub species. Unfortunately they, and many other herbs, are only present during a short period each year, thus reducing their usefulness as community indicators.

Tsuga heterophylla/Polystichum munitum-Adiantum pedatum Community

All seven stands of the Tshe/Pomu-Adpe community (Figure 13) were found between 700 and 2,200 feet in elevation west of the South Fork Trask River between the Trask and Nestucca rivers. Most stands were located in the upper tributaries of East, Moon, Clarence, and East Beaver creeks.

Soils underlying the community are deep and predominantly of basalt origin, being equally divided between the Hembre and Klickitat soils (Table 7). One additional profile, developed from shale, was typical of the Astoria soils closely associated with stands of the lower elevation Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina community.

The community was never found on slope gradients exceeding 50 percent nor on surfaces having a well-drained convex microrelief. Stands were positioned on stone-free side slopes but they were never observed in the top or bottom slope position (Appendix IV).

Tsuga heterophylla dominates the tree canopy and Pseudotsuga menziesii usually occurs as scattered decadent individuals overtopping

Figure 13. An example of the mesic Tsuga heterophylla/Polystichum munitum-Adiantum pedatum community.

Figure 14. Character of the ground layer vegetation in the xeric stands of the Tsuga heterophylla/Vaccinium memberanaceum/Xerophyllum tenax community.

the Tsuga heterophylla canopy (Table 19). The mean maximum DBH statistic for Pseudotsuga menziesii was larger than similar statistics from stands of all other communities. A similar statistic for Tsuga heterophylla was the second largest for that species when compared with those from other communities (Table 10).

The stand understory is open and only sparsely covered by shrub species. Shrubs have a mean cover of 17 percent and four of the six species present, Rubus spectabilis, Oplopanax horridum, Menziesii ferruginea, and Vaccinium ovalifolium indicate that summer moisture is abundant.

Polystichum munitum and Oxalis oregana occur in all stands where their cover is higher than in any of the other 10 communities studied (Table 5). Adiantum pedatum, Montia sibirica, and Galium triflorum all have their highest presence and cover in the Tshe/Pomu-Adpe community. Each of the remaining species in the herb layer does not have more than a two percent canopy coverage (Table 19).

Many similarities exist in the vegetation features of the Tshe/Pomu-Adpe and the Tshe-Pisi/Opho/Atfif communities. Species composition of their shrub layer is practically identical with Vaccinium parvifolium, Menziesia ferruginea, Acer circinatum, Oplopanax horridum, Vaccinium ovalifolium, and Rubus spectabilis each occurring in more than 40 percent of all stands. Athyrium filix-femina, one of the species whose presence, in combination with

Table 19. Descriptive statistics for the Tsuga heterophylla/Polystichum munitum-Adiantum pedatum community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	76	63	38-98	5	4-5
Pseudotsuga menziesii	100	26	18	3-38	3	3-4
Thuja plicata	23	4	0	0-18	0	0-3
Acer macrophyllum	14	1	0	0-8	0	0-3
SHRUBS						
Vaccinium parvifolium	100	5	3	1-8	3	1-3
Acer circinatum	43	5	0	0-18	0	0-5
Oplopanax horridum	43	2	0	0-8	0	0-4
Vaccinium ovalifolium	43	2	0	0-8	0	0-4
Menziesia ferruginea	43	2	0	0-8	0	0-4
Rubus spectabilis	43	1	0	0-3	0	0-2
HERBS						
Oxalis oregana	100	92	98	85-98	3	3-5
Polystichum munitum	100	59	85	18-85	5	3-5
Disporum smithii	100	2	3	1-3	2	1-3
Montia sibirica	86	15	1	0-3	2	0-3
Blechnum spicant	86	2	1	0-8	2	0-2
Cryptogams	71	55	85	0-85	3	0-3
Smilacina sessilifolia	71	1	1	0-3	2	0-2
Coptis laciniata	57	1	0	0-3	0	0-2
Athyrium filix-femina	57	T	1	0-1	2	0-2
Galium triflorum	57	1	1	0-3	1	0-2
Achlys triphylla	57	2	3	0-3	2	0-2
Maianthemum bifolium	43	1	0	0-3	0	0-3
Dryopteris dilatata	43	T	0	0-1	0	0-2
Adiantum pedatum	43	1	0	0-3	0	0-3
Luzula parviflora	43	1	0	0-3	0	0-2
Trillium ovatum	23	T	1	0-1	2	0-2
Viola sempervirens	23	1	0	0-3	0	0-2
Corallorhiza mertensiana	23	T	0	0-1	0	0-1
Listeria cordata	23	1	0	0-3	0	0-2
Vancouveria hexandra	23	1	0	0-3	0	0-2
Stachys mexicana	23	T	0	0-1	0	0-2
Trisetum cernuum	14	T	0	0-1	0	0-1
Carex sp.	14	T	0	0-1	0	0-1
Trientalis latifolia	14	T	0	0-1	0	0-1
Asarum caudatum	14	T	0	0-3	0	0-2
Cryptogramma crispa	14	T	0	0-3	0	0-2

others, helps to identify the Picea sitchensis/Oplopanax horridum/Athyrium filix-femina, also occurs in 57 percent of the Tshe/Pomu-Adpe stands. Achlys triphylla, Dryopteris dilatata, and Adiantum pedatum all have high presence in the Tsuga heterophylla/Polystichum munitum-Adiantum pedatum community but are relatively scarce or absent from stands of the Tsuga heterophylla-Picea sitchensis/Oplop-anax horridum/Athryrium filix-femina community. The presence of Picea sitchensis in stands also serves to separate the identity of the two communities.

Tsuga heterophylla/Vaccinium membranaceum/ Xerophyllum tenax Community

The Tshe/Vame/Xete community (Figure 14) occurs above 2,400 feet elevation in the central interior portion of the study area, principally in the headwater areas of the Trask and Wilson rivers.

The common occurrence of low-seral Vaccinium membranaceum and Xerophyllum tenax associated vegetation at the higher elevations in the Tillamook Burn indicate that stands of the community were abundant between the Nestucca and Nehalem rivers before the 1933 Tillamook fire.

Topography of stands is characteristically mountainous with slope gradients normally exceeding 50 percent (Appendix IV). Rocks of basalt origin, ranging from three to ten inches in diameter, cover

approximately 15 to 20 percent of the soil surface.

With one exception, all soils supporting stands have formed from basic igneous parent material. Seventy-five percent of the soil profiles examined were either classified as the shallow, stony and gravelly Kilchis soils or the relatively deep but stony Klickitat soil mapped by Corliss and Dyrness (1963) and Meurisse and Youngberg (1971) south and west of the Tillamook Burn.

The tree canopy of the community is shared by Pseudotsuga menziesii and Tsuga heterophylla. Though stands of the community frequently occur adjacent to those of the Abies procera/Vaccinium membranaceum/Cryptogramma crispa community, Abies procera rarely occurs in the Tshe/Vame/Xete community.

Stand dominants vary from 350 to 435 years old and 90 percent the 21 stands studied show no evidence of fire scars (Appendix IV). Except for an occasional Pseudotsuga menziesii sapling growing from rocky outcroppings, the species has a relatively uniform age within stands, being the oldest species present.

Tsuga heterophylla is present in all sizes and age classes. As in all communities studied, Tsuga heterophylla found in the understory shows an amazing ability to survive in shaded environments. Stem aging through growth-ring counts revealed that specimens one to two inch DBH are more than 150 years old (Table 20). Abrupt changes in the growth rate on some stumps indicate that suppressed

Table 20. Percentage distribution of Tsuga heterophylla ages by DBH sizes in 385 to 435 year-old stands of the Tsuga heterophylla-Abies procera/ Vaccinium membranaceum/Cryptogramma crispa community.

DBH (inches)	Percentage Distribution Tree Age (years)									
	1-20	21-40	41-60	61-80	81-100	101-150	151-200	201-250	251-300	300+
1-2		17	33	17	17	16				
3-4			29		42	29				
5-6			20	20	20	40				
7-8			20			80				
9-10				14	58	14	14			
11-20					19	33	30	7	11	
21-30				8	8	23	30	15	8	8
31-40							50	25	25	
41+								25	25	50

individuals are capable of accelerating their growth pace when more favorable growing conditions develop.

Stands of the community offer the poorest timber growing sites of any stands encountered in the study. The relatively short growing season and shallow soils in these high elevation areas produce the smallest mean minimum and maximum DBH old-growth Pseudotsuga menziesii encountered in the study area (Table 10). Because of the relatively small crowns of stand dominants, the stem density of Tsuga heterophylla and Pseudotsuga menziesii is higher than in stands of any other community studied.

Berberis nervosa and Gaultheria shallon share prominence in the shrub layer where each provides a mean cover of 30 percent or more (Table 21). Other shrub layer species having high presence and significant cover values include: Acer circinatum, Rosa gymnocarpa, Vaccinium parvifolium, and Vaccinium membranaceum. Taxus brevifolia and Rosa gymnocarpa are of maximum importance here with presence and cover values approaching those of the Tsuga heterophylla/Acer circinatum/Trientalis latifolia community (Tables 4 and 5).

Shrub species with low presence and cover values but displaying high fidelity when present include Pachystima myrsinites, Arctostaphylos uva-ursi, Holodiscus discolor, and Symphoricarpos mollis (Table 21).

Table 21. Descriptive statistics for the Tsuga heterophylla/Vaccinium membranaceum/ Xerophyllum tenax community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Pseudotsuga menziesii	95	46	63	0-85	4	0-5
Tsuga heterophylla	90	51	63	0-85	4	0-5
Abies procera	10	T	0	0-3	0	0-3
Thuja plicata	5	T	0	0-8	0	0-3
SHRUBS						
Berberis nervosa	100	40	38	3-85	4	2-5
Vaccinium parvifolium	90	12	8	0-85	2	0-4
Acer circinatum	86	25	8	0-85	3	0-5
Gaultheria shallon	81	30	18	0-98	4	0-5
Rosa gymnocarpa	71	3	3	0-85	2	0-3
Taxus brevifolia	71	12	0	0-63	3	0-4
Vaccinium membranaceum & Vaccinium ovalifolium	57	7	0	0-38	3	0-5
Rubus ursinus	29	2	0	0-18	1	0-3
Menziesia ferruginea	14	T	0	0-3	1	0-2
Symphoricarpos mollis	5	T	0	0-1	0	0-1
Amelanchier alnifolia	5	T	0	0-1	0	0-1
Oplopanax horridum	5	T	0	0-3	0	0-2
Pachistima myrsinites	5	T	0	0-1	0	0-2
Arctostaphylos uva-ursi	5	T	0	0-3	0	0-2
Holodiscus discolor	5	T	0	0-1	0	0-2
Ceanothus sanguineus	5	T	0	0-1	0	0-1
HERBS						
Cryptogams	95	32	38	0-63	3	0-3
Achlys triphylla	90	21	3	0-85	2	0-5
Xerophyllum tenax	86	22	38	0-98	4	0-5
Polystichum munitum	86	9	3	0-63	2	0-4
Viola sempervirens	86	4	3	0-8	2	0-3
Corallorhiza maculata	86	1	1	0-3	2	0-2
Linnaea borealis	67	3	3	0-18	2	0-2
Cryptogramma crispa	62	16	18	0-38	3	0-3
Smilacina sessilifolia	62	1	1	0-8	2	0-3
Chimaphila menziesii	62	1	1	0-3	2	0-2
Vancouveria hexandra	57	3	0	0-18	2	0-3
Disporum smithii	57	2	3	0-18	2	0-3
Coptis laciniata	57	1	0	0-3	2	0-2
Trillium ovatum	52	1	0	0-3	2	0-2
Trientalis latifolia	52	1	0	0-3	2	0-2
Goodyera oblongifolia	43	T	0	0-3	1	0-2
Listeria cordata	43	T	0	0-3	2	0-2
Clintonia uniflora	38	1	0	0-8	2	0-3
Monotropa uniflora	38	T	0	0-3	2	0-2
Oxalis oregana	24	1	0	0-38	2	0-4
Viola glabella	24	1	0	0-8	0	0-2

Table 21. Continued

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
HERBS						
Cornus canadensis	24	T	0	0-3	2	0-2
Sanicula crassicaulis	24	T	0	0-3	2	0-2
Maianthemum bifolium	10	T	0	0-1	0	0-2
Lilium columbianum	10	T	0	0-1	0	0-2
Hypopitys languginosa	10	T	0	0-3	0	0-2
Corallorhiza mertensiana	10	T	0	0-1	0	0-2
Hieracium albiflorum	5	T	0	0-1	0	0-1
Asarum caudatum	5	T	0	0-1	0	0-1
Penstemon sp.	5	T	0	0-1	0	0-2
Galium triflorum	5	T	0	0-1	0	0-2
Blechnum spicant	5	T	0	0-1	0	0-2

Xerophyllum tenax is characteristically found in most stands of the community where it grows on the elevated microsites having good drainage. Flowering and cover values of Xerophyllum increase when the tree canopy does not exclude direct sunlight from reaching the ground layer vegetation. Table 22 lists species whose high presence, particularly in combination with other species listed, is indicative of the various plant communities identified. Gaultheria shallon, Xerophyllum tenax, Vaccinium membranaceum, and Taxus brevifolia all have indicator value for identifying the Tsuga heterophylla/Vaccinium membranaceum/Xerophyllum tenax community. The presence of any three of the four species will identify the community.

Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa Community

Stands of the Tshe-Abpr/Vame/Crcr community (Figure 15) are found in the 2,500 to 3,100-foot elevational range or in the highest portion of the study area where annual precipitation ranges between 130 and 200 inches (Figure 2). The community receives maximum snowcover, highest wind velocities, minimum winter temperatures, and the shortest growing season.

Stands are found in the headwaters of tributaries to the Wilson and Trask rivers, in the same area studied by Neiland (1958). Seral vegetation and tree stump identification in the higher elevations of

Table 22. Species having diagnostic value in differentiating stands of communities when considered in the context of the groups listed.

Plant Community										
Tshe-Pisi/Opho/Atfif	Tshe-Pisi/Gash/Blsp	Tshe-Abam/Gash/Tiun	Tshe-Abam/Vaov/Oxor	Tshe-Abam/Rhma/Coca	Tshe/Vaov/Pomu	Tshe/Acci/Crcr	Tshe/Bene/Trla2	Tshe/Pomu-Adpe	Tshe/Vame/Xete	Tshe-Abpr/Vame/Crcr
	Gash	Gash		Gash	Gash		Gash		Gash	
Mefe	Mefe	Mefe	Mefe		Mefe			Mefe		
Vaov	Vaov	Vaov	Vaov		Vaov			Vaov		
Pisi	Pisi									
Rusp	Rusp							Rusp		
	Vaov2									
Opho					Opho			Opho		
Atfif								Atfif		
Lupa								Lupa		
Acci					Acci	Acci	Acci	Acci	Acci	Acci
		Abam	Abam	Abam						
		Tiun	Tiun							
		Lico				Lico			Lico	Lico
		Bene			Bene	Bene	Bene		Bene	
		Tabr				Tabr	Tabr		Tabr	
					Actr	Actr	Actr	Actr	Actr	Actr
						Rogy	Rogy		Rogy	
						Trla2	Trla2		Trla2	
						Crcr			Crcr	Crcr
						Gatr		Gatr		
							Ruur			
							Moun		Moun	
							Coma		Coma	
							Goob			
								Adpe		
				Rhma						
				Drdi				Drdi		
				Vame					Vame	Vame
				Libo						Libo
				Coca						Coca
										Abpr
									Chma	
									Xete	

Figure 15. A stand of the high-elevation Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa community.

eastern Tillamook County indicate that the community was widespread before the 1933 Tillamook fire. Stands are also found south of the Salmon River on Saddleback Mountain located in the extreme northeastern corner of Lincoln County.

Stands show no preference for particular aspects. They are usually found on the upper two-thirds of slopes, being most common on broad convex ridges with moderate slope gradients and deep soils (Appendix IV).

Soils underlying the community have developed exclusively from basic igneous rock. With few exceptions, profiles are deep to moderately deep and always well drained. Horizon screenings revealed that upper horizons contain between 21 and 40 percent of their dry weight in sand-sized or larger soil particles. Sixty-nine percent of the profiles were classified as Hembre soils and, except for one Kilchis profile, the remainder are typical of a modal Klickitat soil (Table 7).

Tsuga heterophylla, Abies procera, and Pseudotsuga menziesii usually share prominence in Tillamook County stands. The tree canopy is irregular because the small crowns of Abies procera project above those of the other two species. The unevenness permits light to penetrate through the stratified tree canopy.

Figure 16 shows the tree age distribution of randomly selected trees within, and stumps adjacent to the timber in the Wilson and Trask River stands. Decadent Abies procera are between 400 and

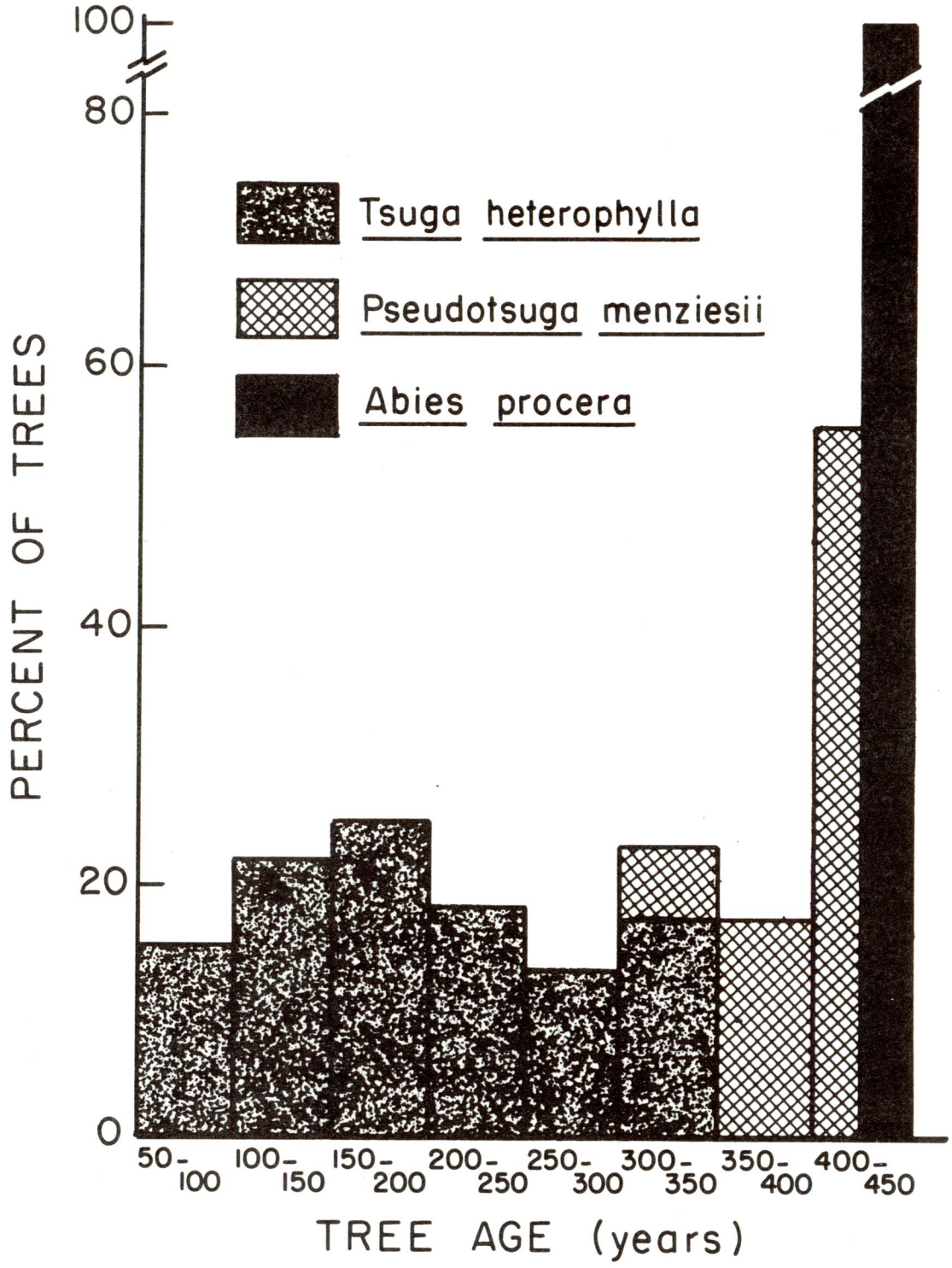

Figure 16. Age distribution of the tree species sharing tree and shrub layer prominence in the Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa community.

450 years old and in the same age class as the oldest Pseudotsuga menziesii, indicating that Abies procera became established at the same time as the old-growth Pseudotsuga menziesii. Abies procera seedlings, saplings, and pole-size reproduction are absent beneath the canopy. Individuals only occurred in small areas within stands where the canopy has been opened by tree losses.

Two stands, located approximately 45 miles south of the Wilson and Trask river area, in the highest rainfall zone within the State (Figure 2), were grouped into the Tshe-Abpr/Vame/Crcr community with some reluctance. The abundance of tree reproduction and extremely heavy duff layer have caused the sparse and species-poor ground and shrub layer development.

With one exception, all species present in the Lincoln County stands are also present in eastern Tillamook County areas. The principal difference between the vegetation in the two areas is the presence of Abies amabilis in the Saddleback and Stott mountain areas and its complete absence in Tillamook stands. In Lincoln County, Abies amabilis reproduction, exceeding that of Tsuga heterophylla, occupies 28 percent of the shrub and three percent of the ground layer (Figure 17).

Contrary to findings of the present study, Merkle (1951) and Nieland (1958) reported significant amounts of Abies procera reproduction beneath closed forest canopies. Franklin (1964) suggests

Figure 17. Abundance of Abies amabilis reproduction in the understory of Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa stands in Lincoln County.

that ecotypic variation may be responsible for greater shade tolerance in Oregon Coast Range Abies procera.

Neither Merkle (1951) or Nieland (1958) found Abies amabilis as a component of Abies procera stands. Abies procera was not observed in eastern Tillamook County stands. Schmidt (1957) indicates that neither climate or soil is directly responsible for controlling Abies amabilis distribution. Rather, vast forest fires have controlled Abies amabilis distribution. Approximately 700 to 800 years are required after extensive fires before the species will occupy an important position in stands. Furthermore, Abies amabilis is "heavy seeded" and is not capable of disseminating seed over great distances (Schmidt, 1957).

In Lincoln County where Abies amabilis occupies an important position in stands, precipitation totals 200 inches annually. The amount is comparable to portions of the Washington Olympic Peninsula where Abies amabilis dominated stands are widespread. Perhaps the relatively mesic Saddleback and Stott Mountain environments discouraged fires and thereby permitted forest succession to advance beyond that observed in eastern Tillamook County. The absence of Pseudotsuga menziesii fire scars and charcoal in soil profiles, combined with the fact that most of the decadent Pseudotsuga has been replaced by Abies amabilis indicates that the Saddleback area is approaching a climax status.

The Tillamook area stands are only 400 to 450 years old and perhaps much younger than Lincoln County stands. If Abies amabilis is not well adapted for long-range seed dissemination and extensive and frequent fires have prevented this species from rapidly extending its distribution, it is understandable that it is not present in some areas that appear well-suited to it.

Vaccinium membranaceum and Vaccinium ovalifolium, collectively have the highest presence and greatest cover of any shrub group (Table 23). They reach a height of 12 to 18 inches under the canopy, giving stands an open park-like appearance. The stature of Vaccinium membranaceum, Vaccinium ovalifolium, and Acer circinatum is greatly increased in light spots created by openings in the forest canopy.

Two additional characteristics of the shrub layer that confirm identification of the community are the absence of Gaultheria shallon and the presence of Sorbus sitchensis. The latter is a low presence but high fidelity shrub having diagnostic value.

Considering all communities, Tshe-Abpr/Vame/Crcr stands have the highest amount of litter on the forest floor where cryptogams are largely restricted to the decaying logs. Polystichum munitum has its lowest presence and cover in the community. Cryptogramma crispa and Smilacina sessilifolia, though present in several communities, reach their highest presence here (Table 4). Corallorhiza

Table 23. Descriptive statistics for the Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa community.

Plant Species	Presence	Percent Cover			Prominence	
	Percent	Mean	Mode	Range	Mode	Range
TREES						
Tsuga heterophylla	100	42	63	3-85	4	4-5
Pseudotsuga menziesii	81	24	18	0-63	4	0-5
Abies procera	76	19	18	0-63	4	0-5
Thuja plicata	29	2	3	0-18	0	0-3
Abies amabilis	10	8	0	0-85	0	0-4
SHRUBS						
Vaccinium membranaceum & Vaccinium ovalifolium	95	32	18	0-98	5	0-5
Vaccinium parvifolium	62	2	3	0-3	2	0-2
Acer circinatum	48	5	0	0-38	0	0-4
Menziesia ferruginea	33	1	0	0-8	0	0-3
Oplopanax horridum	24	2	0	0-18	0	0-4
Berberis nervosa	24	8	0	0-85	0	0-5
Sorbus sitchensis	10	1	0	0-18	0	0-3
Rosa gymnocarpa	10	1	0	0-8	0	0-3
Taxus brevifolia	5	1	0	0-18	0	0-3
Rubus nivalis	5	T	0	0-3	0	0-2
HERBS						
Cryptogramma crispa	95	27	38	0-38	4	0-4
Smilacina sessilifolia	90	13	18	0-38	3	0-4
Cryptogams	86	25	18	0-85	3	0-5
Clintonia uniflora	86	17	38	0-38	4	0-4
Maianthemum bifolium	71	4	3	0-18	2	0-4
Trillium ovatum	67	2	3	0-18	2	0-4
Disporum smithii	62	3	0	0-18	2	0-3
Coptis laciniata	62	4	3	0-38	2	0-3
Achlys triphylla	62	16	0	0-63	0	0-5
Viola sempervirens	57	2	0	0-8	2	0-3
Vancouveria hexandra	57	5	0	0-38	0	0-3
Listeria cordata	52	1	0	0-8	2	0-3
Oxalis oregana	48	19	0	0-85	0	0-5
Cornus canadensis	43	2	0	0-8	0	0-3
Chimaphila menziesii	33	T	0	0-3	0	0-2
Corallorhiza mertensiana	33	T	0	0-3	0	0-2
Blechnum spicant	29	1	0	0-8	0	0-2
Frageria vesca	24	1	0	0-8	0	0-3
Polystichum munitum	24	1	0	0-18	0	0-4
Goodyera oblongifolia	19	T	0	0-3	0	0-2
Corallorhiza maculata	19	T	0	0-3	0	0-2
Montia sibirica	14	T	0	0-3	0	0-3
Dryopteris dilatata	10	T	0	0-3	0	0-2
Linnaea borealis	10	T	0	0-3	0	0-2
Athyrium filix-femina	5	T	0	0-3	0	0-2
Streptopus curvipes	5	T	0	0-1	0	0-2
Luzula parviflora	5	T	0	0-1	0	0-2
Trisetum cernuum	5	T	0	0-3	0	0-2

mertensiana also reaches its highest presence here, but its seasonal nature restricts its usefulness in identifying the community. Picea sitchensis, Trientalis latifolia, Galium triflorum, Adiantum pedatum, and Rubus spectabilis are all absent from the community (Table 23).

IDENTIFICATION OF PLANT COMMUNITIES

The plant communities could not be differentiated by the presence or absence of one or even a few taxa. Species exhibiting high fidelity for a certain community usually had a sporadic presence or they were relatively inconspicuous within stands. Species displaying high presence and prominence invariably had little diagnostic value when considered alone because they were also similarly found in stands of other communities. The presence and cover of groups of species having similar ecological requirements or tolerances were most important in separating and characterizing communities.

Table 22 lists differentiating species within each community that have more than 40 percent presence in some but not all stands of a community. Ephemeral species displaying high fidelity but low presence were important in constructing society tables but they had little value when developing a key for community identification. In developing the identification key, saprophytes, and other short-lived species were omitted so that community identification can be made during most seasons of the year. Table 24 provides a dichotomous key for community identification and Figure 18 shows the occurrence of plant community stands in relation to topography and the Pacific Ocean.

The number of plant communities identified by the present

Table 24. Key for the identification of plant communities

A. Abies procera and/or Abies amabilis present.

B. Abies procera present.

Stands found above 2500 feet elevation on soils of basalt origin. Abies procera only occurring as mature and decadent individuals except where openings occur in the forest canopy. Abies amabilis present in some stands. The shrub layer dominated by Vaccinium membranaceum and Vaccinium ovalifolium. Gaultheria shallon, Taxus brevifolia, and Rubus spectabilis rarely occur. Achyls triphylla, Cryptogramma crispa and Cornus canadensis have high presence.

TSUGA HETEROPHYLLA-ABIES PROCERA/VACCINIUM MEMBRANACEUM/CRYPTOGRAMMA CRISPA COMMUNITY (p. 92)

BB. Abies procera absent but Abies amabilis present.

C. Gaultheria shallon present

D. Rhododendron macrophyllum present. Abies amabilis and Thuja plicata prominent in the tree canopy. Vaccinium membranaceum and Vaccinium ovalifolium collectively provide 50 percent shrub cover. Gaultheria shallon has 30 percent cover. Clintonia uniflora always present and Cornus canadensis and Linnaea borealis usually occur. Found above 2500 feet elevation on basalt soils.

TSUGA HETEROPHYLLA-ABIES AMABILIS/RHODODENDRON MACROPHYLLUM/CORNUS CANADENSIS COMMUNITY (p. 65)

DD. Rhododendron macrophyllum absent. Abies amabilis and Tsuga heterophylla dominate absent. Gaultheria shallon always present with approximately 14 percent cover. Vaccinium ovalifolium, Menziesia ferruginea, and Taxus brefifolia usually present. Stands located near the coast on steep rocky terrain having soils of basalt origin.

TSUGA HETEROPHYLLA-ABIES AMABILIS/ GAULTHERIA SHALLON/TIARELLA UNIFOLIATA COMMUNITY (p. 56)

CC. Gaultheria shallon absent.

Abies amabilis and Tsuga heterophylla share prominence in the canopy. Picea sitchensis occasionally present and Pseudotsuga menziesii absent. Vaccinium ovalifolium usually present as the most prominent shrub. The shrub cover sparse. Blechnum spicant always present with approximately seven percent cover. Ground cover dominated by Oxalis oregana and cryptogams . Most stands found on cool east and north slopes having soils of basalt origin.

TSUGA HETEROPHYLLA-ABIES AMABILIS/ VACCINIUM OVALIFOLIUM/OXALIS OREGANA COMMUNITY (p. 62)

AA. Abies procera and Abies amabilis absent.

E. Picea sitchensis usually present.

F. Gaultheria shallon always present.
Acer circinatum and Oplopanax horridum usually not present. Athyrium filix-femina and Luzula parviflora usually not present and Vaccinium ovatum occasionally present. Ninety percent of all soils supporting stands have developed from marine sediments.

TSUGA HETEROPHYLLA-PICEA SITCHENSIS/ GAULTHERIA SHALLON/BLECHNUM SPICANT COMMUNITY (p. 52)

FF. Gaultheria shallon usually absent.
If present it occupies less than four percent of the shrub layer. Acer circinatum usually present. Oplopanax horridum, Athyrium filix-femina and Luzula parviflora usually present. Vaccinium ovatum never present. Soils both of marine sediment and basalt origin.

TSUGA HETEROPHYLLA-PICEA SITCHENSIS/ OPLOPANAX HORRIDUM/ATHYRIUM FILIX-FEMINA COMMUNITY (p. 36)

EE. Picea sitchensis absent.

G. Gaultheria shallon present.

H. Xerophyllum tenax usually present. Taxus brevifolia, Rosa gymnocarpa are usually present. The community always occurs above 2000 feet elevation on rocky surfaced soils of basalt origin located on slope gradients usually exceeding 50 percent.

TSUGA HETEROPHYLLA/VACCINIUM MEMBRANACEUM/XEROPHYLLUM TENAX COMMUNITY (p. 86)

HH. Xerophyllum tenax always absent.

I. Vaccinium ovalifolium always present with a mean cover of 12 percent. Menziesia ferruginea usually present. Taxus brevifolia and Rosa gymnocarpa usually absent. Soils predominantly of basalt origin.

TSUGA HETEROPHYLLA/VACCINIUM OVALIFOLIUM/POLYSTICHUM MUNITUM COMMUNITY (p. 69)

II. Vaccinium ovalifolium usually absent. Acer circinatum always present with 30 percent cover. Trientalis latifolia, Taxus brevifolia, Rosa gymnocarpa and Rubus ursinus usually present. Soils always developed from igneous parent materials.

TSUGA HETEROPHYLLA/BERBERIS NERVOSA TRIENTALIS LATIFOLIA COMMUNITY (p. 73)

GG. Gaultheria shallon absent.

J. Berberis nervosa usually present Vaccinium ovalifolium never present and Viola sempervirens always present. Montia sibirica, Athyrium filix-femina, Rosa gymnocarpa and Goodyera oblongifolia usually present and Rubus

spectabilis and Rubus ursinus commonly present. Soils supporting communities always of basalt origin.

TSUGA HETEROPHYLLA/ACER CIRCINATUM/ CRYPTOGRAMMA CRISPA COMMUNITY (p. 73)

JJ. Berberis nervosa not present. A sparse shrub cover present. Vaccinium ovalifolium, Taxus brevifolia, Rosa gymnocarpa and Rubus ursinus never present. Polystichum munitum and oxalis oregana have a mean ground cover of 60 and 90 percent, respectively. Athyrium filix-femina, Montia sibirica, and Goodyera oblongifolia never present in the ground layer.

TSUGA HETEROPHYLLA/POLYSTICHUM MUNITUM-ADIANTUM PEDATUM COMMUNITY (p. 82)

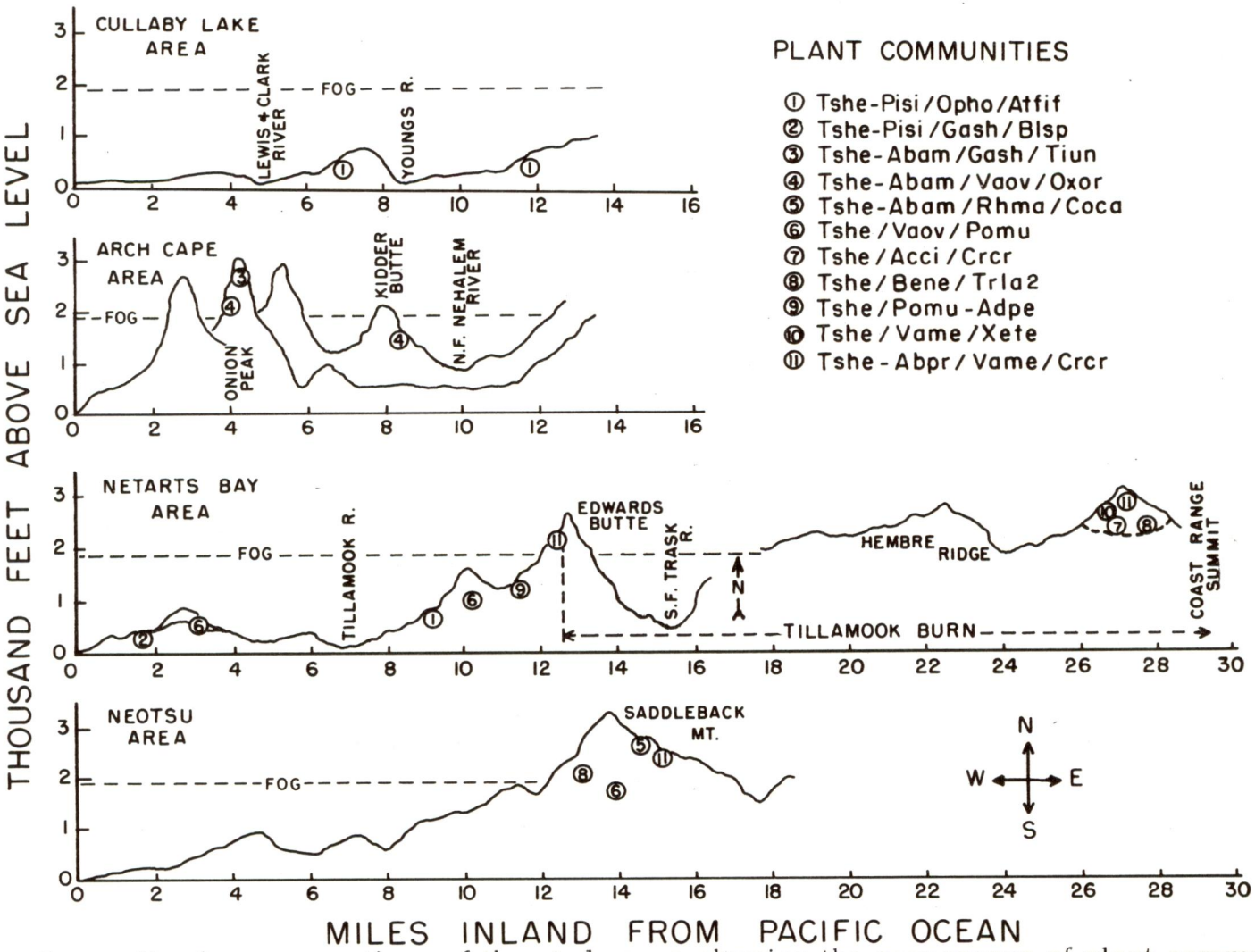

Figure 18. Generalized cross-sections of the study area showing the occurrence of plant community stands in relation to topography and the Pacific Ocean.

study does not provide sufficient insight for developing a hierarchial vegetation classification. Synsystematics must be postponed until a better understanding of the Oregon coastal vegetation has developed.

COMPARISON WITH OTHER COMMUNITY CLASSIFICATIONS

Outside Study Area

Spilsbury and Smith (1947) and Becking (1954) have correlated vegetation differences with growth statistics obtained from various commercial tree species to determine if vegetation can be used to indicate site quality or the relative productive capacity of particular tree species. Such classifications enable foresters to categorize their forest lands, regardless of seral status, into areas having similar site quality.

Bailey (1966) and Franklin (1966) were of the opinion that forests needed to be stratified into areas of essentially equivalent environments, i.e., habitat-types before meaningful silvicultural research is attempted.

Table 25 places the communities identified by the present study into the forest classifications developed by Spilsbury and Smith (1947) and Becking (1954). Individual communities are also compared with similar communities identified by the other investigators.

More than one community identified by the present study falls into a single forest type recognized by other authors. This should cause no alarm among resource managers. Both forest type classifications were developed from research conducted in mid- and

Table 25. Plant communities identified by previous studies showing similarities with those identified by the present study.

Present Study Plant Communities	Spilsbury and Smith (1947) Site-Types	Becking (1954) Forest Types	Franklin (1966) Associations	Bailey (1966) Associations
	Climatic subdivision A			
Tshe-Pisi/Opho/Atfif	Polystichum	Fog Belt-P. munitum		
Tshe-Pisi/Gash/Blsp	Gaultheria	Fog Belt-G. shallan		
Tshe/Pomu-Adpe	Polystichum	A. caudatum-P. munitum		P. munitum/O. oregana
Tshe/Vaov/Pomu	Polystichum-Gaultheria	Lowland-G. shallon		
Tshe-Abam/Vaov/Oxor	Polystichum	Montane-P. munitum	A. amabilis/O. oregana	
Tshe-Abam/Gash/Tiun	Polystichum-Gaultheria	Montane G. shallon	A. amabilis/B. nervosa	
	Climatic subdivision B	Lowland-G. shallon		
Tshe/Acci/Crcr	Gaultheria-Parmelia	Subalpine-P. munitum		
Tshe/Bene/Trla2	Polystichum-Gaultheria	Subalpine-P. munitum		A. circinatum/B. nervosa
	Climatic subdivision D			
Tshe/Vame/Xete	Gaultheria			
Tshe-Abpr/Vame/Crcr	Gaultheria-Parmelia			
Tshe-Abam/Rhma/Coca	Gaultheria-Parmelia			

low-seral forest vegetation in parts of British Columbia, Washington, and Oregon. Obviously, numerous plant communities were encountered and it should not be surprising that several communities have a similar potential for Pseudotsuga menziesii growth and thus are grouped into one class.

These forest type classifications are broad enough not to discourage the forester who is attempting to assess the timber growth potentials of the lands he manages.

Within the framework of the forest types, there are undoubtedly plant community differences that are important to game managers, hydrologists, foresters, forest engineers, and other resource management groups. Plant communities described by Corliss and Dyrness (1963), Bailey (1966), Franklin (1966), and the present study should be considered as attempts to provide a better understanding within Spilsbury and Smith (1947), Becking (1954), and other relatively broad classifications. Eventually such understanding will lead to a refinement of the broad classifications.

Many resource managers have not used the relatively simple Spilsbury and Smith (1947) and Becking (1954) classifications either because they do not understand the utility of such tools or because resource management is just now reaching the point where expenditures for more intensive inventory, mapping, and management are justified.

Whether the task of habitat classification is accomplished by the manager or assigned to specialists, it should offer both refined and broad or generalized classification alternatives, depending upon the intensity of management desired. If the resource manager can realize benefits from a relatively broad ecological classification, then he is more likely to accept a more detailed classification even though it becomes more costly to apply. His acceptance will have been tempered by an appreciation of what a more thorough understanding of the landscape means to resource management. Education of the resource manager into the use of phytosociological classifications should always proceed from the simple or general to the complex or detailed.

Within Study Area

Bailey and Poulton (1968) and Meurisse and Youngberg (1971) have conducted previous studies of soil-vegetation relationships in the study area. Three of the eight associes recognized in the former study within the Tillamook Burn interior were recognized in the western one-third of the present study area by Meurisse and Youngberg (1971).

Based upon species occurrence, soils, and physiographic similarities, six of the associes identified by Bailey and Poulton (1968) appear related to communities identified by the present study (Table

26). The Vapa/Gash and Rupa/Trla2 associes both occur under conditions similar to those of the high-seral Tshe/Bene/Trla2 community.

The Alru/Pomu and Alru/Rupa associes are restricted to north-facing slopes in the Burn interior (Bailey and Poulton, 1968). Soils, physiographic, and understory vegetation data indicate that the two associes are related to near-climax stands of the Tshe/Pomu-Adpe community which are found on all aspects near the coast. Apparently the drier conditions found inland, restrict stands to moist and cool north slopes.

Stands of the Tshe/Vame/Xete have characteristics similar to the Acma/Symo associes. The high elevation Tshe-Abpr/Vame/Crcr community also has similarities in common with the Ptag/Locr associes.

Meurrisse and Youngberg (1971) described a low-seral Vaov/Rusp community near the coast that appears related to the near-climax Tshe-Pisi/Opho/Atfif and/or Tshe/Vaov/Pomu communities (Table 26).

Table 26. Comparison of the low-seral plant communities identified by previous investigators within the study area with the near-climax communities discussed in the present study.

Present Study Plant Communities	Bailey and Poulton (1968) Associes	Meurisse and Youngberg (1971) Communities
Tshe-Pisi/Opho/Atfif		Vaccinium ovalifolium-Rubus spectabilis
Tshe-Pisi/Gash/Blsp		
Tshe-Abam/Gash/Tiun		
Tshe-Abam/Vaov/Oxor		
Tshe-Abam/Rhma/Coca		
Tshe/Vaov/Pomu		Vaccinium ovalifolium-Rubus spectabilis
Tshe/Acci/Crcr		
Tshe/Bene/Trla2	Vaccinium parvifolium/Gaultheria shallon Rubus parviflorus/Trientalis latifolia	Vaccinium parvifolium/Gaultheria shallon Rubus parviflorus/Trientalis latifolia
Tshe/Pomu-Adpe	Alnus rubra/Polystichum munitum Alnus rubra/Rubus parviflorus	
Tshe/Vame/Xete	Acer macrophyllum/Symphoricarpos mollis	
Tshe-Abpr/Vame/Crcr	Pteridium aquilinum/Lotus crassifolius	Pteridium aquilinum/Lotus crassifolius

UTILITY OF PLANT COMMUNITY CLASSIFICATIONS

Forest Management

A classification of forest vegetation into biologically similar units provides a means of stratifying timberlands for intensive forest management. When a community classification has been developed, research is needed to identify the management problems and use potentials that are specific to each habitat. Identification of regeneration, fertility, growth, animal damage, disease, and insect problems specific to each community will enable foresters to realize more efficient and intensive management. It further gives the direction and limitations to optimum land use.

Spilsbury and Smith (1947) and Becking (1954) have conducted studies in the Pseudotsuga menziesii region to develop forest site classifications. These authors, recognizing climate as the most important factor influencing the distribution of vegetation, each subdivided the region into four physiographic subregions. They gave primary consideration to presence, abundance, and stature of Polystichum munitum and Gaultheria shallon in each subregion when developing a classification of habitats that differed in forest site quality.

When subjecting the plant communities described in the present

study to the Spilsbury and Smith (1947) and Becking (1954) classification, all communities except the Tshe/Acci/Crcr and the Tshe/Bene/Trla2 were classified with little difficulty (Table 25). More than one community was grouped into the same forest type, indicating that the forest types offered enough latitude to include more than one community. Conversely, the work of the previous investigators indicate that several of the communities as described in this study have a comparable forest site index for Pseudotsuga menziesii.

Game Management

Abundance of Roosevelt elk Cervus canadensis roosevelti varies widely within the study area. Northern sections contain some of the highest densities in western Oregon while established herds are rare south in the Nestucca, Little Nestucca, Salmon and Siletz drainages. The void continues southward to the vicinity of the Umpqua River, approximately 100 miles south of the Nestucca River.

The animal is principally a forest dwelling species, particularly on the eastern edge of its Coast Range distribution. Differences in the extent of past logging and wildfire in the north coastal area is not directly related to the north-south distribution and decline in elk abundance. Early century logging and human population centers were concentrated in Clatsop County where elk numbers were high. Later, logging and burning spread southward with no apparent

increase in elk. Annual harvests were elevated by increased hunter numbers, improved hunter access, and changes in harvest regulations.

There appears to be a north to south reduction in the amount of "coastal habitat" as indicated by the 1933 timber-type survey by county (Table 27). The distribution of elk in north coastal Oregon appears to follow a similar pattern. Though Clatsop County has the shortest coastline and extends inland a greater distance, some 184,000 acres or 35 percent of the County has a canopy dominated by either a Picea sitchensis, Abies amabilis, Abies procera, or Tsuga heterophylla. The presence of the Columbia River and its estuary on the northern edge of the County undoubtedly contributes to the maritime climate over much of the area. Southward, Tillamook and Lincoln County, with almost twice the coastline, contain much less "coastal habitat." The 1933 Tillamook Burn undoubtedly destroyed many stands dominated by Abies amabilis and Abies procera which would have otherwise been included in the Tillamook County total.

Presence of Picea sitchensis, Abies amabilis or Abies procera as stand dominants indicate a moist, cool environment during all seasons of the year. Tsuga heterophylla dominated stands containing few or no Pseudotsuga menziesii are most commonly found in the cool summer fog zone where minimum variation exists between mean monthly maximum temperatures and where elk are abundant.

Table 27. Relative importance of timber types within counties in 1933 before significant amounts of logging occurred.

County	Total acres	Timber Type Acreages *Picea sitchensis*	*A. amabilis* *A. procera*	*Tsuga heterophylla*	Total Acres "coastal" habitat
Clatsop	525,475	22,190	8,265	153,605	184,060
Tillamook	723,629	37,268	1,550	80,650	119,468
Lincoln	638,610	26,379	2,040	39,825	68,244

Eastward into areas dominated by Pseudotsuga menziesii relatively dry weather patterns and plant succession are more favorable for Pseudotsuga menziesii establishment. Fire has been common enough to prevent Tsuga heterophylla from reaching a climax status.

Herds in the interior of the Coast Range or Cascade Mountains are ususally found where they have access to high-elevation summer ranges, preferably where balsam-fir habitats are present.

Table 28 compares the relative importance of the various plant communities to big game species based upon a subjective evaluation of deer and elk use in each stand. Since old-growth forests were widely scattered in the study area, the communities described provide an incomplete cross-section of habitats in the area. A better understanding of elk habitat preferences would provide one consideration for evaluating presently unoccupied elk ranges as potential locations for artificially extending elk distributions.

Supplemental to extending the elk range by transplanting nuclei to unoccupied areas, habitat improvement on existing ranges offers a second pathway to increased elk numbers for hunters and for transplanting. With a knowledge of the animal preferences for stands of each community, habitat improvements within or adjacent to stands, should assure maximum animal use from such range improvements.

Stratification of sampling by plant community differences

Table 28 Relative importance of plant communities to deer and elk

Plant Community	Elk	Deer
Tshe-Pisi/Opho/Atfif	A+	a
Tshe-Pisi/Gash/Blsp	A	a
Tshe-Abam/Gash/Tiun	A	a
Tshe-Abam/Vaov/Oxor	A+	a
Tshe-Abam/Rhma/Coca	-	s
Tshe/Vaov/Pomu	*	A[1]
Tshe/ Acci/Crcr	-	A[1]
Tshe/Bene/Trla2	-	A[1]
Tshe/Pomu-Adpe	a*	A[1]
Tshe/Vame/Xete	S	s
Tshe-Abpr/Vame/Crcr	S	s

S - High summer use

s - Low summer use

A - High use all seasons

a - Low use all seasons

* - Has many characteristics of high-use areas.

1 - Receives high deer use only where stands are adjacent to logged and burned areas.

provides a biological basis for the application and evaluation of range and forestry improvement practices. A plant community understanding also provides a basis for sound decisions to increase the compatability of game management and forest practices.

SUMMARY

Plant communities in the old-growth forests of western Clatsop, Tillamook, and Lincoln counties were studied to provide a classification of forest vegetation into biologically similar units. The primary objective of the study was to provide a means of stratifying timberlands for intensive resource management.

A species list, estimates of canopy coverage, tree and shrub age-class distributions, and estimates of the tree density were obtained at each sampling location. Descriptions of soil and physiographic features were also developed for each sampling location. Society tables were developed to synthesize the analytical vegetation data into units of similar ecology.

Eleven near-climax forest communities were identified from the vegetation data. The Tsuga heterophylla-Picea sitchensis/Gaultheria shallon/Blechnum spicant community occurs adjacent to the coast on predominantly Astoria soils. Picea sitchensis is present in approximately one-half of these stands where it usually occurs as mature or decadent individuals. Only ten percent of the stands contain Picea seedlings and no saplings were observed in these old forests. Thuja plicata and Pseudotsuga menziesii occur with less regularity than Picea sitchensis. Neither seems capable of reproducing itself beneath a forest overstory where Tsuga heterophylla

regeneration occurs in abundance. Approximately 90 percent of the shrub layer is covered by Gaultheria shallon, Vaccinium parvifolium, and Vaccinium ovalifolium. Vaccinium ovatum displays high fidelity for stands of this community. Blechnum spicant, though it occurs in most communities, has its highest cover in the Tshe-Pisi/Gash/Blsp community.

Stands of the Tsuga heterophylla-Picea sitchensis/Oplopanax horridum/Athyrium filix-femina community, though they occur farther inland and at higher elevations, contain more Picea sitchensis than the more coastal stands of the Tshe-Pisi/Gash/Blsp community. Picea sitchensis seedlings were observed in 29 percent of these stands, but sapling or pole-size individuals were absent. Tsuga can survive for extended period without openings in the forest canopy, but Picea seedlings apparently are not as shade tolerant. Mature and decadent Pseudotsuga menziesii are more common in the more inland Picea community. The three ericads Vaccinium ovalifolium, Vaccinium parvifolium, and Menziesii ferruginea individually dominate or share prominence in the shrub layer. Unlike the Tshe-Pisi/Gash/Blsp community Gaultheria shallon is an infrequent component of the shrub vegetation. Rubus spectabilis and Oplopanax horridum each reach their highest presence and cover in the community. Collectively, cryptogams reach their highest cover in the community.

The Tsuga heterophylla-Abies amabilis/Vaccinium ovalifolium/

Oxalis oregana, and the Tsuga heterophylla-Abies amabilis/Gaultheria shallon/Tiarella unifoliata communities are restricted to the slopes of high-elevation, unlogged promontories located in proximity to the Pacific Ocean in Clatsop County. Stands of the Tshe-Abam/Gash/Tiun community are found on the rugged, rocky topography near the summit of mountains and buttes having soils of basalt origin. Tshe-Abam/Vaov/Oxor stands are found downslope from the Tshe-Abam/Gash/Tiun stands where topography is relatively gentle. Tsuga heterophylla and Abies amabilis share dominance in the canopy of each community. Both communities along with the third, more inland Tshe-Abam/Rhma/Coca community, have the most open tree canopies of all communities studied. Their relatively open nature might favor the establishment and perpetuation of Abies amabilis regeneration. No evidence was found that Pseudotsuga menziesii was ever a component of the vegetation but trace amounts of Picea sitchensis are present indicating the maritime nature of the climate. Thuja plicata reaches its highest presence and cover in stands of the Tshe-Abam/Gash/Tiun, and Tshe-Abam/Rhma/Coca communities which have the most-open forest canopies of all communities studied.

The mean shrub cover within the Tshe-Abam/Gash/Tiun stands is 55 percent or more than twice that of the open park-like Tshe-Abam/Opho/Oxor vegetation. Gaultheria shallon and Vaccinium ovalifolium provide most of the cover in Tshe-Abam/Gash/Tiun

stands. The additional presence of Xerophyllum tenax, Taxus brevifolia, Rosa gymnocarpa, Linnaea borealis, Cornus canadensis, and Frageria vesca helps to separate the Tshe-Abam/Gash/Tiun from the Tshe-Abam/Opho/Oxor community.

The Tsuga heterophylla-Abies amabilis/Rhododendron macrophyllum/Cornus canadensis community occurs in the highest rainfall zone in the State where Abies amabilis and Tsuga heterophylla share prominence in the tree canopy. Decadent Pseudotsuga menziesii only occurs as scattered individuals in stands having the most sparse tree canopy of any community studied. Abies amabilis and Tsuga heterophylla seedings and saplings are abundant beneath the sparse canopy. Rhododendron macrophyllum, Vaccinium membranaceum, Vaccinium ovalifolium, and Gaultheria shallon provide 98 percent of the shrub cover. Cornus canadensis and Clintonia uniflora have their highest presence in the community and Polystichum munitum and Oxalis oregana have their lowest presence and cover within Tshe-Abam/Rhma/Coca stands.

Five communities, lacking Picea sitchensis and/or balsam fir, have Tsuga heterophylla and Pseudotsuga menziesii as codominants in the tree layer. Their ranking from the most mesic to the most xeric is as follows:

Tsuga heterophylla/Polystichum munitum-Adiantum pedatum community

Tsuga heterophylla/Vaccinium ovalifolium/Polystichum munitum community
Tsuga heterophylla/Acer circinatum/Cryptogramma crispa community
Tsuga heterophylla/Berberis nervosa/Trientalis latifolia community
Tsuga heterophylla/Vaccinium membranaceum/Xerophyllum tenax community

There is a corresponding increase in the mean percent cover of mature and decadent Pseudotsuga menziesii with an increase in the xeric status of communities.

Stands of the mesic Tshe/Pomu-Adpe community are usually found at higher elevations than the Tshe-Pisi/Opho/Atfif community. Soils of basalt origin occur within most Tshe/Pomu-Adpe stands. Pseudotsuga menziesii is also present as scattered decadent individuals over-topping a dense Tsuga heterophylla. Tsuga has its highest canopy coverage in this community. Heavy shading results in relatively poor shrub development beneath the canopy. The total mean shrub cover is only 17 percent within these stands. A luxuriant growth of three-foot Polystichum munitum covers approximately 60 percent of the ground layer of Tshe/Pomu-Adpe stands. Oxalis oregana and Montia sibirica reach their highest presence and cover within the stands where they occupy most of the interspaces between Polystichum munitum plants.

Tsuga heterophylla dominates stands of the Tsuga heterophylla/Vaccinium ovalifolium/Polystichum munitum community. Remnant

Pseudotsuga menziesii scattered within stands were, in some instances, over 500 years old. All locations contained three times as many dead Pseudotsuga remnants as living individuals. Mature Thuja plicata occurs in less than one-half the stands examined and seedling and sapling Thuja were so scarce that it is doubtful that the species can perpetuate itself outside the openings in the forest canopy. Gaultheria shallon occurs in all stands with a mean cover of 27 percent. Vaccinium parvifolium, Vaccinium ovalifolium, and Berberis nervosa all have relatively high presence and cover in the shrub layer. The presence of Acer circinatum, Oplopanax horridum, Rosa gymnocarpa, Taxus brevifolia, and Berberis nervosa and the absence of Picea sitchensis separates stands of Tshe/Vaov/Pomu from those of the Tshe-Pisi/Gash/Blsp community which also has Gaultheria shallon as an understory dominant. The character of the herb layer is similar to that of the Tshe-Pisi/Opho/Atfif community.

Stands of the Tsuga heterophylla/Acer circinatum/Cryptogramma crispa and the Tsuga heterophylla/Berberis nervosa/Trientalis latifolia occur outside the summer fog zone in areas of steep topography located in the upper one-third of major river drainages. Prominence in the tree canopy is shared by Tsuga and Pseudotsuga. Thuja plicata occurs in approximately 45 percent of the stands of each community where it has eight percent canopy coverage. Numerous other similarities exist between the two communities, particularly

in their physiography and understory vegetation. Acer circinatum, Taxus brevifolia, Rosa gymnocarpa, Berberis nervosa, and Vaccinium parvifolium all have high presence in the shrub layer of each community. The Tshe/Acci/Crcr community lacks Gaultheria shallon which has a mean cover of 27 percent in Tshe/Bene/Trla2 stands. Rubus spectabilis, Oplopanax horridum, and Menziesia ferruginea are only found in the Tshe/Acci/Crcr stands where soils are deeper and contain more summer moisture. The cover and stature of Polystichum munitum are greater in Tshe/Acci/Crcr stands.

Stands of the Tsuga heterophylla/Vaccinium membranaceum/Xerophyllum tenax occur at high elevations on shallow well-drained basalt soils in areas of extremely steep topography. The casual observer would recognize stands as being relatively poor timber producing areas. Pseudotsuga menziesii has its highest cover but lowest stature within stands where it shares prominence with Tsuga heterophylla. Pseudotsuga has been able to reproduce itself on elevated and exposed rocky terrain but in lower proportions as compared to Tsuga heterophylla. Floristically, the community is rich in species, many of which occur in other Cascade Range communities. Gaultheria shallon and Vaccinium membranaceum share prominence in the shrub layer. Other species, indicative of well-drained soils, are Rosa gymnocarpa and Taxus brevifolia which reach their maximum importance within stands. Shrubs with low presence and cover values but

having diagnostic value when they occur include Pachystima myrsinites, Arctostaphylos uva-ursi, Holodiscus discolor, and Symphoricarpos mollis. Xerophyllum tenax and Achlys triphylla are the two most important herb layer components.

Tsuga heterophylla-Abies procera/Vaccinium membranaceum/Cryptogramma crispa stands are found between 2,500 and 3,100 feet elevation in the highest areas within the study area. Tsuga heterophylla, Abies procera, and Pseudotsuga menziesii usually share prominence in 400-year-old or older stands but Abies amabilis is also present in the tree canopy of Lincoln County stands. Abies procera only occurs as mature and decadent individuals that apparently became established at the same time as Pseudotsuga menziesii. Abies procera reproduction is essentially absent beneath the forest canopy. Tsuga regeneration of all sizes and ages is present in all stands as is Abies amabilis in Lincoln County stands. Low stature Vaccinium membranaceum and Vaccinium ovalifolium, collectively, has the highest presence and greatest cover of any shrub group. Stands appear open and park-like except where openings occur in the canopy. Accumulations of litter on the forest floor are maximum. Cryptogramma crispa, Smilacina sessilifolia, and Corallorhiza mertensiana reach their highest presence in Tshe-Abpr/Vame/Crcr stands.

A classification key for identifying stands of communities was

developed to provide a tool for stratifying a portion of the forest and wildlife habitat in north coastal forests. Additional study is needed to identify management problems specific to each habitat.

The Alru/Pomu, Alru/Rupa, Vapa/Gash, and Acma/Symo associes described by a previous soil-vegetation study in the Tillamook Burn appear related to four of the near-climax communities in the present study. An additional previously described Vaov/Rusp community occurring in stands near the coast has characteristics that may link it to the near-climax Tshe-Pisi/Opho/Atfif and/or Tshe/Vaov/Pomu communities.

There appears to be a geographic, north-to-south decline in the amount of "coastal habitat" within the study area that is related to present Roosevelt elk distribution patterns. The relative importance of the communities to deer and elk is discussed. The plants community key provides a tool for evaluating the suitability of forested areas as potential elk habitat.

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APPENDIX I

Classifications Making Physiographic Descriptions Within Stands

Elevation	Exposure	Percent Slope	Slope Position
0-500	North	0-5	Top
500-1000	Northeast	5-15	Upper 1/3
1000-1500	East	15-30	Middle 1/3
1500-2000	Southeast	30-50	Bottom 1/3
2000-2500	South	50-70	Bottom
2500-3000	Southwest	70-85	
3000-3500	West	85-95	
3500-4000	Northwest	95+	

Disturbance Influences	Microrelief
Logging	Unform flat (UF)
Fire	Uniform concave (UC)
Erosion	Uniform convex (UV)
Grazing	Interrupted by pits and mounds (IPM)
Rodents	
Insects	

Percent Ground Cover	Slope Length
Bare	Estimated by 100 yard intervals
Rock	
Litter	

APPENDIX II

Additional Categories Used for Rating the Relative Importance of Plant Species

Prominence Rating	Rating Description
1	Species which can be seen only by close scrutiny in and around other plants. A thorough search is required to locate all species in the stand deserving a (1) rating.
2	Species which can be seen only by moving around in the stand or by looking intently while standing in one place. The observer need not look in and around other plants to locate species worthy of a (2) prominence rating.
3	Species which are easily seen by standing in one location and looking casually around. Though they are not outstanding, most species in a stand fall in this category.
4	Two or more species sharing prominence each receive a (4) rating. No (5) prominence rating is given when two or more species share prominence in this manner.
5	A single species most prominent in the aspect of the vegetation stratum.

Symbol	Tree and Shrub Size and Age Classes
L	Established seedling or very small individuals
⌐	Sapling or intermediate-sized rapidly growing plants
⌐	Pole-sized or nearly mature, vigorous growing individuals
J	Over-mature and decadent plants

APPENDIX III. List of plant species encountered in the old-growth forest communities.

Scientific Name	Common Name
TREES	
Abies amabilis (Dougl.) Forbes	Pacific silver fir
Abies procera Rehd.	Noble fir
Alnus rubra Bong.	Red alder
Picea sitchensis (Bong.) Carr.	Sitka spruce
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Thuja plicata Donn.	Western red cedar
Tsuga heterophylla (Raf.) Sang.	Western hemlock
SHRUBS	
Acer circinatum Pursh	Vine maple
Amelanchier alnifolia Nutt.	Saskatoon serviceberry
Arctostaphyslos uva-ursi (L.) Spreng.	Kinnikinnick
Berbis nervosa Pursh	Oregongrape
Ceanothus sanguineus Pursh	Redstem ceanothus
Cornus nuttallii Aud. ex T. & G.	Pacific Dogwood
Gaultheria shallon Push	Salal
Holodiscus discolor (Pursh) Maxim.	Creambrush oceanspray
Menziesia ferruginea Smith	Rustyleaf
Oplopanax horridum (J. E. Smith) Mig.	Devilsclub
Pachistima myrsinites (Pursh) Raf.	Oregon boxwood
Rhododendron macrophyllum G. Don.	Pacific rhododendron
Rosa gymnocarpa Nutt.	Baldhip rose
Rubus nivalis Dougl. ex Hook.	Snow dewberry
Rubus parviflorus Nutt.	Thimbleberry
Rubus spectabilis Pursh	Salmonberry
Rubus ursinus Cham. & Schlecht.	Trailing blackberry
Sambucus racemosa L. var. arborescens (T. & G.) Gray	Red elderberry
Sorbus sitchensis var. grayi (Wenzig) C. L. Hitchc.	Mountain ash
Symphoricarpos mollis Nutt.	Creeping snowberry
Taxus brevifolia Nutt.	Western yew
Vaccinium membranaceum Dougl. ex Hook.	Big huckleberry
Vaccinium ovalifolium Smith	Evergreen huckleberry
Vaccinium ovatum Pursh	Red huckleberry
Vaccinium parvifolium Smith	
HERBS	
Achlys triphylla (Smith) DC.	Deerfoot vanillaleaf
Actaea rubra (Ait.) Willd.	Baneberry
Adenocaulon bicolor Hook.	Trail plant
Adiantum pedatum L.	Western maidenhair-fern
Asarum caudatum Lindl.	Wild ginger
Athyrium filix-femina (L.) Roth	Ladyfern
Blechnum spicant (L.) Weis.	Deerfern
Bromus sp.	Brome grass
Carex sp.	Sedge
Chimaphila menziesii (R. Br.) Spreng.	Little Prince's pine

Scientific Name	Common Name
HERBS	
Clintonia uniflora (Schult.) Kunth	Queencup beadily
Coptis laciniata Gray	Cutleaf goldthread
Corallorhiza maculata Raf.	Spotted coralroot
Corallorhiza mertensiana Bong.	Mertens' Coral-root
Cornus canadensis L.	Bunchberry dogwood
Cryptogramma crispa R. Br.	Parsley-fern
Dicentra formosa (Andr.) DC	Western bleeding heart
Disporum smithii (Hook.) Piper	Smith's fairybells
Dryopteris dilatata (Hoffm.) A. Gray	Mountain woodfern
Elymus sp.	Rye-grass
Epilobium sp.	Fire-weed
Festuca rubra L.	Red fescue
Frageria vesca L. var. bracteata (Heller) Davis	Western wood strawberry
Galium triflorum Hichx.	Sweetscented bedstraw
Goodyera oblongifolia Raf.	Rattlesnake plantain
Hieracium albiflorum Hook.	White hawkweed
Hypopitys languinosa Michx.	American pinesap
Lilium columbianum Hans.	Columbia lily
Linnaea borealis L.	Twinflower
Listeria cordata (L.) R. Br.	Heart-leaved twayblade
Luzula parviflora (Ehrh.) Desv.	Small-flowered wood-rush
Maianthemum bifolium DC. var. Kamschaticum (Gmel.) Jeps.	False lily-of-the-valley
Mimulus sp.	Monkey-flower
Monotropa uniflora L.	Indian pipe
Montia sibirica (L.) Howell	Western springbeauty
Oxalis oregana Nutt. ex T. & G.	Oregon oxalis
Penstemom sp.	Penstemon
Poa sp.	Blue grass
Polystichum munitum (Kaulf.) Presl	Swordfern
Pteridium aquilinum (L.) Kuhn.	Bracken fern
Pyrola asarifolia Michx.	Large pyrola
Sanicula crassicaulis Poepp.	Western snake-root
Smilacina sessilifolia (J. G. Bak.) Nutt.	Slim Solomonplume
Stachys mexicana Benth.	Great hedge nettle
Streptopus curvipes Vaill.	Purple twistedstalk
Tiarella trifoliata L.	Three-leaved coolwort
Tiarella unifoliata Hook.	Western coolwort
Trientalis latifolia Hook.	Starflower
Trillium ovatum Pursh	White trillium
Trisetum cernuum Trin.	Nodding trisetum
Vancouveria hexandra (Hook.) Morr. & Dec.	White inside-out-flower
Viola glabella Nutt.	Wood violet
Viola sempervirens Greene	Evergreen violet
Xerophyllum tenax (Pursh) Nutt.	Common beargrass

APPENDIX IV. Percent distribution of environmental features characterizing plant communities.

Plant Community	Aspect								Slope length (yds.)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest	0	1-50	51-100	101-200	201-300	301-400	401-500	500+
Tshe-Pisi/ Opho/ Atfif	9	19	9	17	9	19	9	9	5	9		29	38	19		
Tshe-Pisi/ Gash/ Blsp	16	10	10	6	16	16	16	10	10	6	10	16	30	16	6	6
Tshe-Abam/ Gash/ Tiun		13		13	25	36	13						28	36		36
Tshe-Abam/ Vaov/ Oxor	15	23	23			15	9	15				9	23	37		31
Tshe-Abam/ Rhma/ Coca	25		25		25		25				25		50	25		
Tshe/ Vaov/ Pomu				14	14	44		28					14	86		
Tshe/ Acci/ Cr	13	13		24	13	13		24			13		61	13	13	
Tshe/ Bene / Trla2				28	28	28	16						29	42	29	
Tshe/ Pomu-Adpe	14				13	30	13	30				74	13			13
Tshe/ Vame/ Xete	19	14	5	14	19	24	5						33	48	19	
Tshe-Abpr/ Vame/ Crcr	14	5		5	5	10	37	24				10	20	55	10	5

Plant Community	Slope Percent							Slope Position					
	0-5	6-15	16-30	31-50	51-70	71-85	86-95	96+	Top	Upper 1/3	Middle 1/3	Bottom 1/3	Bottom
Tshe-Pisi/ Opho/ Atfif	5	19	48	19	9				5	42	19	29	5
Tshe-Pisi/ Gash/ Blsp	10	21	21	16	26	6			6	52	16	26	
Tshe-Abam/ Gash/ Tiun	12			13	25	25		25	13	61	13	13	
Tshe-Abam/ Vaov/ Oxor			9	15	15	43	9	9		37	37	15	11
Tshe-Abam/ Rhma/ Coca	25	25	25	25					25	50	25		
Tshe/ Vaov/ Pomu		14	14	44	28					58	28	14	
Tshe/ Acci/ Cr	13	13	13	24	24	13			13	50	24	13	
Tshe/ Bene/ Trla2				28	58	14				71	29		
Tshe/ Pomu/ Adpe		30	44	13		13				57	13	30	
Tshe/ Vame/ Xete			14	14	48	19	5		5	38	38	19	
Tshe-Abpr/ Vame/ Crcr		14	33	29	19		5		15	65	20		

Plant Community	Microrelief				Percent bare ground						Percent rock					
	Uniform convex	Uniform flat	Uniform concave	Pit and Mound	0	1-20	21-40	41-60	61-80	81+	0	1-20	21-40	41-60	61-80	81+
Tshe-Pisi/ Opho/ Atfif	24	35	17	24	78	22					83	17				
Tshe-Pisi/ Gash/ Blsp	16	47	37		83	17					92	8				
Tshe-Abam/ Gash/ Tiun	25	25	50			100						62	38			
Tshe-Abam/ Vaov/ Oxor		15	70	15	15	70	15				31	54	15			
Tshe-Abam/ Rhma/ Coca	25	50	25		100						75	25				
Tshe/ Vaov/ Pomu	44	28	14	14	71	29					57	43				
Tshe/ Acci/ Cr	24	63		13		50	50				100					
Tshe/ Bene / Trla2	14	58	14	14	50	50					25	75				
Tshe/ Pomu- Adpe		44	12	44	88	12					100					
Tshe/ Vame/ Xete	10	38	26	26	62	38					21	69	5	5		
Tshe-Abpr / Vame/ Crcr	19	62	19		86	14					76	14	10			

Plant Community	Percent Litter						Fire scars		Soil Profile Charcoal	
	0	1-20	21-40	41-60	61-80	81+	Yes	No	Yes	No
Tshe-Pisi/ Opho/ Atfif		75	19	6			57	43	41	59
Tshe-Pisi/ Gash/ Blsp		75	25				11	89	35	65
Tshe-Abam/ Gash/ Tiun		87	13					100	50	50
Tshe-Abam/ Vaov/ Oxor		54	23	23			8	92	45	55
Tshe-Abam/ Rhma/ Coca		75		25				100	25	75
Tshe/ Vaov/ Pomu		71	29				14	86	71	29
Tshe/ Acci/ Crcr		100					25	75	75	25
Tshe/ Bene/ Trla2		50			25	25		100	17	83
Tshe/ Pomu-Adpe		88	12				74	26	60	40
Tshe/ Vame/ Xete		57	23	5	5	10	10	90	68	32
Tshe-Abpr/ Vame/ Crcr		35	10	30	10	15	19	81	68	32

APPENDIX V

Descriptions of typical profiles of soil series identified in the study area

Astoria Soil Series

Stand No. 10

01	3-0"	Matted litter composed of partially decomposed leaves and twigs, predominantly from coniferous species.
A1	0-6"	Black (10 YR 2/1, dry) to very dark brown (10 YR 2/3, moist) silt loam; strong, fine to very fine granular structure; friable, slightly sticky, slightly plastic; numerous roots; no pea stones and no cherty sedimentary rocks; very strongly acid (pH 4.3); wavy boundary.
A3	6-13"	Very dark brown (10 YR 2/2, dry) to yellowish brown (10 YR 5/4, moist) silty clay loam; weak, medium subangular blocky structure; friable, slightly sticky and slightly plastic; roots common, no pea stones and cherty sedimentary rocks; very strongly acid (pH 4.3); wavy lower boundary.
B21	13-36"	Very dark grayish brown (10 YR 3/2, dry) to yellowish brown (10 YR 5/4, moist) silty clay loam; moderate, fine subangular blocky structure; sticky and plastic; roots common; no pea stones and no cherty sedimentary rocks; strongly acid (pH 4.7).
B22	36-60"	Yellowish brown (10 YR 5/4, dry) to very pale brown (10 YR 7/4, moist) silty clay loam; medium blocky structure; firm, sticky and plastic; few roots, no pea stones and no cherty sedimentary rocks; strongly acid (pH 5.2); gradual, wavy boundary.
B3	60"+	Yellowish brown (10 YR 5/6, dry) to very pale brown (10 YR 7/4, moist) silty clay; moderate, medium blocky structure; firm, sticky and plastic, few roots; no stones; strongly acid (pH 4.9).

Trask Soil Series

Stand No. 125

01	2-0"	Plant material, predominantly from coniferous plants.
A1	0-10"	Grayish brown (10 YR 5/2, dry) to very dark gray (10 YR 3/1, moist) silt loam, very fine granular structure; friable, nonsticky and nonplastic; no coarse fragments; many fine roots; very strongly acid (pH 4.9); gradual boundary.
A3	10-14"	Brown (10 YR 5/3, dry) to dark grayish brown (10 YR 4/2, moist) silt loam, strong, fine granular structure, slightly sticky and slightly plastic; six percent coarse fragment by weight; many roots; very strongly acid (pH 4.8); irregular boundary.
B2	14-17"+	Very pale brown (10 YR 7/4, dry) to yellowish brown (10 YR 5/4, moist) silt loam, weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; 35 percent coarse shale fragments; very strongly acid (pH 4.8).

Hembre Soil Series

Stand No. 64

01	4-0"	Matted litter of needles and twigs predominantly from coniferous species.
A1	0-7"	Dark brown (7.5 YR 4/4, dry) to dark reddish brown (5 YR 3/3, moist) silt loam, strong, fine granular structure; friable, slightly sticky and slightly plastic; five percent medium shot; many roots; strongly acid (pH 5.0); gradual boundary.
A3	7-13"	Strong brown (7.5 YR 5/6, dry) to dark reddish brown (5 YR 3/4, moist) silt loam, strong, fine granular structure; friable, slightly sticky and slightly plastic; ten percent medium shot; numerous roots; strongly acid (pH 5.3); gradual boundary.
B21	13-24"	Strong brown (7.5 YR 5/6, dry) to reddish brown (5 YR 4/4, moist) loam, weak, fine subangular blocky structure; friable, slightly sticky and slightly plastic; 40 percent shot; many roots; very strongly acid (pH 4.9); irregular, gradual boundary.
B22	24-30"+	Yellow (10 YR 7/6, dry) to strong brown (7.5 YR 5/6, moist) loam, weak, medium subangular blocky structure; slightly sticky and slightly plastic; 60 percent coarse fragments; few roots; strongly acid (pH 5.1).

Klickitat Soil Series

Stand No. 69

01	5-0"	Fresh and partially decomposed conifer needles, twigs, and mosses.
A1	0-6"	Dark brown (7.5 YR 4/4, dry) to dark reddish brown (5 YR 3/4, moist) gravelly loam; strong medium granular structure; friable nonsticky and slightly plastic; 30 percent fine gravel; roots numerous; very strongly acid (pH 4.4); wavy boundary.
B1	6-10"	Dark brown (7.5 YR 4/4, dry) to dark reddish brown (5 YR 3/4, moist) gravelly sandy loam; moderate fine subangular blocky, friable, nonsticky and slightly plastic; 47 percent fine gravel; roots common; very strongly acid (pH 4.8); gradual boundary.
B21	10-25"	Strong brown (7.5 YR 5/6, dry) to dark reddish brown (5 YR 3/3, moist) gravelly sandy loam; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; 63 percent gravel; roots common; strongly acid (pH 5.3); gradual wavy boundary.
B22	25-33"	Yellowish brown (10 YR 5/8, dry) to yellowish red (5 YR 4/6, moist) gravelly sandy loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; 60 percent gravel and stones; few roots; strongly acid (pH 5.4); gradual boundary.
B3	33-37"+	Dark yellowish brown (10 YR 4/4, dry) to yellowish red (5 YR 4/6, moist) gravelly clay loam; massive, breaking to coarse subangular blocky structure; hard, slightly sticky and slightly plastic; 40 percent gravel and stones; few roots; strongly acid (pH 5.8).

Kilchis Soil Series

Stand No. 63

01	4-0"	Litter composed of fresh and partially decomposed materials, predominantly of coniferous species origin.
A	0-6"	Reddish brown (5 YR 4/4, dry) to dark reddish brown (5 YR 3/3, moist) silt loam, moderate, very fine granular structure; friable, nonsticky and nonplastic; 30 percent of weight composed of angular rock; strongly acid (pH 5.1); gradual boundary.
AC	6-15"	Reddish yellow (7.5 YR 6/6, dry) to dark brown (7.5 YR 4/4, moist) silt loam, strong, very fine granular structure; friable, nonsticky and nonplastic; 55 percent of weight composed of angular rock; very strongly acid (pH 4.9); gradual boundary.
C	15-19"+	Brownish yellow (10 YR 6/6, dry) to dark yellowish brown (10 YR 4/4, moist) silt loam, weak, fine granular structure; very friable, nonsticky and nonplastic; 78 percent of weight composed of angular rock fragments; very strongly acid (pH 4.9).