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# FIELD GUIDE **for** FORESTED PLANT ASSOCIATIONS **of the** WENATCHEE NATIONAL FOREST

Terry R. Lillybridge, Bernard L. Kovalchik,
Clinton K. Williams, Bradley G. Smith

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In cooperation with:
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# ABSTRACT

Lillybridge, T.R.; Kovalchik, B.L.; Williams C.K.; Smith, B.G. 1995. Field guide for forested plant associations of the Wenatchee National Forest. Gen. Tech. Rep. PNW-GTR-359. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 335 p. In cooperation with: Pacific Northwest Region, Wenatchee National Forest.

A classification of forest vegetation is presented for the Wenatchee National Forest (NF). It is based on potential vegetation, with the plant association as the basic unit. The sample includes about 570 intensive plots and 840 reconnaissance plots distributed across the Wenatchee National Forest and the southwest portion of the Okanogan National Forest from 1975 through 1994. The hierarchical classification includes 10 forest series and 104 types (plant association or community type). Diagnostic keys and descriptions are presented for each tree series and type. Detailed descriptions are given for each type having at least five sample stands in the Wenatchee NF. Those descriptions include information about plant species occurrences, type distribution, environment and soils, potential timber productivity, management considerations, and relationships to other classifications. Brief descriptions are presented for miscellaneous types (those having fewer than five plots in the Wenatchee NF).

Keywords: Vegetation classification, plant community—climax, plant association, vegetation series, forest ecology, forest environment, Cascade Range, community type, Eastern Washington.

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# INTRODUCTION

In 1967, F.C. Hall noted that "management of non-arable lands (forest and rangelands) is primarily concerned with deriving products from the natural vegetation." These products may be wood for pulp and lumber, but they may also be recreation in the form of a campsite setting, forage for livestock, or clean water. In 1978, C.K. Williams wrote, "Management of natural resources on range and forested lands has become increasingly critical as a result of greater resource needs and increased public awareness. Nowhere is this more evident than in the management of public lands." This is still true. Hall also pointed out in 1967, "as resource management intensifies, knowledge about vegetation must increase."

This Guide is a tool for one overriding purpose: to better conserve and manage the land and resources for which the USDA Forest Service is the responsible public agency. Crucial to this efficient management is making the forest vegetative continuum comprehensible by taking an innumerable number of stands and classifying them into a relatively few plant communities, designated by forest cover (trees and shrubs), but characterized by environmental conditions important for vegetation establishment and growth. While some forest cover type and site classifications presented over the years have been found inadequate to answer many questions being asked by resource managers today, we think the system this Guide uses to classify forest lands works well to provide a means to better understand and manage the Forest's ecosystems. It will help in both long-term planning and shorter-term implementation of large and small projects.

In physical terms, the Guide presents defined, observable types in a classification for the whole Forest, data supporting the classification, and a systematic procedure for identifying the types. Using it allows us to:

(1) Plan management strategies - evaluate resource conditions and productivity and anticipate responses to change;

(2) Communicate - provide a common description of forest conditions for various disciplines and record successes or failures of management actions; and,

(3) Apply research - organize research and data and provide a direct link between research results and practical land management.

The Guide addresses the issues that concerned Hall in 1967 and Williams in 1978, and others besides them: the necessary management of public lands and the need, in order to sensibly do that, for better understanding of the complex ecosystems that make up our National Forests.

## OBJECTIVES AND CONSTRAINTS

The recurrence of similar plant assemblages across a forest can be used to classify the landscape (Daubenmire 1976; Pfister and others 1977). We classify a complex, continuous landscape by organizing it into a few discrete vegetation classes in order to reduce that complexity to a manageable system. [Whether plant associations actually occur as discrete entities has been a subject of considerable debate (Daubenmire 1966; Cottam & Mcintosh 1966). In this Guide the approach has been adopted that even if a vegetation continuum exists, it must still be divided to make it comprehensible.]

The Guide is the result of many years of field and office work, of collection, analysis and interpretation of data about the Forest. The objectives were to:

(1) develop an upland forest vegetation classification based on relatively stable plant communities (associations);

(2) collect adequate data to characterize the physical attributes of each plant association, including soils, slope, aspect, microrelief and landform;

(3) determine and present estimates of site productivity for each association; and,
(4) document the effects of disturbance where possible, and make management recommendations for each association.

Time, monies and staffing dictated that initial work be concentrated on commercial forest lands where management impacts are the greatest. Little work was done in non-commercial forest lands, non-forest, riparian, or roadless areas. This does not mean these other areas were not of concern. They will be classified later. Tree productivity estimates by plant association were needed, and this was to be an important part in the classification development process.

Some additional conditions are worth noting. The types in this classification (i.e., Associations or Community Types) may not fully reflect sites and conditions on elevations below those normally included in National Forest lands. Also, one important constraint on producing the classification and Guide was that classification units must be identifiable by field personnel with a minimum of training.

## CLASSIFICATION CONCEPTS AND DEFINITIONS

Development of classes involves abstraction in that any mixture of attributes or features could be chosen as distinctive for them, or for their members, and members can be grouped in many different classes. This is especially true when classifying something continuous, such as landscapes, vegetation or weather. Also, as the purpose of a classification changes, so may its composition. Classification can be even less exact when dealing with multiple features whose occurrences overlap.

However, a well-designed, meaningful classification is an efficient tool. Defining types provides "pigeon holes" where new members and information about the types and their members can be placed. This makes a classification system both an information storage and retrieval system. New information is put where it belongs and stored information can be found. In addition, a classification forms a framework connecting its types. Ideally, this framework shows relationships of types to the whole and to each other. Thus, new information is generated.

The plant community classification in this Guide groups many stands in the Forest into a relatively few types, based on their climax species. The types are characterized by the environmental factors vegetation responds to on a site. Plant communities having stable composition after a relatively long period free of disturbance have manifested their ability to compete. These communities represent the "climax" plant community (Tansley 1935) and are termed plant Associations. As defined, each of them is a conceptual abstraction, but on a practical level each is a useful reference point for plant succession on a site and is an indicator of a particular environment. Whether this climax community will ever develop is immaterial. What is important is that the Association provides a conceptual end-point and gives an indication of the direction of succession in a closed stand.

Though not all questions about a piece of land can be answered by a plant community classification (Hemstrom and others 1982), vegetation, soils and other physical characteristics of an area can usefully indicate its future species composition, its productivity potential, and its probable responses to management actions.

The concept of a climax dominant tree series is normally used in the same sense as Daubenmire (1968), where all Associations capable of supporting a given climax tree species form a Series.

Series are taxonomic units (Henderson and others 1992). A series is typically named for the most shade-tolerant tree species capable of reproducing itself. The series concept is useful even though it may be difficult to apply in some instances. For instance, it is meaningful to discuss the Subalpine Fir Series as distinct from the Douglas-fir Series because of important differences in environments and plant associations each contains. A single species name is used to name each series, but be aware that single species dominance in a series may be an exception rather than a rule. Also, current stand dominants, particularly in younger stands, are often of minor value in determining the series.

Community Type is applied to plant communities where climax status is unknown or cannot be reasonably inferred. Both plant associations and community types as defined above fall within the more general term "potential natural vegetation." The term "type" is used for either Association or Community Type.

Another term used in the guide is "vegetation zone," sometimes as if it were synonymous with "series." "The vegetation zone is a similar concept [to series], except that it refers to the land area where a particular series occurs." (Henderson and others 1992) Daubenmire (1968) used "association" as the climax plant community and "habitat type" as the land area that supports or may support a particular plant association. This terminology has been employed in many parts of the west. (See Pfister and others 1977; Cooper and others 1991; Steele and others 1981; Clausnitzer and Zamora 1987; Hoffman and Alexander 1976.) This would be acceptable except that biologists often use "habitat type" to mean types of habitat used by wildlife. To avoid this confusion around the terms, this Guide uses, as stated above, Plant Association (e.g., QUGA/AGSP Association) for the climax or assumed climax plant community, and the land area it occupies the habitat or site, and habitat type is then used as defined by Daubenmire.

For additional terms used in this Guide, refer to the Glossary that precedes the Appendices.

# METHODS

## Field Methods

Reconnaissance sampling of the Wenatchee National Forest (NF) took place in 1977-1979, intensive sampling in 1984-1986. A total of 705 reconnaissance and 523 intensive plots form the main database for this report, but of these only 619 reconnaissance and 499 intensive plots were actually classified. Continued sampling has occurred in recent years as part of the efforts to develop non-forest and riparian classifications and a Potential Natural Vegetation (PNV) model. Although these PNV, non-forest, and riparian data were generally not ready for analysis, 98 plots from their data sets were gleaned and used to augment plant associations, primarily at high elevations. The present classification incorporates some 85 intensive and 123 reconnaissance samples from the Methow Valley that were originally used to develop an Okanogan NF classification. Thus, the data for the classification presented in this Field Guide derive from 1424 plots from all sources.

The Wenatchee NF administers approximately 2,657,000 acres. Sampling intensity therefore is about 1 plot for every 1,900 acres. In comparison, the Daubenmires' (1968) sampling intensity, as reported by Cooper and others (1987), was about 1 plot for every 128,000 acres. The Forest estimates are based on the total administered acres with no deductions for non-forested lands.

The northern third of the Wenatchee NF (the Entiat and Chelan Districts), and wilderness and other roadless areas, were sampled lightly, if at all. Much of the roaded portions of these districts burned in the 1970s, so mature stands were largely unavailable for sampling. This left large gaps in our data, which were filled somewhat by using Okanogan NF plots mentioned above and further described under Office Methods, following.

Because of the large size of the Forest, it was first sampled with a reconnaissance technique. This developed familiarity with vegetation patterns and variability, and was used to develop preliminary plant community groups in order to plan intensive sampling. Reconnaissance sampling methods were were adapted from Franklin and others (1970), Pfister and others (1977), and Williams (1978). Sample sites were 375-square-meter circular plots, following Pfister and others. Plots were selected "subjectively without preconceived bias" (Mueller-Dombois and Ellenberg 1974) because random or systematic sampling techniques were rejected as too time consuming and inefficient. Plots were within homogeneous stands with uniform undergrowth and apparent lack of recent disturbance. To reduce travel time, most of them were near roads. All were marked with aluminum tags to aid finding them again. Reconnaissance data included information on slope, aspect, elevation, slope position, slope shape, notes about the sample plot, and a geographic location narrative. Slope positions were recorded as: ridgetop or saddle; upper, middle or lower third of slope; bench, narrow flat; toe of slope; canyon bottom; edge of or in a basin or wetland; or, draw, intermittent stream bottom. Slope shapes were noted as convex, flat, concave or undulating. In order to estimate surface soil coarse fragments, a shallow soil pit was excavated on all but the first one hundred samples.

A list of all vascular plants was made within the circular plot, and a value for foliar cover or a cover dominance rating was estimated for herbs, shrubs, tree understory and tree overstory, by species. For understory plants, a dominance rating was used for values under 10%, but for values above 10%, actual foliar cover was estimated to the nearest 5%. In these samples, "trace" amounts were not used: the minimum cover recorded was 1% whether a species actually had 1% cover or not. Cover by species in a vegetation layer (tree overstory, tree understory, shrubs, and herbs) was estimated independently. Tree coverage information was subdivided into mature and decadent categories in the tree overstory, and in the understory by pole size (>12 feet in height) and young trees.

Intensive plot data for the most part included everything taken on reconnaissance plots, plus additional tree and stand measurements. Individual tree measurements for five individuals of each tree species, if available in the stand, included: tree height; diameter and age at breast height; basal area around each tree; sapwood thickness; and, diameter growth rate. Average stand basal areas were determined by averaging prism counts at several points in the plot, and herbage production by using a double sampling technique. Data on snags and logs were recorded, including height or length, species, diameter, and decay class. Observations on fire scars, wildlife and general stand conditions were also made. Approximately the first 20% of the intensive plots (mainly on the Cle Elum District) had a complete soil description drawn from a sample pit at the plot center, but surface soil coarse fragment estimates were not made in all these, as was done in the reconnaissance sampling.

Floristic, snag and log data were taken using the same size plot as the reconnaissance plot (375 square meters), but tree data were taken with dimensionless (prism) plot techniques. Sampled trees could be outside the floristic plot, but all had to be within the plant community the sample was designed to characterize.

All intensive plots were marked with tags: two on a tree near plot center and two on a tree at the road edge nearest the plot, with one tag at the base and one at breast height. Additionally, all trees sampled for tree growth information were tagged at the base so that the tag faced plot center. A cedar stake was put at plot center of intensive samples. Reconnaissance plots were marked at breast height with one tag on the nearest tree to plot center and one tag on a tree at the nearest road. All tags were 4-inch-square aluminum.

## Office Methods

Data were entered into a computer at the end of each field season and analyzed. Computer programs used in data analysis included synthesis tables, similarity index, cluster analysis, discriminant analysis (Volland and Connelly 1978), two-way indicator species analysis [TWINSPAN] (Hill 1979b), de-trended correspondence analysis [DECORANA] (HILL 1979a), and ZPLOT (Brad Smith personal communication). Synthesis tables and DECORANA were used most.

Initial groups were segregated using climax tree series. Secondary subdivisions were made within each tree series by identifying shrubs and herbs which by their presence or dominance suggested meaningful vegetation patterns. These floristic units were examined for consistency in environmental characteristics and productivity estimates. If the floristic pattern appeared related to consistent environmental and productivity characteristics, then the type (association or community type) was described.

The following indices were determined from the intensive data: Site Index to estimate height growth; Growth Basal Area [GBA] (Hall 1983) to estimate stockability; and, Stand Density Index [SDI] (Reineke 1933) to estimate stand densities. Cubic feet per year productivity estimates were calculated using a combination of Site Index and Growth Basal Area (Hall, personal communication). Clipped herbage was air-dried and weighed to estimate herbage production in pounds per acre. All these techniques have limitations, but because they were applied consistently to each plot, they provide a reasonable means of comparing plots or associations. They are, however, not directly comparable to estimates based on other methods or indices.

Many, if not all, site index curves appear to poorly fit stands here. The site curves used were selected with care in 1988 as the best available for the area. They are noted in the "Productivity Information" section to follow. Others may prefer tables and equations different from those we employed, so the intensive plot data from all 523 intensive plots are available as a computer file. This file includes individual tree measurements by species, snag and log. It is available from the Area II Ecologist or the Wenatchee Forest Ecologist. A computer program is also available that summarizes site index, GBA and radial increment by species, and SDI, total basal area, snags per acre and downed woody material by tons per acre.

The Wenatchee Draft field classification was distributed for use and review in 1991. More recent analysis in 1995 has led to a revision of the classification and to this 1995 version of the Field Guide. To provide a reasonable classification for the largely unsampled Entiat and Chelan Districts, the gaps in data mentioned in the Field Methods section, Okanogan NF data from the vicinity of its Twisp District have been added to the WNF database for analysis and revision of the Ponderosa Pine, Douglas-fir and Subalpine Fir Series. In addition, more recent data from high-elevation forest of the Okanogan Cascades and from the Naches and Lake Wenatchee Districts were used to supplement earlier meager upper elevation Wenatchee NF data. This significantly increased plot numbers and has resulted in a more extensive list of plant associations for the timberline zone (see the Subalpine Larch, Whitebark Pine, Subalpine Fir and Mountain Hemlock Series).

## VEGETATION OVERVIEW

Vegetation patterns on the Wenatchee National Forest differ from elsewhere in Eastern Washington. Table 1 illustrates the difference in occurrence of major coniferous tree zones on the three National Forests in Eastern Washington.

The crest of the Cascade Mountains is a major ecological border that is apparent to even the most casual observer. The east to west transition from intense rain shadow to moist maritime conditions is a major influence on plant species and community distribution. The rain shadow effects cause a great variation in the amount of precipitation across the Forest (Fig. 1) and also result in rapid climatic changes in relatively short distances. For example, mean annual precipitation is under 10 inches in Wenatchee while only 40 miles away at Stevens Pass it is about 80 inches. As a result, the vegetation around Wenatchee is largely shrub-steppe while Stevens Pass lies in mountain hemlock and silver fir zones. Distance east of the Cascade Crest and the relative height and width of the mountains also greatly influence climatic patterns, and hence influence distribution in the Forest of some of the major tree species, such as Pacific silver fir, mountain hemlock, western hemlock and western redcedar. The geology of the Forest is complex as well, and this also greatly influences the pattern of plant community development. David Alt and Donald Hyndman present non-technical descriptions of state geology in *Roadside*

*Geology of Washington* (1984). Furthermore, Not only is there considerable east-west variation in climate, geology and vegetation, there is also noticeable change north to south.

Based on geology and climate patterns, the Wenatchee NF is divided into three major ecological regions. One includes the area north of Entiat that Alt and Hyndman term "Chelan Terrain." From the Entiat fault it extends to the Methow Valley. Part of the ancient North Cascades subcontinent, the mountains are generally higher and wider here than they are farther south. A combination of both continental and mountain glaciation helped shape the landcape, so slopes are often steeper and mountain summits more jagged and angular. Volcanic ash deposits are variable and somewhat more coarse than those found to the east. Granitic and metamorphic rocks predominate.

This northern area has steep climatic gradients within the Cascade's strong rain shadow. Summers are notable for extended periods without rain. Relatively xeric and cold forest types predominate, with Douglas-fir, subalpine fir and ponderosa pine as major climax species. Both subalpine larch and whitebark pine form extensive zones as forests approach timberline. Silver fir and mountain hemlock are restricted to a narrow maritime zone that lies close to the Crest and extends only a few miles eastward along major east-west ridges and drainages. Other important species here include lodgepole pine and Engelmann spruce. Mesic species such as western hemlock, western redcedar, western larch and grand fir are minor forest components or are absent.

Much of the Lake Wenatchee District is within what is known as the Chiwaukum Graben. (A graben is a long sunken area between two parallel geologic faults.) Its vegetation patterns are different from most of the rest of the area north of Entiat.

A second region extends south of the Entiat fault to a line formed approximately by the Yakima River to Ellensburg. This area is typified by complex geologic parent materials ranging from highly acidic granitic rock types to ultrabasic serpentine materials. Extensive areas have marine sandstones. Mountain glaciation was extensive, but most of the region is outside the area covered by the continental ice sheet. Consequently, slopes are often steep and long. Ponderosa pine, Douglas-fir, grand fir and subalpine fir form major forest zones on the drier east side of this area, whereas Pacific silver fir, mountain hemlock, western hemlock and western redcedar form prominent forest zones in the maritime areas to the west. Again, subalpine larch and whitebark pine form prominent zones as forests approach timberline. Other locally important species include lodgepole pine, western larch and Engelmann spruce. This area was also part of the old North Cascades subcontinent, but here the Cascades are lower in average elevation and narrower in average width than in the area to the north, so the rain shadow effect, though still important, is less intense. Relatively mesic forests of Pacific silver fir, western hemlock or grand fir are more extensive than to the north.

The last region extends from the Ellensburg area south to the Yakima Indian Reservation. It is typified by steep climatic gradients and extensive areas of complex extrusive volcanic deposits. Mountain glaciation was extensive and continental glaciation absent. Vegetation patterns respond to climate in a manner similar to the adjacent area to the north, although maritime zones are less extensive here because there are fewer low mountain pass corridors. Ponderosa pine, Douglas-fir, grand fir and subalpine fir form major forest zones on the drier east side of this area, whereas Pacific silver fir, mountain hemlock, Alaska yellow cedar, western hemlock and western redcedar form prominent forest zones in the maritime areas to the west. Although subalpine larch is absent, whitebark pine forms a prominent zone as forests approach timberline. Other species important locally include lodgepole pine and Engelmann spruce. The Cascades are relatively low in total elevation here (excluding the major volcanos) and even narrower in total width than areas farther north. Therefore, mesic forests extend relatively far east of the Crest. Basalt and andesite flows are common, resulting in long, gently sloping ridges with steep, dissected side slopes.

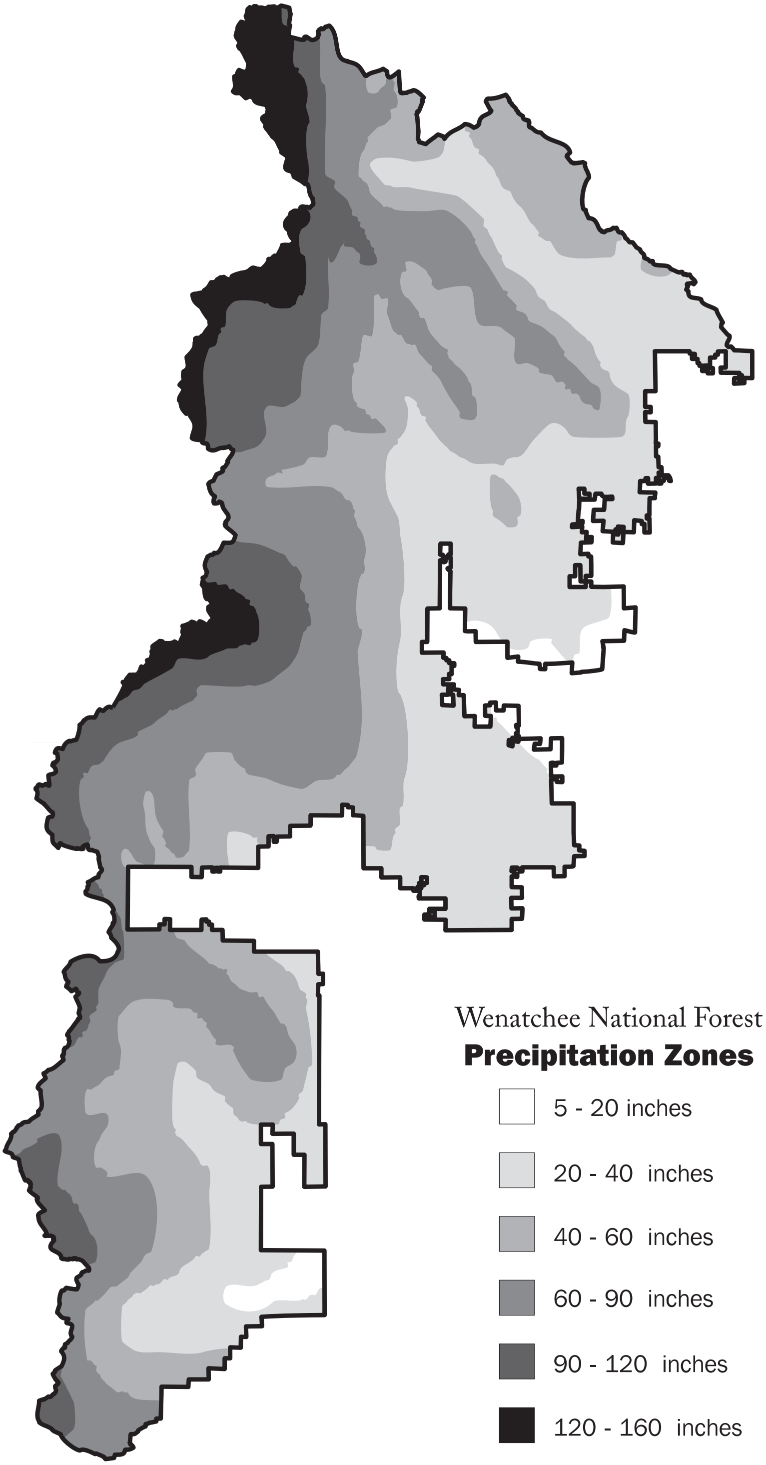



**Figure 1:** Mean annual precipitation for the Wenatchee National Forest (approximate).

## Plant Succession

A simple definition of plant succession is the natural replacement in an area of one species or community by another over time. It is generally a somewhat orderly and predictable process for a specific location. However, it can and does vary according to a multitude of factors, including soils, climate, previous vegetation, adjoining vegetation, type and magnitude of disturbance, and history of use. Traditionally, succession has been termed "primary" or "secondary." Primary succession deals with the development of vegetation on sites that have not previously supported plants and have no soil. Examples are strip mine spoils and bare rock. Managers commonly deal with secondary succession, development of vegetation on sites that already have supported plants and where soils already exist.

**TABLE 1.** Importance of eleven upland forest tree zones in three National Forests in Eastern Washington.

| | NATIONAL FOREST | | |
|---|---|---|---|
| **ZONE**[1] | **Colville** | **Wenatchee** | **Okanogan** |
| Oregon white oak | — | minor | — |
| Ponderosa pine | minor[2] | MAJOR[2] | minor |
| Douglas-fir | MAJOR | MAJOR | MAJOR |
| Grand fir | minor | MAJOR | — |
| Western redcedar | MAJOR | minor | minor |
| Western hemlock | MAJOR | MAJOR | minor |
| Pacific silver fir | — | MAJOR | minor |
| Mountain hemlock | — | MAJOR | minor |
| Subalpine fir | MAJOR | MAJOR | MAJOR |
| Whitebark pine | minor | MAJOR | MAJOR |
| Subalpine larch | — | MAJOR | MAJOR |

1 A zone is the area in which a single tree species is potentially dominant (Franklin and Dyrness 1973).

2 "MAJOR" and "minor" refer to importance in terms of occurrence of the zone in the Forest.

Much of secondary succession concerns the interaction of plants between and among themselves. Tolerance to shade, competition, and various forms of disturbance are major considerations. Table 2 ranks 14 trees according to their shade and fire tolerance, from highest to lowest, e.g., western hemlock is judged to be slightly more shade tolerant than is Pacific silver fir and so forth. Rank in Table 2 is approximate but the general order is correct.

Species more tolerant of shade will normally out-compete intolerant species in closed stands. Tolerant species often require more favorable site conditions in terms of soils and climate than do intolerant species. In part, intolerant species are favored by conditions in early succession, where rapid establishment and early growth are important survival mechanisms. Tolerant species are better at competing with other plants for light, moisture and nutrients than are intolerant species. Fire tolerant species are those with adaptations that make them more likely to survive fire (such as thick bark or flame-resistant foliage).

**TABLE 2.** Comparative autecological characteristics of selected Wenatchee National Forest conifers. Data are compiled from various literature sources (mainly Minore 1979) and field observations.

| Species | Shade Tolerance[1] | Frost Tolerance[2] | Drought Tolerance[2] | Snow Damage Resistance[2] | Fire Resistance[2] | Root Rot Resistance[2] | Seed Weight[2] | Seed Crop Frequency[2] |
|---|---|---|---|---|---|---|---|---|
| ABAM | VT | M | L | M | L | L | M | M |
| ABGR | T | M | M | M | M | L | M | M |
| ABLA2 | T | M | L | H | L | L | M | M |
| ABPR | I | M | L | H | L | M | M | M |
| CHNO | T | L | L | H | L | M | L | L |
| LAOC | VIT | M | M | M | H | M | L | L |
| LALY | VIT | H | L | H | L | U | L | L |
| QUGA | IT | L | H | L | H | H | H | M |
| PIEN | T | H | L | H | L | M | L | M |
| PIAL | VIT | H | H | H | L | U | H | M |
| PICO | IT | H | M | M | L | M | M | H |
| PIMO | I | H | M | M | M | M | M | H |
| PIPO | IT | L | H | L | H | H | H | L |
| PSME | I | L | M | L | H | L | M | M |
| TSHE | VT | L | L | H | L | M | L | M |
| TSME | T | H | L | H | L | M | L | L |
| THPL | VT | L | L | M | L | L | L | H |

[1] VT - Very Tolerant; T - Tolerant; I - Intermediate; IT - Intolerant; VIT - Very Intolerant
[2] H - High; M - Moderate; L - Low; U - Unknown.

"Ecological amplitude defines a species' ability to compete and grow in the variety of environments and plant communities in which it can reproduce" (Hall and Martinez 1995). This is an important concept in succession because the success of a species is dependent on its ability to compete. Since we are identifying series by their climax species, environmental amplitude is important to consider in classifying development on a site. For example, accidental species are often at the "critical" end of their amplitude and will not be successful over time. Also, when determining a tree series, competitive ability of the tree appearing most tolerant on a site may not determine the climax tree if the tolerant tree is at the edge of its amplitude. Species at the edge of their environmental amplitude may not be as shade tolerant, grow as fast, reproduce as well, and so on, as they will in the middle of their amplitude.

Factors other than shade and fire tolerance are important also. Resistance to diseases, animals, insects and mechanical damage, annual heat and water budgets, and allelopathy (chemical warfare by other plants) are just some of the factors important in determining the range and development of a species. They are less well understood, however, and are therefore less helpful in determining plant succession.

Allelopathy is an interesting process wherein chemicals exuded by plants directly or indirectly inhibit or prevent the development of other plants. Engelmann spruce has been shown to limit survival and growth of other plants (including itself) using chemicals leached from the litter. Lodgepole pine is especially sensitive to Engelmann spruce leachates (Taylor and Shaw 1982). Recent work in northern Idaho suggests that some non-forested openings may be partially or wholly the result of bracken fern inhibiting conifer regeneration.

Appendix D displays the fire resistant adaptions of selected shrubs and herbs. It and Table 2 provide much useful information for predicting vegetation response to events such as a fire. By providing information on reproductive strategies, they can also be used to interpret effects of various activities such as logging.

The distribution of trees and other plants is determined by their ability to compete on sites where they become established. Just as individual plants have limited distributions and can indicate site characteristics, so can certain plant assemblages. Significant differences in successional patterns exist between climax tree Series, between Associations, and even between different stands of an Association. Information about succession, and the distribution of plant associations and the site characteristics they indicate, are discussed in the Series and individual Association descriptions in the following section.

The preceding discussion is intended to explain, at least in part, the process of plant succession and how plants and plant assemblages can be used to identify some environmental features. The forest community we see is extremely diverse, complex and interrelated. "With respect to science we must never forget that nature is not more complex than we think but more complex than we can think. The problem is not with science but with the scientist" (Egler 1977).

# USING THIS GUIDE

This guide can be used for all of the Wenatchee National Forest. It should also apply to the Twisp River drainage and the lower Methow Valley in the southwestern portion of the Okanogan National Forest. Field use will determine whether the classification will work better than the previous one for all of the Okanogan NF west of the Okanogan River (see Williams and Lillybridge 1983).

## Naming Conventions and Plant Identification:

Common names for plant species are used in the text and in most tables. Often, the capital letter codes are included as well, although due to space limitations, these codes are used alone for species in some tables. The code is formed by taking the first two letters of each scientific name of a species. For example, PSME is the code for *Pseudotsuga menziesii*. If a code has a number, as in ABLA2, the number says the 4-letter code is shared by more than one species. If it has a fifth letter, as in SPBEL, it stands for a variety. These codes take less space, are better adapted to computer use, and help distinguish between species and Associations in the text. All codes follow Garrison and others (1976). Scientific names follow Hitchcock and Cronquist (1973). Common names follow either Garrison and others or Hitchcock and Cronquist. Common and scientific names and their codes are listed in Appendix A, alphabetically by code.

Plant Associations and Community Types are referred to in the text and tables by capitol letter codes. In Plant Association and Community Type names a slash (/) separates different plant lifeform categories (trees, shrubs and herbs), e.g., PSME/CARU (tree/shrub), and a dash (-) indicates members of the same category, e.g., PSME/CARU-AGSP (tree/herb-herb). Most type names are restricted to the major climax tree species and for brevity to the type's most indicative shrub or herb. Some longer names (three species) have been used for a third important species or to avoid confusion with types from other classifications.

The "official" association name codes and ecoclass codes are presented in the first part of each series section for all the types in the series. This "official" name code and ecoclass code also appears on the title page of each type narrative and in the table of contents; for example: PSME/AGSP wen CDG322. For brevity and readability in the text and tables, this type is shown as PSME/AGSP. Typically, types that have fewer than 5 plots on the Wenatchee, have received an abbreviated write-up, are deamed miscellaneous types and are denoted by an (m) after the type name code. For example, PSME/PUTR (m). Two types include o & c for the Okanogan and Colville; thus indicating the origin of those types.

The distinction between individuals clearly recognizable as "tall" or "shiny" Oregon grape (*Berberis aquifolium*) and those clearly identifiable as "creeping" Oregon grape (*B. repens*) is not clear in much of the survey material. They are lumped into just Oregon grape. Most plants appeared to fit *B. aquifolium* best, although there is considerable variation from plant to plant. Cascade Oregon grape (*B. nervosa*) was always recorded as such.

Alaska huckleberry (*Vaccinium alaskaense*) and oval-leaf huckleberry (*V. ovalifolium*) are morphologically similar species that occur in the study area and are easily confused. Most of the Wenatchee material seems to better fit Alaska huckleberry so we arbitrarily refer to all plants of this group as Alaska huckleberry.

Low huckleberry (*V. myrtillus*) appears at times to intergrade with both big (*V. membranaceum*) and grouse huckleberry (*V. scoparium*). However, the difference in indicator value of the species is most significant when grouse huckleberry is the only or the greatly predominant species, and then species identification is normally readily apparent.

Two groups of herbs have been especially difficult to identify in the field with confidence as to species. These are some *Balsamorhiza* species and several *Lupinus* species. The lupines have been a particularly vexing problem on the Forest. On the Naches District, and perhaps on districts farther north, there appears to be much intergradation between sulfur lupine (*Lupinus sulphureus* var. *subsaccatus*), spurred lupine (*L. laxiflorus* var. *pseudoparviflorus*), and tailcup lupine (*L. caudatus*). These plants appear to be wholly intergradient with each other and also appear to blend northward with the more clearly identifiable silky lupine (*L. sericeus*). Another lupine complex involves species indicative of more moist environments than the group mentioned above. Broadleaf lupine (*L. latifolius*), bigleaf lupine (*L. polyphyllus* var. *burkeii*) and Wyeth lupine (*L. wyethii*) are difficult to separate in the keys because of an inconsistent key character as to whether the flowering stems are branched at flower time. This character does not appear reliable and we tend to call all plants in this group broadleaf lupine.

On the Naches District and part of the Cle Elum District, the large, entire-leaved balsamroots (*Balsamorhiza*) are clearly not the arrowleaf balsamroot (*B. saggitata*) common on relatively dry sites over much of the rest of the Forest. These southern plants key more readily to Puget balsamroot (*B. deltoidea*) than to Carey balsamroot (*B. careyana*). However, Puget balsamroot is mentioned in the taxonomy as being found only in the Puget Sound area. We have labeled these plants Carey balsamroot because of this geographic restriction.

A book has been completed to assist in identifying indicator species: *Major Indicator Shrubs and Herbs on National Forests of Eastern Washington* by Williams and Lillybridge, 1987, USDA Forest Service (R6-TM-TP-304-87). It has color plates, line drawings and descriptions. Though currently out of print, it should be available in most Forest Service offices. A draft photocopy of *Some Common Plants of the Wenatchee National Forest*, by Williams and Lillybridge (1986), with descriptions and line drawings, is still available through the Forest Ecologist on the Wenatchee National Forest (phone: 509-662-4335).

## Series and Association Descriptions

This vegetation guide is organized ecologically by series, with the lowest and warmest series first and the highest and coldest series last. The series order is Oregon white oak, ponderosa pine, Douglas-fir, grand fir, western hemlock, Pacific silver fir, mountain hemlock, subalpine fir, whitebark pine and subalpine larch. Within each series, association descriptions are alphabetically arranged by scientific name code, e.g., ABGR/ACCI is before ABGR/BENE.

The sections for each series contain a series narrative, a key to associations within the series, a table of productivity information, and a list of plant association groups (PAGs), plant associations and ecoclass codes. Series narratives include: “Distribution and Environment”; “Vegetation”; “Productivity/Management”; and, “Relationship to Other Classifications.”

Constancy and Cover are terms used in the Series and Association narratives and in various tables throughout the guide. Table 3 and Appendix D are valuable tables that display the cover and constancy of many important plants by series or type. In all tables this list is necessarily short due to space contraints. Abbreviated “CON,” constancy is the percentage occurrence of a species in the plots used to describe a particular association. Abbreviated "COV" in many tables, cover indicates the arithmetic average of foliar cover of a species. All cover values presented are relative or "characteristic" cover, which is the arithmetic average of cover values relative to the number of plots in which that species occurs. For example, if a species was found in only five of the ten plots representative of an association, the relative cover value would be that for the five plots where it was found, rather than the absolute average across all ten plots, and the constancy would be 50%. Constancy of 100% indicates a species occurred in every plot representative of the association.

Each Association description is presented on two facing pages. Each code title is followed by its ecoclass code. On the left page is a table presenting physical Environment attributes of elevation, aspect, slope, slope position and, in most cases, special notes. Generally, the range and mean are presented for continuous variables (e.g., elevation) while summary statements are made about discrete variables (e.g., slope position). Upper, middle and lower third slope positions have been abbreviated U 1/3, M 1/3 and L 1/3 to save space. The most common positions are underlined. The Vegetation Summary presents constancy and cover values for the most constant and abundant trees, shrubs, and herbs (in that order).

On the right-hand page of each Association description are sections on "Vegetation," "Productivity/Management" and "Relationships to Other Classifications."

## Productivity Information

Summary productivity estimates are presented in each series section and in Appendix C. Tree productivity estimates for each plant association are relative estimates of site potential. A majority of the plots are from mixed species stands and most site productivity estimation techniques are not well suited to multiple species stands. Furthermore, many of the sample stands were too old to provide good growth estimates. (See the Office Methods section for more information.)

All tree site index values are base 50 except for mountain hemlock, Pacific silver fir, noble fir and ponderosa pine, which are base 100. The sources for the equations used to determine the site indexes in the productivity tables are:

| CODE | SCIENTIFIC NAME | SITE INDEX SOURCE |
|---|---|---|
| ABAM | *Abies amabilis* | Herman and others 1978 (base 100) |
| ABGR | *Abies grandis* | Cochran 1979 |
| ABLA2 | *Abies lasiocarpa* | Clendenen 1977 (based on Alexander 1967) |
| ABPR | *Abies procera* | Herman and others 1978 (base 100) |
| CHNO | *Chamaecyparis nootkatensis* | Hegyi and others 1979 |
| LALY | *Larix lyalli* | None used |
| LAOC | *Larix occidentalis* | Schmidt and others 1976 |
| PIEN | *Picea engelmannii* | Clendenen 1977 (based on Alexander 1967) |
| PIAL | *Pinus albicaulis* | Brickell 1970 |
| PICO | *Pinus contorta* | Brickell 1970 (based on Alexander's data in Rockies and Dahm's data in Oregon) |
| PIMO | *Pinus monticola* | Brickell 1970 (based on Haig's 1932 curve) |
| PIPO | *Pinus ponderosa* | Barrett 1978 (base 100) |
| PSME | *Pseudotsuga menziesii* | Cochran 1979 (breast height age $\leq$100); Monserud 1985 (breast height age >100) |
| THPL | *Thuja plicata* | Hegyi and others 1979 |
| TSHE | *Tsuga heterophylla* | Wiley 1978 (breast height age < 120 only) |
| TSME | *Tsuga mertensiana* | Means and others 1986 (base 100) |

The summary tables by type were generated using individual plot output from the computer programs listed under Office Methods, above, as summarized and averaged in a relational data base. Because of different methods of calculating averages (e.g., normal mean versus weighted mean), some figures vary, depending upon which computer program was used to summarize the data. However, the general patterns remain the same between types and species within a type. Absolute values have little meaning and the data are most useful as relative indices.

In addition to site index values, other stand and productivity information presented in each Series section and in Appendix C are trees/acre, total basal area, quadratic mean diameter, stand density index, herbage production, wood volume growth estimates, growth basal area and average stand age. More detailed productivity information will be published in the desk version of this field guide.

## Management Interpretations

Management interpretations in Series and Association descriptions are based on field experience, suggestions in the literature, and interpretation of the data. They are subject to modification as data and experience accumulate and this Guide will be revised in the future. Input from users will be a valuable addition.

Management activities often make site identification more complicated. Site potential may be altered indefinitely or, more commonly, is more difficult to figure out. Use care and judgement when applying interpretations suggested in this or any guide. Events that alter the soil usually have profound effects. Soil erosion, mixing or displacement can degrade and change site potential. Any disturbance that removes the overstory will often make a site temporarily drier and warmer because of increased insolation, and tree species common in what were near-climax stands may be poor selections for planting in the current open stand. Conversely, moist sites may become swamps because removing the tree "pumps" can raise the water table. Development of frost prone areas through harvest practices is also an important consideration (see Figure 2).

Each Series, Association or Community Type description contains specific information on site characteristics and vegetation. Much of this information can be inferred from tables and appendices. Accumulated field experience with the sites and with vegetation's responses to treatments can be related to other locations and forest uses by utilizing this classification as a method of indexing information.

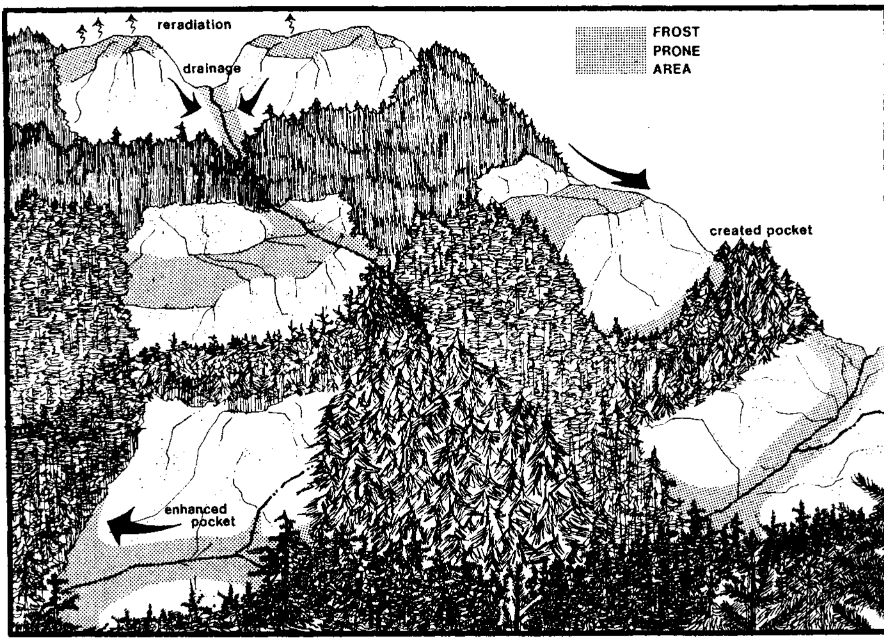



**Figure 2:** Development of frost prone areas in various topographic situations after clearcutting (from Hemstrom and others 1982).

# USING THE KEYS

The keys presented here are the beginning of the development of uniform keys and plant association descriptions for Area II (Eastern Washington: Colville, Okanogan and Wenatchee National Forests). Ultimately, all classifications and keys in Area II will be combined into one uniform classification that will not change when crossing administrative boundaries.

The keys in this guide were developed using stands with little disturbance and in as late a successional stage as could be found. As a result, they work best with undisturbed, late-successional stands. In disturbed stands, or those under about 150 years in age, it may be necessary to utilize the alternate strategies for stand identification presented for disturbed, early seral or dense stands. They follow the primary keys.

Remember, the key is not the classification! It is simply a tool to assist in the identification of the type. Not all sites will key to a type. Some sites may not fit the classification because of data limitations, and because complex biological systems are not easily reduced to a few simple classes. Use your best judgment.

Always use the steps below for any keys in this guide; follow them carefully:
*Incorrect identification can lead to improper management interpretations.*

**1. Select a vegetatively uniform area** representative of the community in question to record data on the field form. Plot size for vegetation data should be either 375 square meters or 1/10 acre. The radius of a 375-square-meter plot is approximately 11 meters, or 36 feet; a 1/10 acre plot has a radius of approximately 11.3 meters, or 37 feet.

**2. Complete the field form** (Appendix E) before trying to key the stand. Record all location and physical attributes listed on the form. Stand age is also helpful and can be approximated by using the age of the oldest tree in the stand. Use stand age to determine if the community is mature enough to fit the keys or whether the community composition will need to be projected to a later stage of succession (and suggest the use of the alternate keys).

Identify and list tree, shrub, and indicator herb species and estimate the cover of each. Although cover is typically estimated to the nearest percent up to 10 percent and to the nearest 5 percent thereafter, the field form displays cover classes. Cover classes are normally adequate, although more precise data may be helpful and can be recorded on the form if desired.

**3. Enter the keys.** The order of the key is important so work through the key step by step from beginning to end and don't skip key choices. Determine whether to use the Timberline or Montane Forest section of the series key. (Refer to Series Key write-up.)

a. Identify the series from the data on the Field Form.
When using the keys, read each lead as a question. For instance, in the montane forest portion of the series key the statement "Forests with ≥10% canopy cover of subalpine fir" should be taken as, "Is the subalpine fir canopy cover greater or equal to 10 percent?" If so, read to the right, i.e., to ABLA2 series. If not, read to the next lead immediately below. In the montane forest series key, the Grand Fir Series is identified in the fifth lead. More mesic trees are essentially absent, and grand fir is present and reproducing successfully, with the capability to support at least 10% canopy cover in older stands. Douglas-fir may be present in the Grand Fir Series on most sites. However, the Douglas-fir Series is identified in a lead below, where the potential for grand fir is less than 10% canopy cover, and the potential cover of Douglas-fir is greater or equal to 10% and it is reproducing successfully.

When the Series has been identified, go to the Association key for that Series. (Located in the section for that Series).

b. Identify the plant association or community type from the data on the Field Form.
For example, the first entry in the key to the subalpine fir types reads "dwarf bramble ≥ 5% cover." If this statement is true, then read to the right, i.e., to the ABLA2/RULA Association. If it is false, go down to the next lead, i.e., to "Cascade azalea ≥ 5%."

c. Once a type has been determined, carefully read its description to verify that the type, as keyed, fits the narrative. The key is a tool to help identify most sites, but the key is not the classification. If the type selected does not fit the narrative, review the key selections to determine if an error was made in the keying process. Further, review the coverage estimates from the field form and determine if, based on any coverage changes, another type is possible. Often in keying, other types might be selected if coverage values were just slightly different. Review those types and compare them with the original selection to determine the best fit. To help correctly place the stand, be sure to review the cover and constancy values in Appendix B for all likely types.

**4. Resolve questions about site identification.** If the key you are using does not seem to fit:

a. Re-evaluate your choice of climax series. Remember, the $\geq$10% cover value for tree series is based on stands over 150 years in age. In the majority of stands of this age, the climax tree will have at least 10% cover. In younger stands, it may be necessary to project the coverage of the potential climax tree into the future to see if it then would meet the 10% cover criterion. The general intent of the series key is to determine the most shade-tolerant or competitive tree, or both, with the capability to have at least 10% cover in the stand. In most stands, however, the selected climax tree will usually dominate canopy cover, given enough time without disturbance. Disturbed stands may likewise make series identification difficult.

b. For disturbed, early seral or dense stands, use the methods outlined below to identify the stand.

## Determining Type for Early Seral, Disturbed or Overstocked Stands

### Series Identification

Many forested stands in eastern Washington originated following large stand replacement fires in the last 100 years. At low to moderate elevations they are usually dominated by seral species such as lodgepole pine, western larch, or ponderosa pine, depending on elevation and aspect. In high subalpine zones (just below timberline), seral species may include subalpine larch and whitebark pine. If the stands have well-developed overstories and understories (roughly 30-100 years old), there are often enough climax indicator trees to determine the potential tree series. However, it is often convenient to substitute "present and reproducing successfully" for "$\geq$ 10%" in the series key. This convention is displayed for you in the OPTIONAL SERIES KEY. This closely parallels conventions currently being used in keys for existing Area II classifications.

"Reproducing successfully" is defined as a species' apparent ability to reproduce itself successfully under current conditions. It applies mainly to closed canopy conditions. The following conditions should be considered when evaluating reproduction success:

1. Trees per acre (An arbitrary starting point is 10 trees per acre — 20 or 30 is even better.)
2. Tree health and vigor (For instance, frost intolerance or extreme age relative to size in some species.)
3. Tree distribution (For instance, species are not restricted to atypical microsites and belong to more than one size or age class in the understory.)

Sometimes it is possible to use understory shrub and herb species to help determine the climax tree series. For example, the Douglas-fir Series is too dry to support vine maple, so if a stand currently dominated by Douglas-fir also supports vine maple, it should fall within one of the more moist series. Table 3, "Species Comparison by Series," (after the Introduction) can be used to compare the typical species composition of all ten Series described in this Guide and is helpful when using understory shrubs and herbs to identify the Series.

## Association Identification

Recent disturbance, such as stand replacement fire, timber harvest or extreme grazing pressure, may make it impossible to identify a Series or Association using indicator plants. Likewise, early successional (generally, less than 30 years old) and overstocked stands can be difficult. This is because disturbed, early seral and closed canopy stands may have depauperate tree regeneration, shrubs and herbs; or they may have abundant vegetation, but the important indicator species may be inconspicuous or absent. In these cases, the keys must be used with extreme caution. Often, indicators are not present and other approaches must be used:

1. In overstocked stands with sparse understory:
   a. lower cover values in the key by one class (e.g., 10 becomes 5, 5 becomes 2, 2 becomes 1, and 1 becomes present ); or,
   b. use relative rather than absolute canopy cover in the keys (i.e., compare the amount of each species cover to the total cover in the sample plot).

2. Project the stand development forward in time, using knowledge of plant succession for the area; enter the key using the projected values.

3. Look at similar sites in nearby areas that may be more open or less disturbed, or both; determine their plant Association and relate it to the stand in question.

4. Predict the Association using environmental variables, (Area II and Area I ecologists are presently working on a model that will be used to predict series and plant associations across the landscape, based on environmental information such precipitation, slope, aspect, elevation, geology and slope position.)

# SERIES KEYS
## FOR FORESTED UPLAND SERIES

Before using the key, the field form in Appendix E should be completed. Refer to the preceding section, "Using the Keys," for more information on key use and if the stand does not key.

### PRIMARY KEYS

**Timberline** or tree line stands. These rarely form a closed canopy, i.e., they are usually open woodland, parkland or krumholtz and variously dominated by species such as subalpine larch, whitebark pine, mountain hemlock, Pacific silver fir, subalpine fir or Engelmann spruce. Generally they are above the elevational limits of species such as Douglas-fir, western larch and white pine.

1. Forests with $\geq$ 5% cover of subalpine larch .................. LALY SERIES p. 251
2. Forests with $\geq$ 5% cover of whitebark pine ................... PIAL SERIES p. 237
3. Forests with $\geq$ 5% cover of mountain hemlock ............. TSME SERIES p. 177
4. Forests with $\geq$ 5% cover of subalpine fir ....................... ABLA2 SERIES p. 205

**Montane forests** at lower elevations. Closed or potentially closed canopies predominate. If open, the canopy is dominated by trees such as ponderosa pine, Douglas-fir, and Oregon white oak.

1. Forests with $\geq$ 10% cover of mountain hemlock........... TSME SERIES p. 177
2. Forests with $\geq$ 10% cover of Pacific silver fir ................ ABAM SERIES p. 149
3. Forests with $\geq$ 10% cover of western hemlock or western redcedar. ................................................. TSHE SERIES p. 123
4. Forests with $\geq$ 10% cover of subalpine fir; or Engelmann spruce cover $\geq$ 10% and spruce more successful than grand fir .......................... ABLA2 SERIES p. 205
5. Forests with $\geq$ 10% cover of grand fir (Engelmann spruce may be present but less successful than grand fir)........................................... ABGR SERIES p. 85
6. Forests with $\geq$ 10% cover of Douglas-fir or ponderosa pine
   - 6a. Oregon white oak dominant or reproducing better than Douglas-fir and ponderosa pine .................. QUGA SERIES p. 25
   - 6b. Forests with $\geq$ 10% cover of Douglas-fir ................ PSME SERIES p. 49
   - 6c. Forests with $\geq$ 10% cover of ponderosa pine ......... PIPO SERIES p. 37
7. Forests with $\geq$ 10% cover of Oregon white oak ............ QUGA SERIES p. 25
8. Forests dominated by quaking aspen and with meager evidence of climax tree species................. POTR community types (See Okanogan Guide until completion of riparian guide)
9. Otherwise (disturbed, early seral or depauperate stands) ................................................ Use Optional Series Key (Below)

## OPTIONAL KEY

(Disturbed or Overstocked Early to Mid Seral Stands)

1. Subalpine larch present and reproducing successfully ............................................ LALY SERIES p. 251

2. Whitebark pine present and reproducing successfully ............................................ PIAL SERIES p. 237

3. Mountain hemlock present and reproducing successfully ............................................ TSME SERIES p. 177

4. Pacific silver fir present and reproducing successfully ............................................ ABAM SERIES p. 149

5. Western hemlock or western redcedar present and reproducing successfully ........................... TSHE SERIES p. 123

6. Subalpine fir present and reproducing successfully; or Engelmann spruce present and reproducing more successfully than grand fir .................................. ABLA2 SERIES p. 205

7. Grand fir present and reproducing successfully (Engelmann spruce may be present but less successful than grand fir) .......................................... ABGR SERIES p. 85

8. Douglas-fir present and reproducing successfully ........... PSME SERIES p. 49

9. Ponderosa pine present and reproducing successfully ............................................ PIPO SERIES p. 37

10. Oregon white oak present and reproducing successfully ............................................ QUGA SERIES p. 25

11. Forests dominated by quaking aspen and with meager evidence of climax tree species ................. POTR community types (See Okanogan Guide until completion of riparian guide)

# TABLE 3 — SPECIES COMPARISON BY SERIES

(COV = mean relative cover; CON = mean constancy)

| | | QUGA | | PIPO | | PSME | | ABGR | | TSHE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 18 Plots | | 31 Plots | | 302 Plots | | 364 Plots | | 138 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | 13 | 2 |
| ABGR | grand fir | . | . | . | . | 1 | 2 | 83 | 21 | 71 | 20 |
| ABLA2 | subalpine fir | . | . | . | . | . | . | 5 | 4 | 12 | 5 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | 1 | 3 |
| ACMA | bigleaf maple | . | . | . | . | . | . | 1 | 5 | 1 | 12 |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | 17 | 18 | 27 | 9 | 35 | 10 |
| PIEN | Engelmann spruce | . | . | . | . | . | . | 5 | 10 | 22 | 8 |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | . | . | 24 | 13 | 26 | 13 | 22 | 8 |
| PIMO | western white pine | . | . | . | . | 1 | 2 | 21 | 4 | 54 | 5 |
| PIPO | ponderosa pine | 61 | 10 | 100 | 30 | 78 | 17 | 56 | 13 | 6 | 6 |
| POTR | quaking aspen | 6 | 20 | . | . | 2 | 5 | . | . | 1 | 1 |
| POTR2 | black cottonwood | 6 | 2 | . | . | 1 | 4 | . | . | 4 | 9 |
| PSME | Douglas-fir | 50 | 15 | 32 | 1 | 98 | 28 | 98 | 32 | 94 | 20 |
| QUGA | Oregon white oak | 94 | 31 | . | . | 2 | 5 | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | 3 | 2 | 59 | 16 |
| TSHE | western hemlock | . | . | . | . | . | . | 1 | 2 | 78 | 20 |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | 1 | 2 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | 20 | 27 | 45 | 13 |
| ARNE | pinemat manzanita | . | . | . | . | 3 | 3 | 8 | 10 | 6 | 21 |
| ARTRV | mountain big sagebrush | . | . | 3 | 2 | 2 | 7 | . | . | . | . |
| ARUV | bearberry | . | . | 6 | 1 | 26 | 11 | 2 | 6 | 1 | 1 |
| BEAQ | Oregon grape | 28 | 2 | 10 | 4 | 27 | 3 | 42 | 3 | 6 | 1 |
| BENE | Cascade Oregon grape | . | . | 3 | 2 | 2 | 1 | 59 | 8 | 91 | 7 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATE2 | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 17 | 5 | 10 | 1 | 19 | 5 | 5 | 3 | . | . |
| CHUMO | western prince's pine | . | . | . | . | 5 | 3 | 60 | 4 | 76 | 4 |
| COCA | bunchberry dogwood | . | . | . | . | . | . | 1 | 3 | 13 | 5 |
| COCO2 | California hazel | 28 | 17 | . | . | 2 | 2 | 7 | 3 | 6 | 2 |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | 2 | 2 | 33 | 3 |
| HODI | ocean-spray | 33 | 3 | 3 | 6 | 23 | 3 | 32 | 4 | 4 | 2 |
| JUCO4 | common juniper | . | . | . | . | 5 | 2 | 1 | 1 | 1 | 3 |
| LIBOL | twinflower | . | . | . | . | 2 | 4 | 28 | 8 | 76 | 8 |
| LUPE | partridgefoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | 10 | 2 |
| OPHO | devil's club | . | . | . | . | . | . | . | . | 12 | 8 |
| PAMY | pachistima | 17 | 1 | 6 | 3 | 57 | 7 | 71 | 5 | 74 | 5 |
| PEFR3 | shrubby penstemon | . | . | . | . | 9 | 2 | 2 | 1 | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | 56 | 3 | 74 | 12 | 24 | 7 | 1 | 3 | . | . |
| PYSE | sidebells pyrola | . | . | . | . | 3 | 2 | 36 | 2 | 65 | 2 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |
| ROGY | baldhip rose | 6 | 10 | . | . | 9 | 3 | 70 | 6 | 72 | 4 |
| ROWOU | Wood's rose | . | . | 3 | 3 | 4 | 2 | 4 | 3 | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | 2 | 2 | 29 | 3 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 33 | 4 | 3 | 1 | 59 | 6 | 71 | 5 | 36 | 3 |
| SYAL | common snowberry | 50 | 27 | 19 | 10 | 27 | 11 | 22 | 6 | 8 | 3 |

# TABLE 3 — SPECIES COMPARISON BY SERIES

(COV = mean relative cover; CON = mean constancy)

| | | QUGA 18 Plots | | PIPO 31 Plots | | PSME 302 Plots | | ABGR 364 Plots | | TSHE 138 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd** | | | | | | | | | | | |
| SYMOH | creeping snowberry | 6 | 3 | . | . | 2 | 6 | 27 | 5 | 34 | 5 |
| SYOR | mountain snowberry | . | . | 3 | 10 | 8 | 5 | 2 | 4 | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | 1 | 6 | 24 | 3 |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | 4 | 2 |
| VACA | dwarf huckleberry | . | . | . | . | 1 | 2 | 1 | 7 | 1 | 1 |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | . | . | 2 | 4 | 26 | 5 | 72 | 5 |
| VAMY | low huckleberry | . | . | . | . | 12 | 11 | 18 | 6 | 12 | 3 |
| VASC | grouse huckleberry | . | . | . | . | . | . | 5 | 10 | 8 | 3 |
| XETE | beargrass | . | . | . | . | . | . | . | . | 9 | 5 |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | 1 | 2 | 31 | 7 | 49 | 10 |
| AGSP | bluebunch wheatgrass | 61 | 11 | 81 | 19 | 17 | 14 | 1 | 1 | 1 | 15 |
| ARCO | heartleaf arnica | 17 | 4 | 3 | 4 | 47 | 6 | 41 | 4 | 6 | 4 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | 4 | 4 | 2 | 2 |
| ASCA3 | wild ginger | . | . | . | . | . | . | 2 | 4 | 22 | 5 |
| ASDE | podfern | . | . | 6 | 2 | 1 | 3 | . | . | 1 | 2 |
| ATFI | ladyfern | . | . | . | . | . | . | 1 | 3 | 12 | 5 |
| BASA | arrowleaf balsamroot | 11 | 7 | 68 | 7 | 25 | 5 | 8 | 3 | . | . |
| BRTE | cheatgrass | 78 | 10 | 45 | 7 | 7 | 6 | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | 18 | 3 | 12 | 2 | 8 | 2 |
| CAGE | elk sedge | 61 | 9 | 23 | 9 | 39 | 10 | 53 | 5 | 9 | 2 |
| CARO | Ross' sedge | . | . | 23 | 2 | 19 | 2 | 5 | 1 | 4 | 1 |
| CARU | pinegrass | 44 | 16 | 58 | 16 | 80 | 23 | 65 | 15 | 11 | 3 |
| CLUN | queencup beadlily | . | . | . | . | . | . | 19 | 5 | 56 | 5 |
| ELGL | blue wildrye | 44 | 1 | 3 | 5 | 5 | 3 | 7 | 3 | 2 | 3 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | 6 | 4 |
| EQAR | common horsetail | . | . | . | . | . | . | 1 | 2 | 3 | 3 |
| FEID | Idaho fescue | 6 | 3 | 42 | 18 | 7 | 6 | 1 | 1 | . | . |
| FEOC | western fescue | . | . | 3 | 2 | 6 | 2 | 25 | 2 | 8 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | 7 | 3 |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 22 | 18 | . | . | 15 | 5 | 22 | 5 | 1 | 1 |
| LULA | broadleaf lupine | 6 | 3 | 3 | 1 | 13 | 9 | 6 | 8 | 3 | 7 |
| LUSE | silky lupine | . | . | 35 | 4 | 9 | 6 | . | . | . | . |
| LUPIN | lupine species | 11 | 3 | 32 | 5 | 22 | 5 | 23 | 5 | 6 | 6 |
| LUSU | sulfur lupine | 50 | 8 | . | . | 6 | 6 | . | . | . | . |
| MOSS | undifferentiated moss | . | . | 3 | 1 | 1 | 3 | 14 | 9 | 25 | 14 |
| PEBR | bracted pedicularis | . | . | . | . | 1 | 2 | 7 | 2 | 1 | 2 |
| PERA | sickletop pedicularis | . | . | . | . | . | . | 6 | 2 | 11 | 1 |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | 2 | 2 | 1 | 2 |
| PTAQ | bracken fern | . | . | . | . | 3 | 6 | 24 | 5 | 44 | 4 |
| SMRA | feather solomonplume | . | . | 3 | 1 | 8 | 2 | 24 | 2 | 21 | 2 |
| SMST | starry solomonplume | 6 | 10 | . | . | 4 | 1 | 23 | 3 | 50 | 3 |
| STRO | rosy twistedstalk | . | . | . | . | . | . | 1 | 2 | 6 | 2 |
| TITRU | coolwort foamflower | . | . | . | . | . | . | 2 | 2 | 26 | 3 |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | 7 | 3 |
| TRLA2 | western starflower | . | . | . | . | 2 | 2 | 24 | 3 | 30 | 4 |
| VASI | Sitka valerian | . | . | . | . | . | . | 2 | 2 | 4 | 1 |
| VIGL | pioneer violet | . | . | . | . | 1 | 2 | 9 | 2 | 23 | 3 |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | 7 | 2 | 30 | 2 |

# TABLE 3 — SPECIES COMPARISON BY SERIES

(COV = mean relative cover; CON = mean constancy)

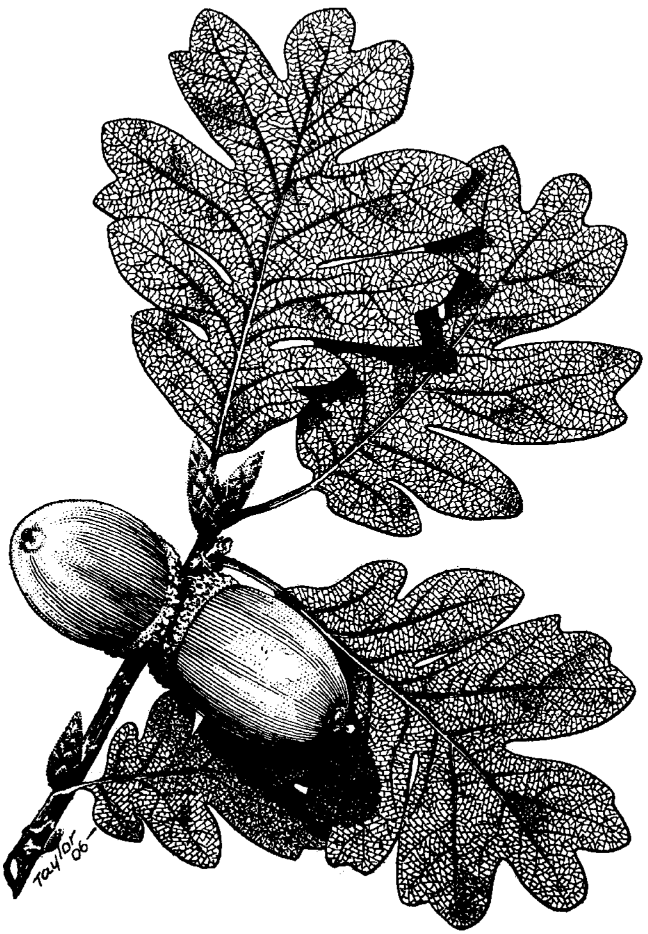
| | | ABAM | | TSME | | ABLA2 | | PIAL | | LALY | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 238 Plots | | 118 Plots | | 154 Plots | | 27 Plots | | 28 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 84 | 20 | 66 | 26 | 1 | 3 | 4 | Tr | . | . |
| ABGR | grand fir | 12 | 10 | 4 | 4 | 13 | 12 | . | . | . | . |
| ABLA2 | subalpine fir | 21 | 11 | 41 | 17 | 79 | 20 | 63 | 5 | 57 | 6 |
| ABPR | noble fir | 8 | 12 | 1 | 5 | 1 | 3 | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | 11 | 9 | 8 | 21 | 1 | 5 | 4 | Tr | . | . |
| LALY | subalpine larch | . | . | . | . | 2 | 2 | 4 | 2 | 89 | 20 |
| LAOC | western larch | 15 | 11 | 24 | 8 | 19 | 17 | . | . | . | . |
| PIEN | Engelmann spruce | 21 | 8 | 16 | 8 | 42 | 15 | 19 | 5 | 61 | 9 |
| PIAL | whitebark pine | . | . | 11 | 5 | 10 | 6 | 96 | 19 | 43 | 4 |
| PICO | lodgepole pine | 8 | 12 | 20 | 16 | 63 | 22 | 26 | 7 | 4 | 5 |
| PIMO | western white pine | 32 | 5 | 21 | 6 | 11 | 6 | 4 | 2 | . | . |
| PIPO | ponderosa pine | . | . | . | . | 9 | 5 | 4 | 1 | . | . |
| POTR | quaking aspen | . | . | . | . | 1 | 1 | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | 1 | 1 | . | . | . | . |
| PSME | Douglas-fir | 74 | 18 | 24 | 8 | 55 | 21 | 26 | 5 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 32 | 9 | 2 | 9 | . | . | . | . | . | . |
| TSHE | western hemlock | 81 | 28 | 28 | 16 | 1 | 4 | . | . | . | . |
| TSME | mountain hemlock | 11 | 4 | 97 | 22 | 3 | 3 | 19 | 4 | 14 | 2 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 21 | 11 | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | 1 | 8 | 3 | 5 | 5 | 7 | 7 | 14 | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | 15 | 14 | . | . |
| ARUV | bearberry | . | . | . | . | 8 | 6 | 11 | 22 | . | . |
| BEAQ | Oregon grape | . | . | 2 | 1 | 5 | 2 | . | . | . | . |
| BENE | Cascade Oregon grape | 53 | 6 | 8 | 3 | 7 | 2 | . | . | . | . |
| CAME | Mertens’ moss-heather | . | . | 3 | 14 | 1 | 8 | . | . | 43 | 17 |
| CATE2 | four-angled moss-heather | . | . | 1 | 3 | . | . | . | . | 25 | 35 |
| CEVE | snowbrush ceanothus | . | . | . | . | 2 | 1 | 4 | Tr | . | . |
| CHUMO | western prince’s pine | 58 | 3 | 15 | 3 | 29 | 3 | 4 | 2 | . | . |
| COCA | bunchberry dogwood | 19 | 6 | 3 | 4 | 1 | 5 | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | 4 | 35 | 18 | 15 |
| GAOV | slender wintergreen | 34 | 4 | 14 | 5 | 1 | 1 | . | . | . | . |
| HODI | ocean-spray | . | . | . | . | 1 | 2 | . | . | . | . |
| JUCO4 | common juniper | . | . | 3 | 1 | 5 | 2 | 30 | 11 | 18 | 8 |
| LIBOL | twinflower | 61 | 5 | 9 | 4 | 10 | 10 | . | . | . | . |
| LUPE | partridgefoot | . | . | 6 | 18 | 3 | 1 | 4 | 65 | 50 | 17 |
| MEFE | rusty menziesia | 31 | 6 | 25 | 16 | 1 | 1 | . | . | . | . |
| OPHO | devil’s club | 9 | 17 | 8 | 2 | . | . | . | . | . | . |
| PAMY | pachistima | 61 | 4 | 25 | 4 | 74 | 8 | 26 | 6 | . | . |
| PEFR3 | shrubby penstemon | . | . | . | . | 1 | 1 | 7 | 2 | . | . |
| PHEM | red mountain heath | 1 | 2 | 8 | 18 | 6 | 12 | 4 | 1 | 61 | 9 |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 82 | 3 | 47 | 5 | 53 | 2 | 4 | 1 | . | . |
| RHAL | Cascade azalea | 18 | 11 | 33 | 19 | 15 | 25 | 4 | 1 | . | . |
| ROGY | baldhip rose | 34 | 3 | 2 | 2 | 11 | 4 | . | . | . | . |
| ROWOU | Wood’s rose | . | . | 1 | 2 | . | . | . | . | . | . |
| RULA | dwarf bramble | 71 | 5 | 60 | 11 | 13 | 19 | 7 | 9 | . | . |
| RUPE | five-leaved bramble | 13 | 4 | 14 | 7 | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 9 | 2 | . | . | 21 | 6 | . | . | . | . |
| SYAL | common snowberry | 3 | 2 | . | . | 6 | 7 | . | . | . | . |

# TABLE 3 — SPECIES COMPARISON BY SERIES

(COV = mean relative cover; CON = mean constancy)

| | | ABAM 238 Plots | | TSME 118 Plots | | ABLA2 154 Plots | | PIAL 27 Plots | | LALY 28 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd** | | | | | | | | | | | |
| SYMOH | creeping snowberry | 5 | 3 | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | 1 | 2 | . | . | . | . |
| TABR | Pacific yew | 18 | 4 | 2 | 2 | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | 30 | 6 | 22 | 11 | 1 | 3 | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | 3 | 5 | 7 | 3 | 11 | 6 |
| VADE | Cascade huckleberry | . | . | 6 | 20 | 5 | 21 | 4 | 5 | 32 | 13 |
| VAME | big huckleberry | 93 | 11 | 74 | 17 | 21 | 9 | 4 | 3 | . | . |
| VAMY | low huckleberry | 17 | 4 | 28 | 17 | 46 | 12 | 22 | 6 | 7 | Tr |
| VASC | grouse huckleberry | 8 | 5 | 38 | 10 | 35 | 13 | 52 | 20 | 61 | 14 |
| XETE | beargrass | 21 | 6 | 36 | 9 | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 46 | 7 | 4 | 5 | 1 | 1 | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | 1 | 2 | 4 | Tr | . | . |
| ARCO | heartleaf arnica | 2 | 2 | 3 | 7 | 36 | 4 | 15 | 3 | . | . |
| ARLA | broadleaf arnica | 16 | 5 | 42 | 9 | 37 | 7 | 30 | 3 | 29 | 2 |
| ASCA3 | wild ginger | 6 | 3 | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | 1 | Tr | . | . | . | . |
| ATFI | ladyfern | 7 | 4 | 3 | 3 | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 1 | 2 | 1 | Tr | 18 | 3 | 11 | 3 | 4 | 7 |
| CAGE | elk sedge | 3 | 2 | 16 | 2 | 31 | 7 | 30 | 15 | . | . |
| CARO | Ross' sedge | 3 | 2 | 2 | 2 | 11 | 2 | 37 | 5 | 18 | 2 |
| CARU | pinegrass | . | . | 4 | 2 | 34 | 15 | 33 | 14 | . | . |
| CLUN | queencup beadlily | 68 | 6 | 25 | 6 | 7 | 4 | . | . | . | . |
| ELGL | blue wildrye | . | . | 2 | 2 | 6 | 2 | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | 2 | 24 | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | 15 | 6 | . | . |
| FEOC | western fescue | 4 | 1 | 2 | 1 | 14 | 2 | 4 | 1 | . | . |
| FEVI | green fescue | . | . | 3 | 6 | 3 | 2 | 33 | 13 | 18 | 6 |
| GYDR | oak fern | 11 | 7 | 6 | 6 | 1 | Tr | . | . | . | . |
| LUHI | smooth woodrush | 1 | 1 | 33 | 11 | 21 | 15 | 40 | 8 | 64 | 12 |
| LUNA2 | silvercrown luina | . | . | 2 | 2 | 8 | 3 | 8 | 6 | . | . |
| LULA | broadleaf lupine | 3 | 3 | 5 | 10 | 19 | 9 | 24 | 13 | 18 | 4 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 9 | 3 | 12 | 7 | 26 | 8 | 32 | 7 | 4 | 2 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | undifferentiated moss | 44 | 20 | 29 | 14 | 16 | 8 | . | . | 7 | 4 |
| PEBR | bracted pedicularis | 1 | 2 | 4 | 1 | 12 | 2 | 11 | Tr | 11 | 1 |
| PERA | sickletop pedicularis | 13 | 2 | 18 | 1 | 20 | 2 | 4 | Tr | . | . |
| POPU | skunkleaf polemonium | 5 | 3 | 18 | 4 | 40 | 4 | 19 | 3 | 7 | 2 |
| PTAQ | bracken fern | 20 | 2 | 2 | 1 | 3 | 2 | . | . | . | . |
| SMRA | feather solomonplume | 8 | 2 | 2 | 1 | 4 | 1 | . | . | . | . |
| SMST | starry solomonplume | 26 | 4 | 4 | 3 | 10 | 3 | . | . | . | . |
| STRO | rosy twistedstalk | 15 | 3 | 14 | 3 | 1 | 1 | . | . | . | . |
| TITRU | coolwort foamflower | 37 | 5 | 10 | 4 | 3 | 2 | . | . | . | . |
| TRCA3 | false bugbane | 4 | 8 | 3 | 3 | 2 | 12 | . | . | . | . |
| TRLA2 | western starflower | 8 | 3 | 1 | 4 | 1 | 4 | . | . | . | . |
| VASI | Sitka valerian | 13 | 5 | 31 | 6 | 23 | 4 | . | . | 25 | 5 |
| VIGL | pioneer violet | 11 | 3 | 6 | 3 | 7 | 3 | . | . | . | . |
| VIOR2 | round-leaved violet | 44 | 2 | 13 | 3 | 17 | 2 | 4 | 3 | . | . |

# OREGON WHITE OAK SERIES



# OREGON WHITE OAK SERIES

DISTRIBUTION AND ENVIRONMENT: Oregon white oak is one of the tree species most tolerant of heat and drought in the northwest (Franklin and Dyrness 1973; Minore 1979). Although widely distributed on the west side of the Cascades, Oregon white oak is limited on the east slope to a relatively small area north and south of the Columbia Gorge. The northernmost stand is separate and occurs on Swauk Creek between Cle Elum and Ellensburg. Cold temperatures seem to be the limiting factor in the northward distribution of Oregon white oak east of the Cascades.

On the Wenatchee NF the Oregon White Oak Series is limited to the lower reaches of the Naches and Tieton Rivers watersheds. It is the hottest and most droughty of the forest Series and where it occurs marks the lower boundary of woodland and forest. As such, the Series is transitional between conifer-dominated forests at higher elevations and shrublands at lower elevations and to the east. The Series is more extensive south of the Forest on the Yakima Indian Reservation (John and others 1988) and into the Columbia Gorge. Most stands on the Wenatchee NF occur below 3100 ft. on steep mid and lower slope positions or along dry river and stream terraces. There seems to be little restriction to southerly aspects, although the data set is very small. Precipitation in these areas is likely to be less than 20 in. annually.

Oregon white oak typically occurs on soils that are very gravelly, stony, and (in uplands) subject to ravel. QUGA/AGSP and QUGA/CARU-CAGE Associations occur largely on soils derived from basalt colluvium. The QUGA/COCO2-SYAL Association typically occurs on basalt alluvium.

VEGETATION: Except on river terraces, many of the sample stands are woodlands or open forest. In both uplands and bottoms, Oregon white oak dominates most of the plots. Tree canopy cover is typically less than 40% in the upland Associations but often exceeds 65% on QUGA/COCO2-SYAL, which is associated with river terraces. Oregon white oak is both a climax dominant and pioneer in these habitats as no other tree species can successfully and consistently regenerate. Many stands also have scattered Douglas-fir or ponderosa pine. In uplands, these conifers often are emergents above the oak canopy, but occur only in favorable microsites. They do not form a consistent canopy, nor do they regenerate well. Conifers are dominant on a few plots, especially on bottoms, but as these stands are projected towards climax oak is clearly the more successful species.

The undergrowth reflects the transitional nature of these woodlands. Species typical of climax sagebrush and bitterbrush shrublands are present, as well as those species typical of conifer-dominated forests. Bitterbrush, serviceberry, shiny-leaf spirea, California hazel, and common snowberry are shrubs that can be found in one or more Associations. Bitterbrush and serviceberry both seem to occur in drier Associations. Snowberry and hazel are associated with dry river terraces and can be very abundant. Shrubs are not abundant in the two upland Associations, except perhaps following wildfire.

Elk sedge and pinegrass are abundant in the QUGA/CARU-CAGE Association while bluebunch wheatgrass dominates the QUGA/AGSP type. Sulfur lupine, Carey balsamroot, showy phlox, yarrow, Sandberg bluegrass and lomatium spp. are other common herbs.

Three plant Associations are listed in the tables following this Series introduction. Of these Associations, one (QUGA/COCO2-SYAL) is composed of recent plots taken for riparian classification work. They are located on dry river terraces.

PRODUCTIVITY/MANAGEMENT: Intensive tree production plots are not available for the oak Series. These sites are presumed to have low timber productivity, due to low stocking and slow growth rates. Productivity is presumed very low in QUGA/AGSP, moderately low in QUGA/CARU-CAGE, and moderate in QUGA/COCO2-SYAL. Large, old oaks, pines or Douglas-firs can still be found on occasion in uplands, but volumes on a per acre basis are low, as is growth potential. The riparian plots are surprisingly dense and productive compared to upland sites. Many stands have been cleared for homesteads, grazing and lumber production, especially on sites belonging to the QUGA/COCO2-SYAL Association. Oregon white oak is an excellent firewood. Opportunity exists to use these woodlands for the production of firewood through a coppice silviculture system. However, since these stands are near the northern limit of the species distribution, growth may not be very good. Upland soils may not survive heavy vehicle traffic or vegetation removal without raveling.

The composition and patterns of abundance of the flora in these stands has been considerably affected by past disturbance, including fire, grazing, homesteading and logging. Historical fire frequency in these areas is judged to be in the 5-30 year range, with most fires being of low intensity. Fire helped maintain the open woodland structure of these stands and the composition and dominance of shrubs. Oregon white oak is very fire tolerant because its foliage is relatively non-flammable and it will resprout should the above-ground stem be killed. Lack of fire or altered fire cycles in recent times have led to changes in floristic composition. Fire sensitive species are more common and fuel ladders have developed. Many stands are scrubby as a result of past logging and grazing and are more susceptible to stand-replacement fires. The ability of Oregon white oak to resprout after fire or cutting allows it to readily revegetate disturbed sites.

The primary root and trunk rot diseases of Oregon white oak include *Armillaria* root disease and oak anthracnose (Paul Hessburg, personal communication). Insects of note on oak include the western oak looper, western tent caterpillar and Pacific tent caterpillar. The primary root diseases affecting associated ponderosa pine include *Annosum* root disease and *Armillaria* root rot (Hessburg and others 1994). Other pathogens affecting ponderosa pine include comandra rust and elytroderma needle disease. They may be locally significant but rarely threaten entire stands of trees. Primary root diseases of Douglas-fir include P- and S-group *Annosum* root diseases, laminated root rot and *Armillaria* root rot (Hessburg and others 1994). These rots were scattered before the era of intensive resource management but have increased dramatically by infecting stumps associated with selection logging. Various dwarf mistletoes currently infest at least 43% of Douglas-fir and 26% of ponderosa pine east of the Cascades. These levels are likely elevated from historical times because lack of wildfires has resulted in denser stands, facilitating the parasite's spread. Insect species that can affect ponderosa pine include western pine beetle, mountain pine beetle, pine engraver, pandora moth, pine butterfly, sawflies, needle miners, tip miners and the sugar pine tortix (Hessburg and others 1994). Of these, western pine beetle, pine engraver and mountain pine beetle have the potential for severe outbreaks in the White Oak Series. Insect species that can be pests of Douglas-fir include the Douglas-fir engraver, fir engraver and Douglas-fir beetle (Hessburg and others 1994). The fir engraver and Douglas-fir beetle have the potential for severe outbreaks in Douglas-fir.

These sites are important wildlife areas and are heavily used, especially as winter and early spring range. Thickets provide hiding cover and oak mast provides good fall and winter forage. Early spring green-up of the abundant grasses helps sustain wildlife until other forage becomes available at higher elevations. Snags and logs provide valuable habitat and perches and are especially critical because tree density is low and therefore snag and log recruitment will also be slow or episodic.

Although clipped plots are not available, the QUGA Series should provide moderate herbage for livestock, especially on the QUGA/AGSP and QUGA/CARU-CAGE Associations. Invasion of noxious weeds is a serious problem, especially diffuse knapweed. Coarse soils are easily displaced on steep slopes. Heavy grazing reduces cover of elk sedge, bluebunch wheatgrass, beardless bluebunch wheatgrass and Idaho fescue. The open nature of these stands leaves them very susceptible to noxious weed encroachment after heavy grazing or other ground disturbing activity. Introduced grasses and forbs may persist for many years in these open environments.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Some of the authors that have described the Oregon White Oak Series include: Williams and others 1991 (Wenatchee NF Draft); John and others 1988 (Yakima Indian Res.); and Topik and others 1988 (Mt. Hood NF).

# Keys to Plant Associations of the Oregon White Oak Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key.



## Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| QUGA/CARU-CAGE | 1 | 121 | 136 | 14 | 216 | 137 |

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| QUGA/CARU-CAGE | PSME | 4 | 53 | 4 | 146 | 54 | 88 |

1 Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

2 Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

## OREGON WHITE OAK PLANT ASSOCIATION GROUPS

1. Hot Dry Grass PAG
   - QUGA/AGSP
   - QUGA/CARU-CAGE

2. Hot Mesic Shrub/Herb PAG
   - QUGA/COCO2-SYAL

## OREGON WHITE OAK PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| 1. QUGA/AGSP | HOG111 |
| 2. QUGA/CARU-CAGE | HOG211 |
| 3. QUGA/COCO2-SYAL | HOG311 |

# QUGA/AGSP ASSOCIATION HOG111

*Quercus garryana/Agropyron spicatum*

Oregon white oak/bluebunch wheatgrass

## ENVIRONMENT:

Elevation: 2000-2500 (2263) ft.

Aspect: south to east

Slope: 48-64 (56)%

Slope position: M, L 1/3

Special: hot, dry, unproductive oak sites

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 100 | 25 |
| PIPO | ponderosa pine | 17 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 100 | 7 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 100 | 4 |
| AMAL | serviceberry | 67 | 2 |
| **HERBS** | | | |
| AGSP | bluebunch wheatgrass | 100 | 17 |
| BRTE | cheatgrass | 100 | 16 |
| LUSUS | sulfur lupine | 100 | 8 |
| ACMI | yarrow | 100 | 2 |
| LOTR | nine-leaf lomatium | 100 | 2 |
| BACA | Carey balsamroot | 83 | 5 |
| POSA3 | Sandberg bluegrass | 83 | 3 |
| PHSP | showy phlox | 83 | 3 |
| HYCA | ballhead waterleaf | 83 | 2 |
| COGR2 | large-flowered collomia | 67 | 1 |
| LOTR | fern-leaved lomatium | 50 | 2 |
| DEDE | slim larkspur | 50 | 2 |
| LIPA | smallflower fringecup | 50 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The QUGA/AGSP Association was sampled from near the eastern boundary of the Forest on the lower reaches of the Tieton River drainage and the Oak Creek Wildlife and Recreation Area. The sample size is small, so the following description is based on limited information.

These are the hottest, driest forest and woodland habitats on the Wenatchee NF and represent the lower limit for forest growth. The sample plots occur at low elevation on hot, steep, mid and lower slopes, with south to east aspects. The type also likely occurs on west aspects.

The regolith is basalt colluvium. Soils are gravelly, shallow and droughty. These soils may possibly be classed as dry ravel. There is abundant gravel on the soil surface. Soil coarse fragments and litter are often abundant.

Drier sites are dominated by bitterbrush and bunchgrass meadows. QUGA/CARU-CAGE lies on more moderate sites, while QUGA/COCO2-SYAL occurs on adjacent river terraces. PIPO/PUTR/AGSP and PIPO/AGSP occur on similar sites outside the range of oak.

VEGETATION: These are woodlands dominated, for the most part, by Oregon white oak. Overstory cover typically ranges between 20 and 30%, which falls nicely into the woodland category. Oregon white oak is also the only regenerating species. Tree reproduction is often patchy, with seedlings and saplings aggregated into groups.

Shrubs are normally inconspicuous. The undergrowth is largely dominated by grasses and forbs. Bitterbrush is present in small amounts in all plots and averages 4% canopy cover. Serviceberry may also be present. Additional data may later warrant describing a QUGA/PUTR/AGSP type.

Abundant bluebunch wheatgrass, mixed with Sandberg bluegrass, yarrow, nine-leaf lomatium, sulfur lupine and Carey balsamroot, characterizes the undergrowth. Other common species include showy phlox, yarrow, fern-leaved lomatium and ballhead waterleaf. Cheatgrass is well represented on all plots, especially in spaces between bunchgrass clumps. It is abundant on more disturbed sites.

PRODUCTIVITY/MANAGEMENT: There is no data available on timber production on QUGA/AGSP sites. However, productivity for these extremely hot, dry sites is presumed to be very low. No methods are known to assure reforestation.

Wildlife forage and shelter is an important use of this vegetation type. Stands are very important deer and elk winter ranges that remain clear of snow for most of the winter. The acorn mast can be an important forage resource during fall and winter months, while the grasses and forbs provide important spring and summer forage.

These habitats have been heavily grazed in the past by livestock, as indicated by the heavy cheatgrass in all the plots. The relative density of cheatgrass to bluebunch wheatgrass and other bunchgrasses is generally accepted as a rough indication of the amount of past intensive grazing. However, naturally raveled sites may also support considerable cheatgrass.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: QUGA/AGSP is similar to parts of the broad QUGA/PUTR and PIPO-QUGA/PUTR types described on the Yakima Indian Reservation (John and others 1988) and Mount Hood NF (Topik and others 1988).

# QUGA/CARU-CAGE ASSOCIATION HOG211

*Quercus garryana/Calamagrostis rubescens-Carex geyeri*

Oregon white oak/pinegrass-elk sedge

*Oregon white oak (QUGA), an indicator of the QUGA/CARU-CAGE Association.*

*PHOTO:*
S.Hahn & M.Reynolds

## ENVIRONMENT:

Elevation: 2200-3000 (2660) ft.
Aspect: east, south, northeast, west
Slope: 14-55 (30)%
Slope position: U, M, L 1/3
Special: moderate oak sites

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 100 | 20 |
| PIPO | ponderosa pine | 100 | 5 |
| PSME | Douglas-fir | 83 | 13 |
| **TREE UNDERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 100 | 6 |
| PSME | Douglas-fir | 50 | 1 |
| PIPO | ponderosa pine | 33 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| AMAL | serviceberry | 50 | 3 |
| SPBEL | shiny-leaf spirea | 83 | 4 |
| CESA | redstem ceanothus | 67 | 15 |
| PUTR | bitterbrush | 67 | 2 |
| CEVE | snowbrush ceanothus | 50 | 5 |
| BEAQ | Oregon grape | 50 | 3 |
| SYAL | common snowberry | 50 | 2 |
| RICE | wax currant | 50 | 2 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 19 |
| CAGE | elk sedge | 100 | 12 |
| ACMI | yarrow | 100 | 3 |
| BRTE | cheatgrass | 83 | 9 |
| COGR2 | large flowered collomia | 83 | 2 |
| AGSP | bluebunch wheatgrass | 67 | 5 |
| LOTR | nine-leaf lomatium | 67 | 2 |
| ALLIU | onion spp. | 67 | 2 |
| LUNA2 | silvercrown luina | 50 | 23 |
| LUSUS | sulfur lupine | 50 | 8 |

## DISTRIBUTION AND ENVIRONMENT:

The QUGA/CARU-CAGE type was sampled from near the eastern boundary of the Forest on the lower reaches of the Tieton River watershed and the Oak Creek Wildlife and Recreation Area. The sample size is small, so the following description is based on limited information.

These are hot, dry sites at the lower edge of conifer forest and woodland. QUGA/ CARU-CAGE occurs at low elevations, mostly on moderate to moderately-steep mid and upper slopes. Elevations are less than 3000 feet.

The regolith is basalt colluvium. The soils are moderately gravelly and contain moderate amounts of rocks and stones. The soil surface is largely covered by litter and vegetation, with little rock or soil exposed. Soil textures, depth, and coarse fragments indicate a more favorable soil than the QUGA/AGSP type.

Drier sites are dominated by QUGA/ AGSP or bitterbrush and bunchgrass meadows. QUGA/COCO2-SYAL occurs on dry river terraces, while conifer-dominated types such as PSME/CARU, PSME/CAGE or PIPO/CARU-AGSP occur just outside the range of oak.

VEGETATION: Oregon white oak, Douglas-fir and ponderosa pine are all overstory components of these woodlands. Oak dominates on four of our plots, while Douglas-fir and ponderosa pine are more abundant on two plots. Scattered, old Oregon white oak, Douglas-fir or ponderosa pine mixed with younger trees (< 100 yr) is a common structure. The younger trees often give these stands a dense closed-in appearance. Oregon white oak is reproducing better than Douglas-fir and ponderosa pine in the data. Half the plots have no conifer regeneration at all. Douglas-fir and ponderosa pine can establish and maintain themselves in these stands, but tree regeneration is limited to times when favorable climatic conditions occur. Conifer regeneration appears to be episodic and these hot, dry habitats may be too marginal for conifers to successfully reproduce on a continuous basis.

Herb-dominated undergrowth is characteristic of the QUGA/CARU-CAGE type. Quite a few shrubs are present, though few are well represented in the data. More common shrubs include serviceberry, both redstem and snowbrush ceanothus, shiny-leaf spirea, wax current and bitterbrush.

Pinegrass and elk sedge characterize the grass- and forb-dominated undergrowth. Other conspicuous species include nine-leaved lomatium, yarrow, silvercrown luina, Carey balsamroot and bluebunch wheatgrass. Although assigned to the Oregon White Oak Series, in many characteristics this Association is transitional to conifer-dominated Series. Many of the undergrowth species present in these stands are more common and more abundant in the closed-forest stands of the Douglas-fir, Grand Fir and Ponderosa Pine Series and reflect the transitional nature of this type.

PRODUCTIVITY/MANAGEMENT: Timber production in QUGA/CARU-CAGE is presumed to be moderately low and perhaps comparable to the PSME/CARU and PSME/CAGE Associations. One intensive plot averaged 121 trees per acre and 136 sq. ft./ac. total basal area (Appendix C). The average site index for Douglas-fir was 53 (base 50). Other values may preclude timber cutting on these sites.

These sites are important winter and early spring range for wildlife. Elk and deer sign are frequently abundant and these species may have a significant effect on the composition and relative abundance of the undergrowth. Elk dust wallows are often indicated by abundant silvercrown luina. These habitats provide forage (including mast, pinegrass and elk sedge) and thermal and hiding cover during winter months.

QUGA/CARU-CAGE may provide moderate herbage for livestock. One clipped plot averaged 137 pounds of herbage per acre (Appendix C). Livestock prefer elk sedge over pinegrass and elk sedge may become almost inconspicuous in heavily grazed areas.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: QUGA/CARU-CAGE has not been described in other classifications but is similar to some stands in the PIPO-QUGA/CAGE of John and others (1988) on the Yakima Indian Reservation.

# QUGA/COCO2-SYAL ASSOCIATION HOG311

*Quercus garryana/Corylus cornuta-Symphoricarpos albus*

Oregon white oak/California hazel-common snowberry

## ENVIRONMENT

Elevation: 1700-2200 (1963) ft.

Aspect: east-draining valley terraces

Slope: 2-7 (5)%

Slope Position: dry river terraces

Special: hot river valleys on Naches District

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 83 | 50 |
| PIPO | ponderosa pine | 67 | 20 |
| PSME | Douglas-fir | 67 | 17 |
| POTR | quaking aspen | 17 | 20 |
| **TREE UNDERSTORY LAYER** | | | |
| QUGA | Oregon white oak | 83 | 13 |
| POTR | quaking aspen | 33 | 1 |
| PSME | Douglas-fir | 17 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SYAL | common snowberry | 83 | 47 |
| COCO2 | California hazel | 83 | 17 |
| PREM | bitter cherry | 83 | 6 |
| ROSA | rose species | 67 | 12 |
| PRVI | chokecherry | 67 | 8 |
| HODI | ocean-spray | 50 | 3 |
| **HERBS** | | | |
| ELGL | blue wildrye | 83 | 1 |
| CAGE | elk sedge | 67 | 4 |
| POPR | Kentucky bluegrass | 50 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

Most of the plots in QUGA/COCO2-SYAL are from recent riparian data. There are two potential plant Associations in this one: QUGA/SYAL and QUGA/COCO2. However, due to the limited number of plots (6) and similarities in both vegetation and site, these two types are being lumped into a single Association until further data is available. QUGA/COCO2-SYAL was sampled near the eastern boundary of the Naches District in the lower Tieton River, Bear Canyon Creek and Oak Creek watersheds.

As presently defined, the QUGA/COCO2-SYAL type occurs on gentle, dry river terraces. Sample plot elevations are low. Aspects are generally easterly (the direction the valleys face). The regolith is basalt alluvium. The soils contain moderate amounts of cobbles and gravels. The soil surface of undisturbed stands is largely covered with litter and vegetation, with little exposed rock or soil. QUGA/COCO2-SYAL is more moderate and supports denser forests and greater biomass than either QUGA/AGSP or QUGA/CARU-CAGE. Adjacent upland sites support bitterbrush, big mountain sagebrush and bunchgrass meadows or forest Associations such as QUGA/AGSP, QUGA/CARU-CAGE, PIPO/AGSP, PIPO/PUTR/AGSP and PSME/AGSP.

VEGETATION: Oregon white oak, Douglas-fir and ponderosa pine are constant overstory components of these relatively dense stands. Oak dominates most of our sample plots. Douglas-fir dominated one plot in which none of the oak regeneration was greater than 5 inches DBH. However, oak was clearly regenerating more successfully than Douglas-fir. Dense, old Oregon white oak, Douglas-fir and ponderosa pine mixed with younger trees is a very common stand structure. Oak is always reproducing more successfully than Douglas-fir or pine. Douglas-fir and ponderosa pine do reproduce and establish in these stands, but this may require long periods of special conditions. Both black cottonwood and quaking aspen are important associates in some stands.

The undergrowth is a rich mixture of medium and tall shrubs. California hazel dominated two plots, was absent on one plot and was subordinate to common snowberry on the others. Common snowberry is usually abundant, except where unusually dense California hazel and other tall shrubs suppress it. Other shrubs include bitter cherry, chokecherry, roses, wax currant and ocean-spray. Pinegrass, elk sedge and bluegrass are common on a few plots. Herbs are inconspicuous on most plots.

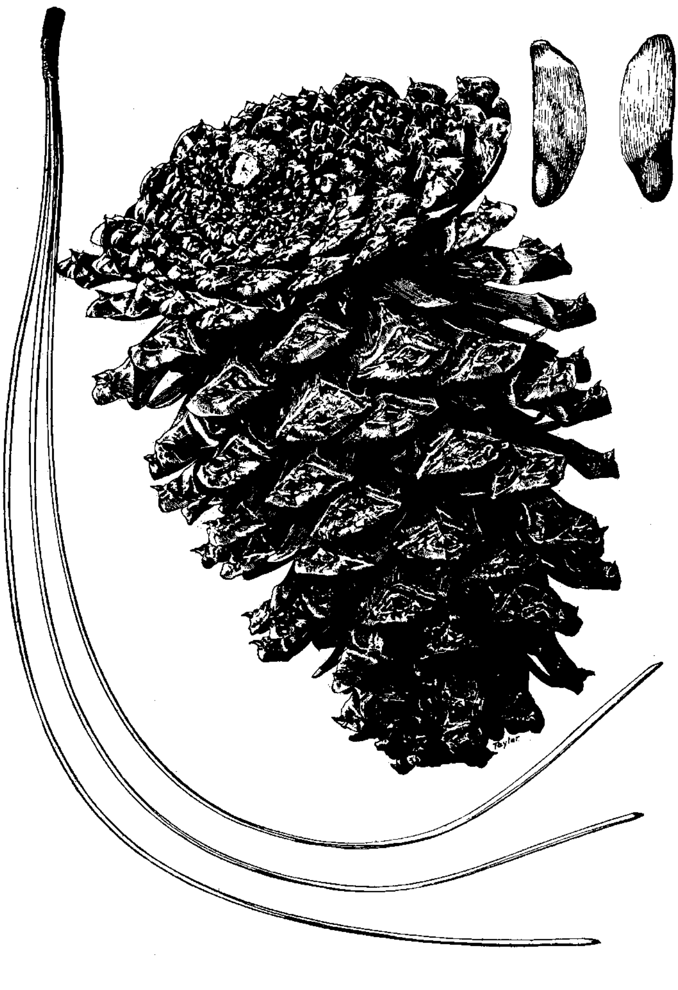
PRODUCTIVITY/MANAGEMENT: Timber production data is lacking but is presumed moderate for white oak, ponderosa pine, Douglas-fir, and, where present, aspen and cottonwood. Watershed, recreation and wildlife values likely exceed the value for timber production.

These are very important winter and early spring range for wildlife. Elk and deer sign is often abundant and these animals may have a significant impact on the relative abundance and composition of the undergrowth. The proximity to water makes these sites very important for a wide variety of small mammals and birds. They also produce forage from oak mast (fallen acorns) and are important thermal and hiding cover in the winter months.

Natural stands probably produced little herbage below the dense shrub layer. Disturbed sites are often indicated by abundant introduced grasses and weeds. This is especially true on areas that were once cleared for homesteads and grazing, or deforested for lumber and fuel.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The QUGA/COCO2-SYAL Association has not been described elsewhere.

# PONDEROSA PINE SERIES



# PONDEROSA PINE SERIES

DISTRIBUTION AND ENVIRONMENT: Ponderosa pine is one of the most widely distributed conifer tree species in western North America, constituting the lower timberline species in many areas. It is also a major seral species in many forest types throughout its range. It is very tolerant of hot, dry conditions and is one of the most drought-tolerant conifers in western North America. Ponderosa pine reaches its westernmost distribution as a major forest species along the east slopes of the Cascade Range in both Washington and Oregon. It is never very abundant in natural stands west of the Cascade Range.

Ponderosa pine is a major seral species in the Douglas-fir and Grand Fir Series on the Wenatchee National Forest and in the Douglas-fir Series on the Okanogan National Forest. It is restricted to drier and warmer sites in the Western Hemlock and Subalpine Fir Series. It may also be found mixed with Oregon White Oak on the Naches District, but distribution of these mixed stands is limited. It is unusual to find ponderosa pine in the Pacific silver fir, Mountain Hemlock, Whitebark Pine and Subalpine Larch Series. It is common only on the warmest sites in the Subalpine Fir Series. Climax ponderosa pine stands are relatively limited on the Forest and occur where soil drought and temperatures are too severe for any other conifer tree species.

The Ponderosa Pine Series grades into the Douglas-fir Series or directly into the Grand Fir Series on normal soils (i.e., those not derived from serpentine) as soil moisture increases and temperatures decrease. As soil temperatures increase and soil moisture decreases, the Series grades into non-forest vegetation. On serpentine soils, the transition to other Series is as abrupt as the contact between serpentine and adjacent rock types. On these sites the Ponderosa Pine Series is found under moisture regimes that on normal substrates would support more moist Series such as the Douglas-fir and Grand Fir Series.

Plots in this Series have been sampled in all Districts except the Lake Wenatchee, but relatively few were sampled, especially on the Entiat and Lake Chelan Districts, because many climax ponderosa pine stands are marginal forestland or were destroyed in recent stand-replacement fires. Twelve plots were borrowed from the lower Methow and Twisp River drainages (Okanogan National Forest) to supplement meager plot numbers (19) on the Wenatchee. More data will eventually be gathered for these vegetation types, and with additional data the miscellaneous ponderosa pine Association may be more completely described.

As in the Subalpine Fir and Douglas-fir Series, the Ponderosa Pine Series has been strengthened with the Okanogan NF data. The user will find descriptions that are less variable and that better describe the Entiat and Lake Chelan Districts (which are very similar climatically and geologically to the southwest portion of the Okanogan NF). In addition, these descriptions will begin the process of revising the Okanogan classification so that it and the Wenatchee/Colville/Rockies classifications mesh at their borders.

Four plant Associations are listed in the tables following this Series introduction. Three are minor types that are fairly well represented in the data. One poorly sampled type is described as a miscellaneous Association: PIPO/AGSP-ASDE.

VEGETATION: Climax ponderosa pine stands on the Forest typically grow as very open forests or woodlands. Ponderosa pine is often the only tree species present, although some Douglas-fir, or in rare instances grand fir, can be found. These last two species are interpreted as occurring only as “accidentals” and are not expected to assume dominance, or even necessarily to persist. They are often found growing in favorable microsites or on ecotones to Douglas-fir and grand fir sites. Many stands of ponderosa pine appear to be relatively uniform in size and spacing, which leads to the impression that they are even-aged. Some stands are even-aged but many stands contain several age classes. Stand age structure and patterns result from past disturbance events as well as from depth to rock or bedrock.

Ponderosa pine is usually the only tree species regenerating. Many stands have few trees, if any, in the seedling or sapling size classes. Ponderosa pine is well known for its episodic regeneration (Cooper 1961). Under natural conditions, successful reproduction and recruitment is only needed every few hundred years for stand maintenance.

Grasses dominate the undergrowth in most of the Associations described for the Series. Shrubs are important in some of them (e.g., PIPO/PUTR/AGSP, PIPO/PUTR/CARU), but even in these Associations, shrubs do not always form a continuous layer. Bluebunch wheatgrass is the most dominant and characteristic grass of the Series. Pinegrass and elk sedge may occur on more mesic types. Bluebunch wheatgrass is mixed with pinegrass on the PIPO/CARU-AGSP Association. Many of the important forbs and grasses found in the Series are species also characteristic of nearby shrublands and grasslands that occur under conditions too harsh for trees. Some important taxa include Sandberg's bluegrass, Wheeler's bluegrass, western yarrow, lupines, balsamroots and lomatiums.

PRODUCTIVITY/MANAGEMENT: These sites have low timber productivity due to low stocking and slow growth rates. However, trees in natural stands typically remain for several centuries and may grow very large. The total basal area for the three major types ranged from only 62 to 88 sq. ft. per acre while the site index for ponderosa pine ranged from 49 to 81 feet (base 100).

Fire has been an integral part of these forest and woodland ecosystems. It acts to maintain the open, grass-dominated undergrowth, reduce litter accumulations, and recycle nutrients bound in the litter. Fire was frequent under natural conditions and helped keep down the cover of shrubs such as bitterbrush and snowberry. Hot, dry conditions during summer months dried the grasses and litter enough to carry ground fires started by lightning. In addition to consuming litter, these fires also consumed small diameter woody material such as shrubs and tree seedlings and saplings, as well as logs and snags. Successful ponderosa pine recruitment occurred only when seedlings and saplings escaped fire until large enough to develop resistance to damage. Fire also exposed bare mineral soil, which is helpful for some species' seed germination. Stand-replacement fires did occur, but were unusual. Tree re-establishment following such an event can often require decades until conditions and a seed source are available. Tree plantings are often not successful.

These sites are important wildlife areas. They supply forage and browse during spring and early summer, and at lower elevations provide important winter range. Snags and logs provide valuable habitat and perches and are especially critical because tree density is low and therefore snag and log recruitment will also be slow or episodic.

The PIPO Series provides moderate herbage for livestock. Average herbage production on the three major Associations ranged from 178 to 313 lbs./ac. Invasion of noxious weeds is a serious problem, especially diffuse knapweed. Coarse soils are easily displaced on steep slopes. Heavy grazing reduces cover of bluebunch wheatgrass, beardless bluebunch wheatgrass and Idaho fescue. Introduced grasses and forbs may persist for many years in these open environments.

Primary root diseases include *Annosum* root disease and *Armillaria* root rot (Hessburg and others 1994). These rots were scattered before the era of resource management, but have increased dramatically by infecting stumps associated with selection logging. Other pathogens include comandra rust and elytroderma needle disease. They may be locally significant, but they rarely threaten entire stands of trees. Western dwarf mistletoe currently infests about 26% of ponderosa pine east of the Cascades. This level, which is likely elevated from historical times because lack of wildfires, has resulted in somewhat more dense stands, facilitating the spread of the parasite.

Insect species that can be pests include western pine beetle, mountain pine beetle, pine engraver, pandora moth, pine butterfly, sawflies, needle miners, tip miners and the sugar pine tortix (Hessburg and others 1994). Of these, the western pine beetle, pine engraver, and mountain pine beetle have the potential for severe outbreaks in the Series.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Ponderosa Pine Series has been described by numerous authors up and down the Cascades and east into the northern Rocky Mountains. Sometimes the Ponderosa Pine Series has been included in the Douglas-fir Series. Some of the authors include: Pfister and others 1977 (Montana); Cooper and others 1991 (Idaho); Williams and others 1990 (Colville NF); Williams and Lillybridge 1983 (Okanogan NF); Williams and Smith 1991 (Wenatchee NF Draft); Clausnitzer and Zamora 1987 (Colville Indian Res.); Zamora 1983 (Spokane Indian Res.); John and others 1988 (Yakima Indian Res.); and, Johnson and Clausnitzer 1992 (northeastern Oregon).

## Keys to Plant Associations of the Ponderosa Pine Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

Bitterbrush ≥ 5% and bluebunch or
beardless b. wheatgrass ≥ 5% .............................. PIPO/PUTR/AGSP p. 46

Pinegrass and/or elk sedge ≥ 5% and
Bluebunch or beardless b. wheatgrass ≥ 5% ........... PIPO/CARU-AGSP p. 44

Bluebunch or beardless b. wheatgrass ≥ 5%
- Podfern present ............................................. PIPO/AGSP-ASDE (M) p. 48
- Not as above ................................................... PIPO/AGSP p. 42

### Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| PIPO/AGSP | 3 | 40 | 71 | 21 | 101 | 236 |
| PIPO/CARU-AGSP | 2 | 32 | 88 | 23 | 116 | 313 |
| PIPO/PUTR/AGSP | 7 | 66 | 62 | 15 | 101 | 178 |

### Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| PIPO/AGSP | PIPO | 2 | 81 | 13 | 67 | 30 | 184 |
| PIPO/CARU-AGSP | PIPO | 3 | 49 | 9 | 65 | 13 | 213 |
| PIPO/PUTR/AGSP | PIPO | 30 | 75 | 33 | 86 | 30 | 96 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

## PONDEROSA PINE PLANT ASSOCIATION GROUPS

1. Hot Dry Shrub/Grass PAG
   - PIPO/AGSP *WEN*
   - PIPO/AGSP-ASDE (M)
   - PIPO/CARU-AGSP
   - PIPO/PUTR/AGSP

## PONDEROSA PINE PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| 1. PIPO/AGSP *WEN* | CPG141 |
| 2. PIPO/AGSP-ASDE (M) | CPG142 |
| 3. PIPO/CARU-AGSP | CPG231 |
| 4. PIPO/PUTR/AGSP | CPS241 |

# PIPO/AGSP *WEN* ASSOCIATION CPG141

*Pinus ponderosa/Agropyron spicatum*

ponderosa pine/bluebunch wheatgrass

*Bluebunch wheatgrass (AGSP), an indicator of the PIPO/AGSP Association*

## ENVIRONMENT

Elevation: 2900-4000 (3386) ft.

Aspect: south to west

Slope: 30-65(50) %

Slope position: mid to upper

Special: hot, dry sites - difficult to regenerate

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 29 |
| **TREE UNDERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 57 | 5 |
| **HERBS** | | | |
| ACMI | yarrow | 100 | 3 |
| AGSP | bluebunch wheatgrass | 86 | 23 |
| KOCR | prairie junegrass | 86 | 2 |
| BASA | arrowleaf balsamroot | 71 | 6 |
| BRTE | cheatgrass | 71 | 4 |
| FEID | Idaho fescue | 57 | 13 |
| POSA3 | Sandberg bluegrass | 57 | 5 |
| COGR2 | large-flowered collomia | 57 | 1 |
| AGIN | beardless b. wheatgrass | 14 | 25 |

## DISTRIBUTION AND ENVIRONMENT:

The PIPO/AGSP type appears to be a minor type on the Wenatchee National Forest but its total distribution is unknown because of low sample size. Three Okanogan plots are used to supplement the Wenatchee data. PIPO/AGSP probably occurs all along the dry eastern fringe of the Wenatchee and Okanogan NFs, but is more common at elevations below the Forest boundary.

PIPO/AGSP is one of the hottest and driest forested Associations. The type resembles a natural grassland with a scattering of trees. It is typically found on steep southerly slopes at relatively low elevations.

Soils are moderately shallow, coarse and very well drained. Surface rock and coarse fragments are usually abundant. Litter and bare ground are also abundant. Parent materials are mostly granite north of the Entiat ridge and basalt and andesite to the south.

Drier sites support bitterbrush, sagebrush or bunchgrass meadows. PIPO/PUTR/AGSP occurs on more coarse soils and PIPO/CARU-AGSP is on more moderate sites.

VEGETATION: Stands are very open and rarely form a closed canopy. Late seral and climax stands are dominated by ponderosa pine and other tree species are usually missing in the type. Ponderosa pine regeneration is relatively scarce. If Douglas-fir, grand fir, or Oregon white oak are present, they are scarce and restricted to microsites.

Shrubs are generally absent or inconspicuous. If bitterbrush is present, it may indicate potential for the site to belong in the PIPO/PUTR/AGSP Association. Evaluate whether bitterbrush is restricted to microsites or its cover is reduced in response to fire. Bitterbrush regenerates slowly following ground fire, so look for recent evidence (last 20 years).

Bluebunch wheatgrass, beardless bluebunch wheatgrass (Okanogan plots), Idaho fescue, prairie junegrass, Sandberg bluegrass, arrowleaf balsamroot and western yarrow are the most characteristic herbs. Cheatgrass is present on most sites, even those with little human-induced disturbance. Present data are too limited to further subdivide the type, though a PIPO/FEID type could be recognized.

PRODUCTIVITY/MANAGEMENT: Stocking levels and growth rates are low. Open stocking should favor more rapid tree growth. Three intensively sampled plots averaged 40 trees per acre and 71 sq. ft./ac. total basal area (Appendix C). The site index for ponderosa pine averaged 81 (base 100). Many stands have been logged in the past because of land ownership, ease of access and high value of large ponderosa pine. Reforestation success is unlikely within 5 years because of drought and heat stress. Silvicultural prescriptions should be limited to single tree selection and salvage or risk of prolonged de-forestation are high.

Many mature trees show evidence of fire. Fire scar patterns suggest a natural fire interval of 5-30 years. Stand-replacement fires remain infrequent. Fire has helped maintain the large, open-grown, ponderosa pine characteristic of the Association. Fire suppression has changed stands little, except perhaps to slightly increase the cover of the ponderosa understory, but the sites are sufficiently harsh that closed-canopy stands are rare. Periodic underburning essentially has little effect on these sites, except to remove small ponderosa pines and improve the vigor of understory vegetation.

Herbaceous forage production is moderate and averaged 236 pounds per acre on three clipped plots (Appendix C). Care must be used in management so that grazing does not lead to a noxious weed problem. Heavy grazing reduces cover of bluebunch wheatgrass, beardless bluebunch wheatgrass and Idaho fescue. Prairie junegrass, Sandberg bluegrass, arrowleaf balsamroot, western yarrow and cheatgrass either increase or become more conspicuous under grazing, and diffuse knapweed may increase markedly. Coarse soils are easily displaced on steep slopes.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PIPO/AGSP is similar to parts of the PIPO-PSME/AGIN and PIPO-PSME/AGSP types described on the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs. It is also similar to the PIPO/AGSP and PIPO/FEID Habitat Types in northern Idaho (Cooper and others 1991), Montana (Pfister and others 1977), and on the Spokane (Zamora 1983) and Colville Indian Reservations (Clausnitzer and Zamora 1987).

# PIPO/CARU-AGSP ASSOCIATION CPG231

*Pinus ponderosa/Calamagrostis rubescens-Agropyron spicatum*

ponderosa pine/pinegrass-bluebunch wheatgrass

## ENVIRONMENT

Elevation: 2500-4320 (3556) ft.

Aspect: south to west

Slope: 24-57 (42) %

Slope position: mid to upper

Special: hot, dry sites - difficult to regenerate

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 33 |
| **TREE UNDERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 86 | 2 |
| PSME | Douglas-fir | 43 | 1 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 57 | 3 |
| AMAL | serviceberry | 43 | 1 |
| **HERBS** | | | |
| ACMI | yarrow | 100 | 3 |
| AGSP | bluebunch wheatgrass | 86 | 22 |
| CARU | pinegrass | 86 | 21 |
| LUPIN | lupines | 86 | 5 |
| CAGE | elk sedge | 57 | 11 |
| BASA | arrowleaf balsamroot | 57 | 4 |
| FEID | Idaho fescue | 43 | 14 |
| AGIN | beardless b. wheatgrass | 14 | 15 |

## DISTRIBUTION AND ENVIRONMENT:

The PIPO/CARU-AGSP Association was sampled from near Lake Chelan to the southeast half of the Leavenworth District. Two plots were borrowed from Okanogan data on the Twisp District. It is not known if it extends further south as our data are limited and the description is based on available information. Other stands that key to the type may well have distributions outside the National Forests.

PIPO/CARU-AGSP occurs at moderately low elevations on moderate to steep, south to west facing, mid and upper slopes.

Soils data are unavailable but soils are likely to be deep and well-drained. Surface rock and coarse fragments are less abundant than in PIPO/AGSP. Litter is usually abundant. The regolith is highly variable, ranging from granite colluvium mixed with pumice to serpentine. Granite rock types are common north of the Entiat Ridge. Other rock types occur to the south. The type also occurs on sandstone and tephra.

PIPO/CARU-AGSP sites are generally more moderate than PIPO/AGSP, as indicated by the abundance of pinegrass.

VEGETATION: These are open woodlands dominated almost exclusively by ponderosa pine. Douglas-fir is rare in this type, and tends to grow only in favorable microsites. Regeneration is sparse and is mostly ponderosa pine. Total overstory cover is usually less than 50%.

The undergrowth is characterized by a pinegrass or elk sedge and wheatgrass matrix. Beardless wheatgrass and Idaho fescue are uncommon and appear to be largely restricted to Okanogan sites. Elk sedge is well represented on Wenatchee plots, whereas it is an uncommon species on the Okanogan NF. Plots with bitterbrush >5% cover were moved to the PIPO/PUTR/AGSP type. Serviceberry is common on a few plots. Other common forbs include western yarrow, ballhead waterleaf, lupines, barestem lomatium and arrowleaf balsamroot. In general, species richness is low and dominance by pinegrass or elk sedge and wheatgrass high.

Undoubtedly, fire and ungulate grazing play important parts in maintaining the appearance of these stands.

PRODUCTIVITY/MANAGEMENT: Even though site index and diameter growth are moderate because of open growing conditions, overall volume growth is low because the sites support relatively few trees per acre. Two intensive plots averaged 32 trees per acre and 88 sq. ft./ac. total basal area (Appendix C). The mean site index for ponderosa pine was 49 feet (base 100). Removal of most basal area will increase the risk of prolonged de-forestation. No known method is will assure reforestation in five years.

Fire scars and charcoal are abundant on our plots. Fire frequency may be high, but stand-replacement fires are rare.

Grazing and wildlife potential is fair. Grass cover is moderate (roughly 50%). Two clipped plots averaged 313 lbs./ac. of herbage (Appendix C). Existing shrubs provide some browse. Water sources may be remote. Pinegrass is moderately low in palatability, while elk sedge and bluebunch wheatgrass are moderate. Idaho fescue typically has high palatability. Soils are moderately raveled by trampling, but not nearly as much as in the PIPO/AGSP type.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PIPO/CARU-AGSP is similar to the PSME/CARU Habitat Type, AGSP Phase, described in Montana (Pfister and others 1977). A PIPO/CARU Association (without bunchgrasses) is described in northeastern Oregon (Johnson and Clausnitzer 1992). Some of the sample stands in the Ponderosa Pine Series from the Yakima Indian Reservation (John and others 1988) would key to this type.

# PIPO/PUTR/AGSP ASSOCIATION CPS241

*Pinus ponderosa/Purshia tridentata/Agropyron spicatum*

ponderosa pine/bitterbrush/bluebunch wheatgrass


## ENVIRONMENT

Elevation: 2120-3920 (2975) ft.

Aspect: southeast to southwest

Slope: 19-58 (44) %

Slope Position: mid to upper

Special: hot, dry sites - difficult to regenerate

## VEGETATION SUMMARY

(Sample size: 13)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 29 |
| PSME | Douglas-fir | 46 | 1 |
| **TREE UNDERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 38 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 100 | 19 |
| AMAL | serviceberry | 54 | 2 |
| **HERBS** | | | |
| ACMI | yarrow | 92 | 2 |
| AGSP | bluebunch wheatgrass | 77 | 19 |
| BASA | arrowleaf balsamroot | 77 | 9 |
| BRTE | cheatgrass | 62 | 10 |
| LUPIN | lupines. | 62 | 3 |
| HIERA | hawkweed spp. | 62 | 2 |
| COGR2 | large flower collomia | 54 | 2 |
| COPA | little flower collinsia | 54 | 2 |
| FEID | Idaho fescue | 46 | 23 |
| CARU | pinegrass | 46 | 13 |
| KOCR | prairie junegrass | 46 | 4 |
| AGIN | beardless b. wheatgrass | 23 | 17 |
| CAGE | elk sedge | 15 | 6 |

## DISTRIBUTION AND ENVIRONMENT:

This common type was sampled on all but the Lake Wenatchee and Cle Elum Districts. PIPO/PUTR/AGSP also extends into the Okanogan NF. Seven plots were borrowed from sites near Twisp. It has also been observed as a dominant type on lands on other ownerships in the foothills of the Cascades and eastward to Spokane (Clausnitzer and Zamora 1987). The sample is relatively large for the Ponderosa Pine Series and these descriptions are more reliable than other PIPO types.

These low to moderate elevation sites are hot, dry and occur on steep, southerly exposures. PIPO/PUTR/AGSP forms extensive stands across mid and upper slope positions.

The soils are colluvium derived largely from granite north of Entiat Ridge and basalt and sandstone to the south. Soil coarse fragments range from well represented to abundant. Bare ground and litter are often abundant.

The seven Okanogan plots were within the broadly defined PIPO-PSME/AGIN Association of Williams and Lillybridge (1983), while the Wenatchee plots were largely assigned to the PIPO/CARU-AGSP and PIPO/PUTR/AGSP Associations in the Wenatchee Draft.

VEGETATION: These are open woodlands dominated by ponderosa pine in all stages of forest succession. Total overstory canopy cover is usually less than 40%. Regeneration is often patchy and sparse, with ponderosa pine as the only species. If present, Douglas-fir, grand fir and white oak overstory and regeneration are uncommon and confined to favorable microsites.

The undergrowth is characterized by a moderate canopy of bitterbrush over an extensive grass layer. Bluebunch wheatgrass or beardless bluebunch wheatgrass are the dominant ground cover. Idaho fescue, pinegrass and elk sedge were well represented on many of our plots. Some PIPO/PUTR/AGSP plots were once in the PIPO/CARU-AGSP type (Wenatchee Draft), but further analysis suggests bitterbrush and wheatgrass are better indicators of these sites. Other common species include lupines, yarrow, arrowleaf balsamroot, prairie junegrass, large-flowered collomia and hawkweeds. Cheatgrass is also common and may be abundant in some stands.

PRODUCTIVITY/MANAGEMENT: Timber productivity is low in these open stands. Trees are widely spaced and relatively slow growing. Intensive tree information is available from 7 intensive plots. These stands averaged 66 trees per acre and 62 sq. ft./ac. total basal area (Appendix C). The mean site index for ponderosa pine was 75 feet (base 100). Reforestation success is unlikely within 5 years because of drought and heat stress. Removal of most basal area will increase the risk of prolonged de-forestation.

Fires are a common event in these stands, although they typically are not stand-replacement fires. Bitterbrush is sensitive to ground fire and may be nearly eliminated from some stands. Stands with recent groundfire (<20 years) may key to the PIPO/AGSP type, so use care when keying such sites.

Wildlife use is heavy during fall, winter and spring. Herbaceous production can be fair, especially early in the spring. Six clipped plots averaged 178 pounds of herbage per acre (Appendix C). Heavy grazing or other forms of disturbance often lead to an increase in weedy species such as cheatgrass and diffuse knapweed. Maintenance of a vigorous native grass is important to reduce the amounts of noxious weeds, such as diffuse knapweed. Soils are easily displaced by both livestock and wildlife trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PIPO/PUTR/AGSP is widespread. Similar PIPO/PUTR Habitat Types, AGSP and FEID Phases, have been described on the Spokane (Zamora 1983), Colville (Clausnitzer and Zamora 1987) and Yakima (John and others 1988) Indian Reservations, as well as in northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977). The type has been observed but not described on the Colville NF, but is common at lower elevations on other land ownerships.

# MISCELLANEOUS PONDEROSA PINE PLANT ASSOCIATION

(less than 5 Wenatchee sample plots)

## PIPO/AGSP-ASDE CPG142

There were three plots in this type (called PIPO/ASDE in the original Draft). Further analysis and a slight change in the interpretation of the Series concept moved one of these plots to the Douglas-fir Series and one to the PIPO/CARU-AGSP Association—leaving one to be PIPO/AGSP-ASDE. Although outwardly similar to the PIPO/AGSP Association, the PIPO/AGSP-ASDE type represents a unique environment characterized by the presence of serpentine substrates. Serpentine substrates are very unusual and typically result in depauperate stands with at least some odd species. Podfern is one of these species, and it usually indicates serpentine environments. These sites are very harsh with poor growth of typically scattered trees. Series determination can be difficult in these stands as Douglas-fir can often be present in small amounts. The type occurs on steep, hot, dry, south slopes below 3500 feet. The dominant vegetation is ponderosa pine, bluebunch wheatgrass and balsamroot. Podfern averages 3% cover in the data.

# DOUGLAS-FIR SERIES

# DOUGLAS-FIR SERIES

DISTRIBUTION AND ENVIRONMENT: Douglas-fir is one of the most important tree species in the Pacific Northwest. It is the dominant seral or climax species over a very broad range of habitats and economically has been the preferred species of the regional softwood industry. It is the climax tree species on habitats either too dry for, or beyond the geographic range of, more shade-tolerant species such as western hemlock, western redcedar, grand fir or subalpine fir. Information from other areas appears to indicate that stands of the Douglas-fir Series have greater moisture losses at 12- and 20-inch soil depths than stands in other Series, except for the Ponderosa Pine and Oregon White Oak Series.

Douglas-fir is often the dominant or co-dominant species within stands of the Western Hemlock, Pacific Silver Fir and Grand Fir Series and is prominent on warmer sites in the Subalpine Fir Series. Within these Series, Douglas-fir is a long-lived pioneer. The Grand Fir Series is found on somewhat more mesic sites, while the Subalpine Fir Series is typical of cooler habitats on north slopes or bottoms, or at higher elevations. Climax Douglas-fir are very abundant in the drier portions of the Forest but closer to the Cascade Crest are more restricted to steep south slopes. On warmer, drier sites, the Douglas-fir Series grades into non-forest communities or into the Ponderosa Pine Series. Rarely, the Douglas-fir Series will grade directly into the Western Hemlock or Pacific Silver Fir Series, which occur on much more mesic sites. Several Associations within the Douglas-fir Series have azonal distributions. That is, these types are not confined to a distinctive climatic belt where Douglas-fir is climax, but rather occur on especially dry habitats in areas where Douglas-fir is normally a seral species. For example, PSME/CAGE, PSME/ARUV and some other types may occur on less harsh sites on dry slopes near 5000 feet surrounded by subalpine fir- or grand fir-dominated stands.

The Douglas-fir Series has been sampled on all the Districts on the Wenatchee NF. However, plot numbers are more limited on the Entiat and Lake Chelan Districts, where there are vast acres of wilderness or where many stands have been destroyed by recent stand-replacement wildfires in the 1970s or the huge fire of 1994. In general, there were not enough plots in the Wenatchee Draft classification to adequately describe these two northern districts. Therefore, 149 plots were borrowed from the lower Methow and Twisp River drainages (Okanogan NF) to supplement the 153 plots from the Wenatchee NF. This will help to characterize the Entiat and Chelan Districts until additional data is gathered in Douglas-fir Series.

This Douglas-fir classification is significantly different from the Wenatchee Draft Guide. The Okanogan and Wenatchee Douglas-fir plots have been intensively analyzed and the Associations now more closely parallel those described on the Colville NF. Also, the types described in this document are less variable. The user will also find several miscellaneous types based largely on the Okanogan NF data. They may better describe Associations in the Entiat and Lake Chelan Districts, which is climatically and geologically very similar to southwest Okanogan districts.

Twenty-three plant Associations are listed in the tables following this Series introduction. Twelve of the plant Associations are described as miscellaneous types because they have limited occurrence on the Wenatchee NF (generally less than 5 plots). These poorly-defined types are PSME/AGSP-ASDE, PSME/ARUV, PSME/ARUV/CARU, PSME/ARUV-PUTR, PSME/PEFR3, PSME/PAMY, PSME/PAMY/CARU, PSME/PUTR, PSME/SPBEL, PSME/VACA, PSME/VAMY, and PSME/VAMY/CARU. Some of them may be elevated to major status after more data are collected or when a three-Forest classification is developed. These descriptions begin the process of revising the Okanogan classification so it and the Wenatchee/Colville/northern Rockies classifications mesh at their borders.

VEGETATION: Ponderosa pine, western larch and lodgepole pine are major seral species within the Douglas-fir Series. The last two species are relatively uncommon members of the sere for most of the Douglas-fir Series on the Wenatchee NF. They are much more important seral species in the Series as found on the Okanogan and Colville NFs. Other than the Ponderosa Pine and Oregon White Oak Series, the Douglas-fir Series is the most xeric forest Series found on the Forest.

The Douglas-fir Series is generally easy to distinguish from more moist Series by the scarcity of mesic site indicators, even though microsite variation may permit occasional mesic indicators within a representative Douglas-fir Association stand. However, the presence of more than trace or accidental amounts of some mesic species should suggest an Association more moist than the Douglas-fir Series. These species include: (trees) subalpine fir, Pacific silver fir, mountain hemlock, Alaska yellow cedar, western hemlock, western redcedar, grand fir and Engelmann spruce; (shrubs) western prince's pine, beargrass, dwarf bramble, Pacific yew, red-osier dogwood, devil's club, Cascade azalea, rusty menziesia, Cascade Oregon grape, bunchberry dogwood, prickly currant and mountain ash; (herbs) queencup beadlily, false bugbane, baneberry, starry solomon's seal, pathfinder, horsetail, skunk cabbage, sweetscented bedstraw, ladyfern, vanilla leaf, coolwort foamflower, oak fern, smooth woodrush, arrowleaf groundsel, Sitka valerian, wild ginger, Hooker fairybells and rosy twistedstalk. Many of these species are listed in Table 3, Species Comparison by Series, at the end of the Introduction.

PRODUCTIVITY/MANAGEMENT: Plant growth on many Associations in the Douglas-fir Series is limited by lack of growing season moisture. Summer soil drought is severe in many types. Douglas-fir sites have low to moderate timber productivity due to low stocking and slow growth rates. The average stand basal area for drier Associations such as PSME/AGSP and PSME/PUTR/AGSP ranged from 60 to 124 sq. ft./acre (Appendix C). The average stand site index for Douglas-fir in these dry Associations ranged from 29 to 62 feet (base 50), while ponderosa pine ranged from 57 to 104 feet (base 100). More mesic Associations such as PSME/SYAL, PSME/CAGE and PSME/VAMY have moderate growth rates. The average stand basal area on these more mesic sites ranged from 140 to 233 sq. ft./acre. The average stand site index for Douglas-fir ranged from 40 to 76 feet (base 50), while ponderosa pine ranged from 73 to 98 feet (base 100). Shade tolerant trees such as western hemlock, western redcedar, subalpine fir and grand fir are unable to successfully occupy habitats within the Douglas-fir Series, due mainly to drought stress.

Many herbs and shrubs in the Series are rhizomatous and respond quickly to disturbances. A vegetative reproduction strategy gives species such as pinegrass, elk sedge, northwestern sedge, common snowberry and shiny-leaf spirea a competitive advantage over species that rely entirely on seeds, especially early in succession.

Low-intensity ground fires (underburns) have significantly influenced the development of many stands, and many pre-European-settlement stands in the Douglas-fir Series were open and park-like in response to frequent ground fire. Individual Douglas-firs, ponderosa pine and western larch are resistant to fires after they have matured enough to develop the characteristic thick, corky, insulating bark typical of the species. Stand-replacement fires were rare in stands in this condition. Fire scars are common, especially on ponderosa pine, which is especially favored by underburns. But without underburning, ponderosa pine is eventually replaced by the more shade-tolerant but somewhat less fire-resistant Douglas-fir. The advent of vigorous fire protection has resulted in longer time periods between ground fire and dense Douglas-fir stands have developed in the absence of underburns. Ground fuel and "ladders" of Douglas-firs of various age classes have developed on more mesic sites, increasing the potential for catastrophic fires (as well as for severe forest health problems).

If a site is capable of supporting lodgepole pine and a seed source is available, then repeated stand-replacing crown fires often lead to a near total dominance by lodgepole pine, through a combination of serotiny, early lodgepole pine seed maturity, and the elimination of seed sources for other species. Lodgepole pine increases in prominence if the interval between crown fires is less than its approximately 200-year average life span. It may be hard to judge the climax on such sites because of the scarcity of Douglas-fir regeneration.

Clearcutting and burning often result in extensive and persistent shrubfields or grasslands that resist reforestation efforts for years. Shrubfields may be an essential part of the sere, functioning to restore organic matter and nutrients before forest restoration can be successful. The emphasis here is on *forest*, not just trees.

Many Douglas-fir Associations are important wildlife areas. The drier types, such as PSME/AGSP, supply forage and browse during spring and early summer, and at lower elevations provide important winter range. Snags and logs provide valuable habitat and perches and are especially critical in the drier types because tree density is low there and, therefore, snag and log recruitment is slow or episodic.

Many Associations in the Douglas-fir Series provide moderate herbage for livestock, especially those with grass dominated ground vegetation. For example, herbage production on the PSME/AGSP, PSME/CARU, PSME/CARU/AGSP, PSME/PUTR/AGSP and PSME/SYAL/AGSP types averaged 201, 262, 421, 244 and 318 lbs./ac., respectively (Appendix C). Invasion of noxious weeds, especially diffuse knapweed, is a serious problem on these drier types. Introduced grasses and forbs can also persist for many years. Coarse soils are easily displaced on these steep slopes and on ravelly soils associated with dry bunchgrass types. Associations with dense shrub layers of elk sedge and pinegrass are more resistant to trampling. Heavy grazing reduces cover of elk sedge, bluebunch wheatgrass, Idaho fescue and other more palatable grasses.

Primary root diseases of Douglas-fir include P- and S-group *Annosum* root diseases, laminated root rot, and *Armillaria* root rot (Hessburg and others 1994). These fungal diseases were scattered before the era of intensive resource management but have increased dramatically by infecting stumps associated with selection logging. They also infect ponderosa pine, although it is resistant to laminated root rot. Other pathogens of ponderosa pine include comandra rust and elytroderma needle disease, which may be locally significant, though they rarely threaten entire stands. Various dwarf mistletoes currently infest at least 43% of Douglas-fir and 26% of ponderosa pine east of the Cascades. Dwarf mistletoe infections are also severe in lodgepole pine and are a major cause of mortality in western larch (Jim Hadfield, personal communication). These levels are likely elevated from historical times because lack of wildfires has resulted in denser stands, facilitating the spread of mistletoe. In some cases dwarf mistletoe and root diseases threaten entire stands of trees. More often, however, they create fuel conditions and fire ladders that hasten and intensify wildfire effects (J. Townsley, personal communication).

Insect species that can be pests of Douglas-fir include the Douglas-fir engraver, fir engraver, western spruce budworm, Douglas-fir tussock moth and Douglas-fir beetle (Hessburg and others 1994; Jim Hadfield, personal communication). The fir engraver and Douglas-fir beetle have the potential for severe outbreaks in Douglas-fir. Insects affecting ponderosa pine include the western pine beetle, mountain pine beetle, pine engraver, pandora moth, pine butterfly, sawflies, needle miners, tip miners, and the sugar pine tortix. Of these, the western pine beetle, pine engraver and mountain pine beetle have the potential for severe outbreaks in ponderosa pine, and the pine engraver and mountain pine beetle can severely impact lodgepole pine. In the past 20 years, the mountain pine beetle has killed the lodgepole pine on hundreds of thousands of acres east of the Cascades and in the Rocky Mountains. Western spruce budworm outbreaks have been increasing in severity since the beginning of the century (Hessburg and others 1994).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Douglas-fir Series has been described by numerous authors up and down the Cascades and east into the northern Rocky Mountains. Some authors include: Pfister and others 1977 (Montana); Cooper and others

1991 (Idaho); Williams and others 1990 (Colville NF); Williams and Lillybridge 1983 (Okanogan NF); Williams and others 1991 (Wenatchee NF Draft); Clausnitzer and Zamora 1987 (Colville Ind. Res.); Zamora 1983 (Spokane Ind. Res.); John and others 1988 (Yakima Ind. Res.); and Johnson and Clausnitzer 1992 (northeastern Oregon).

## Keys to Plant Associations of the Douglas-fir Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

| | | |
|---|---|---|
| Dwarf huckleberry ≥ 5%, cold air drainage on glacial terraces or outwash (use bearberry ≥ 5% only if site requirements are met) | PSME/VACA (M) | p. 82 |
| Low huckleberry or big huckleberry ≥ 5% | | |
| Pinegrass and/or elk sedge ≥ 5% | PSME/VAMY/CARU (M) | p. 83 |
| Not as above | PSME/VAMY (M) | p. 83 |
| Common snowberry or creeping snowberry ≥ 5% | | |
| Bluebunch wheatgrass or Idaho fescue ≥ 5% | PSME/SYAL/AGSP | p. 74 |
| Pinegrass and/or elk sedge ≥ 5% | PSME/SYAL/CARU | p. 76 |
| Not as above | PSME/SYAL | p. 72 |
| Mountain snowberry or mountain big sagebrush ≥ 5% | PSME/SYOR | p. 78 |
| Bearberry ≥ 5% | | |
| Bitterbrush ≥ 5% | PSME/ARUV-PUTR (M) | p. 81 |
| Pinegrass and/or elk sedge ≥ 5% | PSME/ARUV/CARU (M) | p. 80 |
| Not as above | PSME/ARUV (M) | p. 80 |
| Bitterbrush ≥ 5% | | |
| Bluebunch wheatgrass, beardless b. wheatgrass or Idaho fescue ≥ 5% | PSME/PUTR/AGSP | p. 66 |
| Pinegrass and/or elk sedge ≥ 5% | PSME/PUTR/CARU | p. 68 |
| Not as above | PSME/PUTR (M) | p. 82 |
| Shinyleaf spiraea ≥ 5% | | |
| Pinegrass and/or elk sedge ≥ 5% | PSME/SPBEL/CARU | p. 70 |
| Not as above | PSME/SPBEL (M) | p. 82 |
| Pachistima ≥ 5% | | |
| Pinegrass and/or elk sedge ≥ 5% | PSME/PAMY/CARU (M) | p. 81 |
| Not as above | PSME/PAMY (M) | p. 81 |
| Pinegrass and/or elk sedge ≥ 5% | | |
| Bluebunch wheatgrass and/or Idaho fescue ≥ 5% | PSME/CARU-AGSP | p. 64 |
| Pinegrass ≥ 5% | PSME/CARU | p. 62 |
| Elk sedge ≥ 5% | PSME/CAGE | p. 60 |
| Shrubby penstemon ≥ 5% | PSME/PEFR3 (M) | p. 82 |
| Bluebunch wheatgrass, beardless b. wheatgrass and/or Idaho fescue ≥ 5% | | |
| Podfern present | PSME/AGSP-ASDE (M) | p. 80 |
| Not as above | PSME/AGSP | p. 58 |

## Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| PSME/AGSP | 2 | 50 | 76 | 18 | 112 | 201 |
| PSME/AGSP-ASDE (M) | 2 | 25 | 60 | 21 | 82 | 279 |
| PSME/ARUV-PUTR (M) | 4 | 101 | 88 | 13 | 146 | 124 |
| PSME/ARUV/CARU (M) | 11 | 152 | 137 | 14 | 223 | 84 |
| PSME/CAGE | 6 | 325 | 208 | 12 | 357 | 88 |
| PSME/CARU | 18 | 324 | 169 | 14 | 289 | 262 |
| PSME/CARU-AGSP | 7 | 242 | 124 | 14 | 222 | 421 |
| PSME/PAMY/CARU (M) | 4 | 169 | 206 | 16 | 317 | 244 |
| PSME/PEFR3 (M) | 3 | 83 | 92 | 16 | 141 | 44 |
| PSME/PUTR (M) | 3 | 169 | 95 | 12 | 164 | 59 |
| PSME/PUTR/AGSP | 6 | 224 | 96 | 13 | 176 | 244 |
| PSME/PUTR/CARU | 4 | 261 | 138 | 10 | 253 | 106 |
| PSME/SPBEL (M) | 2 | 297 | 165 | 10 | 302 | 10 |
| PSME/SPBEL/CARU | 11 | 238 | 197 | 14 | 326 | 143 |
| PSME/SYAL | 8 | 250 | 178 | 12 | 304 | 75 |
| PSME/SYAL/AGSP | 4 | 61 | 92 | 18 | 137 | 318 |
| PSME/SYAL/CARU | 4 | 306 | 233 | 12 | 396 | 261 |
| PSME/SYOR | 6 | 129 | 117 | 13 | 193 | 347 |
| PSME/VACA (M) | 3 | 619 | 135 | 9 | 285 | 137 |
| PSME/VAMY/CARU (M) | 7 | 517 | 235 | 10 | 437 | 91 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| PSME/AGSP | PIPO | 7 | 61 | 8 | 60 | 16 | 132 |
| | PSME | 8 | 29 | 8 | 79 | 17 | 128 |
| PSME/AGSP-ASDE | PIPO | 3 | 70 | 3 | 50 | 15 | 75 |
| | PSME | 4 | 52 | 4 | 68 | 25 | 145 |
| PSME/ARUV | LAOC | 5 | 42 | 5 | 144 | 42 | 126 |
| | PICO | 5 | 39 | 5 | 140 | 39 | 114 |
| | PSME | 2 | 27 | 5 | 173 | 33 | 236 |
| PSME/ARUV-PUTR | PICO | 5 | 37 | 5 | 62 | 16 | 121 |
| | PIPO | 4 | 85 | 19 | 69 | 33 | 164 |
| | PSME | 9 | 44 | 10 | 67 | 22 | 110 |
| PSME/ARUV/CARU | LAOC | 12 | 47 | 13 | 86 | 29 | 168 |
| | PIPO | 12 | 70 | 29 | 101 | 26 | 213 |
| | PSME | 27 | 31 | 49 | 103 | 21 | 185 |
| PSME/CAGE | PIPO | 3 | 137 | 3 | 276 | 167 | 81 |
| | PSME | 27 | 64 | 28 | 220 | 99 | 101 |
| PSME/CARU | LAOC | 28 | 51 | 29 | 110 | 40 | 161 |
| | PICO | 13 | 44 | 13 | 130 | 42 | 103 |
| | PIPO | 8 | 73 | 16 | 120 | 41 | 139 |
| | PSME | 73 | 50 | 81 | 168 | 60 | 130 |
| PSME/CARU-AGSP | PIPO | 23 | 85 | 26 | 151 | 57 | 107 |
| | PSME | 19 | 55 | 19 | 115 | 44 | 90 |
| PSME/PAMY/CARU | PIPO | 5 | 72 | 8 | 138 | 55 | 162 |
| | PSME | 20 | 50 | 20 | 173 | 60 | 126 |
| PSME/PEFR3 | PIPO | 8 | 74 | 12 | 84 | 27 | 139 |
| | PSME | 9 | 51 | 10 | 83 | 30 | 107 |
| PSME/PUTR | PIPO | 3 | 57 | 11 | 72 | 20 | 212 |
| | PSME | 11 | 42 | 12 | 101 | 31 | 115 |
| PSME/PUTR/AGSP | PIPO | 12 | 74 | 20 | 86 | 27 | 118 |
| | PSME | 21 | 56 | 21 | 145 | 59 | 88 |
| PSME/PUTR/CARU | PIPO | 12 | 83 | 19 | 132 | 60 | 127 |
| | PSME | 12 | 51 | 13 | 153 | 58 | 94 |
| PSME/SPBEL | PSME | 10 | 63 | 10 | 151 | 68 | 70 |
| PSME/SPBEL/CARU | PIPO | 26 | 95 | 40 | 157 | 67 | 124 |
| | PSME | 47 | 60 | 48 | 177 | 77 | 104 |
| PSME/SYAL (WEN) | PIPO | 13 | 98 | 14 | 231 | 108 | 134 |
| | PSME | 40 | 76 | 40 | 244 | 139 | 71 |
| PSME/SYAL/AGSP | PIPO | 2 | 105 | 10 | 146 | 98 | 159 |
| | PSME | 13 | 62 | 13 | 123 | 52 | 78 |
| PSME/SYAL/CARU | PIPO | 1 | 83 | 6 | 120 | 68 | 220 |
| | PSME | 18 | 74 | 18 | 208 | 100 | 76 |
| PSME/SYOR | PIPO | 19 | 70 | 22 | 133 | 47 | 123 |
| | PSME | 21 | 51 | 21 | 149 | 56 | 76 |
| PSME/VACA | LAOC | 10 | 53 | 10 | 84 | 32 | 110 |
| | PICO | 15 | 47 | 15 | 149 | 53 | 84 |
| | PSME | 10 | 53 | 10 | 131 | 49 | 107 |
| PSME/VAMY | LAOC | 4 | 52 | 4 | 81 | 30 | 158 |
| | PICO | 5 | 46 | 5 | 81 | 26 | 91 |
| | PSME | 2 | 46 | 2 | 117 | 37 | 136 |
| PSME/VAMY/CARU | LAOC | 14 | 47 | 19 | 99 | 34 | 170 |
| | PICO | 15 | 37 | 15 | 116 | 31 | 107 |
| | PIPO | 4 | 73 | 6 | 287 | 91 | 116 |
| | PSME | 14 | 40 | 29 | 166 | 50 | 208 |

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF. O&C represents a type identical to the Okanogan and Colville.

DOUGLAS-FIR
PLANT ASSOCIATION
GROUPS

1. Hot Dry Shrub/Grass PAG
   - PSME/AGSP *WEN*
   - PSME/AGSP-ASDE (M)
   - PSME/CARU-AGSP
   - PSME/PUTR (M)
   - PSME/PUTR/AGSP
   - PSME/SYAL/AGSP

2. Warm Dry Shrub/Herb PAG
   - PSME/ARUV *WEN* (M)
   - PSME/ARUV-PUTR (M)
   - PSME/PAMY (M)
   - PSME/PEFR3 (M)
   - PSME/SPBEL (M)
   - PSME/SYOR

3. Warm Mesic Shrub/Herb PAG
   - PSME/SYAL *WEN*
   - PSME/SYAL/CARU

4. Cool Dry Grass PAG
   - PSME/ARUV/CARU (M)
   - PSME/CAGE *WEN*
   - PSME/CARU
   - PSME/PAMY/CARU (M)
   - PSME/PUTR/CARU
   - PSME/SPBEL/CARU

5. Cool Mesic Shrub/Herb PAG
   - PSME/VACA (M)
   - PSME/VAMY *WEN* (M)
   - PSME/VAMY/CARU (M)

DOUGLAS-FIR
PLANT ASSOCIATIONS
AND ECOCLASS CODES

| | |
|---|---|
| PSME/AGSP *WEN* | CDG322 |
| PSME/AGSP-ASDE (M) | CDG323 |
| PSME/ARUV *WEN* (M) | CDS653 |
| PSME/ARUV-PUTR (M) | CDS654 |
| PSME/ARUV/CARU (M) | CDS655 |
| PSME/CAGE *WEN* | CDG132 |
| PSME/CARU o&c | CDG131 |
| PSME/CARU-AGSP | CDG134 |
| PSME/PAMY (M) | CDS411 |
| PSME/PAMY/CARU (M) | CDS412 |
| PSME/PEFR3 (M) | CDF411 |
| PSME/PUTR (M) | CDS673 |
| PSME/PUTR/AGSP | CDS654 |
| PSME/PUTR/CARU | CDS675 |
| PSME/SPBEL (M) | CDS640 |
| PSME/SPBEL/CARU | CDS639 |
| PSME/SYAL *WEN* | CDS636 |
| PSME/SYAL/AGSP | CDS637 |
| PSME/SYAL/CARU | CDS638 |
| PSME/SYOR o&c | CDS632 |
| PSME/VACA (M) | CDS831 |
| PSME/VAMY *WEN* (M) | CDS832 |
| PSME/VAMY/CARU (M) | CDS833 |

# PSME/AGSP WEN ASSOCIATION CDG322

*Pseudotsuga menziesii/Agropyron spicatum*

Douglas-fir/bluebunch wheatgrass

## ENVIRONMENT

Elevation: 2500-5320 (3600) ft.

Aspect: SE to SW, north to east

Slope: 11-74 (45) %

Slope position: ridge, U, M 1/3

Special: very hot, dry slopes

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 19 |
| PIPO | ponderosa pine | 80 | 17 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 60 | 2 |
| PIPO | ponderosa pine | 30 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 50 | 3 |
| AMAL | serviceberry | 40 | 2 |
| **HERBS** | | | |
| AGSP | bluebunch wheatgrass | 70 | 19 |
| BALSA | balsamroot species | 70 | 7 |
| ACMI | yarrow | 70 | 2 |
| FEID | Idaho fescue | 50 | 13 |
| LUPIN | lupines | 40 | 7 |
| BRTE | cheatgrass | 40 | 6 |
| AGIN | beardless b. wheatgrass | 30 | 33 |
| CARU | pinegrass | 30 | 3 |
| CAGE | elk sedge | 30 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/AGSP Association is widespread and occurs all along the dry eastern portions of the northern Cascades. Four Wenatchee plots were located from the east edge of the Leavenworth and Naches Districts. Six additional plots are borrowed from Okanogan NF Data on the Twisp District.

PSME/AGSP is a hot, dry type that occurs on a variety of slopes and aspects. It usually occurs on steep to very steep, southerly slopes with mid and upper slope positions and elevations between 2500 and 3900 ft. A few plots are on northerly aspects at lower elevations, while two plots over 4900 feet were on dry south slopes.

The regolith is colluvium derived from a variety of rock types, depending on geographic location. The sample plots were on sandstone or granite north of Entiat Ridge and basalt to the south. Soils are stony and gravelly and well drained. Soil coarse fragments and litter are usually abundant.

PSME/AGSP grades into bitterbrush-dominated non-forest vegetation on harsher sites, while closed Douglas-fir or grand fir forest occurs on more moderate sites.

VEGETATION: Stand structure varies from very open forest to woodland. Canopy cover ranged from about 15 to 55%. Douglas-fir and ponderosa pine are co-dominant on most plots, although pine was absent on two high-elevation sites. Ponderosa pine is usually the older species in the stand, indicating that it is more successful at regeneration immediately following disturbance, such as stand-replacement wildfire. The tendency for Douglas-fir to be younger indicates either that it requires the shelter of some pine for establishment or that its seed sources are more likely to be removed from a stand. The open and patchy structure of these stands will allow ponderosa pine to continue its role as co-dominant. Regeneration for both species is typically sparse.

The shrub layer is weak and serviceberry and bitterbrush are common on at best about half the plots. The user must be very careful when bitterbrush is present but not well represented. Carefully examine the fire history of the stand. As bitterbrush is sensitive to moderate and hot ground fire, the presence of recent fire activity (<20 years) may indicate the PSME/PUTR/AGSP Association is a better designation for the site.

The abundance of various bunchgrasses characterizes these sites. Bluebunch wheatgrass or beardless bluebunch wheatgrass is well represented on all plots. Idaho fescue is well represented on 50% of the plots. Pinegrass and elk sedge have <5% cover. Cheatgrass is abundant in some stands. Some of the more important forbs include Carey or arrowleaf balsamroot, yarrow, littleflower collinsia, bigleaf collomia and lupine species.

PRODUCTIVITY/MANAGEMENT: Timber productivity is low due to the open nature of the stands and slow tree growth. Two intensive tree plots averaged just 50 trees per acre and 76 sq. ft./ac. total basal area (Appendix C). The average site index for ponderosa pine was 61 feet (base 100) and only 29 feet (base 50) for Douglas-fir. These very harsh, dry sites are very difficult to reforest. It is likely that successful reforestation will depend not on choosing an appropriate silvicultural system but on the right combination of seed availability and on climatic conditions that allow seedling establishment. The concurrence of these two events has been relatively infrequent in the past. No known method will assure reforestation within five years. Soils are subject to displacement on the steep slopes. Soil disturbance can easily lead to a noxious weed problem on these open sites.

Fire is an important part of the history of these stands. Ground fire was frequent and stand-replacement fires rare before the advent of vigorous fire control. Even today, the more open portions of the stands will likely carry only ground fires, with only a few trees dying as a result of fire. However, under hot, dry conditions, denser stands may become more susceptible to crown fire. The grasses, sedges and forbs will generally increase in abundance following fire.

Wildlife values are high and the type is especially important for winter range for elk or deer because of the presence of palatable grasses and forbs. The steep southerly aspects are among the earliest forested sites to become snow-free; green forage develops early.

Gentler slopes can be important for domestic livestock. Herbage production averaged 201 lbs./ac. on two clipped plots. The soils on steeper slopes are easily displaced by trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/AGSP is a widespread type that has been described in various ways in the Pacific Northwest. Sample plots were located in other broad types in previous eastern Washington NF classifications. The Okanogan plots were largely in the PSME-PIPO/AGIN type of the Okanogan classification (Williams and Lillybridge 1983). Wenatchee plots were located in either unclassified Douglas-fir stands or in the PSME-PIPO/CAGE type (Williams and others 1991). PSME/AGSP is similar to most of the Colville's PSME-PIPO/AGSP type (Williams and others 1990). It is also similar to the PSME/AGSP and PSME/FIED habitat types described in northern Idaho (Cooper and others 1991), Montana (Pfister and others 1977), and on the Colville Indian Reservation (Clausnitzer and Zamora 1987).

# PSME/CAGE *WEN* ASSOCIATION CDG132

*Pseudotsuga menziesii/Carex geyeri*

Douglas-fir/elk sedge

## ENVIRONMENT

Elevation: 2020-4880 (3104) ft.

Aspect: southeast to northwest

Slope: 18-62 (42) %

Slope position: ridge, U, M, L 1/3, bench

Special: dry, cool sites:

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 45 |
| PIPO | ponderosa pine | 92 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 83 | 3 |
| PIPO | ponderosa pine | 17 | 6 |
| **SHRUBS AND SUBSHRUBS** | | | |
| AMAL | serviceberry | 75 | 2 |
| SPBEL | shiny-leaf spirea | 58 | 3 |
| SYAL | common snowberry | 58 | 2 |
| BEAQ | Oregon grape | 45 | 2 |
| **HERBS** | | | |
| CAGE | elk sedge | 100 | 11 |
| ARCO | heartleaf arnica | 58 | 5 |
| HIAL | white hawkweed | 58 | 1 |
| LUPIN | lupines | 50 | 2 |
| ARMA3 | bigleaf sandwort | 50 | 2 |
| CARU | pinegrass | 50 | 2 |
| LUNA2 | silvercrown luina | 42 | 8 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/CAGE type was sampled on the Naches, Cle Elum and Leavenworth Districts. These plots extended from the Tieton River on the south end of the Wenatchee NF to the south slopes of the Entiat Mountains in the north. This type may be found on the Entiat District, but doesn't occur to the north where elk sedge is absent.

This is a cool, dry type that is somewhat similar to the PSME/CARU type described for the Okanogan and Colville NFs. It occurs on a wide range of elevations on moderate to very steep, southeast to northwest facing, mid and upper slope positions. South and west exposures are more common for upper elevation plots, while low elevation plots tend to be on northwest to southeast exposures.

The regolith of sample plots is a deep, rocky colluvium derived largely from basalt parent materials. Several plots also occur on sandstone and schist. Ash may be common in the upper soil horizons of some plots. The soil surface is usually covered by large amounts of litter and vegetation. Gravels and cobbles average over 20% in soil surface horizons.

The Wenatchee Draft reported this type as occurring on habitats near the upper elevation limit for the Douglas-fir Series. With the addition of plots from the Naches and Cle Elum Districts, and plots at lower elevations that were unclassified in the Draft, this is no longer true.

VEGETATION: Mature and climax stands are characterized by open to marginally closed stands of Douglas-fir. Douglas-fir is usually the sole reproducing tree species. Ponderosa pine was prominent in the overstory of only 4 of 12 sample plots, partly because most stands are too high in elevation for ponderosa pine to be abundant. All plots are too xeric for grand fir or subalpine fir. Western larch and white pine are absent. Early and mid seral stands have abundant Douglas-fir in a near-uniform size, while all ages are well represented in older stands.

The undergrowth is dominated by forbs and graminoids. The shrub layer is very subordinate to the herbs. Pachistima is scarce and likely will not increase significantly following fire. The only other common shrubs are shiny-leaf spirea, serviceberry, Oregon grape and common snowberry. None are well represented.

The herbaceous layer is relatively poor in species and variable in cover and extent. Elk sedge is the dominant and characteristic species. Silvercrown luina, lupine spp., heartleaf arnica, white hawkweed, bigleaf sandwort and pinegrass are common. If pinegrass is well represented, the type should key to PSME/CARU.

PRODUCTIVITY/MANAGEMENT: Timber production is moderate. Six intensively sampled plots averaged 325 trees/ac. and 208 sq. ft./ac. total basal area (Appendix C). The site index for Douglas-fir averaged 64 feet (base 50). Individual trees can attain large diameters. Douglas-fir is best adapted to these sites, though ponderosa pine may be featured on a few warmer ones. Elk sedge will respond vigorously to moderate burning and scarification. Competition to tree seedlings is not normally a problem until elk sedge cover exceeds 30%. However, if trees are not established in the first year following harvest, subsequent plantings and seedings may fail. Cutting systems that leave an overstory to provide site protection encourage tree regeneration. Stands may have abundant advanced Douglas-fir regeneration (1-5 years old) that can sometimes be featured in management. There is often little need to scarify, burn and plant. Stands rarely need grass seeding for erosion control.

Fire scars on the trees, charcoal on the ground and char on the logs are all common. These dry sites probably experienced ground fires fairly frequently before the advent of vigorous fire control, as they are often located near ridgetops. Crown fires were probably uncommon, but are becoming more common as fuel ladders develop.

Wildlife values are high because, with more rapid snow melt and higher insolation rates to the herb layer, the sites provide habitat conditions much different than most of the surrounding forest. Large, wolfy Douglas-firs on high elevation ridges and knobs are important winter habitat for blue grouse.

Herbage production is surprisingly low. Six clipped plots averaged only 88 pounds of herbage per acre (Appendix C). Some of the plots are located along old stock driveways and still show the effects of severe overgrazing. The abundant silvercrown luina found in some stands reflects this past history of abusive grazing.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/CAGE does not occur on either the Colville (Williams and others 1990) or Okanogan (Williams and Lillybridge 1983) NFs, nor the Yakima, Colville or Spokane Indian Reservations (John and others 1988; Clausnitzer and Zamora 1987; Zamora 1983). It is very similar to the PSME/CAGE types described for northern Idaho (Cooper and others 1991), Montana (Pfister and others 1977), and northeast Oregon (Johnson and Clausnitzer 1992). It appears identical to the PSME/CAGE type from the Mt. Hood.

# PSME/CARU *o&c* ASSOCIATION CDG131

*Pseudotsuga menziesii/Calamagrostis rubescens*

Douglas-fir/pinegrass

## ENVIRONMENT

Elevation: 1810-5560 (4034) ft.

Aspect: all

Slope: 2-70 (34) %

Slope position: ridge, <u>U</u>, <u>M</u>, L 1/3, bottom

Special: cool, dry

## VEGETATION SUMMARY

(Sample size: 76)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 96 | 31 |
| PIPO | ponderosa pine | 68 | 16 |
| PICO | lodgepole pine | 22 | 17 |
| LAOC | western larch | 21 | 17 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 86 | 5 |
| PIPO | ponderosa pine | 26 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SPBEL | shiny-leaf spirea | 51 | 3 |
| AMAL | serviceberry | 45 | 2 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 38 |
| ARCO | heartleaf arnica | 83 | 8 |
| LUPIN | lupines | 62 | 9 |
| CAGE | elk sedge | 43 | 12 |
| HIAL | white hawkweed | 39 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

As presently defined, PSME/CARU is one of the more widely distributed and abundant types on the Wenatchee NF. It is also abundant on the Okanogan and Colville NFs, and in eastern Oregon, northern Idaho and Montana. Forty one plots occurred on the Wenatchee NF. An additional 35 plots in the vicinity of Twisp were borrowed from Okanogan NF data.

These are cool, dry sites. Most sample plot elevations lie between 3000 to 5000 feet. A variety of slope and aspect combinations are represented, but flat or extremely steep slopes are uncommon. While topographic positions range from bottoms to ridgetops, mid and upper slopes are most common, and bottom sites are rare. While not always true, there is a trend for plots to lie on northeast facing slopes at low elevations and on south to west slopes at high elevations.

The regolith is colluvium derived from a variety of rock types. Basalt is most common south of Entiat, while granites prevail to the north. Soil coarse fragments are usually gravels and cobbles and range from 10 to 60%. Litter cover is usually 20-60% and surface rocks are usually apparent.

PSME/CARU grades into ABLA2/CARU at higher elevations. Harsher, higher elevation sites may support PIAL/CARU. Drier slopes support types such as PSME/CARU-AGSP.

VEGETATION: These are generally open forests co-dominated by ponderosa pine and Douglas-fir in early to mid seral stages. Douglas-fir is generally the sole reproducing tree species in mature stands. Ponderosa pine is a prominent seral species. Oregon white oak was well represented on four plots in the Tieton River watershed. As oak was extremely subordinate to Douglas-fir and ponderosa pine, these plots were not put in the QUGA type. Lodgepole pine and western larch are common on about half the plots located on the Okanogan NF, but are mostly absent from Wenatchee data.

The undergrowth is characterized by a grass and sedge sward. Several shrubs may be present but none are well represented. Common shrub associates include serviceberry, shiny-leaf spirea and ocean-spray. Common snowberry or bitterbrush are never well represented. As presently defined, shrubs are an integral but relatively inconspicuous component of the type. If a stand has a visible and distinctive shrub layer overtopping the grass and sedge sward, it probably should key to a PSME/shrub type, such as PSME/PUTR/CARU, PSME/SYAL/CARU, PSME/SPBEL/CARU or PSME/ARUV/CARU.

Forbs are low in cover value and dominated by the pinegrass sward. Important forb associates include heartleaf arnica, white-flowered hawkweed and lupine spp. (including sulfur lupine, broadleaf lupine, silky lupine and spurred lupine). Pure pinegrass swards are very uncommon on the Wenatchee NF, as most sites that support pinegrass also have elk sedge. Elk sedge is less common on the northern part of the Wenatchee NF and is not found on the Okanogan NF.

PRODUCTIVITY/MANAGEMENT: Timber productivity is moderate to good compared to most other types in the Douglas-fir Series. Eighteen intensive plots averaged 324 trees per acre and 169 sq. ft. total basal area (Appendix C). The site index for ponderosa pine averaged 73 feet (base 100) and lodgepole pine, larch and Douglas-fir averaged 44, 51 and 50 feet (base 50), respectively. Douglas-fir and ponderosa pine are best adapted to these sites on the Wenatchee NF. Lodgepole pine and western larch may be considered on the Okanogan NF. Pinegrass and elk sedge respond vigorously to burning and scarification. Competition to tree seedlings is not normally a problem until pinegrass or elk sedge cover exceeds 30%. However, if trees are not established in the first year, subsequent plantings and seedings may fail. Cutting systems that leave an overstory to provide site protection encourage tree regeneration. Stands may have abundant advanced Douglas-fir regeneration (1-5 years old) that can sometimes be featured in management. There is often little need to scarify, burn and plant. Stands rarely need grass seeding for erosion control.

Almost every stand has indicators of fire, including char on bark, charcoal in the soil, and fire scars on trees and stumps. The general composition of this type is well suited to periodic underburning. Data from the Okanogan NF suggest ground fire return periods of 10 to 40 years. Before the advent of vigorous fire control stands were often composed of large, open-grown Douglas-fir and ponderosa pine. Stand-replacement fires were rare. Stand-replacement fires are more common now that fire control has allowed the regeneration and establishment of Douglas-fir fuel ladders.

The value for livestock grazing is low to moderate, depending on the steepness of slope and the relative abundance of elk sedge compared to pine grass. Eighteen clipped plots averaged 262 pounds of herbage per acre. The pinegrass and elk sedge sod resists trampling and displacement.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This type was described in classifications for the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs; for the Colville (Clausnitzer and Zamora 1987) and Yakima Indian Reservations (John and others 1988); and for north Idaho (Cooper and others 1991), Montana (Pfister and others 1977) and northeast Oregon (Johnson and Clausnitzer 1992). It was called PSME/CARU-CAGE in the Wenatchee Draft (Williams and others 1991). PSME/CARU is similar to part of the PSME/CARU Habitat Type on the Spokane Indian Reservation (Zamora 1983). Zamora's plots that had bearberry well represented would key to PSME/ARUV/CARU in this classification.

# PSME/CARU-AGSP ASSOCIATION CDG134

*Pseudotsuga menziesii/Calamagrostis rubescens-Agropyron spicatum*

Douglas-fir/pinegrass-bluebunch wheatgrass

## ENVIRONMENT

Elevation: 1480-3880 (2613) ft.

Aspect: southeast to west

Slope: 31-67 (52) %

Slope position: ridge, U, M, L 1/3

Special: hot, dry pinegrass sites

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 17 |
| PSME | Douglas-fir | 100 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 75 | 3 |
| PIPO | ponderosa pine | 58 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 67 | 3 |
| AMAL | serviceberry | 67 | 2 |
| SYAL | common snowberry | 50 | 3 |
| CEVE | snowbrush ceanothus | 50 | 3 |
| PREM | bitter cherry | 50 | 2 |
| **HERBS** | | | |
| AGSP | bluebunch wheatgrass | 100 | 18 |
| BASA | arrowleaf balsamroot | 92 | 7 |
| ACMI | yarrow | 92 | 3 |
| CAGE | elk sedge | 75 | 16 |
| LUPIN | lupines | 75 | 5 |
| CARU | pinegrass | 58 | 23 |
| APAN | spreading dogbane | 50 | 6 |
| LAPA2 | few-flowered peavine | 50 | 6 |
| HISC | woolly hawkweed | 50 | 4 |
| BRTE | cheatgrass | 33 | 5 |
| FEID | Idaho fescue | 17 | 6 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/CARU-AGSP was sampled southward from the Twenty-five Mile Creek area on the Chelan District to the Naches River on the Naches District. It has been observed but not described on the Colville and Okanogan NFs and is common in the northern Rocky Mountains.

It usually occurs on mid and upper slopes with southeast to west aspects. Most plots were between 2000 and 3500 feet. A few plots occur on north aspects at lower elevations.

The regolith is most often derived from granite colluvium, but a variety of other rock types include sandstone, schist, basalt and conglomerate, depending on geographic location. Soils are moderately cobbly or gravelly. Litter cover is usually 30-60%. Surface gravels and cobbles are usually evident, as is some bare soil.

The PSME/CARU-AGSP type grades into PIPO/CARU-AGSP, PSME/PUTR/AGSP, PSME/AGSP, the PIPO Series, or, on harsher sites, bitterbrush or bunchgrass-dominated non-forest vegetation. Closed Douglas-fir or grand fir forest occurs on more moderate sites. At first glance, PSME/CARU-AGSP appears similar to the PSME/AGSP-CAGE type described in the Wenatchee Draft. However, most plots in that description had bitterbrush or common snowberry well represented and now belong to the PSME/PUTR/AGSP or PSME/SYAL/AGSP Associations.

VEGETATION: Stand structure varies from open forest with canopy cover approaching 60% to woodland with canopy cover as little as 15%. There appears to be some correspondence between density and soil depth, but this has not been verified. Douglas-fir and ponderosa pine typically co-dominate these stands. Ponderosa pine is usually the older species in the stand, indicating that it is more successful at regeneration immediately following disturbance. The tendency for Douglas-fir to have younger ages indicates either that it requires the shelter of some pine for establishment or that its seed sources are more likely to be removed from a stand. The open and patchy structure of these stands will allow ponderosa pine to continue its role as co-dominant. Stands in the Icicle Creek watershed often have small amounts of bigleaf maple. Douglas-fir is slightly more dominant in the regeneration layer.

Several shrubs are common but none are well represented. They include bitterbrush, serviceberry, bitter cherry, snowbrush ceanothus and common snowberry. Mockorange may be common in the Icicle Creek area.

Bluebunch wheatgrass, along with elk sedge and/or pinegrass, dominates all sites. Other important herbs are Idaho fescue, yarrow, dogbane, arrowleaf balsamroot, woolly hawkweed, few-flowered peavine and lupine. Cheatgrass is abundant in some stands.

Fires will reduce or eliminate some shrub species that are intolerant of fire, like bitterbrush, while others may vigorously resprout. Be careful in stands where bitterbrush is common and there is recent evidence of fire (last 20 years). Such stands may belong to the PSME/PUTR/AGSP type. The grasses, sedges and forbs will generally increase in abundance following fire.

PRODUCTIVITY/MANAGEMENT: PSME/CARU-AGSP timber production is moderately low, based on stocking limitations and moderate height growth. Seven intensive plots averaged 242 trees per acre and 124 sq. ft. total basal area (Appendix C). The average site index for ponderosa pine was 85 feet (base 100), while the Douglas-fir site index was 55 feet (base 50). These are harsh, dry sites that may be difficult to reforest. It is likely that successful reforestation will not depend on choosing an appropriate silvicultural system but will depend on the right combinations of seed availability and climatic conditions to allow seedling establishment. The concurrence of these two events has been relatively infrequent in the past. No known method will assure reforestation within five years. Soils are subject to displacement on the steep slopes if the grass sod is eliminated.

Fire is an important part of the history of these stands. Groundfires were frequent before the advent of vigorous fire control. Stand-replacement fires were rare and continue to be less frequent compared to more mesic Douglas-fir types. More open portions of the stands will likely carry ground fire, with only a few trees dying from crown fire. However, denser portions of the stands may become more susceptible to crown fire during drought conditions.

Wildlife values are high and the type is especially important for winter range for deer because of the abundant grasses and the presence of palatable shrubs such as bitterbrush and serviceberry. The steep southerly aspects are among the earliest forested sites to become snow-free and develop green forage early.

Livestock grazing values are moderate. Herbage production on six clipped plots averaged 421 pounds per acre (Appendix C). However, steeper slopes and somewhat unstable soils make many sites unsuitable for livestock grazing.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: As presently defined, PSME/CARU-AGSP is similar to the PSME/CARU Habitat Type, AGSP Phase, and PSME/CAGE Habitat Type, AGSP Phase, in Montana (Pfister and others 1977). A few plots in the PSME/CARU Association described in the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) classifications would key to this type.

# PSME/PUTR/AGSP ASSOCIATION CDS674

*Pseudotsuga menziesii/Purshia tridentata/Agropyron spicatum*

Douglas-fir/bitterbrush/bluebunch wheatgrass

## ENVIRONMENT

Elevation: 2540-4310 (3215) ft.

Aspect: south to west

Slope: 17-60 (42) %

Slope position: U, M, L 1/3

Special: hot, dry sites

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 23 |
| PSME | Douglas-fir | 100 | 14 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 70 | 3 |
| PIPO | ponderosa pine | 60 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 100 | 15 |
| AMAL | serviceberry | 80 | 3 |
| **HERBS** | | | |
| BASA | arrowleaf balsamroot | 90 | 10 |
| AGSP | bluebunch wheatgrass | 70 | 21 |
| CARU | pinegrass | 70 | 8 |
| LUPIN | lupines | 70 | 6 |
| ACMI | yarrow | 70 | 3 |
| HISC | woolly hawkweed | 50 | 4 |
| FEID | Idaho fescue | 40 | 4 |
| AGIN | beardless b. wheatgrass | 30 | 27 |
| CAGE | elk sedge | 30 | 17 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/PUTR/AGSP Association is represented by four plots on the Chelan and Naches Districts of the Wenatchee NF. Eight other plots were borrowed from Okanogan data from the lower Twisp and Methow River drainages. The type should occur throughout the drier portions of the Wenatchee NF.

These are some of the easternmost open forest and woodland stands in the Douglas-fir Series. Sites are typically hot and dry and occur on moderately steep upper and mid slope positions with south to west exposure. Sample plot elevations ranged from 2500 to 2900 feet on the Wenatchee NF and 2900 to 4400 feet on the Okanogan NF.

Soils are generally stony and shallow. Many slopes are steep enough to have active downslope transport of material, and bare ground and surface rock are common. Soil coarse fragments and litter range from well represented to abundant.

The regolith is composed primarily of granite colluvium or glacial till north of Entiat Ridge, and cinders on the Naches District. In a larger sample size, other parent materials would have been represented.

PSME/PUTR/AGSP has harsher sites than PSME/PUTR/CARU and is slightly more moderate than PSME/PUTR. Sites with shallower soils and drier conditions are occupied by either non-forest vegetation or the Ponderosa Pine Series.

VEGETATION: These are open forest or woodland. Ponderosa pine generally dominates early in the sere and persists as an important component through climax. In most stands, it either dominates or is co-dominant with Douglas-fir in the overstory. Douglas-fir dominance gradually increases through the sere, but in these open stands it will never completely exclude ponderosa pine. The sparse regeneration often includes both ponderosa pine and Douglas-fir. A few plots have very little Douglas-fir and could be keyed to PIPO/PUTR/AGSP. When keying these open stands, it is important to look for Douglas-fir over an area larger than the plot.

The undergrowth is characterized by open shrubs intermixed with open areas of forbs and grasses. Bitterbrush is the characteristic shrub. Serviceberry is often present. Other shrubs have low constancy and include spirea, wax current and ceanothus.

The herbaceous layer is well developed and includes a number of characteristic species. Characteristic grasses are bluebunch wheatgrass, beardless bluebunch wheatgrass and Idaho fescue. Beardless b. wheatgrass is in the Okanogan data. Pinegrass and elk sedge represent more moderate environments within the type and are well represented on about half the plots. These plots could have supported an additional PSME/PUTR/CARU-AGSP type, but for these harsh sites, the bunchgrasses appear to be better indicators. Other common herbs include arrowleaf balsamroot, yarrow, bluegrass species, white hawkweed, lupines and large-flowered collomia. There is strong patterning in the forbs and grasses, defined by the presence or absence of shrubs. Many herbs occur only in the shelter of the shrub clusters, while others occupy the area between shrubs.

PRODUCTIVITY/MANAGEMENT: Tree height growth is moderate but in general these stands are too open to produce much volume. Six intensively sampled plots averaged 224 trees per acre and 96 sq. ft. basal area (Appendix C). The average site index for ponderosa pine was 74 (base 100), while Douglas-fir was 56 (base 50). Most stands were composed of several age classes. Ponderosa pine is often the first tree to regenerate following wildfire, and individual trees typically last several centuries and become very large. These are harsh sites, even for the Douglas-fir Series, and no known techniques will consistently assure reforestation within five years. Many of these stands have already been selectively logged for individual large ponderosa pine. These stands are not recommended for intensive timber management. Silviculture should be limited to individual tree selection and salvage.

Fire scars are common. Underburns continue to be common, while stand-replacement fires are rare. Fire intensity and fire return-interval both influence vegetation composition and structure in these stands. Bitterbrush is sensitive to fire and will be temporarily eliminated if the return-interval is too short and the intensities are beyond a critical threshold. If keying stands to this Association, evaluate the fire history to see if bitterbrush cover has been reduced by recent fire (20 years). Fuel loadings and tree density are usually not enough to maintain crown fires, although some denser tree patches could be destroyed.

These sites are heavily used by both livestock and wildlife. They are important winter range for deer and elk. Herbage production is moderate. Six clipped plots averaged 244 pounds per acre (Appendix C). A number of nutritious grass species are common and several of the shrubs provide palatable forage.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/PUTR/AGSP is not as widespread as PIPO/PUTR/AGSP. It was not described in the Wenatchee Draft (Williams and others 1991), where appropriate plots were either unclassified or located in the PSME-PIPO/CAGE Association. Okanogan plots were located within the broad PIPO-PSME/AGIN and PSME/ARUV-PUTR Associations (Williams and Lillybridge 1983). This type was not described in any adjacent classifications, although some PSME/PUTR sample stands from others areas might include enough bluebunch wheatgrass to be included in the Wenatchee's PSME/PUTR/AGSP.

# PSME/PUTR/CARU ASSOCIATION CDS675

*Pseudotsuga menziesii/Purshia tridentata/Calamagrostis rubescens*

Douglas-fir/bitterbrush/pinegrass

## ENVIRONMENT

Elevation: 2650-4000 (3216) ft.

Aspect: southeast to southwest

Slope: 18-64 (42) %

Slope position: U, M, L 1/3

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 100 | 34 |
| PSME | Douglas-fir | 86 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 5 |
| PIPO | ponderosa pine | 86 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PUTR | bitterbrush | 100 | 9 |
| AMAL | serviceberry | 57 | 3 |
| SPBEL | shiny-leaf spirea | 43 | 3 |
| CEVE | snowbrush ceanothus | 43 | 3 |
| BEAQ | Oregon grape | 43 | 2 |
| PAMY | pachistima | 43 | 1 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 21 |
| ACMI | yarrow | 100 | 2 |
| BASA | arrowleaf balsamroot | 71 | 2 |
| CAGE | elk sedge | 57 | 15 |
| HISC | woolly hawkweed | 57 | 4 |
| ARCO | heartleaf arnica | 57 | 1 |
| AGSP | bluebunch wheatgrass | 43 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

This type was sampled from the Chelan District in the north to the Tieton River drainage in the south. PSME/PUTR/CARU probably occurs on all Districts but the Lake Wenatchee. It typically is found at moderate elevations on upper and mid slope positions and has a tendency to occur on south-facing slopes.

The regolith at the north end of the Wenatchee NF is derived from granite and related parent materials, either as colluvium or as glacial deposits. Naches and Leavenworth soils were derived from a variety of parent materials, such as basalt, sandstone and tephra. Soils are gravelly and stony and probably well drained. Soil coarse fragments are well represented, but less abundant than in the PSME/PUTR/AGSP type. Litter is usually abundant.

Many of these plots were initially placed in the PSME/ARUV-PUTR type described in the Okanogan classification and the Wenatchee Draft. As presently described, PSME/PUTR/CARU bears little resemblance to that type because it is restricted to lower elevations and lacks bearberry, western larch and lodgepole pine.

The abundance of pinegrass and elk sedge and the scarcity of bunchgrasses indicate this type is more moderate than PSME/PUTR/AGSP and transitional to PSME/CARU. However, sites are still relatively severe compared to PSME/CARU.

VEGETATION: These are moderately open forests that are often dominated by ponderosa pine. Douglas-fir is subordinate to ponderosa in the sample stands, but seems to be reproducing somewhat better. Douglas-fir should dominate mature stands, even though ponderosa will never be eliminated. Within-stand density is often variable, with small patches of relatively young trees interspersed with open areas containing scattered, large trees. Lodgepole pine and western larch are absent in the data.

The undergrowth is characterized by a mixture of xerophytic shrubs and grasses. Bitterbrush is well represented but is usually not abundant. Other common shrubs include snowbrush ceanothus, Oregon grape, ocean-spray, shiny-leaf spirea, common snowberry, pachistima and serviceberry. None are well represented, except in early seral stands. High cover of snowbrush ceanothus indicates recent disturbance, usually fire. Ceanothus seeds survive long periods in the soil and germinate following heat scarification provided only by fire. Hot fires will generally reduce or temporarily eliminate bitterbrush from a stand, but poorly-represented bitterbrush could still indicate this Association even if there is evidence of recent fire.

Pinegrass dominates the herbaceous layer. Elk sedge is often co-dominant with pinegrass south of Entiat Ridge, but there is presently insufficient data to support a PSME/PUTR-CAGE type. Bunchgrasses are uncommon. Common forbs include balsamroot, yarrow, woollyweed, lupines, dogbane and wild onion.

PRODUCTIVITY/MANAGEMENT: PSME/PUTR/CARU is more productive than PSME/PUTR/AGSP. Four intensively sampled plots averaged 261 trees per acre and 138 sq. ft./ac. basal area (Appendix C). The site index for ponderosa pine averaged 83 feet (base 100), while Douglas-fir averaged 51 feet (base 50). These sites require special attention when designing a silvicultural system. Hot, dry southerly aspects create severe moisture and temperature stress for young trees. Ponderosa pine is suggested for planting, especially on sandy soils. Pinegrass and elk sedge may respond vigorously to burning and scarification, although perhaps not as vigorously in PSME/CARU. Competition to tree seedlings is not normally a problem until shrub, pinegrass or elk sedge cover exceeds 30%. However, if trees are not established in the first year, subsequent plantings and seedings fail. Cutting systems that leave an overstory to provide site protection encourage tree regeneration. Stands may have abundant advanced Douglas-fir regeneration (1-5 years old) that can sometimes be featured in management. There is often little need to scarify, burn and plant. Stands rarely need grass seeding for erosion control.

Fire is undoubtedly important, as fire scars are common. As in PSME/PUTR/AGSP, underburns were frequent and stand-replacement fires rare before the advent of serious fire control. Fire intensity and fire return-interval both influence vegetation composition and structure in these stands. Bitterbrush is sensitive to fire and may be temporarily eliminated if the return-interval is too short and intensities are beyond a critical threshold. When keying stands to this Association, evaluate the fire history to see if bitterbrush cover has been reduced by recent fire (20 years). Fuel loadings and tree density are usually not enough to maintain crown fires, although some of the denser tree patches could be destroyed this way.

These stands are important summer range for livestock as well as for elk and deer. Steep, southerly slopes are often relatively snow free during winter months and are therefore important deer and elk winter range. Bitterbrush provides late fall and early spring browse and the relatively warm sites produce green forage earlier in the spring than most other forested types. Herbage production is low to moderate and averaged 106 lbs./ac. on four clipped plots (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/PUTR/CARU has not been described elsewhere, but some PSME/PUTR sample stands from others areas could include enough pinegrass to be included in the Wenatchee's PSME/PUTR/CARU.

## PSME/SPBEL/CARU ASSOCIATION CDS639

*Pseudotsuga menziesii/Spirea betulifolia/Calamagrostis rubescens*

Douglas-fir/shiny-leaf spirea/pinegrass

### ENVIRONMENT

Elevation: 1830-4540 (3251) ft.

Aspect: all aspects

Slope: 12-76 (39) %

Slope position: ridge, U, M, L 1/3

Special: well drained, stony soils

### VEGETATION SUMMARY

(Sample size: 38)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 28 |
| PIPO | ponderosa pine | 95 | 21 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 87 | 4 |
| PIPO | ponderosa pine | 29 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SPBEL | shiny-leaf spirea | 100 | 12 |
| AMAL | serviceberry | 68 | 3 |
| PAMY | pachistima | 63 | 10 |
| ROSA | roses | 59 | 4 |
| HODI | ocean-spray | 45 | 4 |
| BEAQ | Oregon grape | 42 | 3 |
| **HERBS** | | | |
| CARU | pinegrass | 92 | 23 |
| CAGE | elk sedge | 66 | 8 |
| ARCO | heartleaf arnica | 47 | 4 |
| ARMA3 | bigleaf sandwort | 42 | 2 |
| ACMI | yarrow | 37 | 2 |

### DISTRIBUTION AND ENVIRONMENT:

The PSME/SPBEL/CARU Association is widespread on the Wenatchee NF. Only eleven of the 38 sample plots are located on the Okanogan NF. Plots are especially well represented on the Leavenworth and Naches Districts. There is little data from the Entiat and Chelan Districts as stands suitable for sampling are scarce. Much of the area is inaccessible by road or was burned in the fires of the early 1970s or the huge 1994 fire. The type is common on the Okanogan NF on sites that belonged to PSME/CARU in the Okanogan classification.

These are warm, relatively low elevation sites. Aspects and slopes of sample plots are variable. Slopes are usually moderately steep with mid to upper slope position. The elevations of most plots were between 2000 and 4000 feet.

Soils are stony and well drained. Soil coarse fragments and litter range from well represented to abundant. Soils are formed in a wide variety of parent materials. Granite prevails north of the Entiat Ridge, while cinders, schist and tephra rock types are common to the south.

PSME/SPBEL/CARU is more moderate than PSME/SPBEL, as indicated by the abundance of pinegrass. It is generally at lower elevation compared to PSME/ARUV/CARU or PSME/PAMY/CARU.

VEGETATION: These are moderately open forests of Douglas-fir and ponderosa pine with a well developed low to tall shrub undergrowth and grass sward. Douglas-fir dominates mature stands. Ponderosa pine may dominate early seral stands and often survives as scattered, old trees in mature stands. Most sites are too warm for lodgepole pine and western larch. Either ponderosa pine or Douglas-fir are capable of pioneering on these habitats. Douglas-fir is the main regeneration species, although minor amounts of ponderosa pine can be found in larger openings.

The undergrowth is a mixture of low and tall shrubs and graminoides. Shrubs such as serviceberry or Scouler willow may attain considerable height in early seral stands. Pachistima is not as common as in PSME/SPBEL and was well represented on only 4 of the 32 sample plots. Many other shrubs may be present, depending on stand history and density, and include serviceberry, Scouler willow, rose and ocean-spray.

Pinegrass is the most abundant herb on both the Wenatchee and Okanogan NFs. Elk sedge is common south of Entiat Ridge and uncommon to the north. Herbs are usually inconspicuous members of the flora and include heartleaf arnica, bigleaf sandwort and yarrow.

PRODUCTIVITY/MANAGEMENT: Tree growth data from eleven intensive plots suggest stocking levels are moderate, while site indexes are relatively good for the Douglas-fir Series. These plots averaged 238 trees per acre and 197 sq. ft./ac. total basal area. The average site index for ponderosa pine was 95 (base 100), while Douglas-fir was 60 feet (base 50). The stands are variable in composition and age. Ponderosa pine and Douglas-fir are well suited to these warm sites. Western larch and lodgepole pine are not. Stands are hot and dry in the summer and shade may be essential to assure reforestation. South and west aspects are especially difficult to reforest. Pinegrass and elk sedge respond vigorously to burning and scarification. Competition for tree seedlings is not normally a problem until pinegrass or elk sedge cover exceeds 30%. However, if trees are not established in the first year, subsequent plantings and seedings may fail. Cutting systems that leave an overstory to provide site protection encourage tree regeneration. Stands may have abundant advanced Douglas-fir regeneration (1-5 years old) that can sometimes be featured in management. There is often little need to scarify, burn, and plant or seed grass for erosion control.

Fires have been common in the PSME/SPBEL/CARU type. Relatively few of our sample stands are over 200 years old, yet fire scars, charcoal and stand structures indicate that underburns were frequent and stand-replacement fires rare before the advent of vigorous fire control. Most of the important undergrowth species are well adapted to fire. Many resprout from buried root crowns or, Scouler willow for example, have widely distributed seeds. Others regenerate from buried roots or rhizomes, including pinegrass, elk sedge and shiny-leaf spirea. Others regenerate mainly from seeds buried in the soil, including such species as snowbrush ceanothus and pachistima.

Use by deer is relatively heavy, based on the number of deer trails and sign noted during field work. This is especially true on southerly aspects that may be good deer and elk winter range. The shrubs provide considerable wildlife habitat, providing both forage and hiding cover. Gentler slopes can be important sites for domestic livestock. Herbage production is moderately low. Eleven clipped plots averaged 143 pounds of herbage per acre (Appendix C). More gentle slopes make good sites for recreation developments such as campgrounds and trailheads because the shrubs and grasses are relatively resistant to trampling damage. The shrub layer can also help cover the scars of selective harvest.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Most PSME/SPBEL/CARU plots were located in the PSME/CARU type in the Okanogan classification (Williams and Lillybridge 1983) and PSME/CARU-CAGE and unclassified stands in the Wenatchee Draft (Williams and others 1991). PSME/SPBEL/CARU is similar to the PSME/SPBE and PSME/SPBE2 types described on the Colville (Clausnitzer and Zamora 1987) and Yakima (John and others 1988) Indian Reservations, and in north Idaho (Cooper and others 1991) and Montana (Pfister and others 1977).

# PSME/SYAL *WEN* ASSOCIATION CDS636

*Pseudotsuga menziesii/Symphoricarpos albus*

Douglas-fir/common snowberry

## ENVIRONMENT

Elevation: 2050-4400 (2849) ft.

Aspect: north to southeast (dry terraces)

Slope: 6-70 (31) %

Slope position: M, L 1/3, bottoms, bench

Special: most mesic of Douglas-fir sites

## VEGETATION SUMMARY

(Sample size: 16)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 94 | 53 |
| PIPO | ponderosa pine | 69 | 21 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 63 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SYAL | common snowberry | 100 | 39 |
| AMAL | serviceberry | 88 | 6 |
| BEAQ | Oregon grape | 75 | 3 |
| PAMY | pachistima | 69 | 5 |
| SPBEL | shiny-leaf spirea | 50 | 5 |
| **HERBS** | | | |
| OSCH | sweetroot | 50 | 2 |
| ARCO | heartleaf arnica | 44 | 3 |
| ASCO | showy aster | 38 | 3 |
| THOC | western meadowrue | 38 | 3 |
| CARU | pinegrass | 38 | 2 |
| HIAL | white hawkweed | 38 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/SYAL type was sampled infrequently on the Wenatchee NF. Four plots were located from the northeast part of the Cle Elum District south to the Tieton River on the Naches District. Twelve other plots were borrowed from Okanogan data on the Twisp District. The type should occur throughout the Wenatchee NF, especially north of Entiat Ridge.

PSME/SYAL is the most mesic type in the Douglas-fir Series. Upland plots occur mostly on lower and mid slope positions on north to southeast aspects and at elevations between 2200 and 3600 ft. Six plots borrowed from riparian classification data occur on dry river terraces with elevations between 2000 and 2600 feet.

The regolith is derived primarily from sandstone or basalt on Wenatchee plots and granite and related parent materials on Okanogan plots. Riparian plots were located on alluvium or on glacial terraces. Soil surfaces are largely covered by vegetation and litter, with only small amounts of rock, gravel or bare soil exposed. Soil surface coarse fragments are poorly represented in both upland and riparian soils. However, they may become abundant in lower horizons in riparian soils.

VEGETATION: All the sample stands are less than 100 years old and specific late seral or near climax compositions and structures are unknown. The PSME/SYAL type is characterized by somewhat open to dense canopies dominated by Douglas-fir. Douglas-fir and ponderosa pine both can pioneer in early seral conditions and ponderosa is usually co-dominant with Douglas-fir in mid seral stands. Ponderosa pine is clearly seral, but as stands mature it will often remain as scattered large individuals. Douglas-fir is the only tree species regenerating on the plots.

The undergrowth of most stands is characterized by a moderate to very dense shrub layer. The dominant and characteristic shrub is common snowberry. Other common shrubs include serviceberry, pachistima, rose, Douglas maple, Scouler willow and Oregon grape.

There are a wide variety of forbs, but few show strong constancy or cover. The most common herbs include pinegrass, heartleaf arnica, showy aster, white hawkweed, meadowrue and sweetroot.

PRODUCTIVITY/MANAGEMENT: These are productive habitats for the Douglas-fir Series. Eight intensive sample plots averaged 250 trees per acre and 178 sq. ft. basal area per acre (Appendix C). The average site index for ponderosa pine was 98 feet (base 100), with 76 for Douglas-fir (base 50). Stand structure and ages are relatively inconsistent. Younger Douglas-fir stands may appear even-aged, but often contain two or more age and size classes. Many stands have an older cohort of ponderosa pine. Stocking control may not be a problem following timber harvest because common snowberry and tall shrubs will increase dramatically in abundance once the overstory is opened or removed. This competition with tree seedlings may result in natural thinning. Reforestation can be by planting or by natural regeneration.

As with most forest stands on the Wenatchee NF, fire has been an integral part of the development of these stands. As noted above, all stands in the data are fairly young. They may have been logged near the turn of the century, but it is more likely that extensive fires occurred over most of the Forest. Given the dense overstory typical of the type and the correspondingly heavy fuel loadings, expect fires to burn hot, with extensive crown damage. The tendency for moist conditions to reduce fire frequency may be overcome by the more continuous fuel available in this type.

These stands are heavily used by both livestock and wildlife. They undoubtedly provide some winter range for deer and elk, but may be more important for hiding and thermal cover. Herbaceous production is generally low. Six clipped plots averaged only 75 pounds of herbage per acre (Appendix C).

Elytroderma is chronic to severe on the Okanogan NF (J. Townsley, personal communication).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/SYAL is a widespread type, although it was not described in the Wenatchee Draft (Williams and others 1991). It is part (without pinegrass well represented) of the PSME/SYAL types described in classifications for the Colville (Williams and others 1990) and Okanogan (Williams and Lillybridge 1983) NFs; in northern Idaho (Cooper and others 1991) and northeastern Oregon (Johnson and Clausnitzer 1992); and for the Colville Indian Reservation (Clausnitzer and Zamora 1987). It is very similar to the PSME/SYAL Habitat Type, SYAL Phase, described in Montana (Pfister and others 1977) and to the PSME/SYAL Association on the Mt. Hood NF (Topik and others 1988).

# PSME/SYAL/AGSP ASSOCIATION CDS637

*Pseudotsuga menziesii/Symphoricarpos albus/Agropyron spicatum*

Douglas-fir/common snowberry/bluebunch wheatgrass

*Common snowberry (SYAL), an indicator of the PSME/SYAL/AGSP Association.*

## ENVIRONMENT

Elevation: 2020-3820 (3046) ft.

Aspect: southeast to west

Slope: 28-65 (51) %

Slope position: ridge, U, M, L 1/3

Special: dry, hot slopes

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 12 |
| PIPO | ponderosa pine | 86 | 24 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 71 | 3 |
| PIPO | ponderosa pine | 71 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SYAL | common snowberry | 100 | 10 |
| AMAL | serviceberry | 71 | 5 |
| PUTR | bitterbrush | 57 | 8 |
| BEAQ | Oregon grape | 57 | 6 |
| **HERBS** | | | |
| ACMI | yarrow | 100 | 4 |
| AGSP | bluebunch wheatgrass | 71 | 13 |
| BASA | arrowleaf balsamroot | 71 | 10 |
| COGR2 | large flowered collomia | 71 | 1 |
| CARU | pinegrass | 57 | 10 |
| CAGE | elk sedge | 57 | 3 |
| LIRU | wayside gromwell | 57 | 1 |
| AGIN | beardless b. wheatgrass | 29 | 5 |
| FEID | Idaho fescue | 14 | 7 |

## DISTRIBUTION AND ENVIRONMENT:

The PSME/SYAL/AGSP type is apparently widely distributed, but relatively uncommon. It was sampled from the Entiat District in the north to the Naches District in the south. Two plots were borrowed from Okanogan data from the lower Twisp River drainage. The type may occur on all districts but the Lake Wenatchee.

These sites are hot and dry. Sample plots occurred at moderately low elevation, mostly on mid and upper slope positions. Most slopes are moderate to very steep and face southeast to west.

The regolith of sample plots is derived primarily from either sandstone, basalt or andesite. Okanogan plots are mostly on granite. The soil surface is covered by moderately open shrub and bunchgrass vegetation, with abundant litter and only small amounts of rock, gravel or bare soil exposed. Soil coarse fragments ranged from well represented to abundant.

This type was not described in the Wenatchee Draft. As presently defined, its plots came from a variety of types described there. The Association matches similar PSME/SYAL/AGSP types described throughout the northern Rocky Mountains and Pacific Northwest.

VEGETATION: The sample stands represented a wide range of ages and early seral to near climax compositions and structures. The PSME/SYAL/AGSP type is characterized by open stands dominated by Douglas-fir and ponderosa pine. Douglas-fir and ponderosa pine are both early seral pioneers, with ponderosa pine usually dominant over Douglas-fir in early to mid seral successional stages. Ponderosa pine will usually maintain itself as these open stands mature. Regeneration of Douglas-fir and the pine is often episodic. Western larch and western white pine are usually absent.

The undergrowth of most stands is characterized by a patchy, discontinuous shrub layer interspersed with bunchgrasses. The dominant and characteristic shrub is common snowberry. Bitterbrush was well represented on two plots, but snowberry was dominant and is keyed before bitterbrush. Other common shrubs include serviceberry and Oregon grape. A number of other shrub species may be found, but few are abundant or constant. The dominant and characteristic herbs are bluebunch and beardless bluebunch wheatgrass, Idaho fescue and balsamroot. Constant forbs include yarrow, dogbane, wayside gromwell, lomatiums and bigleaf collomia. Elk sedge and pinegrass are well represented on a few plots, but bunchgrasses are considered better indicators of the site.

PRODUCTIVITY/MANAGEMENT: These are moderately unproductive habitats for the Douglas-fir Series. Site index may be moderate, but the very open nature of these stands limits wood fiber production. Tree production data from four intensive plots averaged only 61 trees per acre and 92 sq. ft./ac. basal area (Appendix C). The site index for Douglas-fir averaged 62 feet (base 50 ). The ponderosa pine site index averaged 105 feet (base 100). No known means will assure successful regeneration within five years.

As with most forest stands on the Wenatchee NF, fire has been an integral in the development of these stands. Fire scars and charcoal are evident. Underburns were frequent before the advent of fire control and stand-replacement fires were rare. They are still rare today because dense conifer regeneration is scarce on these dry sites.

These stands are heavily used by both livestock and wildlife. They provide valuable winter range for deer and elk. Herbaceous production is generally moderate. Four clipped plots averaged 318 pounds of herbage per acre (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/SYAL/AGSP is composed of plots taken from several types described in the Wenatchee Draft (Williams and others 1991). It is similar to drier sites in PSME/SYAL types described in northeastern Oregon (Johnson and Clausnitzer 1992), Okanogan (Williams and Lillybridge 1983) and northern Idaho classifications (Cooper and others 1991). It is also similar to the PSME/SYAL Habitat Type, AGSP Phase, described in Montana (Pfister and others 1977). It has not been sampled on the Colville NF (Williams and others 1990), nor on the Colville (Clausnitzer and Zamora 1987) or Yakima (John and others 1988) Indian Reservations.

# PSME/SYAL/CARU ASSOCIATION CDS638

*Pseudotsuga menziesii/Symphoricarpos albus/Calamagrostis rubescens*

Douglas-fir/common snowberry/pinegrass

## ENVIRONMENT

Elevation: 1980-3640 (2470) ft.

Aspect: southeast to west

Slope: 18-56 (39) %

Slope position: U, M, L 1/3, bench

## VEGETATION SUMMARY

(Sample size: 11)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 49 |
| PIPO | ponderosa pine | 91 | 14 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 64 | 6 |
| PIPO | ponderosa pine | 36 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| AMAL | serviceberry | 91 | 2 |
| SYAL | common snowberry | 82 | 11 |
| HODI | ocean-spray | 73 | 2 |
| BEAQ | Oregon grape | 64 | 2 |
| SYMOH | creeping snowberry | 27 | 12 |
| **HERBS** | | | |
| CAGE | elk sedge | 82 | 11 |
| CARU | pinegrass | 64 | 7 |

## DISTRIBUTION AND ENVIRONMENT:

This widespread type was sampled from the northern portion of the Leavenworth District south to the Tieton River on the Naches District. One plot was borrowed from Okanogan data in the Twisp River drainage. PSME/SYAL/CARU is common in Okanogan and Colville NF data and is presumed to occur on the Cle Elum, Entiat and Chelan Districts.

PSME/SYAL/CARU is a moderately mesic type for the PSME Series and occurs at moderately low elevations, mostly in lower and mid slope positions. Slopes are moderate to steep and face southeast to west.

The regolith is derived primarily from basalt or tephra south of the Entiat Ridge, and granite and related parent materials to the north. The soil surface is largely covered by vegetation and litter, with only small amounts of rock or gravel. Soil coarse fragments average under 15%.

In general, these soils are deeper, less gravelly, and finer textured than PSME/SYAL/AGSP. PSME/SYAL/CARU is nearly equivalent to the PSME/SYAL/CAGE type described in the Wenatchee Draft. Plot membership is somewhat different because the Draft keyed for PSME/SYAL/CAGE based on common snowberry being only present, while this Guide requires snowberry to be well represented.

VEGETATION: The plots ranged from young, even-aged stands of pure Douglas-fir, or mixtures of Douglas-fir and ponderosa pine, to mature stands of pine with younger Douglas-fir understories. There is little evidence of western larch or western white pine. Douglas-fir and ponderosa pine both pioneer early seral conditions. However, ponderosa pine is clearly seral and often hangs on in mature stands as scattered large, old trees. Douglas-fir regenerates better than ponderosa pine.

The undergrowth of most stands is characterized by a moderately open, discontinuous shrub layer interspersed with herbs. The dominant and characteristic shrub is common snowberry, and creeping snowberry was used as the indicator for two plots. Other common shrubs include serviceberry, ocean-spray and Oregon grape. A number of other shrub species may be found, but few are abundant and none have high constancy from stand to stand.

Similarly, there are no forbs that show strong constancy. The dominant and characteristic herbs are elk sedge and pinegrass. Pinegrass is dominant north of the Entiat ridge, while elk sedge dominates or is co-dominant with pinegrass to the south.

PRODUCTIVITY/MANAGEMENT: PSME/SYAL/CARU is one of the more productive types in the Douglas-fir Series. Four intensive plots averaged 306 trees per acre and 233 sq. ft. basal area (Appendix C). The site index for Douglas-fir averaged 74 feet (base 50). Stocking control is usually not a problem because natural thinning results when snowberry, pinegrass and elk sedge increase dramatically in abundance once the overstory is opened or removed. Competition to planted tree seedlings is not normally a problem until snowberry, pinegrass or elk sedge cover exceeds 30%. However, if trees are not established in the first year, subsequent plantings may fail. Cutting systems that leave an overstory to provide site protection encourage tree regeneration. Stands may have abundant advanced Douglas-fir regeneration (1-5 years old) that can sometimes be featured in management. There is often little need to scarify, burn and plant. Stands rarely need grass seeding for erosion control.

As with most forest stands on the Wenatchee NF, fire has been an integral part of their development. As indicated by fire scars on large, scattered ponderosa pines and charcoal in the soil, ground fires were probably common in the type. Before the advent of vigorous fire control, stands tended to develop large, widely-spaced trees. Stand-replacement fires were rare. Today, some stands have developed relatively dense understories of Douglas-fir and stand-replacement fires are more common.

These stands are used by both livestock and wildlife. PSME/SYAL/CARU may provide winter range for deer and elk. Herbaceous production is generally moderate. Four clipped plots averaged 261 pounds of herbage per acre (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/SYAL/CARU is generally equivalent to the PSME/SYAL/CAGE type described in the Wenatchee Draft (Williams and others 1991). The type is similar to the part of the PSME/SYAL types (with pinegrass well represented) described for the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs. It is also similar to the PSME/SYAL Habitat Type in northern Idaho (Cooper and others 1991), and on the Spokane (Zamora 1983) and Colville (Clausnitzer and Zamora 1987) Indian Reservations; the PSME/SYAL Habitat Type, CARU phase, in Montana (Pfister and others 1977); and, the PSME/SYAL type described for northeastern Oregon (Johnson and Clausnitzer 1992). This type was not described on the Yakima Indian Reservation (John and others 1988).

# PSME/SYOR *o&c* ASSOCIATION CDS632

*Pseudotsuga menziesii/Symphoricarpos oreophilus*

Douglas-fir/mountain snowberry

## ENVIRONMENT

Elevation: 3920-5240 (4396) ft.

Aspect: south to west

Slope: 16-60 (28)%

Slope position: U, M 1/3, bench

Special: high, hot, dry slopes

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 86 | 28 |
| PSME | Douglas-fir | 86 | 27 |
| **TREE UNDERSTORY LAYER** | | | |
| PIPO | ponderosa pine | 71 | 2 |
| PSME | Douglas-fir | 57 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SYOR | mountain snowberry | 100 | 11 |
| AMAL | serviceberry | 100 | 2 |
| ARTRV | mountain big sagebrush | 57 | 9 |
| PUTR | bitterbrush | 43 | 5 |
| ACGLD | Douglas maple | 43 | 2 |
| HODI | ocean-spray | 43 | 1 |
| **HERBS** | | | |
| LUPIN | lupines | 86 | 4 |
| ACMI | yarrow | 86 | 3 |
| BASA | arrowleaf balsamroot | 71 | 10 |
| SEIN | western groundsell | 71 | 2 |
| CAGE | elk sedge | 57 | 7 |
| AGSP | bluebunch wheatgrass | 57 | 6 |
| COGR2 | large-flowered collomia | 57 | 2 |
| HYCA | ballhead waterleaf | 57 | 2 |
| LOTR | nine-leaf lomatium | 57 | 1 |
| CARU | pinegrass | 43 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

PSME/ SYOR is represented by six plots on the Wenatchee NF and one on the Okanogan. Wenatchee plots were located along the dry eastern fringe of the Forest on the Cle Elum and Entiat Districts. The type should also occur on the Naches, Leavenworth and Chelan Districts. PSME/SYOR also occurs on the Okanogan and Colville NFs. Although it is widespread, the type to does not cover much area.

PSME/SYOR is a hot, dry type that is normally found in xeric, windswept habitats with coarse-textured soils, usually on a variety of slopes and aspects, on steep to very steep southerly slopes with mid and upper slope positions, and at elevations between 3900 and 4700 ft.

The sample plots are on granite and sandstone north of the Entiat Ridge and basalt to the south. Soils are extremely well drained. Bare ground and surface rocks are usually apparent. Though data are essentially absent, soil coarse fragments are likely abundant.

PSME/SYOR grades into mountain snowberry, big sagebrush, or bitterbrush-dominated non-forest vegetation on harsher sites, while closed Douglas-fir or grand fir forest occurs on more moderate sites. Some of these plots were designated PSME/ ARTRV in the Wenatchee Draft. As more data becomes available, PSME/SYOR may be divided into PSME/SYOR and PSME/ ARTRV/AGSP types.

VEGETATION: Douglas-fir and ponderosa pine are co-dominant in most of these open forests regardless of stand age. One plot was dominated by Douglas-fir at an elevation above the limits of ponderosa pine. Although not consistently, ponderosa pine is the older species in many of our sample plots, indicating that it is more successful at regeneration immediately following disturbance, such as stand-replacement wildfire. The tendency for Douglas-fir to be younger than the pine indicates either that it may require the shelter of pine for establishment or that its seed sources are more likely to be removed from a stand by fire. The open and patchy structure of these stands allows ponderosa pine to continue its role as co-dominant even in mature stands. Regeneration for both species is typically sparse.

The shrub layer is characterized by the presence of mountain snowberry or mountain big sagebrush. As mentioned elsewhere, mountain big sagebrush was used to define the PSME/ARTRV type in the draft classification. Mountain big sagebrush probably identifies sites at slightly higher elevations than those of mountain snowberry. However, limited data and generally similar sites justify lumping these two species into PSME/SYOR as presently defined. Bitterbrush was well represented on a few plots, but we consider snowberry and sagebrush better indicators of these sites. For instance, all the plots in the PSME/PUTR/CARU Association are below 4000 feet elevation, while most of the PSME/SYOR plots are above 4000 feet.

The herb layer is variable. The abundance of various bunchgrasses compared to pinegrass and elk sedge could have been used to characterize PSME/SYOR/AGSP and PSME/SYOR/CARU Associations, but plot data do not justify this action at this time. Bluebunch wheatgrass was well represented on four plots, while elk sedge or pinegrass were well represented on two plots. Another two plots were dominated by mountain snowberry and other shrubs. Some of the more important forbs include arrowleaf balsamroot, yarrow, bigleaf collomia, western groundsell, nine-leaf lomatium, ballhead waterleaf and lupine species.

PRODUCTIVITY/MANAGEMENT: Timber productivity is low due to generally open stands and moderately slow tree growth. Six intensive plots averaged 129 trees per acre and 117 sq. ft. total basal area (Appendix C). The average site index for ponderosa pine was 70 feet (base 100) while Douglas-fir averaged 51 feet (base 50). These harsh, dry sites are very difficult to reforest. It is likely that successful reforestation will depend not on choosing an appropriate silvicultural system but on the right combination of seed availability and climatic conditions that allow seedling establishment. The concurrence of these two circumstances has been relatively infrequent in the past. No known method will assure reforestation within five years. Also, soils are subject to displacement on the steep slopes. Single tree selection or group selection cutting systems are recommended.

Fire is an important part of the history of these stands. Ground fire was frequent and stand-replacement fires rare before the advent of vigorous fire control. Even today, the more open portions of the stands will likely carry only ground fires, with only a few trees dying as a result of fire. However, under hot, dry conditions, denser stands may become more susceptible to crown fire. Shrubs, grasses, sedges and forbs will generally increase in abundance following fire.

Wildlife values are high and the type is especially important for winter range for elk or deer because of the presence of palatable grasses and forbs. The steep southerly aspects are among the earliest forested sites to become snow-free, allowing early development of green forage. Herbage production is moderately high for the Douglas-fir Series. Six clipped plots averaged 347 pounds of herbage per acre (Appendix C). Gentler slopes can be important for domestic livestock. However, on steep slopes the soils may be easily displaced by trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PSME/SYOR has been described on both the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs. It is also similar to the PSME/SYOR types described in Montana (Pfister and others 1977) and northeast Oregon (Johnson and Clausnitzer 1992).

# MISCELLANEOUS DOUGLAS-FIR ASSOCIATIONS:

(generally less than five Wenatchee plots)

## PSME/AGSP-ASDE CDG323

Three plots occur in this Association. All the plots are on serpentine outcrops in the Peshastin and Tumwater watersheds. Although these outcrops mark this type as distinct from other types in the PSME Series, three plots do not justify giving this limited type major status in the classification. Sites are on very steep southerly slopes between 1700 and 3400 feet. The soils are very stony and gravelly and excessively well drained. They are prone to movement on these over-steep slopes. High concentrations of exchangeable magnesium, nickel and chromium, with low concentrations of calcium, nitrogen, potassium and phosphorus, combine to make these soils infertile, or toxic to many plant species (Proctor and Woodell 1975). These open woodlands are dominated by Douglas-fir and ponderosa pine. Bluebunch wheatgrass is well represented to abundant on all plots, and podfern characterizes the serpentine soils. Several shrubs characteristic of low elevation forests are common, including shiny-leaf spirea and cascara buckthorn. Other common herbs include yarrow, bracken fern and big-leaf collomia. These sites may be managed similarly to the PSME/AGSP Association.

## PSME/ARUV *WEN* CDS653

The PSME/ARUV Association is uncommon and represented in the data by only one Wenatchee plot in the Chelan Mountains. This plot is supplemented with four plots borrowed from Okanogan data on the Twisp District. The type may be common on both the Chelan and Entiat Districts, which have geology and climate similar to the Twisp River drainage. These are relatively warm, dry, rocky sites near the upper elevation limits of the PSME Series. The plots occur on steep, mid and upper slope positions with southeast to west aspects. Soils are mostly rocky, very well drained, and derived from granite till or colluvium and glacial outwash or till. Soil coarse fragments and litter are usually very abundant. PSME/ARUV sites are generally drier than PSME/ARUV/CARU and at higher elevations than PSME/PUTR or PSME/SPBEL types. These are moderately open forests with a relatively sparse, low-growing undergrowth of shrubs and forbs. Stand structures are similar to PSME/ARUV/CARU. Douglas-fir dominates late seral and climax stands. Ponderosa pine is well represented only in the lowest elevation stand. Western larch and lodgepole pine are well represented in seral stands and decrease in cover with stand age, but in mature stands they may persist as scattered, old, large individuals. All four species are capable of pioneering in these habitats, but only Douglas-fir is tolerant enough to persist and eventually dominate at climax. Bearberry is the characteristic species and usually the dominant shrub. Serviceberry, shiny-leaf spirea, ceanothus, buffaloberry, spirea and common juniper may be common. Pachistima was well represented on two plots but keys after bearberry. Pinegrass is poorly represented on the PSME/ARUV Association. Elk sedge is absent on all plots. The most constant forbs include heartleaf arnica, woods pussytoes, yarrow, white hawkweed, northwestern sedge and Ross' sedge.

## PSME/ARUV/CARU CDS655

The PSME/ARUV/CARU Association is represented in the data by only one plot on the Wenatchee NF. This Entiat Ridge plot is supplemented with twenty-six plots borrowed from data on the Twisp District. Field observations suggest it will be common on both the Chelan and Entiat Districts, which have geology and climate similar to the Twisp River drainage. These are relatively high-elevation sites for the Douglas-fir Series. Sites are warm, dry and rocky. Most plots occurred on moderate to steep slopes with southeast to west aspects. A very few ridge and bench plots were associated with more northerly aspects and gentler slopes. Soils are mostly derived from coarse, rocky colluvium or glacial outwash and till. Soil coarse fragments and litter are very abundant. Okanogan stands are largely on soils derived from granite and related material, while the Wenatchee stand is derived from andesite. PSME/ARUV/CARU sites are harsher than PSME/CARU, more moderate than PSME/ARUV, and at higher elevations than PSME/PUTR/CARU. The sample plots portray moderately open forests, with Douglas-fir dominating late seral and climax stands. Ponderosa pine is abundant in many young stands but decreases in cover with stand age, though it often persists as scattered, old, large individuals in mature stands. Lodgepole pine and western larch may be present within their range. All these species are capable of pioneering on these habitats, but only Douglas-fir is tolerant enough to persist and eventually dominate at climax. It is also regenerating better than other species. However, larch and ponderosa pine can be found in larger openings, or maintaining themselves as scattered, large individuals. The undergrowth is a mixture of prostrate shrubs, grasses and forbs. Bearberry is the characteristic species and usually the dominant shrub. Shiny-leaf spirea, ceanothus, buffaloberry, spirea and pachistima are often common. Pinegrass is the dominant herbaceous species, but is not as abundant as in the PSME/CARU Association. Elk sedge is absent on the plots. The most constant forbs include heartleaf arnica, woods pussytoes, white hawkweed and Ross' sedge.

## PSME/ARUV-PUTR CDS654

All six plots in this Association are located on the Twisp District and none are on the Chelan-Sawtooth Divide. Its status on the north end of the Wenatchee NF is unknown. PSME/ARUV-PUTR occurs on moderate to steep, south to east slopes at elevations between 3800 to 4500 feet. The soils are largely derived from granite till and colluvium. Surface rock and coarse fragments are common but sites are moderate, as indicated by the abundance of pinegrass. The moderately open overstory is dominated by Douglas-fir and ponderosa pine. Lodgepole pine is a seral dominant in many stands. Bitterbrush and bearberry dominate the shrub layer. Pinegrass is well represented on all the plots. Bluebunch wheatgrass or beardless bluebunch wheatgrass were well represented on two plots. These are the only two plots that are not capable of supporting lodgepole pine. For all practical purposes PSME/ARUV-PUTR can be managed the same as either the PSME/ARUV/CARU or PSME/PUTR/CARU Associations.

## PSME/PAMY CDS411

The two plots remaining in this Association are located on the Twisp District, but the type probably occurs on the Entiat and Chelan Districts. The plots were located on cool, dry, steep, southerly aspects with elevations ranging from 4320 to 5200 feet. They were dominated by moderately dense stands of Douglas-fir and lodgepole pine. Douglas-fir will dominate mature forests. There was a trace of subalpine fir on both plots, indicating sites transitional to the ABLA2/PAMY Association. The undergrowth is dominated by a mixture of shrubs in which pachistima is dominant. The herb layer is very sparse and only heartleaf arnica, showy aster, glacier lily, rattlesnake plantain, sidebells pyrola and meadowrue are common. Pinegrass is poorly represented, which distinguishes PSME/PAMY from the more moderate PSME/PAMY/CARU Association.

## PSME/PAMY/CARU CDS412

Although eight plots are described within this Association, only three plots were located on the Wenatchee NF. They occurred on the Cle Elum, Wenatchee and Entiat Districts. Sites are considered high and cool for the Douglas-fir Series. Slopes and slope positions are variable and range from gentle on lower slopes and ridges to steep on lower and mid slopes. Elevations ranged from 3900 to 5300 feet. Soils are derived from a variety of rock types. Metamorphic rocks predominate south of the Entiat Ridge, while granitic and related rocks are to the north. Soil coarse fragments are well represented and surface litter is usually abundant. Moderately open stands of Douglas-fir dominate late seral and climax stands. Ponderosa pine may be a seral dominant on warm south aspects. Lodgepole pine is a seral dominant on cooler sites or following stand-replacement fires. Pachistima is well represented to abundant. Pinegrass is the most constant and abundant herb. Elk sedge is abundant on two of the Wenatchee plots. Other herbs include heartleaf arnica, asters, yarrow and sweetroot.

## PSME/PEFR3 CDF411

All four plots were located on the northeast corner of the Cle Elum District and may show the influence of local geology and climate. The plots were located on very steep south to southwest slopes between elevations of 3800 to 4100 feet. The soils are derived from basalt and sandstone colluvium and are very gravelly, stony, and excessively well drained. The open overstory is dominated by Douglas-fir and ponderosa pine. The undergrowth is a very sparse mixture of shrubs and herbs. Shrubby penstemon and snowbrush ceanothus are most characteristic of these dry, rocky sites. They are not restricted to rocky microsites. Many other shrubs are present but all either have low constancy or are poorly represented. Balsamroot, purple violet and elk sedge are the most constant herbs. These sites are not suitable for timber production.

## PSME/PUTR CDS673

Only four plots were sampled in this Association, called PSME-PIPO/PUTR in the Wenatchee Draft. All four plots were on the Cle Elum District. It occurs on dry, south to east aspects between 2000 and 3000 feet, mostly on steep mid, upper and ridge slope positions. It may also be found on outwash deposits of coarse alluvium, such as found at the south end of Lake Cle Elum. It may be more common on lands outside Forest Service administration. These open stands are dominated by Douglas-fir and ponderosa pine. Regeneration is very sparse. The undergrowth is characterized by an abundance of bitterbrush. Other shrubs are poorly represented. The herb layer is sparse and species are typical of dry non-forest vegetation. The scarcity of bunchgrasses, pinegrass and elk sedge distinguish this type from PSME/PUTR/CARU and PSME/PUTR/AGSP. These sites are not suitable for timber production.

## PSME/SPBEL CDS640

Only one of the eleven plots in this Association is located on the Wenatchee NF. Field observations suggest the type may be common north of the Entiat Ridge where the climate and geology are similar to the Twisp River drainage. These are rocky, dry, low-elevation sites on relatively cool, north-facing aspects on gentle to very steep mid and upper slope positions. Most sample plots ranged from 2300 to 3000 feet. Soils are well drained. Coarse fragments and litter are usually abundant. Soils are mostly formed in granite and sandstone rock types on colluvium and glacial till. This Association is at lower elevations than either PSME/ARUV or PSME/PAMY. Stands are open to moderately-dense Douglas-fir and ponderosa pine. Douglas-fir dominates mid to late seral and climax stands. Ponderosa pine is an early seral dominant that may survive in mature stands as scattered, large, old individuals. Most sites are too warm for western larch and lodgepole pine. The undergrowth is a mixture of low-growing to tall shrubs. Shiny-leaf spirea is the characteristic shrub and is at least well represented. Pachistima is often abundant. Many other shrubs may be present, depending on stand history and density, and include serviceberry, Scouler willow, Oregon grape, common snowberry and rose. Sites are generally too dry for snowberry, pinegrass and elk sedge to be well represented and herbs are usually inconspicuous.

## PSME/VACA CDS831

This type is common on the Okanogan and Colville NFs. It is reported here because it has been seen on the Chelan District. The three plots used to describe this miscellaneous Association are located on the Twisp District. They were within the PSME/VACCI Association in the Okanogan classification. PSME/VACA is associated with gentle slopes and cold air drainage on glacial outwash terraces and slopes. Young stands are usually dominated by lodgepole pine and western larch. We have few old stands, but stand composition and seral relationships suggest mature stands will be dominated by Douglas-fir and large, scattered remnants of larch. Dwarf huckleberry best characterizes the undergrowth. Bearberry can be used as an alternate indicator to dwarf huckleberry only if the site is associated with cold air drainage. Do not confuse these sites with the dry, warm, upland PSME/ARUV/CARU type, which is vegetatively similar, but lacks dwarf huckleberry. Other common shrubs and herbs include twinflower, low huckleberry, pachistima and pinegrass. Bunchberry dogwood, five-leaved bramble or dwarf bramble indicate the PIEN or ABLA2 Series. More complete descriptions are available in the Colville and the draft riparian classifications.

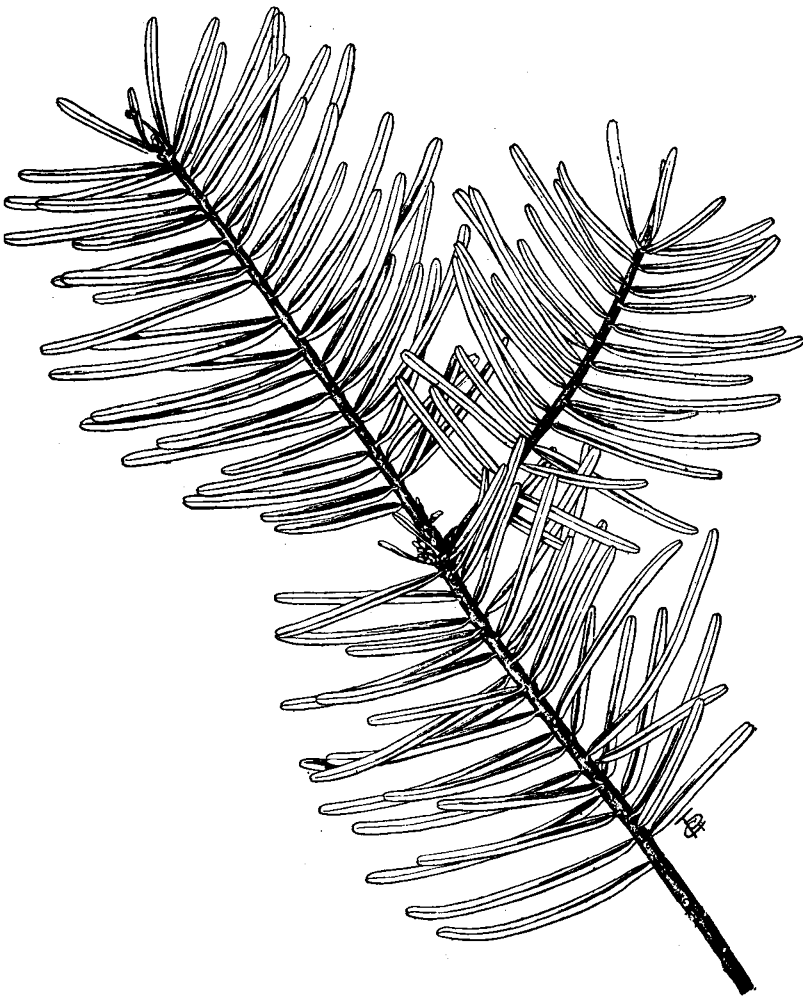
## PSME/VAMY *WEN* CDS832

The PSME/VAMY Association is represented by only two plots on the Wenatchee NF. Four additional plots are borrowed from the Twisp District. The Wenatchee plots were both located on Entiat Ridge and the type is presumed to be relatively common on to the north on the Entiat and Chelan Districts. These sites are relatively cool and moderate for the Douglas-fir Series. Elevations ranged from less than 3000 to over 5000 feet. Most plots were on mid slopes and over 4500 feet. Aspects are generally north at low elevations and south at high elevations. Slopes are moderately steep to very steep. The regolith is derived primarily from granite till or colluvium. The soil surface is covered by moderately open shrub and forb vegetation with abundant litter. Soil coarse fragments range from well represented to abundant. PSME/VAMY is similar to the PSME/VAME type described on the Colville NF. Lodgepole pine and western larch are seral dominants on stands above 4000 feet, while ponderosa pine dominates warmer, low-elevation stands. Douglas-fir and any of these trees can pioneer early seral conditions. Douglas-fir increases in canopy cover as stands mature. Ponderosa pine and larch will maintain themselves as scattered large individuals as stands mature. The undergrowth is characterized by a dense, low and prostrate shrub layer interspersed with grasses and forbs. The dominant and characteristic shrub is low huckleberry. Big huckleberry is used as equivalent to low huckleberry and was well represented on one plot. Other common shrubs include russet buffaloberry, pachistima, shiny-leaf spirea and bearberry. The only constant herb is pinegrass, yet it averages only 2% canopy cover in these stands.

## PSME/VAMY/CARU CDS833

Only two of the 17 plots were on the Wenatchee NF. Fifteen additional plots were borrowed from data on the Twisp District. The Wenatchee plots were both on the Leavenworth side of Entiat Ridge and we presume the type is relatively common on the Entiat and Chelan Districts. These sites are cool and moderate for the Douglas-fir Series. Elevations ranged from less than 3300 to over 4900 feet and are comparable to the PSME/VAMY Association. The type occurs mostly on mid and upper slopes. Aspects are variable and range from northwest to southeast with little correlation to elevation. Slopes are moderate to very steep. The soil surface is covered by moderately open shrub and grass vegetation with abundant litter. Soil coarse fragments range from well represented to abundant. The description is similar to the PSME/VAME type described on the Colville NF. Canopy cover data appear to represent a range of ages and mid seral to old-growth compositions and structures, perhaps reflecting moister sites and longer intervals between stand-replacement fires compared to PSME/VAMY. Douglas-fir is prominent in mature stands, in which larch may maintain itself as scattered large individuals. Lodgepole pine and western larch are seral dominants on almost all of the sample plots, while ponderosa pine was well represented on just 3 plots. Douglas-fir increases in canopy cover as stands mature. The undergrowth is characterized by a moderately dense, low and prostrate shrub layer. The dominant and characteristic shrub is low huckleberry. Big huckleberry is used as equivalent to low huckleberry and was well represented on two plots. Other common shrubs include russet buffaloberry, pachistima, shiny-leaf spirea and bearberry. Spirea and bearberry are especially prominent. Pinegrass is well-represented to abundant. Other herbs include elk sedge, heartleaf arnica and northwestern sedge.

# GRAND FIR SERIES



# GRAND FIR SERIES

DISTRIBUTION AND ENVIRONMENT: In the Cascades on the Wenatchee NF, grand fir reaches its northern limit as an important forest species. Except for a few outlying stands, the northern boundary closely follows the Entiat River. North of there, grand fir is increasingly restricted to a few sheltered habitats. Rarely seen on the Okanogan NF, it is again common east of the Kettle Mountains on the Colville NF and eastward well into western Montana. On the west slope of the Cascades, grand fir extends northward to Vancouver Island and other southern, coastal areas of British Columbia. This distribution suggests that grand fir has an affinity for maritime climates and does not tolerate dry, deep cold well, though it tolerates drier conditions than do western hemlock or western redcedar, which share a similar geographical distribution across the Northwest.

Grand fir is an important forest species on the Wenatchee NF and climax grand fir stands are a major component of the Forest. In addition, it is a major seral species in the Western Hemlock Series, and a seral species in some of the warmer types in the Pacific Silver Fir and Subalpine Fir Series as well. It is virtually absent from the Douglas-fir, Oregon White Oak and Ponderosa Pine Series because they are too hot and dry. The extremely cold and harsh conditions of Whitebark Pine and Subalpine Larch Series also exclude grand fir.

The Grand Fir Series is characterized by warm, moderately dry to moist forest habitats. It is the "middle moderate" Series, and as such supports vegetative elements of both drier and more moist habitats to a greater extent than most other Series. On warmer and drier sites, it grades into the Douglas-fir Series and sometimes, on hot, dry sites, into the Ponderosa Pine Series. In areas with maritime influence, more moist habitats are occupied by the Western Hemlock Series, while more moist and cooler habitats closer to the Cascade Crest are occupied by the Pacific Silver Fir Series. When outside the range of the Western Hemlock or Pacific Silver Fir Series, where climate too continental, the Grand Fir Series will be bounded on upper (colder) sites by the Subalpine Fir Series.

The Grand Fir Series is widely distributed below 5000 feet over much of the Forest east of the Cascade crest and south of the Entiat River. Often found as low as 1800 feet On the northern half of the Forest, its lower elevation limit rises to 2500 feet towards the southern Forest border. It is found across all topographic positions and regolith types, though it does not seem to occur on serpentine-derived soils.

Eight Associations and six Community Types are described for the Grand Fir Series on the Wenatchee National Forest. Geology, elevation, topographic position and geographical location are all important factors that influence the distribution of these types across the landscape. The relatively large number of Community Types is because of the extensive perturbation history of most stands in the Series. Few plots are in stands over 250 years old, and for many stands tree ages indicate less than 100 years since the last major fire or other type of stand-initiating disturbance. Therefore, successional relationships for many communities are complex and not well understood.

Additionally, there are data from several plots that do not fit our types well. Each of these plots represents a mix of species not recorded elsewhere in our data for the Forest. A single plot is not sufficient to describe an abstract vegetation type with any accuracy, but these are worth noting. One plot has an undergrowth dominated by bearberry and dwarf huckleberry. This combination is common in the northern Rocky Mountains (Pfister and others 1977 and Cooper and others 1991). Another plot was dominated only by bearberry. Other species on this plot were similar to those characteristic of the ABGR/ARNE Association. Both of these plots were placed in the ABGR/ARNE Association. Further, the data were insufficient or inconclusive to allow the description of either an ABGR/LIBOL (Johnson and Clausnitzer 1992; Johnson and Simon 1987; Pfister and others 1977) or ABGR/SPBE (Johnson and

Clausnitzer 1992; Johnson and Simon 1987) type. As more data are collected, ABGR/LIBOL may still prove a viable Association. It would have limited extent on the Forest, primarily in areas outside the ranges of vanilla leaf, Cascade Oregon grape and vine maple.

VEGETATION: Douglas-fir or ponderosa pine, or both, dominate the overstory canopy of most stands in the Series. Grand fir often occurs as a co-dominant, especially in the more moist Associations and Community Types, but is less often found as a dominant. Western larch and lodgepole pine are seral species found in some habitats. Western white pine is a significant component only in some types. Western white pine was probably more important in the tree sere in the Grand Fir Series before white pine blister rust was introduced into the area. All stands with Engelmann spruce will key to the Subalpine Fir Series. However, stands on moist benches or in canyon bottoms, where spruce and grand fir are important stand components, and when subalpine fir is absent or relatively unsuccessful, may better fit the Grand Fir Series. Vanilla leaf was always present in the sampled stands with Engelmann spruce, and ABGR/ACTR is the plant Association where these stands best fit.

Those series most commonly confused with the Grand Fir Series in early to mid-seral stands are the Douglas-Fir, Subalpine Fir and Western Hemlock Series. These are the ones that typically bound the grand fir zone and consequently can cause identification difficulties in the transition areas. It is not uncommon to debate the "true" Series on some sites.

Undergrowth in mature forest stands varies from a dense shrub layer difficult to penetrate to grass and sedge-dominated swards that entice the visitor to linger and relax. Few undergrowth species occur across all types in the Series and none are confined to this Series. Some of the most ubiquitous species include baldhip rose, shiny-leaf spirea, pachistima and pinegrass. Most other species are more restricted in their distribution within the Series. Important factors governing species patterns include water availability, temperature, parent material and past disturbances, including grazing, logging and fire.

A number of understory species are common to this Series and almost never found in the drier Douglas-fir, Ponderosa Pine or Oak Series. Generally, stands containing starry solomon-plume, queencup beadlily, Hooker fairybells, vine maple, Cascade Oregon grape or vanilla leaf are able to support a Series more moist than Douglas-fir, pine or oak. The presence of species such as dwarf bramble, oak fern or skunkleaf polemonium indicates more moist, maritime or cooler Series such as Western Hemlock, Pacific Silver Fir, Subalpine Fir or Mountain Hemlock.

On many sites, dense shrubfields typify early successional stages after logging, fires and other disturbances. Perturbation types, timing and intensity, combined with species composition prior to disturbance, are important modifiers of secondary succession. In spite of the complexity of possible successional path, some general patterns exist. Fall broadcast burns tend to favor development of redstem and snowbrush ceanothus, with vine maple and Scouler willow more favored by spring burns. Fall burns meet the scarification and cold wet stratification needs of ceanothus, while spring burns normally do not provide sufficient cold-wet seed stratification for maximum germination. If ceanothus was common on the site prior to burning, it will resprout vigorously. However, even if little ceanothus is evident, seed viability for propagules born in the duff is many years. Similar inferences can be made for other species from data in Appendix D. Spring burning favors species that resprout from root crowns but whose seeds are not stored for long periods of time in the soil.

PRODUCTIVITY/MANAGEMENT: Tree productivity is generally good in this Series (See Appendix C). Site index values for Douglas-fir, grand fir and ponderosa pine ranged from 44-84, 59-96 (base 50) and 88-135 (base 100) respectively. Total basal areas vary from a low of 161 sq. ft./ac. to a high of 282 sq. ft./ac.

Within most of this Series (all but the moist end), as in the Douglas-fir Series, fire prior to European settlement often resulted in open-growth stands of fire resistant seral trees. Fires were typically frequent and of low intensity. Grand fir was present in unburned areas, but generally was much less common and abundant than today. Douglas-fir, ponderosa pine and western larch were the most common tree dominants, being resistant to fires after they have matured enough to develop the characteristic thick, corky, insulating bark typical of the species. Stand-replacement fires were rare in stands in this condition. The advent of vigorous fire protection has resulted in longer time periods between ground fires, the development of "ladders" of grand firs of various age classes, and in the subsequent susceptibility of these stands to stand-replacement fires. Only in the moist end of the Grand Fir Series were frequent, low-intensity fires uncommon. On very moist grand fir sites, conditions were conducive to less frequent fires that were of higher intensity, usually resulting in stand replacement. After high intensity fires, throughout the Grand Fir Series, seral trees are the first to regenerate and claim the open sites. Lodgepole pine can form dense stands in these instances if present in the previous stand.

Stands within this Series commonly serve as some of the most productive spotted owl habitats on the Wenatchee NF. Large amounts of dead and down material and multiple structural layers (often the result of lack of natural fire) provide habitat suitable to meet the owl's requirements. The stands within the Series also tend to be relatively warm and therefore important fawning and forage areas in the spring for large ungulates.

Mature and late seral stands are not normally well suited to domestic livestock grazing, except for the ABGR/CARU and ABGR/CARU-LUPIN types, because of the low amount of palatable forage produced in mature stands. Early seral stages may provide high quantities of forage and consequently serve as excellent transitional range. Areas with high shrub cover are useful for wildlife, providing both forage and cover.

*Armillaria* root rot is present in nearly 80% of stands examined in the Grand Fir Series in the northern Rocky Mountains (McDonald and others 1987b). *Armillaria,* and laminated and *Annosum* root diseases are also very common on the Wenatchee NF (Paul Flanagan, personal communication; Hessburg and others 1994). Laminated root rot and*Armillaria* root disease are now common within the Douglas-fir and grand fir in this Series. New centers of *Annosum* root disease are emerging in grand fir climax areas, especially where large grand fir trees were previously harvested. Pathogenicity of *Armillaria* root rot is low in undisturbed stands, whereas the incidence of pathogenicity is increased threefold if the sites have been subject to man-caused disturbance (i.e., logging or road building; McDonald and others 1987b). Also, the more productive the site, the less the incidence of pathogenicity in undisturbed sites. Thus, the more productive a site is, the less total effect a pathogen has. Apparently this is because the total environmental and biological stress on productive sites does not exceed the adaptive tolerance of the trees. Sites in climax tree Series with lower productivities, such as the Douglas-fir or Subalpine Fir Series, have much higher rates of pathogenicity but lower overall incidence of the pathogen (McDonald and others 1987a). Dwarf mistletoe infections are more widely distributed and more severely damaging than ever before (Hessburg and others 1994). Dwarf mistletoe infections are a major cause of mortality in western larch (Jim Hadfield, personal communication). With the increase in grand fir on sites that historically supported little, there has been a subsequent increase in Indian paint fungus.

As fire frequency has decreased in recent years, insect outbreaks have increased as stands shifted towards being overstocked, late successional ones. The most important insect pests are western pine beetle, mountain pine beetle, pine engraver beetle, Douglas-fir beetle, fir engraver, western spruce budworm and the Douglas-fir tussuck moth (Hessburg and others 1994).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A Grand Fir Series has been described by numerous authors. A partial list of the areas and workers includes the Cascades (Topik and others 1988; Topik 1989); eastern Washington and Oregon (Daubenmire and Daubenmire 1968; Hall 1973; Clausnitzer and Zamora 1987; John and others 1988; Williams and others 1990; Johnson and Clausnitzer 1992); northern Idaho (Cooper and others 1991); and Montana

(Pfister and others 1977). A variety of plant Associations have been described, from quite xeric to quite moist. Typically, grand fir is the climax tree in areas too dry or continental for more shade tolerant trees like western hemlock, and yet with enough moisture that grand fir can reproduce successfully and outcompete the ubiquitous Douglas-fir.

## Keys to Plant Associations of the Grand Fir Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: CT refers to Community Type.

| | | |
|---|---|---|
| Vanilla leaf ≥ 5% | ABGR/ACTR | p. 100 |
| Vine maple ≥ 5% | | |
| Shiny-leaf spirea and prince's pine ≥ 1% | ABGR/ACCI-CHUM CT | p. 96 |
| Starry solomonplume or queencup beadlily ≥1% | ABGR/ACCI/CLUN CT | p. 98 |
| Otherwise | ABGR/ACCI CT | p. 94 |
| Cascade Oregon grape ≥ 5% | | |
| Pinegrass or elk sedge, or both together ≥ 5% | ABGR/BENE/CARU | p. 108 |
| Otherwise | ABGR/BENE | p. 106 |
| Pinemat manzanita or bearberry ≥ 10% | ABGR/ARNE | p. 104 |
| Mountain snowberry ≥ 5% | ABGR/SYOR | p. 120 |
| Common or creeping snowberry ≥ 2%, pinegrass usually well represented | ABGR/SYAL/CARU | p. 118 |
| Ocean-spray ≥ 5%; pinegrass usually well represented | ABGR/HODI/CARU CT | p. 114 |
| Bracken fern and shiny-leaf spirea ≥ 1%, slope >25%, soils with ash or pumice | ABGR/SPBEL/PTAQ CT | p. 116 |
| Heartleaf arnica or broadleaf arnica and elk sedge present and pinegrass < 5%; elevation > 3000' | ABGR/ARCO | p. 102 |
| Lupine spp. ≥ 5% | ABGR/CARU-LUPIN CT | p. 112 |
| Pinegrass ≥ 5% | | |
| Cascade Oregon grape present | ABGR/BENE/CARU | p. 108 |
| Otherwise | ABGR/CARU | p. 110 |

# Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| ABGR/ACCI | 4 | 359 | 228 | 12 | 401 | 151 |
| ABGR/ACCI-CHUM | 5 | 257 | 246 | 14 | 401 | 23 |
| ABGR/ACCI/CLUN | 11 | 324 | 280 | 15 | 443 | 20 |
| ABGR/ACTR | 19 | 380 | 262 | 13 | 447 | 66 |
| ABGR/ARCO | 15 | 726 | 282 | 11 | 531 | 35 |
| ABGR/ARNE | 7 | 282 | 161 | 11 | 284 | 161 |
| ABGR/BENE | 39 | 483 | 237 | 11 | 431 | 25 |
| ABGR/BENE/CARU | 11 | 528 | 251 | 11 | 463 | 150 |
| ABGR/CARU | 16 | 356 | 185 | 11 | 332 | 193 |
| ABGR/CARU-LUPIN | 12 | 368 | 198 | 12 | 354 | 505 |
| ABGR/HODI/CARU | 2 | 255 | 212 | 12 | 357 | 164 |
| ABGR/SPBEL/PTAQ | 16 | 267 | 223 | 14 | 368 | 123 |
| ABGR/SYAL/CARU | 22 | 362 | 236 | 12 | 410 | 58 |
| ABGR/SYOR | 4 | 192 | 209 | 15 | 328 | 200 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABGR/ACCI | ABGR | 3 | 96 | 3 | 511 | 343 | 63 |
| | PIPO | 3 | 108 | 3 | 292 | 139 | 55 |
| | PSME | 20 | 80 | 20 | 336 | 190 | 72 |
| ABGR/ACCI-CHUM | ABGR | 10 | 86 | 10 | 393 | 236 | 79 |
| | PIMO | 3 | 69 | 3 | 399 | 194 | 73 |
| | PSME | 24 | 79 | 25 | 242 | 139 | 104 |
| ABGR/ACCI/CLUN | ABGR | 33 | 90 | 46 | 395 | 263 | 81 |
| | PIPO | 3 | 135 | 4 | 411 | 244 | 136 |
| | PSME | 40 | 84 | 40 | 299 | 185 | 79 |
| ABGR/ACTR | ABGR | 24 | 72 | 40 | 349 | 173 | 100 |
| | LAOC | 8 | 63 | 8 | 204 | 89 | 85 |
| | PSME | 64 | 78 | 78 | 274 | 159 | 125 |
| ABGR/ARCO | ABGR | 25 | 59 | 50 | 272 | 112 | 109 |
| | LAOC | 4 | 64 | 4 | 363 | 163 | 70 |
| | PIPO | 2 | 89 | 14 | 230 | 71 | 186 |
| | PSME | 38 | 60 | 46 | 272 | 113 | 121 |
| ABGR/ARNE | PICO | 3 | 42 | 3 | 135 | 39 | 126 |
| | PIPO | 14 | 88 | 18 | 154 | 58 | 117 |
| | PSME | 14 | 44 | 21 | 156 | 59 | 175 |
| ABGR/BENE | ABGR | 45 | 64 | 74 | 249 | 113 | 98 |
| | LAOC | 43 | 61 | 45 | 169 | 74 | 99 |
| | PICO | 10 | 58 | 10 | 124 | 50 | 103 |
| | PIMO | 3 | 56 | 3 | 191 | 75 | 87 |
| | PIPO | 8 | 102 | 13 | 250 | 70 | 128 |
| | PSME | 153 | 67 | 159 | 218 | 104 | 93 |
| ABGR/BENE/CARU | ABGR | 8 | 70 | 12 | 242 | 114 | 90 |
| | LAOC | 6 | 62 | 6 | 390 | 173 | 91 |
| | PICO | 8 | 57 | 8 | 157 | 62 | 89 |
| | PIPO | 11 | 105 | 20 | 172 | 78 | 119 |
| | PSME | 40 | 66 | 43 | 261 | 120 | 115 |
| ABGR/CARU | ABGR | 3 | 70 | 3 | 175 | 86 | 66 |
| | PICO | 8 | 57 | 8 | 111 | 42 | 75 |
| | PIPO | 28 | 107 | 37 | 211 | 105 | 104 |
| | PSME | 60 | 66 | 69 | 212 | 102 | 110 |
| ABGR/CARU-LUPIN | LAOC | 10 | 60 | 10 | 159 | 65 | 76 |
| | PICO | 13 | 53 | 13 | 171 | 63 | 85 |
| | PIPO | 6 | 90 | 13 | 183 | 77 | 153 |
| | PSME | 45 | 52 | 46 | 214 | 79 | 118 |
| ABGR/HODI/CARU | PIPO | 3 | 95 | 6 | 194 | 79 | 147 |
| | PSME | 15 | 69 | 15 | 258 | 122 | 111 |
| ABGR/SPBEL/PTAQ | ABGR | 3 | 60 | 3 | 215 | 89 | 81 |
| | PICO | 13 | 60 | 13 | 190 | 80 | 78 |
| | PIMO | 3 | 62 | 3 | 247 | 107 | 73 |
| | PIPO | 34 | 113 | 36 | 214 | 106 | 106 |
| | PSME | 77 | 82 | 77 | 283 | 164 | 77 |
| ABGR/SYAL/CARU | ABGR | 11 | 61 | 17 | 260 | 111 | 93 |
| | LAOC | 9 | 66 | 9 | 150 | 70 | 98 |
| | PIPO | 17 | 110 | 17 | 202 | 99 | 94 |
| | PSME | 101 | 69 | 103 | 249 | 121 | 89 |
| ABGR/SYOR | PIPO | 14 | 94 | 14 | 268 | 110 | 83 |
| | PSME | 10 | 69 | 10 | 233 | 111 | 73 |

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

## GRAND FIR PLANT ASSOCIATION GROUPS

1. Warm Dry Shrub/Herb PAG
   - ABGR/ARNE
   - ABGR/HODI/CARU
   - ABGR/SYOR
2. Warm Mesic Shrub/Herb PAG
   - ABGR/SPBEL/PTAQ
   - ABGR/SYAL/CARU
3. Warm Moist Shrub/Herb PAG
   - ABGR/ACCI *WEN*
   - ABGR/ACCI-CHUM
   - ABGR/ACCI/CLUN
4. Cool Dry Grass PAG
   - ABGR/ARCO
   - ABGR/CARU *WEN*
   - ABGR/CARU-LUPIN
5. Cool Mesic Shrub/Herb PAG
   - ABGR/BENE
   - ABGR/BENE/CARU
6. Cool Moist Shrub/Herb PAG
   - ABGR/ACTR *WEN*

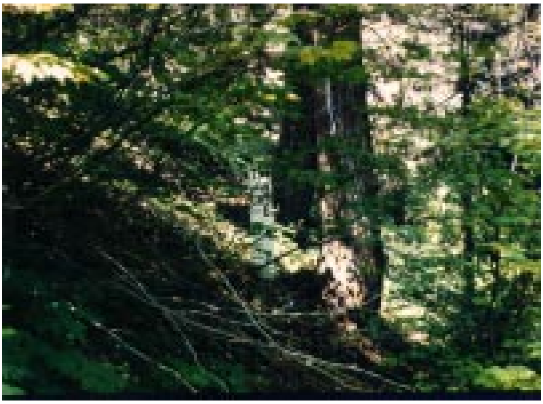
## GRAND FIR PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| ABGR/ACCI *WEN* | CWS551 |
| ABGR/ACCI-CHUM | CWS552 |
| ABGR/ACCI/CLUN | CWS553 |
| ABGR/ACTR *WEN* | CWS524 |
| ABGR/ARCO | CWF444 |
| ABGR/ARNE | CWS338 |
| ABGR/BENE | CWS225 |
| ABGR/BENE/CARU | CWS226 |
| ABGR/CARU *WEN* | CWG124 |
| ABGR/CARU-LUPIN | CWG125 |
| ABGR/HODI/CARU | CWS554 |
| ABGR/SPBEL/PTAQ | CWS335 |
| ABGR/SYAL/CARU | CWS336 |
| ABGR/SYOR | CWS337 |

# ABGR/ACCI *WEN* COMMUNITY TYPE CWS551

*Abies grandis/Acer circinatum*

grand fir/vine maple



## ENVIRONMENT

Elevation: 1900-3680 (2614) ft.

Aspect: southerly

Slope: 8-68 (37) %

Slope position: U, <u>M</u>, <u>L</u> 1/3

Special: warm, mesic, productive, maritime

## VEGETATION SUMMARY

(Sample size: 13)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 48 |
| ABGR | grand fir | 77 | 13 |
| PIPO | ponderosa pine | 54 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 77 | 3 |
| ACMA | bigleaf maple | 23 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 43 |
| ROGY | baldhip rose | 92 | 4 |
| PAMY | pachistima | 77 | 5 |
| BENE | Cascade Oregon grape | 69 | 4 |
| SYMOH | creeping snowberry | 54 | 6 |
| SPBEL | shiny-leaf spirea | 54 | 5 |
| CHME | little prince's pine | 38 | 1 |
| ACGLD | Douglas maple | 23 | 3 |
| PREM | bitter cherry | 15 | 4 |
| **HERBS** | | | |
| TRLA2 | western starflower | 85 | 4 |
| CARU | pinegrass | 54 | 8 |
| OSCH | sweetroot | 38 | 2 |
| GOOB | w. rattlesnake plantain | 38 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/ACCI type was sampled from the southern part of the Lake Wenatchee District, the north end of the Leavenworth District, and the portion of the Cle Elum District north of Interstate 90. It occurs mainly on middle and lower slopes below 3000 feet, although one sample stand was at nearly 3700 ft. and two stands were on upper slopes.

Soils are generally developing in ash, tephra, glacial deposits or in landslide deposits. Pumice was also present in some soils. All these regolith types have the potential to be well drained. Most soils have gravels or cobbles in the surface horizons. A thick leaf litter layer covers soil surfaces.

This type indicates warm, mesic habitats with some maritime climatic influence and well-drained soils.

In and around the Wenatchee NF, vine maple is limited to warm, mesic and maritime sites in the Cascades and nearby foothills.

VEGETATION: Only 4 of 13 plots provide information on stand age. Douglas-fir and grand fir are in the overstory in most stands. Grand fir is normally a minor overstory component until later in the sere. Early in the sere, Douglas-fir is usually dominant over grand fir, which tends to be lower in height. In some stands ponderosa pine may share dominance with Douglas-fir. In late seral or climax stands, however, it is apparent that grand fir dominates the overstory and regeneration layers. Tree regeneration is often sparse and sporadic, especially where vine maple forms a dense canopy. Grand fir is usually the sole reproducing tree species. Bigleaf maple may be present in a few stands and will apparently persist for many years.

The ABGR/ACCI type often has two canopy layers of conifers with Douglas-fir or ponderosa pine, or both, forming the tallest layer, then a shorter intermediate canopy formed by grand fir. Under or about the same height as the grand fir is an additional layer formed by vine maple, or occasionally bigleaf maple. Inmature stands the multiple canopies intercept most of the incoming light and light levels at the forest floor are dim, allowing little development of other shrubs or herbs. If the canopy is opened up, a wide variety of shrubs and herbs may be found on the sites.

Eventual climax dominance for the shrub and herb layers is presently unknown for the ABGR/ACCI Community Type. Vine maple typically forms a dense canopy covering more than 50% of the plot. Presumably, vine maple will decline in cover as stands exceed 150 years in age and maintain itself using canopy gaps in the oldest stands, but the data includes no old stands. Baldhip rose and creeping snowberry are usually present, though only in small amounts. A variety of other shrub species can occasionally found, always with low abundance.

The herbaceous layer is inconspicuous under the dense tree and shrub canopy. Western starflower is the only herbaceous species likely to occur on most sites. Few other species can be found and all have low abundance. Leaf litter covers most of the soil surface.

PRODUCTIVITY/MANAGEMENT: This is one of the most productive sites for tree growth in the Grand Fir Series. Site index values for grand fir, Douglas-fir and ponderosa pine (from only 4 plots) average 96, 80 (base 50) and 108 (base 100) respectively and total basal area averages 228 sq. ft./ac. (Appendix C). Vine maple is a strong competitor, with conifer establishment early in the sere, and can resprout vigorously after fire or clearcutting. Studies in the northern Rocky Mountains indicate that shrub competition and abundance is higher on sites that have been clearcut and then broadcast burned. Shelterwoods normally have less total shrub cover than clearcuts. The ABGR/ACCI type may respond similarly.

Fire was common in these habitats. Charcoal on logs and fire scars on trees and stumps are ubiquitous. None of the 4 sample stands where tree age data were available exceeded 100 years. Multi-layered stands contain a lot of ladder fuels, so when fires occur, they are almost always crown fires. Fire helps maintain the abundance of vine maple because vine maple resprouts from the root crown. Even though the maple's presence indicates a relatively mesic environment, it also indicates, on the Wenatchee NF, a warm environment conducive to frequent burns.

The multiple canopies provide considerable habitat for arboreal mammals and birds. Although herbage production is low (151 lbs./acre; Appendix C), livestock might seek out this type for shade.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Except on the Yakima Indian Reservation (John and others 1988), the ABGR/ACCI type has not been described in most areas adjacent to the Wenatchee. The Yakima Reservation type appears to include both the ABGR/ACCI and ABGR/ACCI/CLUN types described on the Wenatchee. Variations of the ABGR/ACCI type have been described on the Mt. Hood and Gifford Pinchot National Forests. However, in both of these classifications, vine maple was a prominent shrub in a number of other types as well (Topik 1989; Topik and others 1988). The ABGR/ACCI type appears to be included in the Mt. Hood classification as ABGR/TRLA2.

# ABGR/ACCI-CHUM COMMUNITY TYPE CWS552

*Abies grandis/Acer circinatum-Chimaphila umbellata*

grand fir/vine maple-western prince's pine

*Vine maple (ACCI), an indicator of the ABGR/ACCI/CHUM Association.*

## ENVIRONMENT

Elevation: 1900-3680 (2413) ft.

Aspect: south to west

Slope: 1-65 (26) %

Slope position: M, L 1/3, benches

Special: warm, mesic, productive

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 31 |
| ABGR | grand fir | 92 | 19 |
| PIPO | ponderosa pine | 75 | 11 |
| PICO | lodgepole pine | 50 | 9 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 100 | 6 |
| PSME | Douglas-fir | 42 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 36 |
| PAMY | pachistima | 100 | 9 |
| SPBEL | shiny-leaf spirea | 100 | 6 |
| CHUMO | w. prince's pine | 100 | 5 |
| ROGY | baldhip rose | 92 | 3 |
| RUPA | thimbleberry | 83 | 5 |
| BENE | Cascade Oregon grape | 67 | 4 |
| AMAL | serviceberry | 67 | 2 |
| PYPI | whitevein pyrola | 67 | 2 |
| VAME | big huckleberry | 58 | 11 |
| **HERBS** | | | |
| PTAQ | bracken fern | 100 | 4 |
| SMST | starry solomonplume | 92 | 5 |
| TRLA2 | western starflower | 67 | 4 |
| ADBI | pathfinder | 67 | 2 |
| CLUN | queencup beadlily | 58 | 8 |
| GOOB | w. rattlesnake plantain | 58 | 2 |
| CARU | pinegrass | 50 | 11 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/ACCI-CHUM Community Type was sampled only in the Lake Wenatchee, Leavenworth and Cle Elum Districts. Most stands were located near Lake Wenatchee or in the Chiwawa River drainage.

It occurs on lower slopes and benches, generally below 3000 feet elevation (one stand at 3680 ft.). Stands at the upper elevation distribution limits of the type are found on steep, southerly or westerly slopes. Most stands, however, are found on gentle lower slopes, benches or bottoms with southerly or westerly aspects.

Glacial outwash covered by pumice and ash is the primary regolith material (half the plots had pumice). Soils are gravelly and show little horizon development. The litter or duff layer is usually more than 1 in. thick and can be more than 4 in. thick.

These are relatively warm and mesic habitats but the presence of huckleberries and spruce indicate somewhat cooler conditions than the ABGR/ACCI type, probably from cold air accumulation. This type is bounded on more moist habitats by the ABGR/ACCI/CLUN Community Type.

In the area of the Wenatchee Forest, vine maple is limited to the Cascades and nearby foothills.

VEGETATION: The oldest sample stand is less than 200 years old, so late seral or climax conditions are unknown. Douglas-fir, lodgepole pine, ponderosa pine or grand fir may be stand dominants. Multiple conifer canopies are not seen as often in this type as in the ABGR/ACCI Community Type. Grand fir and Douglas-fir are often near the same age and height. Lodgepole pine suggests somewhat cooler or more moist conditions that those in the ABGR/ACCI type. All mid-seral stands in this type contain scattered ponderosa pine or lodgepole pine that are remnants of pioneer stands. Grand fir is the dominant reproduction tree. Scattered Douglas-fir, ponderosa pine or lodgepole pine seedlings may be found.

Vine maple dominates the relatively rich shrub undergrowth. Unlike the other vine maple types in the Grand Fir Series, here vine maple generally has less than 50% cover in mid-seral stands. Consequently, associated shrubs and herbs are more often abundant. Vine maple shows no sign of decline in the oldest stand, so eventual loss or replacement of vine maple by other species is speculative. Other shrubs include prince's pine, pachistima, shiny leaf spirea, Cascade Oregon grape, baldhip rose and thimbleberry. Big huckleberry may be abundant on cooler sites.

The herbaceous layer is less floristically rich than in the ABGR/ACCI/CLUN type, but still contains several characteristic species. Bracken fern is constant and seems to have a strong affinity for sites with soils that have ash or pumice in their upper horizons. Other herbs present in more than half the stands, and which may be abundant, include queencup beadlily, starry solomonplume, western rattlesnake plantain, pinegrass and western starflower.

PRODUCTIVITY/MANAGEMENT: As with all of the vine maple types within the Grand Fir Series this is a very productive site for tree growth (Appendix C). Early in the sere vine maple is a strong competitor with conifer establishment, and it can resprout vigorously after fire or clearcutting. Studies in the northern Rocky Mountains indicate that shrub competition and abundance is higher on sites that have been clearcut and then broadcast burned. Shelterwoods normally have less total shrub cover than clearcuts. Ladder fuels are common and the type is predisposed to intense wildfires. The soils are easily eroded or displaced. Because of the ease with which erosion by water or wind can occur, care should be take to protect the pumice and ash layers from disturbance. Much of the nutrient and moisture holding capacity of the soils is from the ash or fine pumice layers.

Fire is a frequent occurrence in these stands. Charcoal and fire scars are found in nearly every sample stand. Fire helps maintain the abundance of vine maple because it resprouts from the root crown. Fires appear to replace stands rather than underburn. Fire return intervals for this type are probably between 50 and 200 years (Agee 1994). Tree ages from the 5 intensively sampled stands ranged from 73-188 at breast height. Most stands were under 100 years old.

Disease and insect problems seem to be few in the ABGR/ACCI-CHUM Community Type, according to field notes. This may only be the result of the small sample size, or perhaps past intense fires served to sanitize the stands. It is unlikely that these relatively warm, moist sites are inherently resistant to pathogens. Many of these stands, although they support abundant grand fir, appear unusually healthy. Dwarf mistletoe may be an occasional problem and Douglas-fir and grand fir, like most true firs, are susceptible to a variety of root and trunk rots.

The multiple canopies provide considerable habitat for a variety of arboreal mammals and birds.

Herbage production is only about 20 lbs./acre (Appendix C). Livestock might use this type for shade.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/ACCI-CHUM Association has not been described in areas adjacent to the Wenatchee NF. Variations of ABGR/ACCI types have been described on the Mt. Hood and Gifford Pinchot NFs. However, in both of these classifications vine maple was present in a number of other types as well (Topik 1989; Topik and others 1988). The ABGR/ACCI-CHUM type appears to be included in the Mt. Hood's ABGR/TRLA2 type and possibly in the ABGR/ACCI type described on the Yakima Indian Reservation (John and others 1988).

# ABGR/ACCI/CLUN COMMUNITY TYPE CWS553

*Abies grandis/Acer circinatum/Clintonia uniflora*

grand fir/vine maple/queencup beadlily

*Queencup beadlily (CLUN), an indicator of the ABGR/ACCI/CLUN Association.*

## ENVIRONMENT

Elevation: 1860-2900 (2308) ft.

Aspect: variable

Slope: 1-57 (19) %

Slope position: M, L 1/3, benches, bottoms

Special: warm, mesic, productive

## VEGETATION SUMMARY

(Sample size: 21)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 95 | 36 |
| ABGR | grand fir | 95 | 36 |
| PIPO | ponderosa pine | 33 | 8 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 71 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 43 |
| BENE | Cascade Oregon grape | 100 | 5 |
| PAMY | pachistima | 81 | 4 |
| ROGY | baldhip rose | 81 | 3 |
| CHME | little prince's pine | 76 | 2 |
| RUPA | thimbleberry | 52 | 2 |
| RUUR | Pacific blackberry | 43 | 2 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 86 | 7 |
| TROV | trillium | 76 | 2 |
| SMST | starry solomonplume | 71 | 6 |
| SMRA | feather solomonplume | 67 | 4 |
| ADBI | pathfinder | 57 | 2 |
| DIHO | Hooker fairybells | 48 | 4 |
| GOOB | w. rattlesnake plantain | 48 | 2 |
| PTAQ | bracken fern | 43 | 3 |
| ASCA3 | wild ginger | 38 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

This type was sampled mainly from the Lake Wenatchee District, but it can be found in the northwestern part of the Leavenworth District and one plot came from near Lake Cle Elum on the Cle Elum District. It is mainly found on benches, lower slopes or in canyon bottoms on gentle topography below 2500 ft.

The regolith typically is a heterogeneous mixture derived from debris flows, alluvium or glacial outwash. There were a few plots on sandstone. Soils are usually gravelly and have organic horizons up to 6 in. thick. Soils are damp but not wet. Some stands may have impeded drainage.

This type indicates a warm, moist low elevation site, with few species to indicate any significant effects of cold air drainage. Drier sites usually support the ABGR/ACCI/CHUM or AGGR/ACCI Associations. Stands with wild ginger indicate the moist end of the type.

VEGETATION: The oldest sample stand is less than 150 years old and most were under 100 years in age. Late seral or near climax conditions are not known. At least some of the stands that key to the ABGR/ACCI/CLUN Community Type may be a successional stage in the sere of the TSHE/ASCA3 or TSHE/ACCI/ASCA3 Associations, although the data are not conclusive. Douglas-fir is the primary overstory dominant in mid-seral stands. Grand fir is a significant component in most stands and it may dominate the overstory fairly early in some stands. Except for a rare ponderosa pine or an occasional bigleaf maple, few other tree species seem to occur. Regeneration is very sparse in mid-seral stands, due in large part to the deep shade cast by grand fir in the overstory. Grand fir is usually the sole reproducing tree species, although bigleaf maple or Engelmann spruce may also be found. Western redcedar is an accidental species in the type. Two-storied stands are common, with grand fir often being shorter than associated Douglas-firs of approximately the same age.

Vine maple strongly dominates the undergrowth and shows no sign of decline in cover in our oldest stand. There are several other shrub species often present, though seldom abundant, including Cascade Oregon grape, pachistima and little prince's pine. A large number of other shrub species occur, but none with any consistency or abundance.

The herbaceous layer is conspicuous, and composed of species indicating moist conditions. Herbaceous dominants usually include queencup beadlily, starry solomonplume, feather solomonplume, wild ginger and trillium. Stands with wild ginger may be early seral stages of TSHE/ASCA3 or TSHE/ACCI/ASCA3 Associations that presently lack western hemlock or western redcedar. It is possible that a combination of fire-induced mortality and removal of potential seed sources has kept these two shade tolerant trees from re-establishing.

PRODUCTIVITY/MANAGEMENT: The ABGR/ACCI/CLUN Community Type has the highest timber productivity of any site in the Grand Fir Series. Average basal area for the type is 280 sq. ft./ac and the site index (base 50) for Douglas-fir is 84 (Appendix C). Vine maple may compete with conifer establishment early in the sere and can resprout vigorously after fire or clearcutting. Studies in the northern Rocky Mountains (although vine maple is absent there) indicate that shrub competition and abundance is higher on sites that have been clearcut and broadcast burned. Shelterwoods normally have less total shrub cover than clearcuts. Site productivity should be protected by following the guidelines of Harvey and others (1987), i.e., by leaving adequate organic materials on the sites. Moist soils are easily compacted. These sheltered, moist sites in lower slope positions are areas of moisture accumulation. Removal of trees may raise water tables on the sites because of reduced evapo-transpiration (particularly in stands with wild ginger). Frost potential in natural stands is low, but the sites are in topographic positions that may accumulate cold air if canopies are removed. Disease and insect problems seem to be few, according to the field notes. Perhaps past intense fires served to sanitize the stands. It is unlikely that these relatively warm, moist sites are inherently resistant to pathogens. Many of these stands, although they support abundant grand fir, appear unusually healthy. Douglas-fir may have dwarf mistletoe, and there have been a few instances of root rot noted.

Fire indicators, such as scars on stumps or charcoal, are common and point to recurrent fires. Ladder fuels are also common, predisposing the type to intense wildfires. These warm habitats may burn relatively frequently, inhibiting the development of old-growth conditions. Further, many of these low elevation sites are relatively accessible and may have been logged by early settlers.

Multiple canopies of conifers and vine maple provide a wide range of habitats for arboreal mammals and birds. Herbage production in low (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/ACCI/CLUN Association has not been described in areas adjacent to the Wenatchee NF. However, variations of an ABGR/ACCI type have been described on the Mt. Hood and Gifford Pinchot National Forests (Topik 1989; Topik and others 1988), and many of their other types have vine maple. The ABGR/ACCI/CLUN type appears to be included in the ABGR/ACCI type described for the Yakima Indian Reservation (John and others 1988).

# ABGR/ACTR *WEN* ASSOCIATION CWS524

*Abies grandis/Achlys triphylla*

grand fir/vanilla leaf

## ENVIRONMENT

Elevation: 2130-4870 (3386) ft.

Aspect: variable

Slope: 1-84 (29) %

Slope position: U, M, L 1/3, benches, bottoms

Special: somewhat cool, mesic

## VEGETATION SUMMARY

(Sample size: 43)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABGR | grand fir | 95 | 31 |
| PSME | Douglas-fir | 91 | 31 |
| LAOC | western larch | 40 | 8 |
| PIMO | western white pine | 30 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 98 | 9 |
| PSME | Douglas-fir | 37 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ROGY | baldhip rose | 86 | 7 |
| BENE | Cascade Oregon grape | 84 | 9 |
| CHUMO | w. prince's pine | 79 | 4 |
| LIBOL | twinflower | 63 | 11 |
| PAMY | pachistima | 67 | 3 |
| PYSE | sidebells pyrola | 60 | 2 |
| SPBEL | shiny-leaf spirea | 58 | 4 |
| SYMOH | creeping snowberry | 51 | 5 |
| VAME | big huckleberry | 37 | 6 |
| **HERBS** | | | |
| ACTR | vanilla leaf | 100 | 14 |
| GOOB | w. rattlesnake plantain | 81 | 2 |
| ARMA3 | bigleaf sandwort | 69 | 3 |
| OSCH | sweetroot | 62 | 2 |
| TROV | trillium | 59 | 2 |
| TRLA2 | western starflower | 47 | 4 |
| CLUN | queencup beadlily | 44 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/ACTR Association was sampled from just south of Leavenworth on the Leavenworth District to the southern border of the Forest. It is most common in maritime areas of the Cle Elum and Naches Districts.

These are cool, well-watered and productive sites. They are cool sites for the Grand Fir Series. The type occurs on moderately-steep to flat slopes, generally with a northerly aspect. Most stands are over 3000 feet. Sites are sheltered, sometimes by adjoining ridges, and often have flat or concave slope configurations. Most stands occur in upslope locations.

The regolith varies in composition. Ash, tephra and basalts form the majority of the parent materials, although alluvium predominates on flat canyon bottoms, and colluvium is characteristic of the toe slope and lower slope positions. Soils are deep, somewhat well-drained, well-watered and not very stony. Sites on old landslides are still inherently unstable.

The ABGR/ACTR type may be adjoined on slightly more moist sites by the TSHE/ACTR Association. Better-drained uplands sites will often fall in the ABGR/BENE or ABGR/BENE/CARU Associations. Warmer, lower elevation sites often support one of the ABGR/ACCI types.

VEGETATION: The oldest sample stands are nearly 300 years old. All plots over 150 years are at elevations above 4000 feet. In the oldest stands, Douglas-fir may be 200 years older than associated grand firs. Long-lived seral species that may remain for several hundred years include western larch, Douglas-fir and ponderosa pine. Grand fir can be dominant in the tree overstory at any stage in the tree sere, depending on stand history and disturbance history. Stands on relatively cold, moist flats often have little Douglas-fir. Instead, Engelmann spruce can become an important species, although grand fir is obviously more successful, and subalpine fir is an accidental species. Western larch or ponderosa pine can be found on some of the lower slope stands, with the ponderosa restricted to the warmest sites within the type. Grand fir is usually the sole regenerating species, except on the moist flats, where Engelmann spruce regeneration can occur in small amounts.

An herb-rich undergrowth mixed with low-growing shrubs is characteristic. A number of shrubs are typically present, although seldom abundant. Common species include baldhip rose, sidebells pyrola, twinflower, pachistima, prince's pine, shiny-leaf spirea, creeping snowberry, common snowberry and Cascade Oregon grape.

Vanilla leaf is usually the most abundant herb and is characteristic of the type. A rich assortment of other herbs occur in each stand, but are seldom abundant. Common species include western rattlesnake plantain, bigleaf sandwort, trillium, starry solomonplume, sidebells pyrola and sweetroot. Pathfinder can be abundant in some stands. Ground moss often occurs in small amounts. Ladyfern indicates sites at the wet end of the range of soil moisture conditions representative of the type. Ladyfern and spruce were well represented in a few plots, suggesting the possible need for an ABLA2/ATFI type in the future riparian classification.

PRODUCTIVITY/MANAGEMENT: These are very productive stands, with high basal areas and site indexes for the Grand Fir Series. Basal areas average 262 sq. ft./acre and site index values for grand fir and Douglas-fir are 72 and 78 (base 50), respectively (Appendix C). This type should be easy to manage if the soils are not unstable. Soils are easily compacted by equipment, and harvest may cause high water tables because of reduced evapo-transpiration. Frost pockets can develop on flats if attention is not paid to local topography and air drainage patterns.

Sites under 3500 feet appear to burn more frequently than sites over that elevation, perhaps reflecting a "thermal belt" of more frequent fire occurrence. Many stands have fire scars and charred bark on Douglas-fir or western larch, indicating they periodically underburned in the past. This may account for the wide range in ages between dominant Douglas-firs and subdominant grand firs.

Field notes mention that a variety of root and bole diseases are common, especially on grand fir. Mistletoe is common on both grand fir and Douglas-fir. Older stands often contain considerable snags and logs. Pileated woodpeckers were observed several times while sampling.

Field notes indicate heavy use by wild and domestic ungulates. Forage and browse are abundant, as are water and cover. Deer and elk trails and beds are common. Mature stands with snags, logs and multiple tree canopies provide habitat and forage for a variety of wildlife, including cavity excavators, fossorial mammals and arboreal species.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: An ABGR/ACTR Association has been described on the Mt. Hood NF (Topik 1989) and it appears to be the same as the Wenatchee ABGR/ACTR type. The Gifford Pinchot NF (Topik and others 1988) does not describe an ABGR/ACTR as such, but does describe a number of types where vanilla leaf is an important component. The Wenatchee ABGR/ACTR encompasses the ABGR/BENE/ACTR and ABGR/SYMOH/ACTR described on the Gifford Pinchot NF.

# ABGR/ARCO ASSOCIATION CWF444

*Abies grandis/Arnica cordifolia*

grand fir/heartleaf arnica

*Heartleaf arnica (ARCO), an indicator of the ABGR/ACCI/CLUN Association.*

## ENVIRONMENT

Elevation: 2940-5130 (4313) ft.

Aspect: variable

Slope: 1-84 (29) %

Slope position: Ridge, U, M, L 1/3, bench

Special: cool-cold, mesic

## VEGETATION SUMMARY

(Sample size: 24)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 24 |
| ABGR | grand fir | 96 | 37 |
| LAOC | western larch | 63 | 5 |
| PIPO | ponderosa pine | 58 | 11 |
| PIEN | Engelmann spruce | 8 | 13 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 100 | 13 |
| PSME | Douglas-fir | 54 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 63 | 3 |
| PYSE | sidebells pyrola | 54 | 1 |
| CHUMO | western prince's pine | 50 | 3 |
| VAMY | low huckleberry | 42 | 3 |
| CHME | little prince's pine | 33 | 1 |
| **HERBS** | | | |
| CAGE | elk sedge | 100 | 5 |
| ARCO | heartleaf arnica | 96 | 3 |
| ARMA3 | bigleaf sandwort | 92 | 4 |
| HIAL | white hawkweed | 63 | 2 |
| GOOB | w. rattlesnake plantain | 54 | 2 |
| LUPIN | lupines | 48 | 4 |
| CARU | pinegrass | 46 | 3 |
| LAPA2 | few-flowered peavine | 38 | 10 |
| CACO | northwestrn sedge | 33 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/ARCO Association is best developed on Table Mountain on the Cle Elum District but may be found on the Naches or Leavenworth Districts. One plot was on the south end of the Entiat District.

This type, at the upper elevations of the Grand Fir Series, represents cool, sheltered habitats in areas outside of maritime climatic influences. The type typically occurs on moderately steep slopes between 4000 and 5000 feet. Only 3 plots occurred below 3500 ft. Although topographic positions are predominantly upper to middle slopes, a few stands occur on ridges, benches and lower 1/3 slopes.

Deep volcanic ash over basalt or sandstone comprises the regolith. The ash layer wets slowly and is well drained. Many profiles show extreme stoniness below the ash. Organic horizons are 1 to 3 inches thick.

Cooler sites usually support Associations within the ABLA2 Series.

VEGETATION: The oldest sample stand was about 220 years old, so late seral or near climax conditions are not well understood and must be inferred from species composition and successional relationships. Grand fir becomes dominant in the overstory and tree regeneration layers in stands over 150 years of age if underburning has been absent. Canopy cover of grand fir alone can exceed 100% (due to overlapping). The shrub and herb layers are often depauperate in such heavily shaded conditions. Douglas-fir, larch and occasionally ponderosa pine dominate most seral stands, although grand fir may also be a significant component. Grand fir (well distributed in all size classes) dominates the oldest samples, with remnant, large Douglas-fir and western larch forming an emergent canopy above the grand fir. Larch snags and logs are common. Grand fir dominates the regeneration layer and may be abundant. Douglas-fir regeneration is often present but is rarely abundant.

Dense shade in mid to late seral stands causes sparse undergrowth. No shrubs were constant. Medium to tall shrubs are poorly represented in the data. The only relatively consistent shrubs are low shrubs or subshrubs such as prince's pine, pachistima and low huckleberry. Heartleaf arnica, bigleaf sandwort, elk sedge, white hawkweed, and western rattlesnake plantain are all commonly present in small amounts.

PRODUCTIVITY/MANAGEMENT: Site index values for grand fir, Douglas-fir and ponderosa pine are 59, 60 (base 50) and 89 (base 100) respectively. Total basal area at 282 sq. ft./ acre was higher on this type than for any other in the Grand Fir Series (Appendix C).

Even though natural stands may have little shrub and herb development, the shrub and herb layers respond vigorously to tree removal. Ross' sedge, snowbrush ceanothus and sticky currant often increase dramatically after logging and broadcast burning. Ross' sedge is not a component of closed forests but responds to canopy openings. It may compete strongly with tree seedlings. Snowbrush ceanothus is especially favored by broadcast burning in the fall because both the seed scarification and cold-wet stratification needs of the seeds are met.

Soil compaction and sometimes frost can cause serious regeneration problems. Frost can be a problem in some higher elevation stands. Dense shrub and herb communities can also develop after overstory removal. Until the sites are properly managed for soil and frost protection, reducing plant competition doesn't much help reforestation. This is because soil compaction and frost are the primary causes of reforestation failures and the secondary problem with vegetation competition develops after sites fail to reforest. Windthrow is common because most tree roots are in the surface ash layers and do not penetrate deep into the soil profile. Western larch, ponderosa pine, Douglas-fir and grand fir are suitable for regeneration if frost and compaction are avoided. Two- or even three-tree canopy layers are common in mid and late seral stands, thereby providing a diverse habitat for arboreal species and for elk and deer.

Fire scars and charred logs and snags are common. Under a natural fire regime it appears that seral stands of western larch, Douglas-fir or ponderosa pine had periodic underburns with moderately long intervals for stand-replacement fires. This type would likely fit into the "cool, moist Grand Fir Series" addressed by Agee (1994), with fire return intervals of 66 years and 100-200 years. Breast-height tree ages from the data ranged from 64 to 220 years, with 7 of 13 stands over 150 years in age.

Field notes indicate that root and bole rots (including laminated root rot) are common, especially on grand fir. Many stands have a lot of snags and logs, and pileated woodpeckers were observed during sampling. Considerable grazing has occurred around these stands. Some are located along old stock driveways. The soil description for one stand notes a compressed and hardened soil surface and attributes this to past sheep grazing. Ungulate grazing may have altered species composition in some stands. Abundant few-flowered peavine, for example, may indicate past heavy grazing.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/ARCO type has not been described in areas adjacent to the Wenatchee NF, but an ABGR/ARCO Community Type was described in the Blue and Ochoco Mountains classification (Johnson and Clausnitzer 1992).

# ABGR/ARNE ASSOCIATION CWS338

*Abies grandis/Arctostaphylos nevadensis*

grand fir/pinemat manzanita

## ENVIRONMENT

Elevation: 1950-4400 (3307) ft.

Aspect: all

Slope: 2-56 (30) %

Slope position: <u>ridges</u>, U, M, L 1/3, benches

Special: surface & soil rock; dry

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 22 |
| PIPO | ponderosa pine | 70 | 19 |
| ABGR | grand fir | 60 | 7 |
| PICO | lodgepole pine | 40 | 6 |
| LAOC | western larch | 40 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 90 | 5 |
| PSME | Douglas-fir | 90 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ARNE | pinemat manzanita | 80 | 28 |
| PAMY | pachistima | 60 | 3 |
| SPBEL | shiny-leaf spirea | 70 | 4 |
| AMAL | serviceberry | 60 | 2 |
| VAME | big huckleberry | 40 | 10 |
| ROGY | baldhip rose | 40 | 2 |
| ARUV | bearberry | 20 | 15 |
| VACA | dwarf huckleberry | 20 | 13 |
| **HERBS** | | | |
| CARU | pinegrass | 80 | 23 |
| FEOC | western fescue | 80 | 2 |
| CAGE | elk sedge | 70 | 6 |
| LUPIN | lupines. | 60 | 5 |
| ARMA3 | bigleaf sandwort | 60 | 2 |
| HIAL | white hawkweed | 60 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

This type occurs throughout the range of the Grand Fir Series on the Forest. The typical stand has very shallow rocky soils and low productivity.

It is found on ridge tops, upper slopes and, on occasion, glacial outwash terraces or till ridges. Slopes generally have low gradients and the configuration is flat or convex.

Elevations are low to moderate and the sites are typically warm and effectively dry. The substrate is a major controlling factor of the vegetation and, consequently, aspect is not as crucial for determining the plant community.

Soils are shallow and stony, often with exposed bedrock. The type is also occasionally found on outwash or till, where coarse fragments are high. Lichens are found on most exposed rock surfaces. Parent material is variable, with no preference for any particular rock type.

Note: Stands on glacial outwash terraces with pinemat manzanita cover greater than 5% should be keyed to this Association, even though they are distinctly different from other pinemat manzanita stands. They are included here until more data are collected.

VEGETATION: Douglas-fir, often mixed with a significant amount of ponderosa pine, dominates the sparse overstory of mid to late seral sample stands. Grand fir, lodgepole pine and several other tree species may also occur, but only in small amounts. The overstory is usually very open, almost a woodland in some cases. This is a natural condition, attributable in part to the harsh sites. Grand fir and Douglas-fir co-dominate the regeneration layer. These sites are open enough that ponderosa pine and lodgepole pine are sometimes present in the regeneration layer.

The undergrowth often appears to be quite scabby, with abundant surface rock visible through the prostrate vegetation. Pinemat manzanita and bearberry are considered equivalent indicators for this type. Dwarf huckleberry commonly occurs on outwash type deposits in areas of cold air accumulation. Few tall shrubs are present, which enhances the open appearance of these stands.

Characteristic herbaceous species of the undergrowth include pinegrass, western fescue, elk sedge, lupine species, bigleaf sandwort and white hawkweed. Pinegrass cover is variable from plot to plot. It can be missing or may have a cover as high as 50%. The other herbaceous species are seldom abundant.

PRODUCTIVITY/MANAGEMENT: From limited data it appears that tree growth and stocking are very low for the ABGR Series (Appendix C), although glacial outwash terraces may be somewhat more productive. The Douglas-fir site index was only 44 (base 50) and total tree basal area averaged about 160 sq. ft./ac. Insect and disease problems are commonly noted for Douglas-fir. The open stand structure results in very wolfy trees, with branches well down the bole.

Fire signs are almost always present. These include char on logs and snags and charcoal fragments in the soil. Fire frequency in these stands is judged to be fairly high historically, probably in the 30- to 50-year range if stands are extensive. Small islands within more moist grand fir types may have a longer return interval.

Many stands appear to have been used as stock driveways, which is consistent with a common historical use of ridgelines in these areas. Forage values are typically low, although wildlife signs are common. These sites may be important for early spring forage by elk or deer. Herbage production averaged 161 lbs./ac. (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/ARNE type has not been described in other areas adjacent to the Wenatchee NF. The type is identical to that described in the Wenatchee Draft Guide, except that in this Field Guide, bearberry has been added as an indicator.

# ABGR/BENE ASSOCIATION CWS225

*Abies grandis/Berberis nervosa*

grand fir/Cascade Oregon grape

*Cascade Oregon grape (BENE), an indicator of the ABGR/BENE Association.*

## ENVIRONMENT

Elevation: 2100-4760 (3094) ft.

Aspect: all

Slope: 2-68 (37) %

Slope position: ridges, U, M, L 1/3, benches

Special: moderate sites

## VEGETATION SUMMARY

(Sample size: 66)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 34 |
| ABGR | grand fir | 95 | 25 |
| LAOC | western larch | 39 | 13 |
| PIPO | ponderosa pine | 35 | 6 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 97 | 8 |
| PSME | Douglas-fir | 23 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| BENE | Cascade Oregon grape | 100 | 13 |
| ROGY | baldhip rose | 92 | 7 |
| PAMY | pachistima | 85 | 5 |
| SPBEL | shiny-leaf spirea | 82 | 4 |
| CHUMO | western prince's pine | 76 | 4 |
| LIBOL | twinflower | 48 | 8 |
| **HERBS** | | | |
| ARMA3 | bigleaf sandwort | 62 | 2 |
| GOOB | w. rattlesnake plantain | 62 | 1 |
| ACTR | vanilla leaf | 64 | 2 |
| HIAL | white hawkweed | 51 | 2 |
| CARU | pinegrass | 50 | 2 |
| TROV | trillium | 46 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/BENE Association was sampled from the Naches District north to the Chiwawa River watershed on the Lake Wenatchee District.

This common type occurs over a wide elevation range on a variety of slope-aspect combinations. Most sites are between 2500 and 3500 feet elevation. Only 7 of 66 plots were over 4000 feet. The highest elevation stands were sampled near Blewett Pass and on Manastash Ridge. The ABGR/BENE type is rarely found in canyon bottoms and is most frequent on mid slope sites.

Most stands have significant coarse fragments in the soil surface horizons. Rock types include sandstone, basalt and schist. More than half of the sampled soils had significant amounts of ash mixed into the upper horizon. Only 2 of the plots were recorded as occurring on glacial deposits. Effective rooting depth, where measured, was usually greater than 30 inches.

ABGR/ACTR often occurs on slightly more moist sites. Slightly drier stands often support the ABGR/BENE/CARU Association.

VEGETATION: The oldest sample stand is about 200 years old. Most stands are between 75 and 125 years of age, so late successional or near-climax conditions must be inferred from present species composition and successional relationships. Douglas-fir usually dominates early seral stands, although lodgepole pine or western larch, or both, may be important in some stands. Lodgepole generally declines in importance after about 100 years, while larch and Douglas-fir may continue dominance for several centuries. Grand fir may also become established early in the sere if a seed source is available. If a seed source is available after a fire that leaves much of the canopy intact, grand fir will increase greatly in prominence because it is much more able to regenerate in shaded conditions. Grand fir is virtually the only tree species regenerating in closed canopy stands.

A compact layer of low-growing shrubs mixed with herbs characterizes the undergrowth. The density of the undergrowth varies considerably in response to overstory canopy conditions. Dense, tall canopies of Douglas-fir mixed with grand fir effectively reduce light levels available at the forest floor and also effectively use much of the soil moisture. This results in very sparse undergrowth. Other stands have a nearly continuous layer of vegetation across the forest floor. Cascade Oregon grape, pachistima, baldhip rose, shiny-leaf spirea and prince's pine are the important shrubs in this layer. Small patches of taller shrubs like Douglas maple or ocean-spray may be present, especially in openings.

The herbaceous component is usually a minor part of the undergrowth. Vanilla leaf, rattlesnake plantain and bigleaf sandwort are the only species consistently present in most stands, but are never very abundant. Other species present include white hawkweed and pinegrass. A number of other species occur, none with consistency or abundance (Appendix B).

PRODUCTIVITY/MANAGEMENT: Timber productivity is fairly low for the Grand Fir Series (Appendix C). Tree growth is fairly good, but stocking levels are moderate. Site index values for Douglas-fir, western larch and grand fir are 67, 61 and 64 (base 50), but total basal area is only 237 sq. ft./ac. White pine was an important part of the tree sere before white pine blister rust was introduced. Ponderosa pine appears adapted only to the warmest stands in the type.

Soils formed in volcanic ash or basalt are especially subject to compaction from equipment. Soils with ash over basalt or very rocky substrates are more prone to windthrow because tree roots cannot penetrate deeply into the profile. Mistletoe and various root rots are prevalent in these stands. Mistletoe infestations are often light, but are quite visible in some stands. Affected species include Douglas-fir, larch and grand fir. Root rot has infected, in one stand or another, nearly all tree species. Lodgepole pine, western larch and Douglas-fir all seem susceptible. Grand fir boles often have conks.

Fire indicators are ubiquitous. Charcoal, charred bark, snags and charred logs are common. Fire is the usual mechanism for stand regeneration. Dense stands of grand fir are especially prone to intense crown fires. Stand ages of under 100 years are common, suggesting relatively high fire frequency. Only 6 of 39 sample stands had breast-height tree ages over 150 years.

Forage in mature stands for ungulates is poor (<30 lbs./ac.), but the sites tend to be dark and cool because of the dense canopy characteristic of the type. Domestic livestock use was seldom noted. Multiple tree canopies are common and provide habitat for arboreal mammals and birds. These stands appear to receive moderate big game use, mainly as travel corridors, with only minor browsing and foraging visible. Cascade Oregon grape is relatively tolerant of trampling damage and persists fairly well in campgrounds if the plants are not picked or dug. The type offers little in the way of floral displays or screening of one campsite from another.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/BENE type has not been described on areas adjacent to the Wenatchee NF. The Gifford Pinchot NF classification does describe a similar ABGR/BENE/ACTR, but that type may be more similar to the Wenatchee's ABGR/ACTR.

# ABGR/BENE/CARU *WEN* ASSOCIATION CWS226

*Abies grandis/Berberis nervosa/Calamagrostis rubescens*

grand fir/Cascade Oregon grape/pinegrass

## ENVIRONMENT

Elevation: 1910-5190 (3190) ft.

Aspect: all

Slope: 3-63 (24) %

Slope position: ridges, U, M, L 1/3, benches

Special: warm, well-drained sites

## VEGETATION SUMMARY

(Sample size: 28)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 24 |
| ABGR | grand fir | 86 | 14 |
| PICO | lodgepole pine | 54 | 18 |
| LAOC | western larch | 50 | 9 |
| PIPO | ponderosa pine | 43 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 100 | 8 |
| PSME | Douglas-fir | 64 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| BENE | Cascade Oregon grape | 100 | 6 |
| ROGY | baldhip rose | 86 | 6 |
| SPBEL | shiny-leaf spirea | 82 | 5 |
| PAMY | pachistima | 75 | 4 |
| CHUMO | western prince's pine | 61 | 3 |
| SYMOH | creeping snowberry | 57 | 4 |
| LIBOL | twinflower | 29 | 13 |
| VAMY | low huckleberry | 25 | 7 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 17 |
| LAPA2 | few-flowered peavine | 64 | 9 |
| CAGE | elk sedge | 64 | 5 |
| HIAL | white hawkweed | 61 | 2 |
| ARCO | heartleaf arnica | 46 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/BENE/CARU Association was sampled from the Lake Wenatchee District south to the Naches River watershed on the Naches District. It typically occurs between 2600 and 3600 feet on moderately steep upper to lower third slopes and benches. Few stands were in valley bottoms. One plot was over 5000 feet in elevation on a steep southerly slope, an elevation much higher than the majority of plots in the type.

The regolith is primarily depositional, from a variety of rock types. Basalt or andesite is the most common rock type. Schist, outwash, sandstone and conglomerate also occur. About a third of the samples had ash or tephra in the upper soil horizons. The soil surface has noticeable gravel and bare soil exposed. Effective rooting depth, where measured, averaged about 16 inches.

This type indicates relatively warm, well-drained sites. Sites with deeper soils (and presumably more mesic conditions) are usually in the ABGR/BENE Association. Still drier sites, or those with a less maritime climatic influence, are commonly in the ABGR/CARU Association.

VEGETATION: The oldest stand is less than 200 years old, so late seral or near climax conditions must be inferred from species composition and successional dynamics. Tree canopies tend to be less dense than in many other Grand Fir Series types, so the shrub and herbaceous layer is more diverse and productive. Two-tree canopies are common, with western larch, Douglas-fir or ponderosa pine forming the tallest layer and grand fir forming a layer 10 to 20 feet lower. Grand fir dominates the tree regeneration layer and is the indicated climax conifer. Most mid seral stands are dominated by long-lived seral species such as western larch, Douglas-fir or ponderosa pine. Lodgepole pine may dominate stands up to 150 years old, but it is less common in older stands. Our data shows a pattern of less western larch in 150-year and older stands than is characteristic of other Associations in the Grand Fir Series. It is presently unclear whether this pattern is related to the site or is simply an artifact of the plots. Pioneer stands are often dominated by ponderosa pine or lodgepole pine. Grand fir also seems to establish well early in the sere and in many stands often co-dominates in the overstory by year 100, though generally less so than in the ABGR/BENE or ABGR/ARCO Associations. Grand fir is usually the sole regenerating species and may be very abundant among regeneration-size trees.

The undergrowth is characterized by a diverse but not dense layer of low-growing shrubs and herbs. Cascade Oregon grape, creeping snowberry, baldhip rose, pachistima, western prince's pine, shiny-leaf spirea, pinegrass elk sedge and few-flowered peavine are all usually present. A number of other species may also be present, and sometimes fairly abundant. These include grouse, low or big huckleberry, and twinflower. Few-flowered peavine can also be well represented and appears to be especially common in stands with evidence of past or present heavy grazing. Broadleaf, spurred, or bigleaf lupine are present in most stands.

PRODUCTIVITY/MANAGEMENT: Sites are on the low end of productivity for the Grand Fir Series (Appendix C). Site index values for Douglas-fir, grand fir and ponderosa pine are 66, 70 (base 50) and 105 (base 100), respectively. Total tree basal area averaged 251 sq. ft./ac.

Field notes indicate that remnant larch in mature stands often have heavy mistletoe infestations. Root rot pockets may also be found. Pinegrass is generally not dense enough to be a problem for reforestation on most sites. The ABGR/BENE/CARU Association should be relatively easy to manage for timber production if soil compaction and erosion are avoided. Soils formed in volcanic ash or in basalts are especially subject to soil compaction. Sites with gentle topography may be subject to the development of frost pockets if harvest activities have created conditions for cold air concentrations.

Fire indicators, such as charcoal on logs and snags and fire scars on trees and stumps, are common. The natural fire regime appears to have been one of relatively frequent but low intensity underburns with only occasional crown fires. Fire suppression has lead to a greater proportion of grand fir in the stands with an attendant increase in ladder fuels. This has predisposed most stands to stand-replacing wildfires.

Mean herbage production was 150 lbs./ac. (Appendix C). Cascade Oregon grape is relatively tolerant of trampling damage and persists fairly well in campgrounds. The type offers little in the way of floral displays or screening of one camp site from another. Stands that support abundant pinegrass will provide an attractive, grassy, parklike appearance.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/BENE/CARU type has not been described on areas adjacent to the Wenatchee NF.

# ABGR/CARU *WEN* ASSOCIATION CWG124

*Abies grandis/Calamagrostis rubescens*

grand fir/pinegrass

## ENVIRONMENT

Elevation: 1880-5000 (3338) ft.

Aspect: all

Slope: 2-64 (35) %

Slope position: ridges, U, M, L 1/3, benches

Special: dry

## VEGETATION SUMMARY

(Sample size: 32)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 97 | 31 |
| PIPO | ponderosa pine | 91 | 16 |
| ABGR | grand fir | 66 | 10 |
| PICO | lodgepole pine | 22 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 94 | 5 |
| PSME | Douglas-fir | 75 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SPBEL | shiny-leaf spirea | 78 | 9 |
| PAMY | pachistima | 63 | 6 |
| BEAQ | Oregon grape | 59 | 3 |
| AMAL | serviceberry | 59 | 2 |
| HODI | ocean-spray | 47 | 2 |
| ROGY | baldhip rose | 44 | 5 |
| CHUMO | western prince's pine | 44 | 4 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 23 |
| CAGE | elk sedge | 81 | 8 |
| HIAL | white hawkweed | 66 | 2 |
| ARMA3 | bigleaf sandwort | 63 | 3 |
| ARCO | heartleaf arnica | 50 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/CARU Association is one of the most widespread types in the Grand Fir Series. It was sampled throughout the Forest, although rarely north of the Entiat Mountains.

The type encompasses a broad range of habitats with variable elevations and aspects. Middle and, to a lesser extent, upper slope positions are most common. Most stands are found on moderately steep, southerly slopes.

The regolith is primarily colluvium derived from a variety of rock types, including basalt, granite and sandstone. Many soils are capped by ash or have ash mixed into the upper soil horizons. The soils appear to be deep and well drained. Effective rooting depth, where measured, is more than 30 inches.

Drier sites are commonly in the Douglas-fir Series. More moist sites may support the ABGR/CARU-LUPIN Association.

Some of the variation in this type is due to its large geographic range. It may be possible to split the type at Interstate-90 to reduce this physical variation.

VEGETATION: Grand fir occupies only a minor position in the overstory canopy until late in the sere, and even then is rarely the dominant species in the data. The oldest sample stand is 260 years old and grand fir does not dominate the overstory. It commonly dominates the tree regeneration layer in stands of all ages, and grand fir and Douglas-fir regeneration is present in most stands, but grand fir does not appear capable of initiating the sere. It appears to enter the sere after ponderosa pine or Douglas-fir, which are the primary seral co-dominants. Ponderosa may re-establish more effectively following fire, but is quickly followed by Douglas-fir. Western larch is nearly absent from the data, even though most plots are within its geographic range. Apparently the ABGR/CARU Association is too xeric for western larch. Lodgepole pine may be present in some stands but is seldom abundant.

Tall shrubs are uncommon but include serviceberry, ocean-spray or Scouler willow. Low-growing shrubs partially hidden by pinegrass are common and sometimes abundant. Shiny-leaf spirea, pachistima, one of the prince's pines and Oregon grape are usually present.

Pinegrass is the most conspicuous herb in the majority of stands and characterizes the Association. Elk sedge is often present and may dominate in some stands. Other common herbs include bigleaf sandwort, white hawkweed, few-flowered peavine, silvercrown luina, spreading dogbane and lupines. Abundant silvercrown luina or few-flowered peavine indicate past heavy grazing. Both species persist for long periods after grazing has stopped.

PRODUCTIVITY/MANAGEMENT: Douglas-fir and ponderosa pine appear to be the best adapted species to the sites, especially after deforestation. Basal areas for the type were low for the Grand Fir Series. Site index values for Douglas-fir, ponderosa pine and grand fir were in the top 40% (Appendix C). Soil drought and herbaceous competition for soil moisture make reforestation more difficult than in more mesic types in the Series. Southerly slopes are best treated as shelterwoods to provide shade for young trees. Pinegrass and elk sedge can compete strongly with tree seedlings if pre-harvest cover of pinegrass or elk sedge is over 30%. Broadcast burning stimulates both pinegrass and elk sedge unless the fire is so hot it kills the rhizomes buried in the soil. Fires this hot also degrade the site by removing organic matter and nutrients. Natural regeneration is a viable option if shelter and a seed source are left on the site.

All older ponderosa pines have multiple fire scars. Natural fire regimes of underburns appear to have maintained ponderosa pine dominance and the open, grass-dominated undergrowth, effectively restricting Douglas-fir and grand fir. Recruitment by these species required special circumstances of long periods between burns or a series of especially cool burns. With the advent of fire suppression several decades ago, succession to Douglas-fir and grand fir has been accelerated, with the forest undergoing a type change. A secondary canopy of grand fir under Douglas-fir and ponderosa pine is common. This secondary canopy provides additional habitat for arboreal mammals and birds, but also makes these stands more prone to crown fire because grand fir provides ladder fuels into the crowns of dominant Douglas-fir and ponderosa pines.

Field notes indicate mistletoe is common in Douglas-fir. Various root and bole rots may be found on ponderosa pine, Douglas-fir or grand fir, but none seem to be widespread or very common.

Big game trails and droppings are common. Livestock use has been heavy in some stands in the past, as evidenced by abundant silvercrown luina or few-flowered peavine. Herbage production averaged about 200 lbs./ac. Stands that support abundant pinegrass will provide an attractive, grassy, parklike appearance to campers.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: An ABGR/CARU Association has been described in the Blue, Ochoco and Wallowa Mountains of Washington and Oregon (Johnson and Simon 1987; Johnson and Clausnitzer 1992), and on the Yakima Indian Reservation (John and others 1988). Stands within the ABGR/CARU type described on the Gifford Pinchot NF (Topik 1989) that have no ocean-spray are very similar.

# ABGR/CARU-LUPIN COMMUNITY TYPE CWG125

*Abies grandis/Calamagrostis rubescens-Lupinus spp.*

grand fir/pinegrass-lupine

## ENVIRONMENT

Elevation: 3030-5100 (4231) ft.

Aspect: all

Slope: 6-63 (31) %

Slope position: <u>ridges</u>, <u>U</u>, <u>M</u>, L 1/3, bottoms

Special: dry, cool

## VEGETATION SUMMARY

(Sample size: 28)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 23 |
| PIPO | ponderosa pine | 61 | 13 |
| ABGR | grand fir | 61 | 10 |
| PICO | lodgepole pine | 50 | 18 |
| LAOC | western larch | 36 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 96 | 4 |
| PSME | Douglas-fir | 93 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 82 | 8 |
| CHUMO | western prince's pine | 71 | 4 |
| SASC | Scouler willow | 57 | 2 |
| SPBEL | shiny-leaf spirea | 54 | 3 |
| VAMY | low huckleberry | 50 | 13 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 36 |
| LUPIN | lupines | 64 | 11 |
| ARCO | heartleaf arnica | 64 | 6 |
| CAGE | elk sedge | 54 | 9 |
| HIAL | white hawkweed | 54 | 2 |
| GOOB | w. rattlesnake plantain | 46 | 2 |
| ANRA | raceme pussytoes | 43 | 4 |
| LULA | broadleaf lupine | 36 | 13 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/CARU-LUPIN type was sampled from the Entiat River drainage south to near the southern Forest border.

It occurs on a variety of topographic positions, but is typically found on ridgetops to middle 1/3 slope, with a few stands on lower 1/3 slopes and in valley bottoms. The typical stand is a moderately-sloping site at 4200 feet on an upper or middle slope, although all aspects are represented in the data.

The regolith is composed of gravelly colluvium or alluvium, or glacial deposits derived from schist, gneiss, sandstone or basalt, depending on geographic location. Ash or tephra may be present in the upper soil horizons. Soils are often shallow (<24 inches) and very stony beneath the surface ash-influenced horizons.

The ABGR/CARU-LUPIN Community Type appears to be on somewhat more mesic and cooler sites than the ABGR/CARU Association. However, the abundance of lupines in this type may at least partially be the result of past grazing.

VEGETATION: The oldest stand is less than 250 years old, so late seral or near successional conditions must be based on species composition and successional dynamics. Many of the plots are in or near old stock driveways and herbaceous composition may reflect historical grazing use as much or more than intrinsic site characteristics. Seral stands may be dominated by ponderosa pine or western larch, or both. Douglas-fir is usually present as co-dominant in most mid-seral stands (>100 years of age). Grand fir is seldom present in the overstory until later in the tree sere. Douglas-fir will likely remain an overstory component for several centuries. Grand fir regeneration is common once a tree overstory is established, although Douglas-fir regeneration may be locally more abundant. Western larch is a major component of fire initiated stands in the type. Lodgepole pine will often form nearly pure stands if the interval between catastrophic fires is less than 200 years. Plots with some subalpine fir may better fit the Subalpine Fir Series, based upon a judgement of its success for regeneration. Many stands that key to this type but are improperly placed in the Grand Fir Series will better fit the ABLA2/ARLA/POPU type. Plots with skunkleaf polemonium are typically Subalpine Fir Series.

The undergrowth is lush and herbaceous in appearance. Few tall shrubs are present, none with much consistency. Scouler willow may be found in scattered clumps, often growing as a tree to nearly 40 ft. tall. The predominant feature of the undergrowth is the lush, herbaceous low-shrub layer. Pinegrass and lupines are dominant and characteristic. These are mostly broadleaf lupine, but lupines hybridize in the Wenatchee Mountains, so positive identification can be difficult. (See “Species identification and naming conventions” in the Introduction.) Pachistima is found mixed with these herbs. Other common taxa include low huckleberry, shiny-leaf spirea, western prince’s pine, heartleaf arnica and elk sedge.

PRODUCTIVITY/MANAGEMENT: Douglas-fir, ponderosa pine, lodgepole pine and western larch are all adapted to the sites, especially after deforestation. But the sites are not very productive for trees. Both basal area and site index values are low when compared to other types in the Grand Fir Series (Appendix C). Fire suppression over the last several decades has apparently led to an increase in the amount of grand fir on most sites, to the point that some stands have a secondary canopy of grand fir under other conifers, such as western larch, ponderosa pine or Douglas-fir. Sites with ash soils or with soils developed in basalt are especially prone to soil compaction. Lupines fix nitrogen and they may play an important role in nutrient cycling on the sites. Sites with low huckleberry may be more frost-prone than sites without.

These stands are now predisposed to crown fires rather than to the more common fire pattern of underburns with only occasional crown fires. Fire is a major feature of this type. Snags and logs in all sampled stands have significant charcoal and burn marks. The dominance of lodgepole pine in pioneer and early seral stands also indicates that fire initiated most if not all stands. The herbaceous understory and relatively dry conditions suggest stands that historically experienced frequent, low intensity fires. The upper slope and ridgetop locations of this type would also predispose the stands to lightning strikes

Some of these stands are located along old stock driveways. The effects of this past use on current vegetation composition and future succession are largely unknown. This type has the highest herbage production of any Association or Community Type on the Forest (over 500 lbs./ac.; see Appendix C). These stands would commonly have a lush stand of vegetation, attractive to campers. However, the typical steep slopes would discourage use.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/CARU-LUPIN type has not been described on areas adjacent to the Wenatchee NF, although some samples in the ABGR/CARU types from other areas may be similar.

# ABGR/HODI/CARU COMMUNITY TYPE CWS554

*Abies grandis/Holodiscus discolor/Calamagrostis rubescens*

grand fir/ocean-spray/pinegrass

*Ocean-spray (HODI), an indicator of the ABGR/HODI/CARU Association.*

## ENVIRONMENT

Elevation: 1800-4800 (3109) ft.

Aspect: all

Slope: 2-64 (35) %

Slope position: ridges, U, M, L 1/3

Special: Dry, rocky

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 32 |
| ABGR | grand fir | 90 | 15 |
| PIPO | ponderosa pine | 70 | 14 |
| LAOC | western larch | 27 | 3 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 100 | 6 |
| PSME | Douglas-fir | 50 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ROGY | baldhip rose | 100 | 12 |
| HODI | ocean-spray | 100 | 10 |
| SPBEL | shiny-leaf spirea | 80 | 10 |
| BEAQ | Oregon grape | 70 | 4 |
| AMAL | serviceberry | 64 | 2 |
| **HERBS** | | | |
| CARU | pinegrass | 90 | 10 |
| CAGE | elk sedge | 80 | 9 |
| ARMA3 | bigleaf sandwort | 80 | 3 |
| ARCO | heartleaf arnica | 60 | 4 |
| GOOB | w. rattlesnake plantain | 64 | 1 |
| LAPA2 | few-flowered peavine | 55 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/HODI/CARU Community Type was sampled from the Leavenworth District south to the southern border of the Forest. It is characteristically on steep slopes of any aspect, but with gravelly soils. Only three plots have slopes under 40%.

The type occurs over a broad range of elevations and upslope topographic positions, although most stands occurred on middle to lower 1/3 slopes. Only one stand occurred in a canyon bottom.

The regolith is colluvium derived from either sandstone, granite or basalt. Soils are droughty, rocky and coarse-textured. Most soils have ash mixed into the upper horizons. In all instances the soils are rocky, with considerable microsite variation.

The ABGR/HODI/CARU Community Type is similar to the ABGR/SPBEL/PTAQ Community Type in that both are characteristic of relatively steep slopes. However the ABGR/SPBEL/PTAQ type has soils with a greater proportion of volcanic ash or pumice in the profile than do most sites that key to ABGR/HODI/CARU.

VEGETATION: The data on stand ages are limited but it appears that Douglas-fir and ponderosa pine dominate the overstory of early and mid seral stands. Grand fir is present in the overstory in most stands and will likely increase in dominance as stands mature towards climax. These stands are typically very open; some almost approach a woodland spatial structure. Grand fir and Douglas-fir are the major reproducing species. Ponderosa pine may be found in the more open stands. One stand also had abundant bigleaf maple in the understory.

The undergrowth is dominated by patches of ocean-spray set in a matrix of pinegrass, elk sedge, or both. Baldhip rose, shiny-leaf spirea and Oregon grape are all important shrubs. The herbaceous layer is dominated by pinegrass or elk sedge. Few other species seem to show any consistency or abundance. Abundant few-flowered peavine indicates past heavy grazing.

PRODUCTIVITY/MANAGEMENT: These stands seldom appear vigorous. Tree growth is in the middle range for the Grand Fir Series (Appendix C), although only two stands were sampled for tree growth information. Basal area of trees averaged 212 sq. ft./ac. Douglas-fir, ponderosa pine and western larch are the typical tree dominants in most stands.

Reforestation is difficult to assure, especially on steep west or southerly slopes. Sheltered microsites are important for tree establishment. Soil drought appears to be the main limitation to conifer establishment and growth. Soils are easily displaced by heavy equipment and are prone to ravel. Most stands are natural shelterwoods and this appears to be the best method to reforest the sites. Planting may be difficult because of rocky sites. The coarse soil textures, high coarse fragment percentages, steep slopes and relatively low elevations effectively make the sites droughty and susceptible to regeneration failures. Overstory removal sites are hot and dry at the soil surface, due to the southerly aspects and steep slopes.

Fire is the major natural disturbance in these stands. Only two sample stands have age data, and breast-height ages there were 78 and 101. It is likely that older stands have experienced a number of lower intensity burns, although as ladder fuels accumulate, the likelihood of a stand replacing fire increases.

Mistletoe, spruce budworm and bark beetles have all been noted.

Snow melts early on the sites with lower elevations and with southerly aspects, and early snow melt and the abundance of shrubs may provide important early spring forage for wildlife. Herbage production on the two sample stands averaged 164 lb./ac. (Appendix C)

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/HODI/CARU type has not been described elsewhere. However, a similar ABGR/HODI type has been described in the Blue and Wallowa Mountains of Washington and Oregon (Johnson and Simon 1986; Johnson and Clausnitzer 1992). ABGR/HODI plant Associations have also been described for both the Mt. Hood and Gifford Pinchot NFs (Topik 1989; Topik and others 1988), although both types have little or no pinegrass.

# ABGR/SPBEL/PTAQ COMMUNITY TYPE CWS335

*Abies grandis/Spirea betulafolia* var. *lucida/Pteridium aquilinum*

grand fir/shiny-leaf spirea/bracken fern

## ENVIRONMENT

Elevation: 1940-4310 (2909) ft.

Aspect: southeast to west (southerly)

Slope: 21-70 (44) %

Slope position: ridges, U, M, L 1/3, benches

Special: pumice soils

## VEGETATION SUMMARY

(Sample size: 30)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 36 |
| PIPO | ponderosa pine | 80 | 15 |
| ABGR | grand fir | 67 | 9 |
| PIMO | western white pine | 50 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 97 | 4 |
| PSME | Douglas-fir | 77 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SPBEL | shiny-leaf spirea | 100 | 7 |
| PAMY | pachistima | 97 | 8 |
| CHUMO | western prince's pine | 93 | 5 |
| PYPI | whitevein pyrola | 83 | 2 |
| RUPA | thimbleberry | 73 | 5 |
| PYSE | sidebells pyrola | 73 | 3 |
| AMAL | serviceberry | 60 | 2 |
| ROGY | baldhip rose | 60 | 3 |
| BENE | Cascade Oregon grape | 50 | 2 |
| **HERBS** | | | |
| PTAQ | bracken fern | 100 | 7 |
| CARU | pinegrass | 73 | 18 |
| HIAL | white hawkweed | 59 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/SPBEL/PTAQ Community Type was sampled mainly from the Entiat District but was also found (1 sample each) on the Cle Elum, Leavenworth and Lake Wenatchee Districts.

The type occurs on moderately steep, southerly or westerly slopes over a broad elevation range. Only one sample occurred on a northerly aspect (NW), and only three were under 25% slope. It most frequently occurs on upper, mid and lower slope positions, but may occasionally be found on ridgetops and benches.

The regolith is typically deep pumice overlying granite, gneiss or schist. Some sites were covered with ash or other ejecta. Small amounts of gravel are found on the soil surface in nearly every sample stand. Soils are typically cobbly and/or gravelly and exhibit signs of downslope creep, pistol butts on trees, for instance. The soil surface is usually covered by a thick litter layer. Given the presence of pumice or coarse fragments, or both, these soils are likely to be well or excessively drained and droughty. Coarse fragments are usually gravel-size and average over 30% by volume. This does not appear to be as harsh a type as the ABGR/HODI/CARU Community Type.

VEGETATION: Douglas-fir, alone or mixed with ponderosa pine, dominates the overstory in early to mid-seral stands. Relict lodgepole pine occurs in many mid-seral stands and may be a significant component in early phases of the sere. The current data include stands to 150 years old and show little grand fir recruitment into the overstory. Grand fir and Douglas-fir co-dominate the regeneration layer. Both species seem to be successfully reproducing, with Douglas-fir doing better in stands with relatively open canopies. Small amounts of subalpine fir regeneration frequently occur even though aspects are southerly and elevations are low. Douglas-fir regeneration may be excluded under an overstory canopy composed largely of grand fir, and this exclusion will require several centuries without crown fires to overcome.

The undergrowth consists of scattered tall shrubs, mainly Douglas maple, Scouler willow or serviceberry, over a denser layer of low shrubs, subshrubs and herbs. One or more of these tall shrubs is nearly always present, but in only 3 samples did cover of any one of these shrubs exceed 5%. Pachistima, prince's pine, thimbleberry and shiny-leaf spirea dominate the low shrub layer. Pachistima may be abundant in some stands.

Bracken fern is usually the dominant herb. Sub-shrubs such as whitevein and sidebells pyrola are typically present. Whitevein pyrola has higher constancy in this type than in any other on the Forest. Pinegrass can occasionally be abundant. Bracken fern may be allopathic to associated species, especially if abundant (Ferguson and Boyd 1988).

PRODUCTIVITY/MANAGEMENT: Of the trees present, Douglas-fir and ponderosa pine appear to grow particularly well on these sites. Site index for Douglas-fir (base 50) is 82 and for ponderosa pine (base 100) is 113 (Appendix C). Ponderosa pine appears best adapted to initiate the forest sere. Grand fir appears to grow slowly here (site index of 60, base 50) in relation to the rest of the Series. Total Basal area averages 223 sq. ft./ac.

These stands often occur near talus and may have relatively unstable soils. Trees are often pistol butted, even at elevations where snow cannot be the cause. This suggests noticeable soil creep. Soils are subject to erosion if left without a vegetative or litter cover.

In this middle-elevation type within the Grand Fir Series, and with stand ages less than 150 years, fire has played an important role. Indicators of past fire, such as charcoal and fire scars, are ubiquitous. Historically, ponderosa pine was the most common tree species, maintained in the stands by frequent recurrent fire. Now, with fire suppression, grand fir and particularly Douglas-fir have become much more important and dominant stand components. The presence of lodgepole pine in the early seral stages of this type indicates past episodes of stand-replacement fires.

A number of diseases may be present. Dwarf mistletoe is common on both Douglas-fir and grand fir and may be severe enough to contribute to mortality. Grand fir may incur frost cracks and attendant decay at the upper elevation limits of this type. Root rots of various kinds are also prevalent on both Douglas-fir and grand fir. Some western white pine are infected by blister rust.

Deer trails are often observed in the type, although extensive browsing is not evident. Herbage production averaged 123 lbs./ac. (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/SPBEL/PTAQ type has not been described on areas adjacent to the Wenatchee NF. An ABGR/SPBEL type has been described on the Yakima Indian Reservation, but it appears to be very different (John and others 1988).

# ABGR/SYAL/CARU ASSOCIATION CWS336

*Abies grandis/Symphoricarpos albus/Calamagrostis rubescens*

grand fir/common snowberry/pinegrass

## ENVIRONMENT

Elevation: 1910-4050 (2945) ft.

Aspect: all (southerly to west)

Slope: 1-78 (35) %

Slope position: ridges, U, M, L 1/3, benches

Special: many tall shrubs

## VEGETATION SUMMARY

(Sample size: 42)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 98 | 40 |
| ABGR | grand fir | 83 | 14 |
| PIPO | ponderosa pine | 74 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 88 | 6 |
| PSME | Douglas-fir | 67 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ROGY | baldhip rose | 81 | 5 |
| SPBEL | shiny-leaf spirea | 72 | 5 |
| BEAQ | Oregon grape | 71 | 4 |
| SYAL | common snowberry | 67 | 8 |
| HODI | ocean-spray | 64 | 6 |
| AMAL | serviceberry | 56 | 2 |
| SYMOH | creeping snowberry | 49 | 7 |
| **HERBS** | | | |
| CARU | pinegrass | 90 | 10 |
| ARMA3 | bigleaf sandwort | 81 | 4 |
| CAGE | elk sedge | 79 | 6 |
| OSCH | sweetroot | 72 | 2 |
| LAPA2 | few-flowered peavine | 58 | 6 |
| LUNA2 | silvercrown luina | 56 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/SYAL/CARU Association was sampled from the Naches District north to Icicle Creek on the Leavenworth District.

This type is uncommon on ridgetops and benches, and 80% of the stands occurred on either upper, mid or lower slopes and between 2500 and 3500 ft. in elevation. Only one stand exceeds 4000 feet. Most slopes are steep and southerly or westerly facing.

The most commonly occurring regolith material is basalt colluvium. 70% of the stands occurred on basalt, sandstone or tephra, typically colluvial material, or mixed with colluvial material. Most stands have gravel or rock on the soil surface. Several stands have soils covered by dry ravel or talus to 8 in. deep. The organic horizon is typically less than 2 in. thick. Logs, branches and twigs on the soil surface are abundant in most stands.

VEGETATION: Because of the relative youth of the stands in the data, late seral or near climax conditions must be based on species composition and successional relationships. The oldest sample stand is less than 200 years old and grand fir is not yet the tree overstory dominant, though it clearly dominates the tree regeneration layer. Grand fir dominates many of our younger plots, so it appears able to enter the tree sere at nearly any time if seed sources are nearby. Ponderosa pine, or sometimes western larch mixed with Douglas-fir, dominates most early seral stands (<100 years old). All these trees can remain as stand dominants for many decades, though in some cases Douglas-fir may remain as a stand dominant long after the ponderosa pine and larch die out. Both grand fir and Douglas-fir are present in the regeneration, though the former is usually more abundant.

The undergrowth is characterized and dominated by a variety of shrubs, including common snowberry, creeping snowberry, ocean-spray, shiny-leaf spirea and baldhip rose. Other common but not necessarily constant shrubs include Oregon grape, Douglas maple, trumpet honeysuckle and pachistima.

A number of herbs exhibit fairly high abundance beneath the shrub layer, including pinegrass, bigleaf sandwort, elk sedge few-flowered peavine and silvercrown luina. Sweetroot has high constancy but low cover.

PRODUCTIVITY/MANAGEMENT: In this type, ponderosa pine has one of the higher site index values, 110 (base 100), in the Grand Fir Series (Appendix C). Tree basal area averages almost 240 sq. ft./ac. Several plots in the data are from stands logged around WW I. These stands have generally regenerated well. Since many of the stands in this type have a gravel or cobble layer at the soil surface, tree reestablishment could be difficult. After establishment, however, the gravel acts as a mulch to preserve soil moisture. Planting would be difficult through the gravel horizon. Natural regeneration would best succeed if sufficient sheltered microsites (e.g., rotten logs, branch piles) were left. Douglas-fir and ponderosa pine appear to be the best conifers to initiate the tree sere. Western larch is common only on the more mesic sites within the type. Some soils have ash caps, especially those stands on the Cle Elum District. These soils, as with all other ash cap soils, are sensitive to compaction by heavy equipment, resulting in a loss of soil productivity.

Fire signs such as charring on trees and logs are present in nearly all stands. Fires often crown out in these stands because the tree layers are relatively dense and shrub cover is dense enough to allow fires to get into tree crowns in many cases. Fire return intervals are likely in the 50-200-year range. The sites are warm and dry, which further predisposes them to fire.

Dwarf mistletoe on Douglas-fir was noted on nearly every sample plot and was sometimes very abundant. Stem cankers on Douglas-fir and laminated root rot pockets are also common.

The ABGR/SYAL/CARU Association is heavily used by livestock and big game for forage, browse and shelter even though herbage production is quite low (<60 lbs./ac.). Silvercrown luina and few-flowered peavine are especially abundant in overgrazed stands. These shrubby stands provide thermal and hiding cover for wildlife. Trails and signs of browsing are common. Multiple tree layers provide habitat for arboreal mammals and birds.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: An ABGR/SYAL/CARU type has not been described elsewhere. Similar ABGR/SYAL and ABGR/SYMOH types have been described on the Yakima Indian Reservation (John and others 1988). An ABGR/SYMPH plant Association has been described for the Mt. Hood NF (Topik and others 1988). The Mt. Hood type uses both common and creeping snowberry as indicators. Compared to ABGR/SYAL/CARU, the Mt. Hood type has few graminoids.

# ABGR/SYOR ASSOCIATION CWS337

*Abies grandis/Symphoricarpos oreophilus*

grand fir/mountain snowberry

## ENVIRONMENT

Elevation: 2840-4670 (3897) ft.

Aspect: mainly southerly

Slope: 10-37 (25) %

Slope position: ridges, U, M 1/3

Special: forest/non-forest margins, limited data

## VEGETATION SUMMARY

(Sample size: 5)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 29 |
| PIPO | ponderosa pine | 100 | 29 |
| ABGR | grand fir | 40 | 3 |
| **TREE UNDERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 2 |
| PIPO | ponderosa pine | 60 | 3 |
| ABGR | grand fir | 60 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| SYOR | mountain snowberry | 100 | 5 |
| BEAQ | Oregon grape | 100 | 2 |
| AMAL | serviceberry | 80 | 3 |
| SYAL | common snowberry | 60 | 9 |
| **HERBS** | | | |
| CAGE | elk sedge | 100 | 8 |
| LAPA2 | few-flowered peavine | 100 | 5 |
| COPA | little flower collinsia | 100 | 2 |
| LUNA2 | silvercrown luina | 80 | 7 |
| BASA | arrowleaf balsamroot | 80 | 5 |
| ARCO | heartleaf arnica | 80 | 4 |
| ACMI | yarrow | 80 | 3 |
| MOPE | miner's lettuce | 80 | 3 |
| HYCA | ballhead waterleaf | 80 | 3 |
| CARU | pinegrass | 60 | 6 |
| LUPIN | lupines | 60 | 5 |
| ARMA3 | bigleaf sandwort | 60 | 3 |
| LOTR | nine-leaf lomatium | 60 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABGR/SYOR Association was sampled only in the Table Mountain and Taneum Ridge areas of the Cle Elum District, but might also be found elsewhere where grand fir stands on drier/warmer aspects are adjacent to non-forest. The data are limited but the type appears distinctive. These marginal grand fir habitats are commonly found on southerly slopes in small swales intermixed with scablands.

Soils are developing from basalt colluvium generally more than 3 feet deep. These soils become very stony below the first 8 to 10 inches. Gravels and cobbles are exposed at the soil surface in every stand. Litter cover ranges from 0 to 80% in the samples.

Drier sites will often be in the PSME/SYOR Association. Stands with mountain big sage may also better fit the PSME/SYOR type.

VEGETATION: The few sample plots represent young stands around 100 years old. Ponderosa pine and Douglas-fir dominate the overstories of these mid-seral stands, but those with slightly more soil moisture may have higher covers of Douglas-fir. Douglas-fir regenerates successfully in all the sample stands and likely will never be excluded from these sites. Scattered ponderosa pine regeneration may be present in some stands. Stumps of large, 700-year-old ponderosa pines were present in one stand. Grand fir is a minor component of both the overstory and understory, but is present and persistent in these stands and is predicted to achieve at least 10% cover in old stands. However, some stands may not have adequate grand fir to key to this type and may actually better fit within the Douglas-fir Series.

The shrub layer is comprised mostly of medium to tall shrubs such as mountain snowberry, Oregon grape, serviceberry and common snowberry. Several of these species occur in each stand. Shrub cover ranged from 14-34% in the sample stands. These shrubs occur as scattered patches. A number of other shrub species, such as ocean-spray, bitterbrush and Wood's rose, occur in small amounts, with little consistency from stand to stand.

A variety of relatively abundant herbaceous plants are typically found in the undergrowth of these stands. Although few species have an individual ground cover greater than 10%, there are a large number of species present. The total cover of herbaceous species commonly exceeds 50%. Few-flowered peavine, heartleaf arnica, elk sedge, ballhead waterleaf, pinegrass, silvercrown luina, arrowleaf balsamroot and yarrow may all be present or important in the undergrowth.

PRODUCTIVITY/MANAGEMENT: Tree growth, although not rapid, is probably significantly higher than in the closely related PSME/SYOR Association (Appendix C). Only six trees were sampled for growth information so it is difficult to draw too many conclusions. The Douglas-fir site index was 69 (base 50), but total basal area was quite low in relation to other types in the Series (209 sq. ft./ac.).

Young stand ages, abundance of flashy fuels, and the dry conditions indicate that these stands burned frequently before humans suppressed fires. This type is commonly adjacent to non-forest areas, which further predisposes it to frequent fire. Abundant fire scars on stumps and charcoal found in the upper soil horizons suggest that fires were frequent on these sites. Most historical fires occurred as relatively frequent underburns that would sweep quickly through the surrounding scablands and kill most of the young trees. Ground fire probably maintained an open forest with widely spaced large ponderosa pine and fewer Douglas-fir. Fire suppression has now allowed grand fir to start to occupy these xeric, fire-prone habitats.

ABGR/SYOR sites are exposed, and trees may have wind damage or suffer from winter desiccation. Ponderosa pine regeneration is abundant in some logged-over stands. Root rot present on ponderosa pine in some stands may cause problems as trees mature. Dwarf mistletoe may also be present on Douglas-fir.

This type is heavily used by both livestock and big game. Herbage production averages 200 lbs./ac. Many stands occur on the "edge" of non-forest. Their juxtaposition to non-forested meadows can make them important for shade and hiding cover for big game or livestock. Elk trails are common and appear well used in most stands. These habitats also provide winter range and shelter for elk. Woodpecker foraging occurs on ponderosa pine logs and stumps, but no snags were noted in the 4 intensive samples. Past livestock grazing and heavy big game use has certainly altered undergrowth composition by favoring few-flowered peavine or silvercrown luina, or both.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABGR/SYOR type has not been described on areas adjacent to the Wenatchee NF.

# WESTERN HEMLOCK SERIES

# WESTERN HEMLOCK SERIES

DISTRIBUTION AND ENVIRONMENT: Western hemlock is one of the most shade tolerant and environmentally restricted conifers on the Wenatchee National Forest. The best development of the Series is in areas with the strongest maritime climatic influence but where Pacific silver fir and mountain hemlock are absent. The Series is most extensive on the western parts of the Cle Elum, Lake Wenatchee and Naches Districts. There is considerable intergradation between the Western Hemlock, Pacific Silver Fir and Grand Fir Series. Grand fir will occupy more continental sites, while Pacific silver fir prefers cooler, more maritime environments.

Elevations range from just under 2000 feet to over 5000 feet, although over 80% of all stands fall below 4000 ft. Western hemlock can be found at elevations approaching 6000 ft., though it is not the climax dominant tree on those sites. Soils tend to be deep, of mixed material, and often with volcanic ash in the surface horizons. On colder sites, the Series is normally bounded by the Pacific Silver Fir Series, and on warmer, slightly drier sites, by the Grand Fir Series. Western redcedar and western hemlock are co-dominant on very wet sites. Western redcedar tolerates warm temperatures and both wetter and drier conditions better than western hemlock (Minore 1979). Including wet sites in the Western Hemlock Series follows the convention of Daubenmire and Daubenmire (1968). Western redcedar does not normally form upland climax stands on the east slopes of the Cascade Range, as it often does in the northern Rocky Mountains.

VEGETATION: Because of its superior shade tolerance, western hemlock is judged as the climax dominant on sites too warm for Pacific silver fir and mountain hemlock wherever there is sufficient evidence to indicate its success. On cool sites that support Pacific silver fir or mountain hemlock, western hemlock is judged to function as a long-lived seral species. Pacific silver fir and mountain hemlock both tolerate cooler temperatures and deeper snowpacks better than western hemlock. Mid seral stands (100-200 years old) often have abundant, vigorous grand fir under a canopy of long-lived seral species such as larch or white pine. Grand fir may be nearly the same age as the larch and pine, but slow early growth keeps it a minor component of stands until its superior shade tolerance and vigorous later growth allow it to increase in prominence. Ponderosa pine is typically found only on the warmest sites.

Disturbance types, timing and intensity, combined with species composition prior to disturbance, are important modifiers of secondary succession within the Series. Nearly any tree species on the Forest may be important during early seral stages in the warmer areas of this Series. After removal of the humus layer by fire, quaking aspen, western or paper birch, black cottonwood, or even red alder (in areas with strong maritime climate influence), may form extensive stands early in the sere. In spite of the complexity of possible successional paths, some general patterns exist and have been discussed in the literature.

There are some places on the Wenatchee NF, apparently too continental in climate to support western hemlock, that support western redcedar. The data, however, are inadequate to describe a western redcedar Series at this time. Consequently, in areas where western redcedar is present the sites are typically placed within the Western Hemlock Series. Some well-drained sites, where both grand fir and western redcedar are present and western hemlock is absent or nearly so, may fit better in the Grand Fir Series, particularly if there is some question about the success of the cedar.

Although commonly associated with western hemlock, western redcedar influences soil development and associated herbs and shrubs much differently. Mineral soil next to cedar trees in a mixed species stand has higher extractable calcium, base saturation, pH and nitrification potential than does soil next to neighboring hemlocks (Turner and Franz 1986). Turner and

Franz also note that shrubs and herbs under cedars are greater in terms of both numbers of species and size of individuals than shrubs and herbs under hemlocks.

The shrub and herb layers found in this Series are somewhat reminiscent of those described by Daubenmire and Daubenmire (1968) in northern Idaho and eastern Washington. Queencup beadlily has been identified as one of the most useful indicators in this Series for northern Idaho and western Montana (Cooper and others 1991; Pfister and others 1977). On the Wenatchee, however, queencup beadlily is so ubiquitous over much of the Western Hemlock Series it is less useful as an indicator than such other species as wild ginger or vanilla leaf. Vine maple, a widespread shrub in ths Series, has been judged to indicate important intrinsic site factors and has been used to identify different plant Associations (e.g., the TSHE/ACCI/ASCA3 and TSHE/ACCI/CLUN Associations). Other indicator species include devil's club, pinemat manzanita and Cascade Oregon grape.

Dense shrubfields often typify early successional stages after logging, fire and other disturbances on habitats within the Series. Although the development of shrubfields may initially appear deleterious to conifer establishment and early growth, the actual ecologic role of the shrub-dominant stage of succession is not well understood. Shrubs provide shade for conifers and add organic matter to the soil, and species such as *Ceanothus* and alders fix nitrogen. Further, many shrubs provide important forage and cover for insectivorous wildlife, which also influences stand health and vigor. Common shrubfield species include vine maple, Scouler willow, big huckleberry, serviceberry, Sitka alder and snowbrush ceanothus. Shrub growth and twig production are generally related to time since logging and to residual tree cover (Irwin and Peek 1979). Shrub size and twig production peaks between 10 and 14 years after logging. Seed tree and shelterwood treatments have significantly less shrub development than clearcuts. Late summer and fall broadcast burning in clearcuts leads to the greatest shrub development, due to increased snowbrush ceanothus cover. For optimum germination, *Ceanothus* seeds have both seed coat scarification and cold-wet seed stratification requirements. These are met by most fall and late summer burns. Spring burns usually do not provide the necessary cold-wet stratification and *Ceanothus* germination is reduced. Spring burning favors species that sprout from root crowns or buried roots (see Appendix D). Stands with even relatively small amounts of vine maple may support dense stands after harvest.

PRODUCTIVITY/MANAGEMENT: The Western Hemlock Series is highly productive, as indicated by high basal areas and high site index values (Appendix C). However, most seral tree species exhibit better growth than western hemlock on Western Hemlock Series sites. This is true in most Series: the climax dominant tree does not grow as rapidly as some seral tree species. Intense frost is not typically a problem in this Series because sites where western hemlock is climax are inherently mild. On the other hand, cutting practices can create frost pockets in some situations if cold air drainage is impeded. Regeneration harvests in the THPL/OPHO, and to a lesser extent in the TSHE/ASCA3 Association, can raise the water table, possibly creating a swamp.

Less than 10% of the 54 plots that had tree age data collected exceeded 200 years in age. Most stands were between 100 and 200 years old, suggesting a typical fire interval for the Series of perhaps 100-200 years. Associations in the dry end of the type with lots of ladder fuels would tend to burn more often. Agee (1994) suggests that low to moderate severity fire may occur every 50 to 100 years, while the stand-replacement interval might be 150 to 500 years. However, no data are from eastern Washington and return intervals for this Series are not well known. On the Wenatchee, where contiguous western hemlock sites are widespread or associated with Pacific silver fir sites, fire intervals will tend to be long and fires severe. Lodgepole pine can gain dominance on some sites and, because of its flammability, cause an increase in fire frequency. Generally, when the fire interval is less than 200 years and lodgepole was in the original stand, intensive fires favor lodgepole pine. However, even though few stands exceed

200 years breast-height age, the data record few stands where lodgepole pine is the dominant tree in the Western Hemlock Series. Longer intervals between conflagrations favor western larch or western white pine. Less intense fires favor larch, white pine and Douglas-fir. Fires are variable in intensity and effect on individuals and stands. The pattern in the Rockies that may apply here tends to be "(1) complete stand replacement, (2) partially killed overstory (resistant species surviving), (3) underburning with little overstory mortality, and (4) unburned forest" (Arno and Davis 1980). Stands on steep mid-slopes may form a "thermal belt" that burned hot in past fires. Such sites are warmer, drier and more wind-exposed than are stands on sheltered slopes and slope positions (Arno and Davis 1980).

After harvest, shrub competition with tree seedlings can be significant, particularly if vine maple was present in the pre-harvest stand. Snowbrush ceanothus, after sprouting from seed, also has the ability to form dense stands on many Western Hemlock Series sites. The amount of *Ceanothus* competition can be difficult to predict unless the plant is evident in the undisturbed stand.

Hessburg and others (1994) note four diseases as primary influences in both historical and current forests: laminated root rot, *Armillaria* root disease, S-group *Annosum* root disease, and brown cubical butt rot. Of these, laminated root rot is probably the most common and damaging root disease within the Series (Hessburg, personal communication). Laminated root rot was especially common in early and mid seral stands dominated by Douglas-fir and grand fir, where trees of all ages were killed (Hessburg and others 1994). The more shade-tolerant western hemlock shows little effect until maturity, when butt defects develop. Dwarf mistletoe can be a major cause of mortality in western larch, particularly where larch is a major stand component.

White pine blister rust, an exotic disease introduced to western North America about 1910, has also had major impact on five-needle pines throughout the United States. In this Series, the result of the disease is a significant reduction in the abundance of western white pine (Hessburg and others 1994). Data from over 300 plots in the Series indicate that white pine is found in over half of all plots, though in no case does total cover exceed 25%. Uninfected mature trees are unusual.

Most Associations are not suited for forage production for livestock because of heavy shade in mature stands and low palatability of common herbs. Shade and proximity to water may result in localized heavy use by livestock for resting. Early seral stages with high shrub and herb development provide better forage and cover for livestock.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Numerous authors have described the Western Hemlock Series in the Cascades, northeastern Washington, northern Idaho and Montana. Some of these are: Daubenmire and Daubenmire 1968; Pfister and others 1977; Topik and others 1988; John and others 1988; Halverson and others 1986; Williams and others 1990; and, Henderson and others 1992. A variety of plant Associations have been described, with perhaps the common link being that western hemlock, like Pacific silver fir and mountain hemlock, is strongly limited to areas with a maritime climate.

# Keys to Plant Associations of the Western Hemlock Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

Skunk cabbage ≥ 5% .......................................... TSHE/LYAM (M) p. 148

Devil's club or ladyfern ≥ 5% ................................ THPL/OPHO p. 130

Pinemat manzanita or bearberry ≥ 5% .................... TSHE/ARNE p. 140

Vine maple ≥ 5%
- wild ginger or ladyfern ≥ 1% ............................ TSHE/ACCI/ASCA3 p. 134
- vanilla leaf ≥ 1% ........................................... TSHE/ACCI/ACTR p. 132
- queencup beadlily ≥ 1% ................................. TSHE/ACCI/CLUN p. 136
- Cascade Oregon grape ≥ 1% ........................... TSHE/BENE p. 144

Wild ginger or ladyfern ≥ 1% ................................ TSHE/ASCA3 p. 142

Vanilla leaf ≥ 1% ................................................ TSHE/ACTR p. 138

Queencup beadlily ≥ 1% ...................................... TSHE/PAMY/CLUN p. 146

Cascade Oregon grape ≥ 1% ................................ TSHE/BENE p. 144

## Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| THPL/OPHO | 6 | 134 | 340 | 23 | 454 | 176 |
| TSHE/ACCI/ACTR | 2 | 322 | 244 | 12 | 412 | 14 |
| TSHE/ACCI/ASCA3 | 4 | 257 | 347 | 16 | 525 | 36 |
| TSHE/ACCI/CLUN | 6 | 402 | 239 | 13 | 413 | 40 |
| TSHE/ACTR | 12 | 482 | 252 | 11 | 454 | 94 |
| TSHE/ARNE | 4 | 370 | 167 | 11 | 295 | 242 |
| TSHE/ASCA3 | 7 | 363 | 406 | 16 | 630 | 40 |
| TSHE/BENE | 11 | 328 | 275 | 13 | 454 | 19 |
| TSHE/PAMY/CLUN | 2 | 139 | 252 | 18 | 364 | 265 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

# Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| THPL/OPHO | ABGR | 2 | 101 | 20 | 387 | 280 | 127 |
| | PIEN | 5 | 84 | 5 | 201 | 118 | 1043 |
| | PSME | 13 | 83 | 13 | 363 | 227 | 138 |
| | THPL | 17 | 66 | 17 | 354 | 161 | 129 |
| TSHE/ACCI/ACTR | LAOC | 5 | 79 | 5 | 351 | 195 | 73 |
| | PSME | 5 | 87 | 5 | 328 | 200 | 67 |
| | TSHE | 1 | 55 | 5 | 183 | 70 | 160 |
| TSHE/ACCI/ASCA3 | ABGR | 8 | 100 | 8 | 611 | 431 | 75 |
| | PSME | 14 | 84 | 15 | 315 | 188 | 109 |
| | TSHE | 3 | 68 | 5 | 388 | 185 | 115 |
| TSHE/ACCI/CLUN | ABGR | 16 | 73 | 30 | 249 | 129 | 111 |
| | LAOC | 6 | 77 | 9 | 189 | 103 | 136 |
| | PIMO | 2 | 71 | 3 | 260 | 130 | 145 |
| | PSME | 6 | 76 | 6 | 336 | 184 | 113 |
| | THPL | 8 | 62 | 8 | 230 | 98 | 128 |
| TSHE/ACTR | ABGR | 11 | 81 | 19 | 313 | 200 | 92 |
| | LAOC | 23 | 71 | 23 | 244 | 119 | 101 |
| | PIEN | 4 | 94 | 4 | 559 | 370 | 81 |
| | PSME | 44 | 68 | 44 | 271 | 136 | 99 |
| | THPL | 5 | 47 | 5 | 223 | 73 | 117 |
| | TSHE | 6 | 56 | 8 | 227 | 89 | 95 |
| TSHE/ARNE | PICO | 10 | 40 | 10 | 88 | 25 | 94 |
| | PIMO | 1 | 33 | 3 | 137 | 31 | 154 |
| | PSME | 6 | 45 | 11 | 147 | 28 | 185 |
| TSHE/ASCA3 | ABGR | 12 | 104 | 23 | 566 | 487 | 108 |
| | PIEN | 3 | 88 | 3 | 512 | 314 | 69 |
| | PSME | 13 | 82 | 13 | 454 | 265 | 97 |
| | THPL | 10 | 65 | 10 | 447 | 210 | 125 |
| | TSHE | 5 | 82 | 5 | 313 | 180 | 102 |
| TSHE/BENE | ABGR | 15 | 79 | 16 | 257 | 141 | 83 |
| | PICO | 3 | 59 | 3 | 106 | 43 | 118 |
| | PIMO | 7 | 59 | 7 | 393 | 164 | 112 |
| | PSME | 20 | 73 | 23 | 214 | 103 | 150 |
| | TSHE | 9 | 67 | 26 | 253 | 125 | 183 |
| TSHE/PAMY/CLUN | PSME | 10 | 70 | 10 | 230 | 114 | 109 |

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

WESTERN HEMLOCK
PLANT ASSOCIATION
GROUPS

1. Warm Dry Shrub/Herb PAG
   - TSHE/ARNE
2. Warm Mesic Shrub/Herb PAG
   - TSHE/ACCI/ACTR *WEN*
   - TSHE/ACCI/CLUN
3. Warm Moist Shrub/Herb PAG
   - TSHE/ACCI/ASCA3
   - TSHE/ASCA3
4. Cool Mesic Shrub/Herb PAG
   - TSHE/BENE *WEN*
   - TSHE/PAMY/CLUN
5. Cool Moist Shrub/Herb PAG
   - TSHE/ACTR *WEN*
6. Wet Shrub/Herb PAG
   - TSHE/LYAM (M)
   - THPL/OPHO

WESTERN HEMLOCK
PLANT ASSOCIATIONS
AND ECOCLASS CODES

| | |
|---|---|
| THPL/OPHO | CCS211 |
| TSHE/ACCI/ACTR *WEN* | CHS225 |
| TSHE/ACCI/ASCA3 | CHS226 |
| TSHE/ACCI/CLUN | CHS227 |
| TSHE/ACTR *WEN* | CHF223 |
| TSHE/ARNE | CHS144 |
| TSHE/ASCA3 | CHF313 |
| TSHE/BENE *WEN* | CHS142 |
| TSHE/PAMY/CLUN | CHS143 |
| TSHE/LYAM (M) | CHM121 |

# THPL/OPHO ASSOCIATION CCS211

*Thuja plicata/Oplopanax horridum*

western redcedar/devil's club

## ENVIRONMENT

Elevation: 1920-3340 (2597) ft.

Aspect: variable (generally unimportant)

Slope: 2-39 (11) %

Slope position: M 1/3, bench, toe, bottom

Special: moderate, wet, maritime

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| THPL | western redcedar | 90 | 28 |
| ABGR | grand fir | 80 | 24 |
| PSME | Douglas-fir | 80 | 14 |
| TSHE | western hemlock | 60 | 15 |
| ALRU | Red alder | 20 | 6 |
| **TREE UNDERSTORY LAYER** | | | |
| THPL | western redcedar | 100 | 5 |
| TSHE | western hemlock | 40 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 90 | 15 |
| OPHO | devil's club | 80 | 13 |
| BENE | Cascade Oregon grape | 80 | 3 |
| RUPA | thimbleberry | 70 | 9 |
| RILA | prickly currant | 70 | 2 |
| ROGY | baldhip rose | 60 | 3 |
| **HERBS** | | | |
| SMST | starry solomonplume | 100 | 6 |
| ASCA3 | wild ginger | 90 | 8 |
| CLUN | queencup beadlily | 90 | 4 |
| VIGL | pioneer violet | 90 | 3 |
| ATFI | ladyfern | 80 | 9 |
| TITRU | coolwort foamflower | 80 | 4 |
| TROV | trillium | 80 | 2 |
| GATR | sweetscented bedstraw | 80 | 2 |
| DIHO | Hooker fairybells | 70 | 2 |
| ACTR | vanilla leaf | 50 | 14 |
| TRLA2 | western starflower | 50 | 7 |
| GYDR | oak fern | 50 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

The THPL/OPHO Association is a minor type widely distributed along the Cascade Range. Most plots are from the Cle Elum District, but Leavenworth, Lake Wenatchee and Naches Districts also support the type.

Most slopes are gentle (only two stands exceeded 20% slope). Aspects are variable, but are not important factors of site location because of the valley bottom positions typical of the type. The stands are sheltered, relatively warm and have poor drainage. The microrelief is usually flat or undulating.

Soils are generally formed in alluvium of various geologic origins. They are dark, high in organic matter and poorly drained. High water tables and standing surface water are characteristic of these sites. The type is typically found along streams or seeps. Mid-slope sites have perched water tables. Sites are hummucky, and microsite variation strongly affects vegetative composition, with mound-growing species requiring better drainage than that available between the mounds.

The type is related to the ABAM/OPHO Association, but is found on warmer (lower elevation) sites.

VEGETATION: All the sample stands are less than 200 years old, so late seral or climax conditions must be based on species composition and successional dynamics. It is unlikely that single species climax will ever be reached on these sites because of the variable microsites and stream dynamics. Western redcedar is usually more abundant than western hemlock. Sites with Pacific silver fir better fit the ABAM/OPHO Association. Red alder may form part of the early tree sere. Other seral trees are more characteristic of the mounds and include Douglas-fir, grand fir and perhaps western white pine. These sites appear too warm to support Engelmann spruce or subalpine fir. Western redcedar and western hemlock are found in all stages of the tree sere.

The shrub layer is characterized by devil's club and vine maple, but a variety of other shrubs may also be present. The distinctively shaped, armed, and horizontally arranged leaves of devil's club give a distinctive appearance to the stands. Other shrubs that may be abundant include prickly current, Cascade Oregon grape, thimbleberry, Pacific blackberry, creeping snowberry and, occasionally, salmonberry. Ladyfern is well represented on most sites and is also an indicator for the type. Other important herbs include wild ginger, starry solomonplume, coolwort foamflower, vanilla leaf, western starflower, horsetails, oak fern, queencup beadlily and false bugbane. The herb layer is quite variable in number and amount of species.

PRODUCTIVITY/MANAGEMENT: Timber productivity is high, based on basal areas and site index (Appendix C), but high water tables and riparian conditions limit silvicultural options. Regeneration is difficult to assure after harvest and methods of reliably reforesting such wet sites are not known. Soils are subject to compaction and flooding, making harvesting and road building very difficult. Natural stands often have a high proportion of "cull" trees because of rot or multiple tops. Western hemlock, Douglas-fir and grand fir require downed logs or root wads to regenerate on these swampy sites. THPL/OPHO sites have high wildlife and watershed values.

Fires are relatively rare in these wet environments, but these sites appear to burn more often than the related but cooler ABAM/OPHO Association. Mean stand age for the type, based on six samples, was about 150 years, surprisingly young in view of the wet conditions. The fire frequency of surrounding stands may help dictate how often these stands burn. Most fires appear to have been spot fires and rarely extended throughout the entire stand.

The THPL/OPHO Association provides valuable riparian habitat for a variety of wildlife, providing water, cover and forage. The variety of succulent herbs provides forage for ungulates. Elk relish devil's club.

The valley bottom location of the type makes its sites appear appropriate for recreational development, but they are poorly suited to such use. Trails require special design to be successful here and the shrubs and herbs are susceptible to trampling damage. Further, abundant free standing water often makes these sites productive nurseries for mosquitos.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A THPL/OPHO Association has not been described by others in the Cascades but it is very similar to the TSHE/OPHO, TSHE/OPHO/POMU or TSHE/OPHO/ATFI types of a variety of workers for areas all along the Cascades (Halverson and others 1986; Topik and others 1986; Franklin and others 1988; Henderson and others 1991). A THPL/OPHO type was described in northeastern Washington, northern Idaho and Montana (Williams and others 1990; Cooper and others 1991; Pfister and others 1977). All those Associations are very similar, indicating the wet end of the Western Hemlock Series. The Wenatchee Association includes stands with 5% or more ladyfern as well, and these stands fit into the THPL/ATFI type described in some classifications.

# TSHE/ACCI/ACTR *WEN* ASSOCIATION CHS225

*Tsuga heterophylla/Acer circinatum/Achylys triphylla*

western hemlock/vine maple/vanilla leaf


## ENVIRONMENT

Elevation: 2080-3190 (2533) ft.

Aspect: various

Slope: 3-56 (56) %

Slope position: U, M, L 1/3, bench

Special: warm, moist, maritime

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 24 |
| TSHE | western hemlock | 80 | 23 |
| ABGR | grand fir | 60 | 16 |
| THPL | western redcedar | 50 | 10 |
| PIMO | western white pine | 40 | 7 |
| **TREE UNDERSTORY LAYER** | | | |
| TSHE | western hemlock | 80 | 5 |
| THPL | western redcedar | 80 | 4 |
| ABGR | grand fir | 60 | 7 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 20 |
| ROGY | baldhip rose | 100 | 4 |
| BENE | Cascade Oregon grape | 90 | 8 |
| PAMY | pachistima | 90 | 8 |
| VAME | big huckleberry | 90 | 8 |
| LIBOL | twinflower | 80 | 9 |
| CHUMO | western prince's pine | 80 | 3 |
| RUUR | Pacific blackberry | 70 | 3 |
| PYSE | sidebells pyrola | 70 | 2 |
| SYMOH | creeping snowberry | 60 | 3 |
| XETE | beargrass | 40 | 5 |
| **HERBS** | | | |
| ACTR | vanilla leaf | 100 | 4 |
| TROV | trillium | 80 | 2 |
| GOOB | w. rattlesnake plantain | 70 | 2 |
| TRLA2 | western starflower | 60 | 6 |
| CLUN | queencup beadlily | 50 | 6 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/ACCI/ACTR Association is known only from the Cle Elum District near Lakes Kachess and Cle Elum. No plots representative of the type were sampled on other districts although it is possible this type is more widespread than the limited data indicate.

Elevations are low, with only one plot over 3000 feet. This type is significantly lower than the closely related TSHE/ACTR. 80% of the plots were on slopes under 30%. Typical stands are on upper to lower slope positions and on benches.

Soils are generally well-drained and are predominantly formed in outwash/till of a variety of mixed geologic materials. Coarse fragments are typically gravels and average 30% by volume in eight samples.

This type is similar to the ABAM/ACCI and ABGR/ACCI types, but it occupies sites too warm for Pacific silver fir, yet moist enough for western hemlock to exclude grand fir over time. It is slightly warmer and better drained than the TSHE/ACTR *WEN* Association. Wetter habitats are often occupied by TSHE/ASCA3 or THPL/OPHO Associations. Drier sites will often support the TSHE/BENE type. Cooler sites with higher snowpacks are commonly within the Pacific Silver Fir Series in either ABAM/ACCI or ABAM/ACTR Associations.

VEGETATION: Only two stands had age data available. One of these was only about 75 years at breast height while the other was 160 years breast height age. Consequently, climax conditions must be inferred from species composition and successional dynamics. Presumably, western hemlock, as the most shade-tolerant species capable of growing and reproducing on the sites, will come to dominate the tree canopy and tree regeneration. Western redcedar is a long-lived dominant or co-dominant in some stands. Seral trees include Douglas-fir, grand fir, western larch, western white pine and lodgepole pine, although Douglas-fir and grand fir are the most common. Grand fir is especially important in the sere between 75 and 125 years. It tends to be a few years younger at breast height than associated Douglas-fir trees. All the trees may enter the sere at about the same time, but the slower early growth of grand fir compared to larch and Douglas-fir may give the impression that it is younger. The superior shade tolerance of grand fir allows it to increase in prominence in mid-seral stands.

The undergrowth is characterized by a tall shrub layer of vine maple, with a variety of mesophytic herbs characterized by vanilla leaf. The shrub layer is floristically rich, but many shrubs or subshrubs are relatively low in stature. Common shrubs include twinflower, Cascade Oregon grape, big huckleberry, western prince's pine, baldhip rose, pachistima, creeping snowberry and alpine pyrola. As in TSHE/ACCI/ASCA3 and TSHE/ACCI/CLUN Associations, vine maple is an important long-lived stand component. There is some question whether vine maple can maintain itself in stands over 200 years, but the data seem to indicate that it can and does; especially as stands develop canopy gaps in mature and climax conditions.

The herb layer is characterized by a sparse to dense stand of vanilla leaf mixed with a wide variety of mesophytic herbs, including queen cup beadlily, pathfinder, trillium and a range of other herbs that vary greatly in cover and constancy depending on stand density and history of disturbance. Moist-site ferns and herbs are typically absent or uncommon in this type and grasses are seldom abundant. Bracken fern is much more constant here than in the similar TSHE/ACTR *WEN* Association.

PRODUCTIVITY/MANAGEMENT: These should be productive timber sites, but data are limited (Appendix C). The site index value for Douglas-fir is 87 (base 50), but the mean basal area is only 244 sq. ft./ac. (from 2 plots). Shrub competition will often be a concern on these sites because of the abundant vine maple. Soils are subject to compaction and displacement by heavy equipment. Soil protection is important for maintaining long-term productivity on these warm, fertile sites.

Tree age data are limited and it is difficult to ascertain the age of last stand replacement. One stand was quite young (<75 years) while the other was 160 years old. The low elevations and relatively warm moist conditions of this type suggest a moderate fire return interval of perhaps 100-200 years.

Forage production in the two stands measured was only 14 lbs./ac. If not too far from water, these sites would likely be used by domestic livestock for shade. Trees are often tall and the mixture of species in the crowns often leads to development of multiple crown layers that may be important for arboreal species. These sites are attractive for recreation developments because of their sheltered, warm conditions, gentle slopes and tall trees. The shrub and herb layers are easily damaged by recreational traffic and trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A TSHE/ACCI/ACTR Association has been described in the Mt. Hood NF classification (Halverson and others 1986), but the species compositions are quite different. The TSHE/ACTR Association described for Mt. Rainier and for the Gifford Pinchot NF both include sample stands that support abundant vine maple. Both vine maple and vanilla leaf are restricted to the vicinity of the Cascades.

# TSHE/ACCI/ASCA3 ASSOCIATION CHS226

*Tsuga heterophylla/Acer circinatum/Asarum caudatum*

western hemlock/vine maple/wild ginger

## ENVIRONMENT

Elevation: 2140-2730 (2457) ft.

Aspect: variable

Slope: 1-48 (22) %

Slope position: M, <u>L</u> 1/3, bench, <u>bottom</u>

Special: moderate, moist, maritime

## VEGETATION SUMMARY

(Sample size: 9)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 27 |
| THPL | western redcedar | 78 | 15 |
| TSHE | western hemlock | 89 | 12 |
| ABGR | grand fir | 78 | 22 |
| PIMO | western white pine | 56 | 3 |
| **TREE UNDERSTORY LAYER** | | | |
| THPL | western redcedar | 89 | 3 |
| TSHE | western hemlock | 78 | 4 |
| ABGR | grand fir | 89 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 23 |
| BENE | Cascade Oregon grape | 89 | 5 |
| RUUR | Pacific blackberry | 78 | 3 |
| LIBOL | twinflower | 67 | 5 |
| CHUMO | western prince's pine | 67 | 3 |
| ROGY | baldhip rose | 67 | 2 |
| PYSE | sidebells pyrola | 67 | 2 |
| PAMY | pachistima | 67 | 2 |
| RUPA | thimbleberry | 56 | 4 |
| **HERBS** | | | |
| SMST | starry solomonplume | 100 | 3 |
| ASCA3 | wild ginger | 100 | 2 |
| CLUN | queencup beadlily | 89 | 5 |
| GOOB | w. rattlesnake plantain | 89 | 2 |
| ACTR | vanilla leaf | 78 | 16 |
| PTAQ | bracken fern | 78 | 3 |
| TROV | trillium | 78 | 2 |
| POMU | sword fern | 56 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/ACCI/ASCA3 Community Type is found in suitable environments from the Cle Elum to Lake Wenatchee Districts. Vine maple persists even in stands 150+ years old, and its presence with wild ginger separates this type from the similar TSHE/ASCA3. All stands are within a few miles of the Cascade Crest or in areas with a strong maritime climatic influence, or both.

Elevations are significantly lower than the closely related TSHE/ASCA3 Association. Most slopes are less than 25%, though some plots have slopes over 40%. Sites are characteristically on sheltered lower slopes and bottoms. The type occupies areas of low insolation and of moisture accumulation in the soils. It is characterized by warm, well-watered, sheltered sites with fertile soils.

Most soils are formed in alluvium, colluvium or glacial drift from a wide variety of parent materials. Coarse fragments (usually gravels) average over 30% in the surface horizons.

Sites are moist, but not as much so as the TSHE/ASCA3, nor as wet as the related THPL/OPHO Association. Less moist environments support TSHE/PAMY/CLUN or TSHE/ACTR *WEN* types.

VEGETATION: The oldest stand sampled was just over 170 years old, so late seral and climax conditions are unclear and must be inferred from species composition and successional dynamics. Western hemlock is co-dominant with Douglas-fir in the oldest stand, overstory canopy cover is over 80%, and vine maple cover is still 10%. Both western redcedar and grand fir are important stand components in nearly all of the plots. Trees important early in the sere on most sites include grand fir and Douglas-fir. Western white pine may also form part of the tallest tree layer in some stands. Red alder may occur here as well.

The shrub layer in late seral or climax conditions will be fairly sparse when compared to early successional conditions. Vine maple is expected to maintain itself in these stands and typically will flourish when the tree canopy is removed. There is some question whether vine maple can maintain itself in very dense older stands. However, it appears capable of remaining for at least 200 years and any canopy gaps should result in higher shrub canopy cover of vine maple. Cascade Oregon grape is the next most constant shrub species. Other shrubs or subshrubs that may be abundant, depending on the age, seral stage and history of disturbance, include twinflower, alpine pyrola, western prince's pine, pachistima, sidebells pyrola and baldhip rose.

The herb layer is characterized by a rich assemblage of mesophytic herbs. Wild ginger is the definitive species but other moist site herbs include starry solomonplume, queencup beadlily, trillium, pathfinder, vanilla leaf, and sword fern. Other less constant species may also be well represented (See Appendix B).

PRODUCTIVITY/MANAGEMENT: Sites are warm, moist and fertile. Site index values for Douglas-fir, and grand fir are 84 and 100 (base 50), respectively, and total basal area is 347 sq. ft./ac. (Appendix C). These are some of the most productive sites on the Forest and their productivity should be protected by minimizing soil disturbance and compaction. Tree harvest may raise the water table somewhat, but much less so than in the THPL/OPHO type. Frost is not a problem in natural stands but careful attention should be paid to air drainage patterns to avoid creating a frost pocket through harvest activities.

Vine maple competition can be severe following overstory removal. Other shrubs such as baldhip rose (that also resprout from root crowns) are favored by spring burns. Anecdotal evidence from this area indicates that fall burning generally increases the amount of shrubs on the site, especially if *Ceanothus* species (particularly snowbrush ceanothus) are present or their seeds are in the soil. This is because *Ceanothus* seeds have both a scarification as well as a cold-wet stratification requirement. Spring burns often do not meet the stratification requirement of the seeds, so seed germination and subsequent shrub development is reduced.

Fires are likely infrequent in these stands. However, when they burn, they burn hot due to high fuel loading. Tree ages were quite variable in the type (and data limited), making it difficult to verify fire frequency. The limited data suggest that fire frequency is probably in the range of 100-200 years.

Mature stands often develop multiple tree canopies, with Douglas-fir as the tallest layer, above one or more layers of more tolerant species such as grand fir, western hemlock, western redcedar, or even red alder. This diversity in tree layers provides a diverse habitat for many wildlife species, including arboreal mammals and birds. Herbage production averaged 36 lbs./ac.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/ACCI/ASCA3 Association has not been described in adjacent forest areas.

# TSHE/ACCI/CLUN ASSOCIATION CHS227

*Tsuga heterophylla/Acer circinatum/Clintonia uniflora*

western hemlock/vine maple/queencup beadlily


## ENVIRONMENT

Elevation: 2140-2940 (2589) ft.

Aspect: variable

Slope: 2-53 (14) %

Slope position: bench, toe, bottom

Special: moderate, mesic, maritime

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 11 |
| ABGR | grand fir | 86 | 33 |
| THPL | western redcedar | 86 | 19 |
| TSHE | western hemlock | 86 | 17 |
| PIMO | western white pine | 86 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| THPL | western redcedar | 100 | 9 |
| ABGR | grand fir | 71 | 8 |
| TSHE | western hemlock | 71 | 6 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 25 |
| LIBOL | twinflower | 100 | 11 |
| BENE | Cascade Oregon grape | 86 | 7 |
| PAMY | pachistima | 86 | 6 |
| ROGY | baldhip rose | 86 | 3 |
| RUPA | thimbleberry | 86 | 3 |
| CHUMO | western prince's pine | 71 | 6 |
| VAME | big huckleberry | 71 | 2 |
| AMAL | serviceberry | 57 | 2 |
| GAOV | slender wintergreen | 57 | 2 |
| COCA | bunchberry dogwood | 43 | 14 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 100 | 9 |
| GOOB | w. rattlesnake plantain | 100 | 3 |
| TROV | trillium | 86 | 2 |
| SMST | starry solomonplume | 71 | 4 |
| SMRA | feather solomonplume | 57 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

Limited data indicate that the TSHE/ACCI/CLUN Association is most common on the Leavenworth and Lake Wenatchee Districts. One plot occurred on the Cle Elum District.

Elevations do not exceed 3000 feet in the plots. Benches and toe slopes are the predominant micropositions and only one plot had greater than 15% slope. Microreliefs are either flat or concave.

Sites are warm and well-watered, though stands with bunchberry dogwood and spruce indicate some cold air drainage. Frost is uncommon, although snowpacks may be relatively high.

Soils are formed in a variety of parent materials, including granite, sandstone, ash and pumice (one plot). There are virtually no data on soil coarse fragments.

TSHE/PAMY/CLUN or TSHE/BENE types are common on steeper and/or drier sites. TSHE/ASCA3 or TSHE/ACCI/ASCA3 Associations occur on more moist and fertile sites. Cooler sites are usually occupied by TSHE/ACTR *WEN*.

VEGETATION: Few stands were over 150 years old when sampled, so late successional or climax conditions must be inferred from species composition and successional dynamics. Both cedar and hemlock are fairly abundant in most stands. Western redcedar is an important species that will never be fully replaced by western hemlock on these sites. In general, grand fir seems to be an especially important part of the sere in stands between 100 and 200 years of age. Grand fir is either dominant or important in all stands. Douglas-fir is also abundant in most stands. Other trees may form part of the tree sere, depending on stand history and timing and type of disturbance. Most stands have age information in their data, and they range from 118 to 156 years old, measurd at breast height.

Stands are characterized by abundant vine maple and numerous relatively abundant shrubs and subshrubs, such as Cascade Oregon grape, pachistima, western prince's pine and twinflower. Other shrubs that may be important in the sere include serviceberry, big huckleberry, baldhip rose and thimbleberry. Bunchberry dogwood with Engelmann spruce indicates sites cooler than normal for the type. Twinflower becomes more common, or at least more apparent, on heavily grazed sites. Stands approaching 150 years of age have relatively low amounts of tall shrub cover, with the exception of vine maple. It is abundant even in the oldest sample stands and even where overstory canopy cover is high. It may decline in older stands, particularly when overtopped by a dense middle canopy stratum, but it is expected that canopy gaps in very old stands will provide for its continuance. In some cases, vine maple's presence and abundance appear more related to previous stand conditions and age than to intrinsic site factors. Nevertheless, in this type, vine maple is judged to indicate site factors adequately different to justify the Association.

The herb layer is characterized by a collection of mesophytic herbs, including queencup beadlily, rattlesnake plantain, starry solomonplume, trillium, feather solomonplume and bracken fern. All of these herbs may be well represented in some stands.

PRODUCTIVITY/MANAGEMENT: These sites are relatively warm and moist and can be highly productive timber sites with a wide variety of options available to managers (Appendix C). However, the sites can be degraded by soil compaction and excessive disturbance. Shrub competition can be severe, particularly from vine maple. Maximum shrub cover will occur within ten years of clearcutting or burning. Vine maple resprouts after all but the hottest fires. Fires hot enough to kill the root crowns are so intense as to greatly reduce the amount of nutrients, such as nitrogen, that are important for long-term site productivity. Although not present in any of the samples, snowbrush ceanothus can often develop dense stands from seed. Shelterwoods, with minimum site disturbance, are suggested to reduce shrub competition. Western hemlock sites in the northern Rocky Mountains have less total shrub cover, if the stands are not burned and some tree overstory is left on the site. Destruction of soil organic matter contributes to the development of dense shrubfields (Harvey and others 1987). Dense shelterwood and selection treatments favor grand fir, western redcedar and western hemlock.

These dense stands have high fuel loads, but are usually moist enough to avoid frequent fires. Tree ages from 6 stands were all less than 160 years breast height, suggesting a fire return interval of 100-200 years for stand-replacement fires.

These warm, sheltered sites provide good habitat for a wide range of wildlife. Although herbage is low, deer and elk likely use these areas for shade (Appendix C). Stands with high vine maple cover are excellent hiding cover for ungulates. Multiple tree canopies are common and provide habitat for arboreal mammals and birds. Sites on gentle slopes with high vine maple cover provide screening for campsites, but the herb and low shrub layer is easily damaged by foot and vehicular traffic.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/ACCI/CLUN Association has not been described in adjacent areas.

# TSHE/ACTR *WEN* ASSOCIATION CHF223

*Tsuga heterophylla/Achylys triphylla*

western hemlock/vanilla leaf

## ENVIRONMENT

Elevation: 2170-4280 (3364) ft.

Aspect: various

Slope: 1-62 (25) %

Slope pos: ridge, U, M, L 1/3, bench, bottom

Special: warm, moist, maritime

## VEGETATION SUMMARY

(Sample size: 41)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 95 | 21 |
| TSHE | western hemlock | 85 | 18 |
| ABGR | grand fir | 73 | 21 |
| LAOC | western larch | 61 | 10 |
| THPL | western redcedar | 54 | 11 |
| PIMO | western white pine | 54 | 6 |
| PICO | lodgepole pine | 27 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| TSHE | western hemlock | 88 | 4 |
| ABGR | grand fir | 80 | 8 |
| THPL | western redcedar | 56 | 6 |
| **SHRUBS AND SUBSHRUBS** | | | |
| BENE | Cascade Oregon grape | 98 | 9 |
| LIBOL | twinflower | 95 | 8 |
| CHUMO | western prince's pine | 88 | 3 |
| ROGY | baldhip rose | 85 | 5 |
| PAMY | pachistima | 80 | 5 |
| VAME | big huckleberry | 74 | 4 |
| PYSE | sidebells pyrola | 73 | 2 |
| SYMOH | creeping snowberry | 54 | 4 |
| ACCI | vine maple | 20 | 4 |
| XETE | beargrass | 10 | 7 |
| **HERBS** | | | |
| ACTR | vanilla leaf | 100 | 10 |
| GOOB | w. rattlesnake plantain | 73 | 2 |
| TROV | trillium | 66 | 1 |
| CLUN | queencup beadlily | 59 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/ACTR *WEN* Association is most common on the Naches and Cle Elum Districts. It was not sampled on other districts. It is possible the type is more widespread than indicated.

Elevations are variable. 90% of all plots are between 2000 and 4000 feet elevation. No plots are below 2000 feet and only 5 above 4000 feet. Slopes are moderate and most stands are on mid and lower slope positions where moisture accumulates but the soils are generally well drained. The TSHE/ACTR *WEN* Association is characterized by relatively warm, sheltered, well-watered, yet well-drained sites on deep soils.

Soils are typically depositional in nature, formed in tephra/breccia or outwash/till from a variety of mixed geologic materials. 25% of the plots were on residual basalt substrates (on Naches). Coarse fragments are usually gravels and average over 20% in the surface horizons.

TSHE/ACTR *WEN* grades into TSHE/ACCI/ACTR *WEN* on warmer sites that are generally at lower elevations. ABAM/ACTR occurs on cooler sites at higher elevations, while TSHE/ASCA3, TSHE/ACCI/ASCA3 and THPL/OPHO are on more moist sites. ABGR/ACTR often occurs on slightly drier (and typically more continental) sites.

VEGETATION: Few sample stands were over 150 years old, so late successional or climax conditions must be inferred from species composition and successional dynamics. Presumably, western hemlock is the most shade tolerant species capable of growing and reproducing on the sites, and will dominate the tree canopy and tree regeneration in mature stands. Western redcedar is a common long-lived co-dominant. Seral trees include Douglas-fir, grand fir, western larch, western white pine, Engelmann spruce and lodgepole pine. Grand fir is especially important in the sere between 75 and 125 years. It tends to appear a few years younger than associated western larch or Douglas-fir trees. All the trees may enter the sere at about the same time, but the slower early growth of grand fir compared to larch and Douglas-fir may give the impression it is younger. The superior shade tolerance of grand fir allows it to increase in prominence in mid-seral stands.

The shrub layer is floristically rich, but many species are relatively low in stature. Common species include twinflower, Cascade Oregon grape, big huckleberry, western prince's pine, baldhip rose, pachistima, creeping snowberry and alpine pyrola. Vine maple may be present in small amounts, particularly in stands below 3000 feet. If vine maple was in the previous stand, it will persist for a hundred years or more on these sites. Very dense stands with some vine maple may better fit the TSHE/ACCI/ACTR *WEN* type.

Herbs are characterized by a sparse to dense stand of vanilla leaf mixed with a wide variety of mesophytic herbs, including queencup beadlily, pathfinder and trillium. A range of other herbs may occur and vary greatly in cover and constancy, depending on stand density and history of disturbance. Ladyfern and oak fern indicate especially moist sites which approach being TSHE/ASCA3, or even THPL/OPHO Associations. Abundant few-flowered peavine indicates heavy grazing by cattle or elk.

PRODUCTIVITY/MANAGEMENT: These are fairly productive, easily managed timber sites (Appendix C). The Douglas-fir site index is 68 (base 50) and total basal area averaged 252 sq. ft./ac. Shrub competition should not be much of a problem due to the lack of vine maple as a major component of the understory. Soils are subject to compaction and displacement by heavy equipment. Soil protection is important for maintaining long-term productivity on these warm, fertile sites. Tree harvest may raise the water table somewhat and be a concern, especially on sites at the moist extreme for the type.

Herbage production averaged 94 lbs./ac. on 12 clipped plots. Trees are often tall, of mixed species and ages, which leads to development of multiple crown layers that are important for arboreal species. These sites are attractive for recreation developments because of their sheltered, warm conditions, gentle slopes and tall trees. The shrub and herb layers are easily damaged by recreational traffic and trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A TSHE/ACTR Association has been described on the Yakima Indian Reservation, the Mt. Hood NF, the Gifford Pinchot NF, and for Mt. Rainier National Park (John and others 1988; Halverson and others 1986; Topik and others 1986; Franklin and others 1988). However, the Mt. Rainier and Gifford Pinchot NF types described sample stands supporting abundant vine maple, which better fit in the Wenatchee's TSHE/ACCI/ACTR. The TSHE/ACTR type on the Yakima Reservation is similar, although some of their plots may key to the Wenatchee ABGR/ACTR type.

# TSHE/ARNE COMMUNITY TYPE  CHS144

*Tsuga heterophylla/Arctostaphylos nevadensis*

western hemlock/pinemat manzanita

## ENVIRONMENT

Elevation:  2450-3500 (3098) ft.
Aspect: various (few plots)
Slope:  2-45 (18) %
Slope position: ridge, M, toe, bench
Special: warm, very dry, maritime

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 83 | 18 |
| PICO | lodgepole pine | 83 | 15 |
| TSHE | western hemlock | 67 | 7 |
| PIMO | western white pine | 67 | 5 |
| ABLA2 | subalpine fir | 50 | 4 |
| LAOC | western larch | 33 | 13 |
| **TREE UNDERSTORY LAYER** | | | |
| PIMO | western white pine | 100 | 5 |
| PICO | lodgepole pine | 83 | 10 |
| TSHE | western hemlock | 67 | 3 |
| ABLA2 | subalpine fir | 50 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ARNE | pinemat manzanita | 100 | 28 |
| VAME | big huckleberry | 83 | 16 |
| CHUMO | western prince's pine | 83 | 5 |
| SPBEL | shiny-leaf spirea | 83 | 4 |
| PAMY | pachistima | 83 | 3 |
| LIBOL | twinflower | 67 | 9 |
| GAOV | slender wintergreen | 67 | 8 |
| BENE | Cascade Oregon grape | 67 | 4 |
| ROGY | baldhip rose | 67 | 2 |
| SOSC2 | mountain ash | 50 | 2 |
| VASC | grouse huckleberry | 33 | 5 |
| **HERBS** | | | |
| CARU | pinegrass | 67 | 6 |
| HIAL | white hawkweed | 67 | 3 |
| PTAQ | bracken fern | 50 | 12 |
| GOOB | w. rattlesnake plantain | 50 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The minor TSHE/ARNE Community Type was sampled on the Naches and Cle Elum Districts.  It may occur elsewhere.

Most sample stands were between 2900 and 3500 feet.  Slopes, aspects and slope positions are variable.

This type represents very rocky or severely degraded sites with low moisture and nutrient holding capacity in an area of strong maritime climate. The TSHE/ARNE type is something of an anomaly because sites that support pinemat manzanita are usually too dry to support western hemlock.  However, the western hemlock is found in specialized microsites with moisture accumulation, such as rock crevices.  The climate is sufficiently maritime for western hemlock to persist, though in most instances the sites are too harsh to form a closed canopy.

These visibly rocky sites simply do not have enough soil to support more than an impoverished tree canopy.  The soils are usually of mixed parent material.  Most of the plots in the type are on rocky ridges or on very rocky glacial outwash.  One plot is on sands in an area that burned intensely several decades ago.

This Community Type is treated as part of the Western Hemlock Series because many sites will key here via the western hemlock key. As organic matter and nutrients accumulate with plant succession, this degraded site will likely eventually support a Pacific Silver Fir Series Association.

VEGETATION: Tree canopies are sparse, with most stands supporting less than 50% canopy cover. Trees are often stunted in appearance compared to stands on better sites nearby. A wide variety of species may be present, depending on seed sources and microsite variation. The most common trees are Douglas-fir, western hemlock, lodgepole pine, western white pine, subalpine fir, western larch, and even an occasional ponderosa pine. Lodgepole pine and Douglas-fir appear best adapted to these poor quality sites and may persist on the sites because the canopies remain open. Lodgepole pine is more common here than in any other western hemlock Association.

Pinemat manzanita forms a low mat that characterizes the shrub layer. Other shrubs include big huckleberry, twinflower, slender wintergreen, western prince's pine, Cascade Oregon grape, pachistima, shiny-leaf spirea, baldhip rose and either low or grouse huckleberry. Beargrass and mountain ash are sometimes present. The abundance of the shrubs listed above and others depends on individual site history and microsite variation.

Herbs are generally inconspicuous members of the community. White hawkweed, bracken fern and pinegrass may be well represented on some sites. The relative lack of vegetative cover in these open stands may be due to heavy use by grazing animals such as elk, and to the harsh site conditions. Trails, beds and droppings were common in our plots.

PRODUCTIVITY/MANAGEMENT: No known methods will assure reforestation. Tree growth rates and stocking levels are low (Appendix C). The site index value for Douglas-fir was only 45 (base 50) and the average basal area 167 sq. ft./ac.

Several stands were between 200 and 300 years old, suggesting a long fire-free interval. However, most stands did support lodgepole pine, which often burns every 100 years or so. Typically, the fire frequency in this type is highly dependent on the surrounding vegetation because these communities are usually "islands" in the landscape.

These areas are important for wildlife because they provide habitat much different from the dense forests that typically adjoin the type. They add to biodiversity because of their variety of microsites and their lack of dense tree cover. Wildlife also benefits from the relative abundance of berry producing shrubs. Herbage production is quite high for the Series (242 lbs./ac.) and is often composed of species such as pinegrass or even bluebunch wheatgrass. However, the limited extent of the type and its position within a densely forested landscape lower its use by livestock.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/ARNE Association has not been described in other nearby classifications.

# TSHE/ASCA3 ASSOCIATION CHF313

*Tsuga heterophylla/Asarum caudatum*

western hemlock/wild ginger

*Wild ginger (ASCA3), an indicator of the TSHE/ASCA3 Association.*

## ENVIRONMENT

Elevation: 2200-3400 (2822) ft.

Aspect: northerly, west, southwest

Slope: 1-57 (27) %

Slope position: M, L 1/3, bench, bottom

Special: moderate, moist, maritime

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| THPL | western redcedar | 100 | 32 |
| PSME | Douglas-fir | 92 | 21 |
| ABGR | grand fir | 83 | 21 |
| TSHE | western hemlock | 75 | 11 |
| PIEN | Engelmann spruce | 33 | 9 |
| POTR2 | black cottonwood | 25 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| THPL | western redcedar | 92 | 8 |
| TSHE | western hemlock | 58 | 6 |
| ABGR | grand fir | 50 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| BENE | Cascade Oregon grape | 92 | 4 |
| CHUMO | western prince's pine | 58 | 2 |
| LIBOL | twinflower | 50 | 6 |
| PYSE | sidebells pyrola | 50 | 2 |
| PAMY | pachistima | 50 | 2 |
| **HERBS** | | | |
| SMST | starry solomonplume | 100 | 3 |
| ASCA3 | wild ginger | 100 | 5 |
| CLUN | queencup beadlily | 92 | 4 |
| TROV | trillium | 92 | 2 |
| GOOB | w. rattlesnake plantain | 83 | 3 |
| VIGL | pioneer violet | 58 | 4 |
| POMU | swordfern | 58 | 2 |
| ADBI | pathfinder | 50 | 5 |
| TITRU | coolwort foamflower | 50 | 4 |
| ACTR | vanilla leaf | 33 | 13 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/ASCA3 Association is found in suitable environments from the south end of the Forest to the Lake Wenatchee District. Most stands are within a few miles of the Cascade Crest in areas with a strong maritime influence to the climate.

Elevations are low to moderate and range from 2200 to 3400 feet. Slopes are moderate, averaging about 30%, but range from 1 to near 60%. Sites are typically found on mid to lower slopes or on moist benches. This Association characterizes warm, moist, sheltered sites with fertile soils that are somewhat poorly drained.

Soils are moist, but not as wet as the THPL/OPHO Association. The type occupies areas of low solar insolation and zones of moisture accumulation in the soils. Most soils are formed in depositional material from a wide variety of parent materials.

Wetter sites normally support the THPL/OPHO Association, while slightly less moist environments support TSHE/ACCI/ASCA3, TSHE/PAMY/CLUN or TSHE/ACTR *WEN* types.

VEGETATION: The oldest stand is just over 200 years old, so late seral and climax conditions are unclear and must be inferred from species composition and successional dynamics. Presumably, western hemlock will dominate the tree overstory and regeneration layers in late seral stands. Western redcedar is an important stand component of both overstory and understory in nearly all plots. Due to the lack of western hemlock in some stands, usually at the range margins of western hemlock, western redcedar will be used to key to the Series. These warm, moist sites are adapted to a wide variety of species. Trees important early in the sere on most sites include grand fir and Douglas-fir. Black cottonwood, Engelmann spruce, western larch, western white pine and bigleaf maple may be important on some sites.

The shrub layer in late seral or climax conditions will apparently be fairly sparse, with Cascade Oregon grape as the most constant species. However, a wide variety of other shrubs may be common, depending on the age, seral stage and history of disturbance for a site. Shrubs or subshrubs that may be abundant include twinflower, alpine pyrola, western prince's pine, pachistima, sidebells pyrola and baldhip rose.

The herb layer is characterized by a rich assemblage of mesophytic herbs. Wild ginger is the definitive species but others include starry solomonplume, queencup beadlily, trillium, pathfinder, vanilla leaf and sword fern. Other, less constant species may also be abundant (See Appendix B).

PRODUCTIVITY/MANAGEMENT: Sites are warm, moist and fertile and are highly productive for timber, shrub and herb biomass (Appendix C). These are some of the most productive sites on the Forest and their productivity should be protected by minimizing soil disturbance and compaction. Average basal area for seven samples stands was 406 sq. ft./ac. Site index values (base 50) for western hemlock and grand fir were both 82 (Appendix C). Tree harvest may raise the water table so the sites become swampy. Frost is not a problem in natural stands, but careful attention should be paid to air drainage patterns to avoid creating frost pockets through harvest activities.

Fires are likely infrequent in these stands. However, when they burn, they will burn hot due to high fuel loadings. Tree ages were quite variable in the type, making it difficult to verify fire frequency. The limited data suggest that fire frequency is probably in the range of 100-200 years.

Shrubs, such as baldhip rose, that resprout from root crowns are favored by spring burns. Fall burning in western hemlock sites in the northern Rocky Mountains generally increases the amount of shrubs on the site, especially if *Ceanothus* species are on the site or their seeds are in the soil. This is because *Ceanothus* seeds have both a scarification as well as a cold-wet stratification requirement. Spring burns often do not meet the stratification requirement of the seeds, so seed germination and subsequent shrub development is reduced.

Mature stands often develop multiple tree canopies, with western larch and Douglas-fir as the tallest layers, over one or more layers of more tolerant species, such as grand fir, western hemlock, western redcedar or even black cottonwood. This diversity in tree layers provides a diverse habitat for many wildlife species, including arboreal mammals and birds.

These sites are not suited to livestock foraging, but often provide shady spots near water. Herbage production is only about 50 lbs./acre.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/ASCA3 Association has been described for northern Idaho (Cooper and others 1991). The TSHE/ASCA3 type described for the Yakima Indian Reservation contains some sample stands that would key to the Wenatchee's TSHE/ASCA3. Other classifications in the Cascades describe moist-site herb types that often include wild ginger, but there is no TSHE/ASCA3 Association described.

# TSHE/BENE *WEN* ASSOCIATION CHS142

*Tsuga heterophylla/Berberis nervosa*

western hemlock/Cascade Oregon grape

## ENVIRONMENT

Elevation: 2120-4260 (3206) ft.

Aspect: mainly northerly or easterly

Slope: 3-74 (37) %

Slope position: ridge, U, M, L, bench, bottom

Special: moderate, maritime

## VEGETATION SUMMARY

(Sample size: 31)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 94 | 18 |
| TSHE | western hemlock | 77 | 32 |
| PIMO | western white pine | 65 | 5 |
| ABGR | grand fir | 61 | 19 |
| THPL | western redcedar | 45 | 8 |
| LAOC | western larch | 29 | 9 |
| PICO | lodgepole pine | 29 | 8 |
| ABPR | noble fir | 3 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| TSHE | western hemlock | 84 | 4 |
| THPL | western redcedar | 65 | 4 |
| ABGR | grand fir | 55 | 6 |
| ABAM | Pacific silver fir | 32 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| BENE | Cascade Oregon grape | 100 | 6 |
| CHUMO | western prince's pine | 81 | 4 |
| LIBOL | twinflower | 77 | 7 |
| VAME | big huckleberry | 77 | 3 |
| PAMY | pachistima | 74 | 3 |
| PYSE | sidebells pyrola | 71 | 2 |
| ROGY | baldhip rose | 55 | 4 |
| PYPI | whitevein pyrola | 45 | 1 |
| PYAS | alpine pyrola | 39 | 3 |
| ACCI | vine maple | 32 | 5 |
| **HERBS** | | | |
| GOOB | w. rattlesnake plantain | 65 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/BENE Association is widespread along the east slope of the Cascades within a climatic pattern sufficiently maritime to support western hemlock. The plots extend from the Naches District to the Lake Wenatchee.

Eighty percent of the plots are at elevations between 2500 and 4000 feet. Slopes are gentle to steep. Most slopes are greater than 20% because less steep sites are usually in more moist Associations within the Western Hemlock Series. Only one plot occurred in a bottom position.

Soils are formed in a wide variety of parent materials. Many plots on the Lake Wenatchee District are on soils with ash or pumice in the surface horizons. Sites on Naches District are most often on basalts or other types of extrusive igneous materials.

Slightly more moist sites are commonly in the TSHE/PAMY/CLUN Association. Drier ones are most often in the Grand Fir Series.

VEGETATION: Dominant trees in our oldest stand were over 300 years old at breast height. Late seral or near climax stands are characterized by dominance of western hemlock in the overstory and tree regeneration layers. Western hemlock appears capable of completely replacing all other associated conifers if sufficient time elapses between perturbations. The undergrowth in late seral stands has few if any herbs and Cascade Oregon grape dominates the shrub layer.

A wide variety of conifers may form part of the tree sere, depending on stand ages and history prior to disturbance. Douglas-fir is the most abundant tree on many sites and lingers in the canopy until well past the age of the oldest stands sampled. However, it does not reproduce itself well in competition with western hemlock. Other seral trees include grand fir, western white pine, western larch, western redcedar, noble fir, lodgepole pine and Engelmann spruce. It is also not uncommon to find small amounts of Pacific silver fir as unsuccessful accidentals in this type. Grand fir is most abundant in stands between 50 and 150 years old. By the time stands reach 250 years of age, only western hemlock and Douglas-fir form major parts of the tree overstory and other species make up only a small proportion of the stand.

Vine maple can occur on sites below 3000 feet that are transitional to the TSHE/ACCI/CLUN Association. However, vine maple is not particularly well adapted to this type and only four plots supported over 5% cover. No intrinsic site factors were identified to justify developing another type. Unlike with some other Associations within this Series, vine maple is not normally a major part of the shrub sere. Cascade Oregon grape is the most common and consistent shrub, but others that may be common include western prince's pine, twinflower, big huckleberry and pachistima. In many stands, twinflower cover will equal or exceed that of Cascade Oregon grape.

Herbs are abundant in early seral stands but our three oldest stands have virtually no herbs present. Only western rattlesnake plantain was in more than half of the plots.

PRODUCTIVITY/MANAGEMENT: The TSHE/BENE Association represents the driest site capable of consistently supporting western hemlock. (In the even more xeric TSHE/ARNE Association, western hemlock is restricted to moist microsites in rock crevices or to areas of deep soils, and hemlock regeneration is episodic.) Nevertheless, these are productive sites with high basal areas and volume growth (Appendix C). Frost is not common and the sites should be relatively easy to regenerate if soil compaction is avoided. Shrub competition is not normally much of a problem, but broadcast burning will greatly increase shrub cover for the first decade or few decades after fire. Beware of increased competition after harvest in the few stands that support much vine maple.

Fires are likely infrequent in these stands. However, when they burn, they will burn hot due to high fuel loadings. Tree ages were quite variable in the type, but 4 of 11 stands exceeded 200 years. The data suggest that fire frequency is probably in the range of 100-300 years.

Forage for ungulates in mature stands is poor, but the sites tend to be dark and cool because of the dense canopy characteristic of the type. Multiple tree canopies are common and provide important habitat for arboreal animals.

Cascade Oregon grape is relatively tolerant of trampling damage and persists fairly well in campgrounds if the plants are not picked or dug.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/BENE Association has been described, with a variety of subtypes, throughout the Cascades. Generally, except for some unusual populations, Cascade Oregon grape is restricted to the Cascade vicinity and west. Typically, this type indicates the drier end of the Western Hemlock Series.

# TSHE/PAMY/CLUN ASSOCIATION CHS143

*Tsuga heterophylla/Pachistima myrsinites/Clintonia uniflora*

western hemlock/pachistima/queencup beadlily

## ENVIRONMENT

Elevation: 2440-4100 (3120) ft.

Aspect: various

Slope: 3-58 (33) %

Slope position: ridge, U, M, L, bench

Special: moderate, maritime

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 24 |
| ABGR | grand fir | 83 | 13 |
| TSHE | western hemlock | 58 | 13 |
| PIMO | western white pine | 58 | 4 |
| THPL | western redcedar | 50 | 6 |
| LAOC | western larch | 42 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| ABGR | grand fir | 58 | 8 |
| THPL | western redcedar | 58 | 5 |
| TSHE | western hemlock | 50 | 2 |
| PIMO | western white pine | 50 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 100 | 10 |
| VAME | big huckleberry | 92 | 9 |
| ROGY | baldhip rose | 92 | 5 |
| PYSE | sidebells pyrola | 83 | 2 |
| BENE | Cascade Oregon grape | 75 | 10 |
| CHUMO | western prince's pine | 75 | 6 |
| AMAL | serviceberry | 75 | 2 |
| RULA | dwarf bramble | 75 | 2 |
| LIBOL | twinflower | 58 | 15 |
| RUPA | thimbleberry | 50 | 2 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 100 | 4 |
| PTAQ | bracken fern | 92 | 6 |
| GOOB | w. rattlesnake plantain | 67 | 2 |
| SMST | starry solomonplume | 67 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The TSHE/PAMY/CLUN Association is most common on the Leavenworth and Lake Wenatchee Districts. There are, however, plots of the type from the Naches District in the south to at least Highway 20 in the North Cascades

Though average elevation is about 3100 feet, Sand Creek area plots in the Naches District approach or exceed 4000 feet on southerly aspects. Most plots elsewhere are below 3000 feet. Slopes vary in steepness, but most sites are on mid to lower slopes and the microrelief is typically flat.

Soils are formed in a variety of parent materials, but soils with pumice are more common in this Association than in any other type in the Western Hemlock Series (33% of plots were noted to have pumice). Coarse fragments, usually gravels, average about 25% in the surface horizons.

Sites are warm and moist. Although snowpacks may be relatively high, frost is uncommon. Adjacent benches and toe slopes commonly support the TSHE/ACCI/CLUN Association. The TSHE/BENE Association is found on slightly drier sites and TSHE/ASCA3 or TSHE/ACCI/ASCA3 Associations are on more moist and fertile sites. Cooler sites usually support the TSHE/ACTR WEN Association.

VEGETATION: Only two plots had tree age data. Dominant trees in the oldest sample stand were only 110 years old, so late seral or climax conditions must be inferred from species composition and successional dynamics. Presumably, older stands will be dominated by western hemlock in the overstory and regeneration layers. This Association has low constancy of western hemlock and consequently will be difficult at times to identify. Western redcedar is presently used to key both the Series and type until further data are available to describe a cedar Series. Western redcedar is an important species that will never be fully replaced by western hemlock on these sites, and a number of stands support western redcedar with little or no hemlock evident. The four plots from the Sand Creek area of the Naches District are difficult to fit into the Western Hemlock Series, but don't match the Grand Fir Series either. A wide variety of trees may form part of the tree sere, depending on stand history, and timing and type of disturbance. Grand fir is an especially important part of the sere in most stands. Western larch, Douglas-fir, grand fir and western white pine may also be common. Pacific silver fir, subalpine fir and Engelmann spruce may be present in some stands.

Stands within this type seem to be characterized by numerous relatively abundant low-to-medium size shrubs and subshrubs, such as dwarf bramble, sidebells pyrola, Cascade Oregon grape, pachistima, western prince's pine, baldhip rose, big huckleberry and twinflower. Other shrubs that may be important in the sere include serviceberry and thimbleberry. Vine maple is uncommon here but can occur. The Sand Creek plots are the only ones with creeping snowberry. Stands with bunchberry dogwood and Engelmann spruce are on the cool end for this type and may be transitional to TSHE/ACCI/CLUN, particularly if vine maple is present. With grazing, dwarf bramble and twinflower become more common or noticeable.

The herb layer is characterized by a collection of mesophytic herbs, such as queencup beadlily, rattlesnake plantain, starry solomonplume, trillium and round-leaved violet. Bracken fern has high constancy and is abundant in some stands.

PRODUCTIVITY/MANAGEMENT: Tree growth data are limited to only two plots (Appendix C). Sites are relatively warm, moist and productive timber sites. However, they can be degraded by soil compaction and excessive disturbance. Destruction of soil organic matter contributes to the development of dense shrubfields (Harvey and others 1987). Shrub cover will become abundant within 10 years of clearcutting and burning. Shrub competition from vine maple shouldn't be a big problem here, but snowbrush ceanothus can, because it often regenerates prolifically from seed, even if absent before a disturbance. Sites within the hemlock Series in the northern Rocky Mountains have less total shrub cover, if the stands are not burned and some tree overstory is left. Shelterwoods with minimum site disturbance are suggested to reduce shrub competition. Dense shelterwood and selection treatments favor grand fir, western redcedar and western hemlock.

Due to limited data, the fire return interval for the type is impossible to determine. Agee (1994) suggests that low to moderate severity fire may occur every 50 to 100 years, while the stand-replacement interval might be 150 to 500 years. However, no data are from eastern Washington and return intervals for this Series are not well known.

These warm, somewhat sheltered sites provide good habitat for a wide range of wildlife. Stands with much tall shrub cover provide excellent hiding cover for ungulates. Herbage, although probably not particularly palatable to livestock, was the highest in the Series (Appendix C). The capability of this type to grow a variety of conifer species provides for multiple tree canopies and diverse habitat for arboreal mammals and birds. Sites are typically too steep for campsites, and the herb and low shrub layer is easily damaged by foot and vehicular traffic.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSHE/PAMY/CLUN Association is similar to the TSHE/CLUN Association in northern Idaho, northeastern Washington, and Montana (Cooper and others 1991; Williams and others 1990; Pfister and others 1977). It is also similar to parts of the TSHE/PAMY of Daubenmire and Daubenmire (1968). It has not been described elsewhere in the Cascades.

# MISCELLANEOUS WESTERN HEMLOCK ASSOCIATION

(less than 5 Wenatchee sample plots)

## TSHE/LYAM CHM121

This is a minor type on the Wenatchee NF and was represented by only one plot in the data set, but it has been described elsewhere and is highly distinctive (Henderson and others 1992; Topik 1986; Halverson and others 1986). The unique appearance of skunk cabbage (LYAM) and the usual presence of surface water give this Association a distinct appearance. And it is the wettest type in the Western Hemlock Series. Although similar, due to the presence of skunk cabbage, to types described for both the Mt. Baker-Snoqualmie, Mt. Hood and Gifford Pinchot National Forests, the elevation of the one sample plot on the Wenatchee is much higher than the other Forests' Associations—over 4700 feet. The presence of Pacific silver fir may place this type in a similar ABAM/LYAM Association, but no data were obtained for this type on the Wenatchee NF.

# PACIFIC SILVER FIR SERIES

# PACIFIC SILVER FIR SERIES

DISTRIBUTION AND ENVIRONMENT: Pacific silver fir is one of the most shade-tolerant and environmentally restricted conifers on the Wenatchee National Forest. It is found only in areas of strong maritime climatic influence, usually within a few miles of the Cascade Crest. The Series is on sites that rarely if ever experience soil drought. Snowpacks are high and temperatures are cool to cold, but sites rarely experience intense, long-lasting cold temperatures below 0 degrees F. Although Pacific Silver Fir Series is found on all districts of the Forest near the Cascade Crest, it is best developed on the Naches, Cle Elum and Lake Wenatchee Districts. Pacific silver fir is more abundant and widespread on suitable sites west of the Cascade Crest than it is on the eastern slopes. Mountain hemlock is an accidental species in the Series.

The Pacific Silver Fir Series includes all forest stands potentially dominated at climax by silver fir, unless mountain hemlock has the potential to have over 10% cover. In the Washington Cascades, mountain hemlock and Pacific silver fir broadly overlap in their ecological distribution, so distinguishing between the two Series can be difficult. The capability of mountain hemlock to maintain at least 10% cover in later successional stands is the convention used in this guide. That is, sites that can support at least 10% cover of mountain hemlock are deemed different from sites that can support only Pacific silver fir and they are assigned to the Mountain Hemlock Series. Pacific silver fir climax sites are more moderate than those in the Mountain Hemlock Series.

Most sites are over 3000 feet, but stands of Pacific silver fir may follow cold air down valley bottoms to as low as 2000 feet. The Series is normally bounded, on yet cooler sites with deeper snowpacks, by the Mountain Hemlock Series. Warmer, less snowy sites support the Western Hemlock Series.

VEGETATION: Because of its superior shade tolerance, Pacific silver fir is often the most abundant species in the tree regeneration layer in mixed species stands. Some Pacific silver firs less than 10 feet tall are often 50 or more years old. Pacific silver fir can persist in the understory for years and then respond to canopy openings from windfall or the death of taller trees. Very old Pacific silver fir stands (>400 years) are rare on the east slope of the Cascades because of fire and other forms of disturbance, including wind, avalanches and disease. The largest Pacific silver firs in the sample stands are often 100 years or more younger than associated western hemlocks. Pacific silver fir dominates the regeneration layers on these sites but is more prone to diseases than the hemlock.

In spite of the cool, wet climate characteristic of the Series, fire has played a major role in the development of all sample stands. Tree age samples indicate that fire return intervals are normally less than 400 years, even on the wettest sites. Fires are usually severe in these dense forests that characteristically have two or more tree canopy layers.

Species that may form part of the tree sere in the Pacific Silver Fir Series include western hemlock, western redcedar, subalpine fir, Douglas-fir, western larch, western white pine, noble fir, lodgepole pine, Engelmann spruce and Alaska Alaska yellow cedar. The seral role of each species varies from Association to Association. For example western hemlock is more important on warmer sites and Alaska yellow cedar is only a component of some Associations on the south end of the Forest. On warm sites that have been deforested, Pacific silver fir may require establishment of a tree canopy by another species, such as western hemlock, western white pine, grand fir or Douglas-fir, before it can enter the sere. As forest canopies develop, the interior of the stands is cooler and Pacific silver fir gains a competitive advantage over the equally shade-tolerant western hemlock.

Mature stands characteristically have two or more tree canopies, with species such as Douglas-fir, noble fir and western larch forming a tall, emergent canopy above a layer made up of more shade-tolerant and slower-growing species such as Pacific silver fir, western hemlock and grand fir.

The shrub and herb layers are floristically rich and varied, but heavily shaded stands are characterized by very low understory plant cover (depauperate). Very dense canopies, deep litter layers and low light levels at the forest floor all appear to reduce the number and amounts of shrubs and herbs. In very dense stands with very low cover of understory species, inspection of adjacent, more open stands or use of relative cover may be needed to identify the type. Heavy grazing by elk reduces cover and species composition in at least some depauperate stands.

PRODUCTIVITY/MANAGEMENT: Sites are very productive (Appendix C). Cool average annual temperatures and heavy snowpacks are the main limitations to tree growth. Some sites, such as in the ABAM/OPHO Association, are swampy and as such, although tree growth is rapid, are difficult to manage for timber production. Site index values for Pacific silver fir ranged from 58 to 101(base 100). The most productive sites appear to be ABAM/TITRU and ABAM/OPHO, while the least productive are ABAM/VAME/CLUN *WEN*, ABAM/VAME-PYSE and ABAM/RHAL-VAME (Appendix C). Note that basal areas approach or exceed 300 sq. ft./acre on most sites. Douglas-fir is not well suited to the colder Associations such as ABAM/RHAL-VAME *WEN* and ABAM/MEFE. Ponderosa pine is not suited to the environmental conditions representative of the Pacific Silver Fir Series.

Primary root diseases include *Annosum* root disease and laminated root rot. *Annosum* root disease attacks subalpine fire, grand fir, Engelmann spruce, Pacific silver fir, western hemlock and mountain hemlock, typically causing root and butt rot at maturity. *Tomentosus* root disease can be present in lodgepole pine stands. The Indian paint fungus is a causal agent for heart rot of true firs, western hemlock and mountain hemlock. Western white pine has been drastically affected by white pine blister rust and there have been dramatic increases in mountain pine beetle attacks on this tree (Hessburg and others 1994). Western larch can be severely affected by dwarf mistletoe (Jim Hadfield, personal communication).

Insect species that can be pests include the silver fir beetle, mountain pine beetle, spruce beetle, western spruce budworm and fir engraver. Of these, only the silver fir beetle and mountain pine beetle have the potential for severe outbreaks in this Series. The silver fir beetle can kill thousands of trees in an area. Presumably, this is most likely to occur in areas with extensive, pure, mature Pacific silver fir (Paul Flanagan, personal communication). The mountain pine beetle causes extensive mortality mainly in the limited areas within this Series dominated by lodgepole pine. Douglas-fir tussock moth and western spruce budworm can occur, but attack mainly Douglas-fir and grand fir. This Series is really too snowy and cold to develop a major component of grand fir, although many stands do have a significant Douglas-fir component.

Dense shrubfields often typify early successional stages after logging, fire or other disturbance within the Series, especially on ABAM/ACCI sites. Although the development of shrubfields may initially appear deleterious to conifer establishment and early growth, the ecologic role of the shrub-dominated stage of succession is not well understood. Shrubs provide shade for conifers, add organic matter to the soil, and species such as *Ceanothus*, alders and russet buffaloberry fix nitrogen. Further, many shrubs provide important forage and cover for insectivorous wildlife, which also influence stand health and vigor. Common shrubfield species include vine maple, Douglas maple, Scouler willow, pachistima, big huckleberry, serviceberry, Sitka alder and snowbrush ceanothus.

In the northern Rocky Mountains, shrub height growth and twig production are generally related to time since logging and to residual tree cover (Irwin and Peek 1979). Shrub size and twig production peaks between 10 and 14 years after logging. Seed tree and shelterwood treatments have significantly less shrub development than clearcuts. Late summer and fall broadcast burning in clearcuts leads to the greatest shrub development, due to increased snowbrush ceanothus cover. Presumably, the same holds true for the east slope of the Cascades.

*Ceanothus* seeds have both seed coat scarification and cold-wet seed stratification requirements for optimum germination. These are met by most fall and late summer burns. Spring burns usually do not provide the necessary cold-wet stratification, so *Ceanothus* germination is greatly reduced. Spring burning favors species that sprout from root crowns or buried roots (see Appendix D).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Pacific Silver Fir Series has been described by numerous authors up and down the Cascades. Some of these authors are: Hemstrom and others 1982; Brockway and others 1983; Williams and Lillybridge 1983; Hemstrom and others 1987; Franklin and others 1988; John and others 1988; Henderson and others 1992. Sometimes they included some mountain hemlock zone types. The distinction between the Mountain Hemlock and Pacific Silver Fir Series has not been consistent between authors. The broad overlap in the ranges of Pacific silver fir and mountain hemlock, their ability to cohabit on the same sites, and questions about relative competitive ability, have made for confusion over the best way to handle climax status. In this Guide, sites with the ability to support 10% cover of mountain hemlock (in mature stands) are included in the Mountain Hemlock Series.

A variety of plant Associations have been described in the Pacific Silver Fir Series on the Wenatchee NF. Perhaps the common link to other classifications is that Pacific silver fir is strongly limited to the Cascades and requires a maritime climate.

## Keys to Plant Associations of the Pacific Silver Fir Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

| | | |
|---|---|---|
| Devil's club or ladyfern ≥ 5%, oak fern usually present | ABAM/OPHO | p. 162 |
| Rusty menziesia ≥ 5% | ABAM/MEFE | p. 160 |
| Cascade azalea ≥ 5%, big huckleberry usually present | ABAM/RHAL-VAME | p. 164 |
| Vine maple ≥ 5% | ABAM/ACCI | p. 156 |
| Alaska huckleberry or five-leaved bramble ≥ 5% | ABAM/VAAL | p. 170 |
| Vanilla leaf ≥ 2% | ABAM/ACTR | p. 158 |
| Oak fern, rosy twistedstalk, coolwort foamflower or false bugbane ≥ 5% | ABAM/TITRU | p. 168 |
| Dwarf bramble ≥ 1% and elevations > 5000' (broadleaf arnica usually present) | ABAM/RULA | p. 166 |
| Queencup beadlily ≥ 1%, big huckleberry usually present | ABAM/VAME/CLUN | p. 172 |
| Big huckleberry ≥ 1% (sidebells pyrola usually present) | ABAM/VAME-PYSE | p. 174 |

## Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| ABAM/ACCI | 9 | 343 | 356 | 17 | 544 | 25 |
| ABAM/ACTR | 28 | 412 | 291 | 13 | 490 | 37 |
| ABAM/MEFE | 7 | 276 | 346 | 17 | 529 | 13 |
| ABAM/OPHO | 4 | 116 | 316 | 25 | 414 | 178 |
| ABAM/RHAL-VAME | 3 | 987 | 288 | 13 | 542 | 62 |
| ABAM/TITRU | 6 | 289 | 279 | 15 | 441 | 79 |
| ABAM/VAAL | 8 | 294 | 349 | 17 | 532 | 23 |
| ABAM/VAME/CLUN | 13 | 344 | 264 | 12 | 445 | 48 |
| ABAM/VAME-PYSE | 17 | 326 | 290 | 14 | 474 | 6 |

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABAM/ACCI | ABAM | 30 | 90 | 34 | 306 | 124 | 164 |
| | ABPR | 3 | 94 | 3 | 305 | 126 | 171 |
| | PSME | 2 | 73 | 24 | 334 | 255 | 252 |
| ABAM/ACTR | ABAM | 30 | 97 | 32 | 294 | 130 | 126 |
| | ABLA2 | 20 | 58 | 20 | 227 | 95 | 90 |
| | ABPR | 13 | 122 | 13 | 323 | 174 | 78 |
| | LAOC | 33 | 66 | 33 | 124 | 58 | 86 |
| | PICO | 5 | 65 | 5 | 149 | 68 | 84 |
| | PIEN | 11 | 81 | 11 | 278 | 160 | 152 |
| | PIMO | 7 | 58 | 7 | 183 | 75 | 84 |
| | PSME | 61 | 73 | 93 | 277 | 139 | 156 |
| | TSHE | 6 | 67 | 34 | 292 | 133 | 203 |
| ABAM/MEFE | ABAM | 23 | 72 | 26 | 342 | 110 | 215 |
| ABAM/OPHO | ABAM | 19 | 114 | 20 | 384 | 191 | 156 |
| | THPL | 8 | 73 | 10 | 297 | 151 | 227 |
| ABAM/RHAL-VAME | ABLA2 | 5 | 24 | 5 | 268 | 44 | 224 |
| | PIEN | 4 | 52 | 4 | 243 | 88 | 172 |
| ABAM/TITRU | ABAM | 8 | 122 | 8 | 447 | 238 | 117 |
| | ABPR | 3 | 118 | 3 | 269 | 140 | 60 |
| | LAOC | 4 | 62 | 4 | 197 | 86 | 159 |
| | PIEN | 10 | 75 | 10 | 337 | 186 | 136 |
| | PSME | 10 | 80 | 14 | 269 | 158 | 121 |
| ABAM/VAAL | ABAM | 24 | 90 | 28 | 316 | 125 | 178 |
| | PIEN | 5 | 73 | 5 | 513 | 263 | 250 |
| | PSME | 1 | 90 | 8 | 279 | 195 | 258 |
| | TSME | 3 | 103 | 3 | 340 | 154 | 106 |
| ABAM/VAME-PYSE | ABAM | 16 | 58 | 19 | 241 | 64 | 227 |
| | PICO | 3 | 59 | 3 | 118 | 49 | 116 |
| | PSME | 14 | 58 | 32 | 303 | 136 | 201 |
| | TSHE | 6 | 53 | 55 | 262 | 78 | 224 |
| ABAM/VAME/CLUN | ABAM | 5 | 69 | 5 | 254 | 76 | 210 |
| | ABGR | 3 | 84 | 3 | 308 | 181 | 64 |
| | ABLA2 | 5 | 82 | 5 | 438 | 252 | 82 |
| | ABPR | 3 | 128 | 3 | 175 | 99 | 64 |
| | PICO | 13 | 53 | 13 | 123 | 45 | 104 |
| | PIEN | 5 | 84 | 5 | 623 | 365 | 108 |
| | PSME | 20 | 72 | 31 | 238 | 123 | 120 |
| | TSHE | 4 | 62 | 18 | 477 | 144 | 177 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

SILVER FIR
PLANT ASSOCIATION
GROUPS

1. Cool Mesic Shrub/Herb PAG
   - ABAM/ACCI
   - ABAM/VAME-PYSE
   - ABAM/VAME/CLUN *WEN*
2. Cool Moist Shrub/Herb PAG
   - ABAM/ACTR *WEN*
   - ABAM/MEFE *WEN*
   - ABAM/TITRU
   - ABAM/VAAL *WEN*
3. Cold Mesic Shrub/Herb PAG
   - ABAM/RHAL-VAME *WEN*
   - ABAM/RULA *WEN*
4. Wet Shrub/Herb PAG
   - ABAM/OPHO

SILVER FIR
PLANT ASSOCIATIONS
AND ECOCLASS CODES

| | |
|---|---|
| ABAM/ACCI | CFS621 |
| ABAM/ACTR *WEN* | CFF254 |
| ABAM/MEFE *WEN* | CFS542 |
| ABAM/OPHO | CFS351 |
| ABAM/TITRU | CFF162 |
| ABAM/RHAL-VAME *WEN* | CFS556 |
| ABAM/RULA *WEN* | CFS413 |
| ABAM/VAAL *WEN* | CFS232 |
| ABAM/VAME/CLUN *WEN* | CFS233 |
| ABAM/VAME-PYSE | CFS234 |

# ABAM/ACCI ASSOCIATION CFS621

*Abies amabilis/Acer circinatum*

Pacific silver fir/vine maple

## ENVIRONMENT

Elevation: 2280-4160 (3268) ft.

Aspect: east-West (Southerly)

Slope: 2-62 (37) %

Slope position: U, M, L 1/3, terrace, toe

Special: cool, moist, maritime

## VEGETATION SUMMARY

(Sample size: 24)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 100 | 26 |
| TSHE | western hemlock | 88 | 23 |
| ABAM | Pacific silver fir | 88 | 19 |
| THPL | western redcedar | 42 | 7 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 96 | 13 |
| TSHE | western hemlock | 79 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| ACCI | vine maple | 100 | 19 |
| VAME | big huckleberry | 100 | 9 |
| RULA | dwarf bramble | 88 | 4 |
| CHUMO | western prince's pine | 88 | 3 |
| BENE | Cascade Oregon grape | 79 | 7 |
| LIBOL | twinflower | 79 | 7 |
| PAMY | pachistima | 79 | 3 |
| PYSE | sidebells pyrola | 75 | 4 |
| ROGY | baldhip rose | 71 | 3 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 83 | 7 |
| ACTR | vanilla leaf | 79 | 8 |
| VIOR2 | round-leaved violet | 71 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/ACCI Association is a restricted type most often found on the Naches and Cle Elum Districts. Most of the plots are less than 5 map miles east of the Cascade Crest.

This type represents the warmest environment where Pacific silver fir is the indicated climax species, although it is relatively cool and moist when compared to other Series. The climate is strongly influenced by westerly air flows. Lingering clouds and fog may be important climatic characteristics for Pacific silver fir to persist on steep southerly slopes.

The type typically occurs on mid-slope or lower positions on moderate to steep (>45%) southerly aspects. Only one stand was on a terrace and one on a toe slope. Elevations are low for the Pacific Silver Fir Series. Only three stands were over 4000 feet.

Soils are formed in a variety of depositional materials, such as till, outwash, colluvium or tephra. Basalts and most tephra substrates are on the Naches District.

Slightly cooler sites typically support the ABAM/VAME/CLUN *WEN* or ABAM/VAME-PYSE types. As moisture increases, ABAM/ACTR or ABAM/TITRU are likely to occur. Stands with marginal amounts of vine maple and with wet site herbs may better fit the ABAM/TITRU type.

VEGETATION: Late seral or near climax stands are characterized by dense tree canopies with about 75% tree cover. Pacific silver fir, Douglas-fir and western hemlock are the usual dominants in the sample stands, but the proportion of Pacific silver fir tends to increase in older stands. Western hemlock is absent from the regeneration layer in the three oldest stands, suggesting eventual climax dominance of Pacific silver fir, barring major perturbations. Data on breast height ages of dominant trees show that Douglas-firs are 50 to 100 years older than the Pacific silver firs. Western hemlock is younger than Douglas-fir, but older than Pacific silver fir in the same stand. Douglas-fir often dominates early seral stages of forest succession. Other seral conifers may include western redcedar, western white pine and noble fir. Only Pacific silver fir and western hemlock were in the tree regeneration layer, and Pacific silver fir is generally the most abundant species.

The shrub layer is floristically rich and varied, but vine maple is the most abundant species. Vine maple and big huckleberry are found in all stands. Other shrubs found in half or more of our plots include dwarf bramble, pachistima, Cascade Oregon grape, twinflower, western prince's pine, baldhip rose, beargrass, little prince's pine and mountain ash.

The herb layer is rich and varied. Queencup beadlily and vanilla leaf are the most constant and one or both are found in every stand and average over 5% cover. Other common herbs include rattlesnake orchid, round-leaved violet, bracken fern and trillium.

PRODUCTIVITY/MANAGEMENT: These are productive sites where deep soil moisture is available for tree growth (Appendix C). Site index values for Douglas-fir is 86 (base 50) and 90 (base 100) for Pacific silver fir. Mean basal area is 356 sq. ft./ac. Expect severe shrub competition after regeneration harvests. Vine maple resprouts after burning and experience with shrub fields of different species in the northern Rocky Mountains indicates that broadcast burning encourages shrub development. Snowbrush ceanothus is especially favored by fall burns because both the seed scarification and the cold-wet stratification needs of the seeds are met. Snowbrush ceanothus is less abundant after spring burns because the stratification requirements of the seeds are not as likely to be completed. Most shrubs and herbs resprout after burning unless the fire was so hot it caused death of surface soil meristematic tissue. Shelterwood or seed tree harvest prescriptions are suggested on these relatively warm sites.

Tree ages suggest that fire return intervals are quite long in this type, and stand-replacement fires are the norm. The mean age of the oldest trees in the sample stands is nearly 250 years. However, the fire interval is shorter than in most other types in the Pacific Silver Fir Series. When fires occur they are intense conflagration burns because of the amount of ladder fuels in the shrub, tree regeneration and tree canopy layers.

Multiple canopy levels in mature stands include an overstory of long-lived seral species, such as Douglas-fir, over an intermediate canopy of tolerant species, such as western hemlock and Pacific silver fir, and still another canopy of vine maple. This diversity of tree and tall shrub canopies provides considerable habitat diversity for arboreal mammals and birds. The ABAM/ACCI Association provides valuable habitat for wildlife because of its variety of shrubs and herbs and its relatively warm, sheltered sites. Grazing is usually low due to lack of forage.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABAM/ACCI Association appears unique to the Wenatchee NF, although an ABAM/ACCI/TIUN type has been described for the Mt. Hood and Willamette NFs (Hemstrom and others 1982). Some of the Pacific silver fir Associations from the Mt. Baker-Snoqualmie and the Gifford Pinchot NFs do not include this type, although they have similar species compositions (Henderson and others 1992; Brockway and others 1983). The ABAM/ACTR-CLUN type described on the Gifford Pinchot NF is similar, but also contains some west-side species not found on the Wenatchee.

# ABAM/ACTR *WEN* ASSOCIATION CFF254

*Abies amabilis/Achlys triphylla*

Pacific silver fir/vanilla leaf

## ENVIRONMENT

Elevation: 2300-4580 (3843) ft.

Aspect: all (mostly easterly)

Slope: 3-74 (26) %

Slope position: ridge, U, M, L 1/3, bottom

Special: cool, moist, maritime

## VEGETATION SUMMARY

(Sample size: 56)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 93 | 20 |
| ABAM | Pacific silver fir | 80 | 18 |
| TSHE | western hemlock | 79 | 19 |
| PIMO | western white pine | 45 | 7 |
| LAOC | western larch | 36 | 12 |
| THPL | western redcedar | 30 | 10 |
| ABGR | grand fir | 21 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 95 | 12 |
| TSHE | western hemlock | 84 | 6 |
| THPL | western redcedar | 39 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAME | big huckleberry | 89 | 13 |
| PYSE | sidebells pyrola | 86 | 4 |
| RULA | dwarf bramble | 84 | 6 |
| PAMY | pachistima | 79 | 6 |
| BENE | Cascade Oregon grape | 71 | 8 |
| LIBOL | twinflower | 68 | 7 |
| CHUMO | western prince's pine | 66 | 4 |
| ROGY | baldhip rose | 59 | 4 |
| **HERBS** | | | |
| ACTR | vanilla leaf | 100 | 9 |
| CLUN | queencup beadlily | 89 | 7 |
| GOOB | w. rattlesnake plantain | 71 | 2 |
| VIOR | round-leaved violet | 70 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/ACTR Association was sampled only on Naches and Cle Elum Districts. It may be found farther north along the east slope of the Cascades, but there are no data.

The ABAM/ACTR Association is characterized by relatively warm (for Pacific silver fir), sheltered, well-watered and well-drained sites with deep soils. Elevations are moderate and most slopes are gentle to moderate (<35%). Sample stands were found on all slope positions, but mostly from ridges to lower 1/3 slopes. It is best developed on middle and lower slope positions, where it occupies non-swampy areas of moisture accumulation. It is common to find this type in swales, with better drained types in geographically higher positions.

Soils are formed in a variety of materials, including till, outwash and tephra, with a fair number of basalts substrates as well. Gravel and cobble size rocks average over 20% by volume in the surface soil horizons.

Wetter sites support the ABAM/TITRU or ABAM/OPHO Associations. Slightly warmer habitats are occupied by the TSHE/ACTR *WEN* Association, and cooler environments often support ABAM/VAAL. Drier sites support ABAM/ACCI, ABAM/VAME-PYSE or ABAM/VAME/CLUN *WEN* types. Relative reproductive success of Pacific silver fir or western hemlock regeneration separates the ABAM/ACTR and TSHE/ACTR *WEN* types.

VEGETATION: Pacific silver fir dominates the overstory and tree regeneration layers in late seral and near climax stands. Western hemlock and western redcedar are commonly associated with Pacific silver fir and are especially important on warmer sites within the type where the sites are transitional to the TSHE/ACTR *WEN* Association. Early seral stands may be occupied by a wide variety of trees, including Douglas-fir, Engelmann spruce, lodgepole pine, grand fir, western larch, western white pine and subalpine fir. Douglas-fir is the most common and abundant overstory tree in the sample stands. Alaska yellow cedar may form part of late seral or near climax stands on sites at the cooler extreme for the type.

Big huckleberry is in most sample stands and may be abundant. It and baldhip rose are the only common shrubs that average over two feet in height. Other shrubs are normally low in stature and include Cascade Oregon grape, dwarf bramble, sidebells pyrola, pachistima, western prince's pine and twinflower.

Herbs are often highly visible in the undergrowth. Vanilla leaf's unique horizontally-spreading leaves lend a characteristic appearance to the type. Other herbs that may be abundant include queencup beadlily, round-leaved violet, trillium, coolwort foamflower, starry solomonplume and broadleaf arnica.

PRODUCTIVITY/MANAGEMENT: These are highly productive, easily managed timber sites (Appendix C). Soils are subject to compaction and displacement by heavy equipment. Tree harvest may raise the water table. Frost is usually not a problem in natural stands. However, managers should pay attention to local topography and air drainage patterns to avoid creating frost pockets.

The trees on ten of twenty-eight intensively sampled stands were over 200 years breast-height age, suggesting that fires are infrequent in these sheltered, moist sites but are usually intense when they occur.

With their variety of herbs and shrubs, these sites are important habitat for wildlife. Trees may be large, with heights >150 feet and diameters >4 feet, and several different tree canopies may occur under the dominants. This diversity in arboreal habitat may be important to spotted owls and other wildlife that require large trees and a variety of structures. Elk are known to use these areas for cover and food. They sometimes remove the leaves and inflorescences of vanilla leaf, leaving just the stems spaced at intervals above the ground and following the pattern of their underground rhizomes.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A number of types described for the Mt. Baker-Snoqualmie, Mt. Hood and Gifford Pinchot NFs have vanilla leaf in their species list. However, organization of these classifications has resulted in types that are different from the ABAM/ACTR Association described on the Wenatchee (Henderson 1992; Brockway 1983; Hemstrom and others 1982). Vanilla leaf is a very restricted species on the Wenatchee NF and consequently is a more important indicator here than west of the Cascades where it is wide spread.

# ABAM/MEFE *WEN* ASSOCIATION CFS542

*Abies amabilis/Menziesia ferruginea*

Pacific silver fir/rusty menziesia

## ENVIRONMENT

Elevation: 2510-4820 (3539) ft.

Aspect: mostly north to northeast

Slope: 8-70 (36) %

Slope position: ridge, U, M, L 1/3, bottoms, benches

Special: cool, moist, maritime

## VEGETATION SUMMARY

(Sample size: 27)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 93 | 25 |
| TSHE | western hemlock | 89 | 31 |
| PSME | Douglas-fir | 44 | 10 |
| THPL | western redcedar | 26 | 9 |
| TSME | mountain hemlock | 19 | 5 |
| CHNO | Alaska yellow cedar | 15 | 21 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 14 |
| TSHE | western hemlock | 89 | 31 |
| THPL | western redcedar | 26 | 9 |
| **SHRUBS AND SUBSHRUBS** | | | |
| MEFE | rusty menziesia | 100 | 14 |
| VAME | big huckleberry | 89 | 11 |
| PYSE | sidebells pyrola | 81 | 3 |
| RULA | dwarf bramble | 74 | 3 |
| VAAL | Alaska huckleberry | 67 | 8 |
| RHAL | Cascade azalea | 48 | 11 |
| RUPE | five-leaved bramble | 41 | 4 |
| XETE | beargrass | 33 | 12 |
| COCA | bunchberry dogwood | 33 | 5 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 74 | 5 |
| GOOB | w. rattlesnake plantain | 44 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/MEFE Association is best developed on the Lake Wenatchee, Cle Elum and Naches Districts. It often extends northward on suitable environments along the east slopes of the Cascades.

The ABAM/MEFE Association is characterized by a cool maritime climate with deep snowpacks. Elevations of sample stands are quite variable and depend on the relationship of the site to the movement of maritime air masses and depth of snowpacks. Slopes are also variable. The type is most often in middle and lower positions. Sites have northerly aspects or have lingering snowpacks.

All the plots are in areas once occupied by valley glaciers and most soils are developed in tills or glacial outwash. This is reflected by the soil coarse fragments, which are cobble-sized and average about 40% by volume in the surface horizon.

Colder sites support the ABAM/RHAL-VAME *WEN* type, or Mountain Hemlock Series types where RHAL, VAAL or MEFE dominate. Areas with lower snowpacks and somewhat warmer temperatures are in the ABAM/VAAL type. Wetter sites often support ABAM/OPHO or ABAM/TITRU Associations. Stands with abundant beargrass indicate the dry end of the type and those with Alaska huckleberry are grading into the ABAM/VAAL Association.

VEGETATION: Late seral and near climax stands are fairly common. Trees from all six intensive plots had ages over 200 years. Late seral stands are dominated by Pacific silver fir in both the overstory and tree regeneration layers. Pacific silver fir may dominate any stage of the tree sere, depending on local seed sources and timing, and type and intensity of disturbance. Western hemlock is the major overstory species in mid seral stands and maintains this major role even in the oldest stands sampled. However, Pacific silver fir will eventually dominate these stands. Alaska yellow cedar is an important long-lived seral species on some sites on the Naches District but is less common north of Snoqualmie Pass. Western redcedar may be common on warm sites within the type. Douglas-fir is rarely a dominant stand component and therefore does not appear well suited to the type.

The dense shrub layer forms at least two distinct strata. Rusty menziesia is the most common and abundant shrub and is indicative of the type. Rusty menziesia, big huckleberry, Alaska huckleberry and Cascade azalea may dominate the tallest shrub layer, while species such as dwarf bramble, sidebells pyrola, five-leaved bramble and twinflower collectively make up a low shrub or subshrub layer. A variety of other shrubs may be abundant but are irregular in occurrence.

The herb layer is more variable in species composition, cover and constancy than the shrub layer. Queencup beadlily is the most constant herb and is usually the most abundant. Undifferentiated mosses are present in most stands and average over 25% cover. All other herbs are in less than half of the stands and only vanilla leaf exceeded 5% cover in the sample plots. Stands with wet-site herbs and marginal amounts of Rusty menziesia may better fit the ABAM/TITRU type.

PRODUCTIVITY/MANAGEMENT: This type is at the lower end of productivity for the Pacific Silver Fir Series. Tree growth is not particularly rapid but basal areas are high. High snow packs, short growing seasons and cold soil temperatures are the likely reasons for relatively slow tree growth. The Pacific silver fir site index is only 72 (base 100) and basal areas average about 350 sq. ft./ac.(Appendix C). Soil moisture is usually abundant, although the sites are well drained. Snow pack and short growing season also limit the tree species suitable for timber management. Pacific silver fir or western hemlock are the preferred species. If the proper species are selected, regeneration should not be difficult, using either planted stock or natural regeneration. Rusty menziesia and Cascade azalea are usually not problems in reforestation, and they decrease after burning or scarification (Fielder 1982). Big and Alaska huckleberry will typically become very abundant after harvest.

Tree ages in most stands were well over 200 years, indicating infrequent stand-replacement fire regimes. These stands are usually moist and relatively inflammable; however, when conditions are finally right for fires, they tend to be catastrophic.

This Association produces little or no forage for livestock (Appendix C). It has considerable value for wildlife because of the abundance of berry-producing shrubs and the multiple shrub and tree layers characteristic of the type.

The ABAM/MEFE Association is not suitable for campground or similar uses because of wet, cold conditions, abundant insects and late melting snow. Recreational berrying is a potential use, especially in early to mid-seral stands. Watershed values are high and sites often adjoin streams or lakes.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Gifford Pinchot classification includes a very similar type (Brockway and others 1983). The classification of Mt. Rainier National Park (Franklin and others 1988) included an ABAM/MEFE type that supports both Pacific silver fir and mountain hemlock. The Mt. Baker-Snoqualmie classification (Henderson and others 1992) includes a number of Associations that are similar in that they support rusty menziesia. The Mt. Hood and Willamette classifications describe a similar ABAM/MEFE Association (Hemstrom and others 1982).

# ABAM/OPHO ASSOCIATION CFS351

*Abies amabilis/Oplopanax horridum*

Pacific silver fir/devil's club

## ENVIRONMENT

Elevation: 2610-4200 (3285) ft.
Aspect: variable
Slope: 2-55 (24) %
Slope position: U, M, L 1/3, bottoms, benches
Special: cool , wet, maritime

## VEGETATION SUMMARY

(Sample size: 11)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 31 |
| TSHE | western hemlock | 91 | 23 |
| THPL | western redcedar | 64 | 15 |
| PSME | Douglas-fir | 36 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 8 |
| TSHE | western hemlock | 64 | 6 |
| **SHRUBS AND SUBSHRUBS** | | | |
| OPHO | devil's club | 100 | 33 |
| RULA | dwarf bramble | 82 | 4 |
| PYSE | sidebells pyrola | 73 | 3 |
| VAME | big huckleberry | 73 | 3 |
| VAAL | Alaska huckleberry | 55 | 4 |
| RUPA | thimbleberry | 55 | 2 |
| RUPE | five-leaved bramble | 36 | 8 |
| ACCI | vine maple | 27 | 7 |
| **HERBS** | | | |
| TITRU | coolwort foamflower | 100 | 12 |
| CLUN | queencup beadlily | 100 | 11 |
| GYDR | oak fern | 100 | 10 |
| ATFI | ladyfern | 91 | 6 |
| TROV | trillium | 82 | 2 |
| GATR | sweetscented bedstraw | 82 | 2 |
| VIGL | pioneer violet | 73 | 4 |
| STRO | rosy twistedstalk | 64 | 6 |
| ACRU | baneberry | 64 | 1 |
| SMST | starry solomonplume | 55 | 8 |
| ASCA3 | wild ginger | 55 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/OPHO Association is a minor type widely distributed along the Cascade Range. Plots range from the Naches District to west of the Cascades Crest along Highway 20. The majority of the data are from the Rainy Creek area of the Lake Wenatchee District. Most plots are 5 to 6 map miles from the Crest.

The Association is typified by cool, wet-to-swampy sites. Elevations are relatively low for the Series, with only the Okanogan plot exceeding 4000 ft. Most sites are at elevations between 2800 and 4000 feet. The type typically occurs on wet bottomlands or seeps, often as narrow "stringers." It can also occur on slopes or terraces with seepage. It covers limited acreage.

Soils are wet and poorly drained and often have standing water. Soils are usually very dark, high in organic matter, and have 10-40% gravels and cobbles in the surface horizons.

Microsite variation strongly affects vegetative composition. Hummocky sites along or between stream channels are common. Mounds support species requiring better drainage. Water-loving plants grow between hummocks.

Slightly better-drained sites typically support the ABAM/TITRU Association. Wetter sites are usually non-forested wetlands.

VEGETATION: All our stands are less than 300 years old, so late seral or near climax conditions are not well understood. It is unlikely that a single species climax will ever be reached on these sites because of their variable microsites and stream dynamics. Pacific silver fir and western hemlock are present in all the plots. Engelmann spruce is absent in the data, which is surprising because of the cool, wet conditions. Western redcedar is abundant in some stands, though most sites appear too cool for it to thrive. Douglas-fir is found only on the driest microsites.

Many shrubs are commonly present. The shrub layer is characterized by a layer of devil's club, which gives it a singular appearance. Other common shrubs that are occasionally abundant include dwarf bramble, big huckleberry, Alaska huckleberry and rusty menziesia.

The herb layer is floristically rich and variable. Coolwort foamflower, oak fern and queencup beadlily are constant and may be abundant. Other common herbs include ladyfern, trillium, rosy twistedstalk, pioneer violet, sweetscented bedstraw, wild ginger, baneberry and starry solomonplume. Many other herbs may be present.

PRODUCTIVITY/MANAGEMENT: High water tables and near riparian conditions limit silvicultural options, although the tree growth rate is high (Appendix C). Rot is common in the trees. The site index value for Pacific silver fir is 114 (base 100), and basal areas average 316 sq. ft./ac. No successful method of reforesting such wet sites is known. Logs and root wads create favorable microsites for western hemlock and other plants. The availability of water for both plants and animals make these sites high in diversity. Stream dynamics appear to play an important role in stand dynamics and development.

Fires are rare in this swampy habitat. Wet conditions result in large accumulations of fuel, yet high fuel moisture makes ground fires unlikely. Any ground fires that do occur will typically creep through the litter from hummock to hummock and rarely cause significant overstory mortality. Stand-replacement fires are unusual and only occur if fire weather is severe.

ABAM/OPHO sites have high wildlife and watershed values, but have sensitive soils and are difficult to regenerate after harvest. Their valley bottom locations and the old growth character of many stands in the type make them appear appropriate for recreational development, but they are poorly suited to such use due to their swampy conditions. Trails require special design to be successful here and the shrubs and herbs are susceptible to trampling damage. Further, free standing water often makes these sites a nursery for abundant mosquitos.

The sites are valuable riparian habitat for a variety of wildlife, offering water, cover and forage. Elk relish the spiny leaves of devil's club, and succulent herbs provide green forage throughout the growing season. Average herbage production in the sample stands was 178 lbs./ac.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABAM/OPHO Association has been described for many areas in the Cascades (Hemstrom and others 1982; Brockway and others 1983; Hemstrom and others 1987; Franklin and others 1988). Henderson and others (1992) described an ABAM/OPHO/GYDR Association for the Mt. Baker-Snowqualmie NF which is similar.

# ABAM/RHAL-VAME *WEN* ASSOCIATION CFS556

*Abies amabilis/Rhododendron albiflorum/Vaccinium membranaceum*

Pacific silver fir/Cascade azalea/big huckleberry

## ENVIRONMENT

Elevation: 4160-5530 (4778) ft.

Aspect: mostly NE to NW

Slope: 1-70 (38) %

Slope position: U, M 1/3, benches

Special: cold, maritime

## VEGETATION SUMMARY:

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 83 | 26 |
| PSME | Douglas-fir | 67 | 8 |
| ABLA2 | subalpine fir | 50 | 23 |
| TSHE | western hemlock | 50 | 19 |
| PIMO | western white pine | 42 | 2 |
| CHNO | Alaska yellow cedar | 33 | 11 |
| PIEN | Engelmann spruce | 25 | 15 |
| PICO | lodgepole pine | 17 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 83 | 16 |
| TSHE | western hemlock | 50 | 4 |
| ABLA2 | subalpine fir | 42 | 6 |
| TSME | mountain hemlock | 25 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RHAL | Cascade azalea | 100 | 25 |
| PYSE | sidebells pyrola | 92 | 3 |
| VAME | big huckleberry | 75 | 14 |
| RULA | dwarf bramble | 75 | 10 |
| PAMY | pachistima | 58 | 3 |
| VAMY | low huckleberry | 50 | 3 |
| **HERBS** | | | |
| GOOB | w. rattlesnake plantain | 67 | 2 |
| VIOR | round-leaved violet | 58 | 3 |
| ARLA | broadleaf arnica | 50 | 4 |
| CLUN | queencup beadlily | 33 | 9 |
| ACTR | vanilla leaf | 33 | 11 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/RHAL-VAME type is most common on the Naches, Cle Elum and Lake Wenatchee Districts. The farther away from the Cascade Crest a stand is, the more likely it is to be on steep, northerly aspects.

Sites are characterized by fairly deep accumulations of snow that remain relatively late. Slopes are moderate to steep. Elevations are high for the Pacific Silver Fir Series. Sites are on upper and middle 1/3 slope positions, with northerly aspects. Slope configuration is usually flat or convex.

Soils are formed in many parent materials, but usually in material of volcanic deposition. Soil coarse fragments are usually gravel size and average over 20% by volume of the surface horizons.

Subalpine fir replaces Pacific silver fir on similar habitats with a less maritime climatic influence. Two of the plots that key to the ABAM/RHAL-VAME *WEN* Association are in the Entiat Mountains, nearly 30 map miles from the Cascade Crest and miles from the nearest extensive areas of silver fir. Successional dynamics are unclear in these two stands, but they may be transitional to the ABLA2/RHAL Association. More strongly maritime (and less severe) sites fit in ABAM/MEFE. Areas with higher snowpacks nearer the Crest will support TSME/RHAL, TSME/MEFE or TSME/MEFE-VAAL. Stands with marginal amounts of Cascade azalea and wet-site herbs may better fit the ABAM/TITRU type.

VEGETATION: Late seral or near climax stands are rare in the data and only two stands supplied tree growth and age information. The oldest stands are less than 300 years old. Pacific silver fir is the most consistent and dominant species in the tree regeneration layer in the sample stands. Other species may form part of the sere, depending on disturbance history, seed source and type of disturbance. Subalpine fir is more successful at higher elevations away from the Crest. It also seems favored by severe site disturbance. Early seral species include Douglas-fir, western larch, Engelmann spruce, western white pine, subalpine fir and Alaska yellow cedar. Sites at the upper elevation range of the type may support small amounts of mountain hemlock, but in general, this Association is too warm or continental, or both, for mountain hemlock to thrive. Alaska yellow cedar and Engelmann spruce are more common on wet sites.

Shrub cover is typically high and a variety of species may be abundant, but Cascade azalea is usually the most abundant species. Other common shrubs include big huckleberry, dwarf bramble, pachistima and sidebells pyrola. No other shrubs are present in over half the stands, and seldom have over 5% cover when present.

Herbs are usually inconspicuous beneath the dense shrub layer. Western rattlesnake plantain and broadleaf arnica are the most common herbs and the arnica may be well represented in some stands.

PRODUCTIVITY/MANAGEMENT: Data are limited so it is difficult to quantify tree productivity. The limited data and tree size and composition suggest that tree growth is low and management opportunities limited (Appendix C). Sites are moist and well-drained, cold, and have a very short growing season. Snowpack and short growing seasons limit the tree species suitable for timber management. If sites have not been degraded and the proper species are selected, regeneration should not be difficult, using either planted stock or natural regeneration. Cascade azalea is not normally a problem in reforestation, and it decreases after burning or scarification (Fielder 1982), but big huckleberry will likely increase in harvested stands.

Fire is infrequent in the ABAM/RHAL-VAME *WEN* type. The upslope position of many of the stands within this Association may experience frequent lightning strikes, but cold, moist and snowy northerly aspects limit the extent and frequency of fires. The limited tree age data and anecdotal information suggest that the stand-replacement fire interval exceeds 200 years.

Watershed values are high. This Association produces little or no forage for livestock (Appendix C), but the dense shrub layer and berry producing shrubs provide both forage and cover for wildlife. The cold, wet sites are not desirable for campgrounds and similar uses. Herbage production is low (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Variations of the ABAM/RHAL-VAME type are recognized by most workers in the Cascades (Hemstrom and others 1982; Brockway and others 1983; Hemstrom and others 1987; Franklin and others 1988; John and others 1988; Henderson and others 1992). Some classifications include mountain hemlock in this type, and some use other indicator species to split the type. Stands with Alaska huckleberry have not been separated into another type on the Wenatchee, but they do closely resemble the ABAM/RHAL-VAAL type described on the Mt. Baker-Snoqualmie NF. Most of the west-side classifications lack the relatively high constancy/cover of the more continental species such as Engelmann spruce and subalpine fir found on the Wenatchee NF.

# ABAM/RULA *WEN* COMMUNITY TYPE CFS413

*Abies amabilis/Rubus lasiococcus*

Pacific silver fir/dwarf bramble

*Dwarf bramble (RULA), an indicator of the ABAM/RULA type.*

## ENVIRONMENT

Elevation: 4950-5320 (5146) ft.

Aspect: mainly N to SE

Slope: 17-40 (26) %

Slope position: U 1/3

Special: cold, maritime influence

## SUMMARY TABLE

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 11 |
| ABAM | Pacific silver fir | 86 | 20 |
| PSME | Douglas-fir | 71 | 20 |
| PICO | lodgepole pine | 57 | 14 |
| PIEN | Engelmann spruce | 57 | 10 |
| PIMO | western white pine | 57 | 7 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 86 | 4 |
| ABLA2 | subalpine fir | 71 | 8 |
| PIEN | Engelmann spruce | 71 | 1 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RULA | dwarf bramble | 100 | 16 |
| VAME | big huckleberry | 100 | 14 |
| PAMY | pachistima | 71 | 4 |
| PYSE | sidebells pyrola | 71 | 3 |
| VASC | grouse huckleberry | 29 | 9 |
| VAMY | low huckleberry | 29 | 2 |
| **HERBS** | | | |
| ARLA | broadleaf arnica | 100 | 15 |
| VIOR2 | round-leaved violet | 100 | 4 |
| POPU | skunkleaf polemonium | 86 | 3 |
| HIAL | white hawkweed | 71 | 2 |
| VASI | Sitka valerian | 43 | 6 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/RULA Community Type is currently represented only on the Naches District and on Manastash Ridge on the Cle Elum District (just north of the district boundary with Naches).

Sites are on long ridges leading to subalpine and alpine meadows. The type occurs at high elevations and on upper 1/3 slopes. Most slopes are less than 25%. Aspects are mostly southerly. Snowpacks are high.

Soils are formed mainly in glacial outwash with some andesite. Surface soil horizons typically average about 10% gravels. Soil surface litter is usually about 50%.

The successional relationships of some of these stands were unclear. This type is closely associated to the TSME/RULA type, both geographically and compositionally. ABAM/RULA occurs on slightly drier sites, as indicated by the lack of mountain hemlock.

High elevations and dwarf bramble suggest that a number of plots originally in ABAM/VAME-PYSE or VAME/CLUN types fit better here. Additional data may better define this type. Some of the samples have traces of smooth woodrush, but are below the elevation of TSME/LUHI yet higher than TSME/VAME-PYSE. Slightly more maritime sites in similar areas will likely support mountain hemlock and key to the TSME/RULA type.

VEGETATION: Lodgepole pine and subalpine fir can dominate early seral stands that have been burned in the last 100 years. Douglas-fir is an important component of the youngest stands. Subalpine fir is a major stand component in both the overstory and understory and as such makes up an important part of the tree sere, entering the stands with or soon after lodgepole pine. Pacific silver fir becomes more common as the stands become older. Apparently the short-lived subalpine firs and lodgepole pines may go through more than one generation in the canopy, while the same longer-lived Pacific silver firs form the major canopy.

Dwarf bramble is the most consistent shrub or subshrub, although in all stands big huckleberry is abundant and forms a taller shrub layer. The only other shrubs found in half or more of the plots are sidebells pyrola and pachistima. Low or grouse huckleberry was found in some plots and can be well represented. Other shrubs are uncommon.

The herb layer is often rich, but few species occur in over half the plots. Broadleaf arnica and other Arnica species (*A. mollis*?), Sitka valerian and skunkleaf polemonium are the most common herbs. Broadleaf arnica and skunkleaf polemonium were the most abundant. Other herbs are sporadic in occurrence and usually low in cover.

PRODUCTIVITY/MANAGEMENT: These sites are harsh and difficult to reforest. Timber productivity is apparently very low, but no tree age or growth data are available. The data for the TSME/RULA type are presumed similar (Appendix C). To become established, Pacific silver fir may need shelter from lodgepole pine or subalpine fir. Snow packs are high and top damage is common in the trees, apparently from snow and ice. Additionally, the sites are exposed to wind and lightning because of their position on upper slopes and ridges. After deforestation, succession to trees is slow.

The type has a high incidence of lightning, providing the ignition source for fires, but environmental conditions result in few fires of any extent. The data indicate that some stands are dominated by lodgepole pine, which may result in these stands being more susceptible to fire.

The ridges were used as livestock driveways and the plant community may reflect past grazing use more than intrinsic environmental conditions. Most sites have a history of overgrazing, so it is difficult to know the potential composition and productivity of the shrub and herb layers. Herbage production in this type is unknown.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This type is similar to some phases of the ABAM/RULA described by Franklin and others (1988). Some high-elevation samples from the ABAM/VAME/XETE type described on the Willamette and Mt. Hood NFs are closely related. The TSME/VAME-RULA of Henderson and others (1992) is environmentally similar, although in another Series.

# ABAM/TITRU ASSOCIATION  CFF162

*Abies amabilis/Tiarella trifoliata* var. *unifoliata*

Pacific silver fir/coolwort foamflower

*Coolwort foamflower (TITRU), an indicator of the ABAM/TITRU Association.*

*PHOTO:*
S.Hahn & M.Reynolds

## ENVIRONMENT

Elevation:  3000-4850 (3741) ft.
Aspect: northerly or easterly
Slope:  3-67  (29) %
Slope position: M, L 1/3, bench, bottom
Special: cool , moist, maritime

## VEGETATION SUMMARY

(Sample size: 9)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 89 | 26 |
| TSHE | western hemlock | 78 | 29 |
| PSME | Douglas-fir | 56 | 18 |
| THPL | western redcedar | 56 | 6 |
| PIEN | Engelmann spruce | 44 | 18 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 9 |
| TSHE | western hemlock | 67 | 4 |
| THPL | western redcedar | 44 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAME | big huckleberry | 100 | 6 |
| PYSE | sidebells pyrola | 89 | 3 |
| RULA | dwarf bramble | 78 | 7 |
| PAMY | pachistima | 56 | 2 |
| COCA | bunchberry dogwood | 44 | 4 |
| BENE | Cascade Oregon grape | 44 | 4 |
| RILA | prickly currant | 50 | 2 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 89 | 5 |
| TITRU | coolwort foamflower | 89 | 4 |
| GOOB | w. rattlesnake plantain | 76 | 2 |
| SMST | starry solomonplume | 67 | 3 |
| TROV | trillium | 67 | 2 |
| TRCA3 | false bugbane | 56 | 10 |
| GYDR | oak fern | 44 | 3 |
| STRO | rosy twistedstalk | 33 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/TITRU Association was sampled from the Okanogan NF south to the Naches District.  It is likely that it occurs on the Chelan, Entiat and Leavenworth Districts.

The ABAM/TITRU Association is characterized by a relatively warm (for Pacific silver fir), sheltered, well-watered and poorly-drained sites on deep soils.  Elevations are moderate and those approaching 5000 ft. were from the Okanogan NF. Most slopes are gentle to moderate (<35%).  The type is best developed on middle and lower slope positions and in bottoms.  It occupies areas of moisture accumulation, with water very near the surface. It is common to find this type in swales with better-drained sites on the slopes above.

Soils are formed mainly in outwash or till. Some ash, tephra, fluvial deposits, basalt and colluvium were also noted.  Most stands had 30% gravels and cobbles in surface soil horizons.

The ABAM/OPHO Association occurs on wetter sites.  ABAM/VAME-PYSE, ABAM/VAME/CLUN *WEN*, ABAM/ACCI or ABAM/ACTR occur on better drained sites. Slightly warmer habitats support the TSHE/ASCA3 Association, and cooler environments support the ABAM/VAAL Association.

VEGETATION: Late seral and near climax stands are dominated by Pacific silver fir in the overstory and tree regeneration layers. However, stands over 200 years old may still be dominated by western hemlock or Engelmann spruce. Western hemlock and western redcedar are commonly associated with Pacific silver fir and are especially important on warmer sites transitional to the TSHE Series. Western hemlock, western redcedar, Engelmann spruce and Douglas-fir can all be important components in the overstory of many stands. Early seral stands may be occupied by a wide variety of trees, including Douglas-fir, Engelmann spruce, western larch, western white pine and subalpine fir. Grand fir and lodgepole pine are usually absent. Alaska yellow cedar may form part of late seral or near climax stands on some sites, particularly on the south end of the Forest.

Big huckleberry is the most common and abundant tall shrub, although mean cover is only 6%. Rusty menziesia and Alaska huckleberry are present as a taller shrub layer in less than half the stands. Devil's club is one of the indicators for the type, although if it is well represented the stand will better fit in the ABAM/OPHO Association. Other common shrubs are normally low in stature and include dwarf bramble, sidebells pyrola, pachistima and bunchberry dogwood.

Herbs are highly visible in the undergrowth. Queencup beadlily and coolwort foamflower are usually well represented, adding to the lush appearance of the type. Other less common herbs include oak fern, rosy twistedstalk and false bugbane.

PRODUCTIVITY/MANAGEMENT: These are highly productive timber sites, but the high water tables restrict timber management opportunities and harvest may create swampy conditions. The site index value for Pacific silver fir is 122 (base 100) and for Douglas-fir is 80 (base 50) (Appendix C). Mean tree basal area averages 279 sq. ft./acre. Soils are subject to compaction and displacement by heavy equipment. Frost is not a problem in natural stands, but careful attention should be paid to local topography and air drainage patterns to keep harvest from creating frost pockets.

Fires are infrequent in these sheltered, sub-irrigated sites. Moist conditions result in large accumulations of fuel, yet high fuel moisture makes ground fires unlikely. Any ground fires that do occur will typically creep through the litter and rarely cause significant overstory mortality.

Trees may be large, with heights over 150 feet and diameters over 4 feet. There may be several different tree canopies under the dominants and this diversity in arboreal habitat may be important to spotted owls and other wildlife that require large trees and numerous canopy layers. The presence of water is also an important attribute, leading to greater diversity of both plants and animals. With their variety of herbs and shrubs, these sites are important habitat for wildlife. The type is poorly suited to recreation developments and trails because of swampy conditions and the susceptibility of its shrubs and herbs to trampling damage.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This type is very similar to the ABAM/TIUN-STRO Association described for the Mt. Baker-Snoqualmie NF (Henderson and others 1992). Some sample stands of other workers do support oak fern (or other type indicators) and could be similar. In particular, the ABAM/TIUN type from the Gifford Pinchot NF (Brockway and others 1983) and Mt. Hood NF have a high percentage of plots that support coolwort foamflower or other indicators for this type, although their types may be somewhat more productive.

# ABAM/VAAL *WEN* ASSOCIATION CFS232

*Abies amabilis/Vaccinium alaskaense*

Pacific silver fir/Alaska huckleberry

## ENVIRONMENT

Elevation: 2740-4560 (3365) ft.

Aspect: variable

Slope: 2-72 (38) %

Slope position: U, M, L 1/3, toe, bottom

Special: cool, maritime

## VEGETATION SUMMARY

(Sample size: 22)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSHE | western hemlock | 100 | 32 |
| ABAM | Pacific silver fir | 91 | 24 |
| PSME | Douglas-fir | 59 | 15 |
| THPL | western redcedar | 36 | 10 |
| PIEN | Engelmann spruce | 14 | 13 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 20 |
| TSHE | western hemlock | 73 | 4 |
| THPL | western redcedar | 36 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAAL | Alaska huckleberry | 100 | 11 |
| VAME | big huckleberry | 100 | 9 |
| PYSE | sidebells pyrola | 95 | 3 |
| RULA | dwarf bramble | 82 | 2 |
| MEFE | rusty menziesia | 59 | 3 |
| LIBOL | twinflower | 55 | 2 |
| VAPA | red huckleberry | 50 | 3 |
| XETE | beargrass | 23 | 10 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 86 | 4 |
| MOSS | mosses | 59 | 36 |
| GOOB | w. rattlesnake plantain | 41 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/VAAL Association is found on the Naches, Cle Elum and Lake Wenatchee Districts. It may also be found along the Cascade Crest on the Entiat and Chelan Districts. It is normally found within 5 miles of the Crest.

The ABAM/VAAL Association appears to represent sites with ample moisture and cloudy conditions, but on warm slopes with good soil drainage. Elevations are relatively low for the Series, with most sites well under 4000 feet. Slopes are often steep (>40%) and aspects are variable. Only two of the sample stands occurred on other than middle or lower 1/3 slopes.

Soils are formed in extrusive volcanic materials, mainly tephra and ash, and often mixed with pumice. Gravel-size rocks are usually present in soil surface horizons.

Colder sites with more snowpack support the ABAM/RHAL-VAME *WEN* type. Wetter sites may support the ABAM/TITRU Association. Stands with marginal amounts of Alaska huckleberry and with wet-site herbs may better fit the ABAM/TITRU type.

VEGETATION: Pacific silver fir dominates the overstory and tree regeneration layers in late seral and climax stands. Western hemlock may be co-dominant with Pacific silver fir, but appears less able to reproduce itself. Mature stands typically have 65% or greater canopy cover. Pacific silver fir regeneration may be so dense as to make travel through the stands difficult. Douglas-fir, western hemlock, western redcedar, Engelmann spruce and noble fir may form part of the tree sere and may remain in the overstory for hundreds of years, but Douglas-fir and western hemlock are the most common and abundant seral trees in this Association. The lack of grand fir is notable.

A rich and varied shrub layer dominates the undergrowth. Alaska huckleberry is the most characteristic species, but big huckleberry is also well represented and dominance between these two species varies from stand to stand. Red huckleberry is also present and has higher constancy than in any other Association of the Pacific Silver Fir Series. Other shrubs are less conspicuous and include dwarf bramble, rusty menziesia, sidebells pyrola and twinflower. Beargrass is well represented in less than half the plots. It appears to indicate the dry end of the type.

Herbs are inconspicuous under the dense tree regeneration and shrub layers. Queencup beadlily is the only herb in more than half of our plots and varies greatly in the amount of cover from plot to plot.

PRODUCTIVITY/MANAGEMENT: Sites are moist, relatively warm, productive and sheltered. Both stocking levels and individual tree growth are high (Appendix C), although the sample size is limited. The total basal area averages nearly 350 sq. ft./acre and the site index value is 93 (base 100) for Pacific silver fir. The abundant Pacific silver fir regeneration suggests that moisture is not limiting to reforestation, even in dense shrub stands. Light may limit Douglas-fir regeneration more than moisture. Advanced Pacific silver fir regeneration will not respond to overstory removal until approximately five years after harvest because the trees need to replace their shade needles with needles suited to open conditions. However, this regeneration will release if the trees are healthy, even after decades of suppression. Some Pacific silver fir in the regeneration layers may approach 100 years in age. Soils are subject to erosion and soil compaction because of the amount of angular, fine-textured material in the profile. Most shrubs resprout after burning but are greatly reduced by mechanical scarification.

The limited tree age data indicate that some of the stands sampled were over 200 years old. Age data and stand structure and composition suggest that like other Pacific Silver Fir Series sites, this type probably burns infrequently, but burns hot when conditions allow the fire to get into the tree crowns. Most fires started by lightning strikes never grow large nor into the crowns. Both big and Alaska huckleberry resprout after fires if the fire does not destroy the duff layer. Their brittle stems and shallow rhizomes are easily damaged by heavy equipment or trampling. Beargrass is especially favored by broadcast burning, and it may increase markedly afterwards.

High shrub and tree regeneration cover, with abundant berry producing shrubs, makes these sites valuable for a wide variety of wildlife. The two or more tree and shrub layers, characteristic of mature stands provide a variety of habitat niches for wildlife, including arboreal mammals and birds. Recreational huckleberry picking may be an important use of these sites because of the amount of huckleberries produced.

These sites produce very little herbage for livestock grazing (Appendix C).

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This ubiquitous type is recognized by most workers in the Cascades (Hemstrom and others 1982; Brockway and others 1983; Hemstrom and others 1987; Franklin and others 1988; Henderson and others 1992). Some classifications include mountain hemlock in this type, and some use other indicator species to subdivide the type.

# ABAM/VAME/CLUN *WEN* ASSOCIATION CFS233

*Abies amabilis/Vaccinium membranaceum/Clintonia uniflora*

Pacific silver fir/big huckleberry/queencup beadlily

*Big huckleberry (VAME), an indicator of the ABAM/VAME/CLUN Association.*

## ENVIRONMENT

Elevation: 2330-4630 (3492) ft.

Aspect: variable

Slope: 2-62 (29) %

Slope position: M, L 1/3, toe, benches

Special: cool, dry, maritime

## VEGETATION SUMMARY

(Sample size: 30)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 77 | 19 |
| ABAM | Pacific silver fir | 70 | 15 |
| TSHE | western hemlock | 63 | 36 |
| THPL | western redcedar | 50 | 6 |
| PIMO | western white pine | 47 | 4 |
| ABLA2 | subalpine fir | 30 | 16 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 97 | 9 |
| TSHE | western hemlock | 60 | 5 |
| ABLA2 | subalpine fir | 43 | 6 |
| THPL | western redcedar | 37 | 4 |
| PIMO | western white pine | 30 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAME | big huckleberry | 97 | 15 |
| PYSE | sidebells pyrola | 83 | 3 |
| PAMY | pachistima | 77 | 5 |
| LIBOL | twinflower | 63 | 6 |
| CHUMO | western prince's pine | 63 | 3 |
| RULA | dwarf bramble | 60 | 7 |
| BENE | Cascade Oregon grape | 57 | 6 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 100 | 5 |
| GOOB | w. rattlesnake plantain | 53 | 2 |
| TITRU | coolwort foamflower | 37 | 2 |
| MOSS | mosses | 40 | 13 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/VAME/CLUN *WEN* Association is widespread. It extends at least from the Naches District north to the Canadian border. Most stands are within a few miles of the Cascade Crest, but the type is occasionally found over ten map miles from the Crest. Some plots that key to the ABAM/VAME/CLUN *WEN* type may actually be seral stages within ABAM/ACTR and ABAM/MEFE Associations. Many stands that may key to the type lack or have low cover of indicator species such as vanilla leaf and rusty menziesia.

These relatively dry, well-drained sites lie on the continental end of Pacific silver fir distribution. Elevations are fairly low for Pacific silver fir and vary with slope and aspect. Slope positions are variable also, and a few stands are on ridgetops or in canyon bottoms.

Most soils are formed in a variety of extrusive volcanic materials (ash, basalt, andesite) or in glacial drift (outwash/till). Coarse fragments average about 30% and are usually gravels.

This type is a bit more moist and sheltered than the closely associated ABAM/VAME-PYSE Association. More moist and cooler sites will fall in the ABAM/ACTR, ABAM/MEFE, or ABAM/TITRU types. The ABAM/VAAL type in particular indicates stronger maritime influences.

VEGETATION: Western hemlock, Douglas-fir or Pacific silver fir variously dominate the overstory of the sample stands. When western hemlock is present, it typically has higher cover than any other tree. The few sample stands approaching 250 years old were still dominated by western hemlock, although Pacific silver fir was the most abundant regenerating tree. Younger stands were always dominated by seral tree species. Early seral trees include Douglas-fir, western white pine, western larch, subalpine fir, Engelmann spruce, lodgepole pine and noble fir. Douglas-fir is the most common seral dominant after western hemlock. Alaska yellow cedar and noble fir are uncommon in the data. Western hemlock tends to increase in stands over 100 years in age. Pacific silver fir and western hemlock may be common in stands less than 100 years old, depending on seed sources and disturbance history. Often, the Pacific silver fir may be as much as 100 years younger than associated western hemlock. Lodgepole pine dominated the overstory of two stands, which averaged 85 and 115 years old.

The shrub layer supports a wide variety. Big huckleberry is the most constant and averages 15% cover. Its cover tends to be much less in dense stands. Other common shrubs and subshrubs include pachistima, dwarf bramble, twinflower, Cascade Oregon grape, western prince's pine and sidebells pyrola.

Queencup beadlily is the only constant herb and usually the most abundant. Other herbs are typically low in cover and none were found in more than half of the sample stands. Although mosses occur in less than half the plots, their coverage is high. Other herbs may occasionally be well represented but are low in constancy.

PRODUCTIVITY/MANAGEMENT: This is probably one of the least productive sites in the Pacific Silver Fir Series, but the data on stand ages and tree growth are limited and few older stands are recorded. This type appears to be slightly more moist and productive than the closely related ABAM/VAME-PYSE type. Site index values for western hemlock and Douglas-fir average 62 and 72 (base 50) , respectively, and 69 (base 100) for Pacific silver fir (Appendix C). Lack of moisture during the growing season is probably the most limiting factor. Frost and high water tables are normally of little concern in the type. Steep southerly slopes will be slow to reforest after clearcutting because of high insolation rates and potential for shrub and herb competition if the sites are not promptly reforested. To protect tree seedlings, harvest techniques that leave a light to medium overstory are suggested. Light to moderate burning will probably increase the potential for shrub competition with tree seedlings. Light and moderate burns favor big huckleberry, as long as its shallow rhizomes are not damaged. A wide range of conifers are suitable for the sites.

Many ABAM/VAME/CLUN *WEN* stands are less than 100 years old and occur on relatively warm and dry upslope positions. These drier conditions and young ages suggest that fire could be more frequent than in many other types in the Pacific Silver Fir Series.

Warm slopes and abundant big huckleberry and other shrubs make these sites important for wildlife. Southerly slopes become snow-free sooner than most other types in the Pacific Silver Fir Series. Most natural stands provide little suitable forage for domestic livestock (Appendix C). These sites can be important areas for recreational berrying.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Types of the same name have been described for the Yakima Indian Reservation, the Gifford Pinchot NF, and the classification for the Willamette and Mt. Hood NFs (John and others 1988; Brockway and others 1983; Hemstrom and others 1982) and they appear to be very similar. The Mt. Baker-Snoqualmie NF (Henderson and others 1992) has a variety of ABAM Associations where VAME is part of the name and an important indicator, but none compare to the Wenatchee's ABAM/VAME/CLUN *WEN*. Most of the west-side classifications appear to be somewhat more productive. The Yakima Reservation classification includes a number of stands with mountain hemlock which would key to the Mountain Hemlock Series in the Wenatchee classification.

# ABAM/VAME-PYSE ASSOCIATION CFS234

*Abies amabilis/Vaccinium membranaceum-Pyrola secunda*

Pacific silver fir/big huckleberry-sidebells pyrola

*Sidebells pyrola (PYSE), an indicator of the ABAM/VAME/PYSE Association.*

## ENVIRONMENT

Elevation: 2140-4720 (3453) ft.
Aspect: variable
Slope: 1-74 (23) %
Slope position: ridge, U, M, L 1/3, bench, bottom
Special: cool, dry, maritime

## VEGETATION SUMMARY

(Sample size: 40)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSHE | western hemlock | 95 | 38 |
| ABAM | Pacific silver fir | 83 | 16 |
| PSME | Douglas-fir | 75 | 14 |
| PIMO | western white pine | 38 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 95 | 9 |
| TSHE | western hemlock | 78 | 5 |
| THPL | western redcedar | 53 | 4 |
| PIMO | western white pine | 25 | 2 |
| TSME | mountain hemlock | 23 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAME | big huckleberry | 98 | 9 |
| CHUMO | w. prince's pine | 80 | 3 |
| LIBOL | twinflower | 78 | 5 |
| PYSE | sidebells pyrola | 73 | 2 |
| BENE | Cascade Oregon grape | 70 | 4 |
| GAOV | slender wintergreen | 65 | 4 |
| PAMY | pachistima | 60 | 3 |
| XETE | beargrass | 28 | 6 |
| **HERBS** | | | |
| MOSS | mosses | 53 | 20 |
| GOOB | w. rattlesnake plantain | 53 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The ABAM/VAME-PYSE Association is widespread. It extends at least from the Naches District north to the Canadian border. Most stands are within a few miles of the Cascade Crest, but the type is occasionally found over ten map miles from the it. Some plots that key to the ABAM/VAME-PYSE type may actually be seral stages of ABAM/ ACTR and ABAM/MEFE Associations.

These are relatively dry, well-drained sites on the dry and continental end of Pacific silver fir distribution. Elevations are fairly low for Pacific silver fir and vary with slope and aspect. Slope positions are variable also but there is a tendency toward drier, southerly or westerly aspects. A few stands are on ridgetops, upper 1/3 slopes, and in canyon bottoms, but the majority are on middle and lower 1/3 slopes and benches.

Most soils are formed in a variety of extrusive volcanic materials. Some stands have soils developed in glacial tills and outwash. In nineteen of the sample stands a shallow soil pit yielded an average of 35% by volume of either gravels or cobbles in the soil surface horizons.

Slightly more moist stands will likely fall in the ABAM/VAME/CLUN Association, while drier sites will likely be in the Hemlock or Grand Fir Series. More moist and cooler sites will fall in the ABAM/ACTR, ABAM/ MEFE, or ABAM/TITRU types. The ABAM/VAAL type in particular indicates stronger maritime influences.

VEGETATION: Western hemlock was often the overstory dominant in the sample stands. Strangely, late seral and near climax stands (>300 years old) often have less Pacific silver fir in the overstory than stands between 100 and 300 years of age. However, Pacific silver fir normally dominates the regeneration layers of stands from 100 to 300+ years of age and its decrease in the overstory composition between 200 and 300 hundred years may reflect the shorter average life span of individual Pacific silver firs compared to western hemlocks. Early seral stands may support a variety of conifers, including Douglas-fir, western white pine, western larch, subalpine fir, Engelmann spruce, lodgepole pine and noble fir. Douglas-fir is the most common seral dominant after western hemlock. Alaska yellow cedar is found on a few sites transitional to the ABAM/MEFE Association. Western hemlock tends to increase in stands over 100 years in age. Pacific silver fir and western hemlock may be common in stands less than 100 years old, depending on seed sources and disturbance history. Often the silver fir may be as much as 100 years younger than associated western hemlock.

The shrub layer supports a wide variety of shrubs, but only big huckleberry is constant, and it averages nearly 10% cover. Other common shrubs and subshrubs include twinflower, Cascade Oregon grape, slender wintergreen, western prince's pine, sidebells pyrola and pachistima.

Herbs are typically low in cover and no one herb was in more than half of the sample stands. Mosses occur in half the stands with high cover. Other herbs may occasionally be well represented, but all are low in constancy.

PRODUCTIVITY/MANAGEMENT: This is the least productive type in the Pacific Silver Fir Series (Appendix C). Site index values for Pacific silver fir, western hemlock and Douglas-fir average 58 (base 100) , and 53 and 58 (base 50), respectively. Mean basal area was relatively low at 290 sq. ft./ac. Frost and high water tables are normally of little concern in the type. These steep southerly slopes will be slow to reforest after clearcutting because of high insolation rates and high potential for shrub and herb competition. To protect tree seedlings, harvest techniques that leave a light to medium overstory are suggested. Burning will probably increase the potential for shrub competition with tree seedlings. Light and moderate burns favor big huckleberry, as long as its shallow rhizomes are not damaged. A wide range of conifers are suitable for the sites.

Tree ages indicate that stand-replacement fire is relatively infrequent. However, the relatively dry conditions suggest that fire is still more likely than in most other types within the Series. There were a few stands around 100 years old, but most were well over 200, and some over 300. The oldest stands are all in sheltered lower slopes and bottoms.

Warm slopes and abundant big huckleberry and other shrubs make these sites important for wildlife. Southerly slopes become snow-free sooner than most other types in the Pacific Silver Fir Series. Most natural stands provide little suitable forage for domestic livestock (Appendix C). These sites can be important areas for recreational berrying.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABAM/VAME-PYSE Association has not been described by most workers in the Cascades (Hemstrom and others 1982; Brockway and others 1983; Hemstrom and others 1987;Franklin and others 1988). On the Mt. Baker Snoqualmie NF, this type is depauperate (Henderson and others 1992).

# MOUNTAIN HEMLOCK SERIES

# MOUNTAIN HEMLOCK SERIES

DISTRIBUTION AND ENVIRONMENT: Mountain hemlock is widely distributed in the Pacific Northwest in cold, maritime climates. It is the major upper timberline tree species along the Cascade Crest. Its presence indicates cold, snowy habitats where snow accumulations of several feet or more during winter are normal. These snowpacks, seldom occurring more than 15 miles from the divide, persist well into June, resulting in a relatively short growing season. Mountain hemlock appears to be the tree species most resistant to physical snow damage. In eastern Washington contiguous stands of mountain hemlock are restricted to areas near the Cascade Crest and are absent from other more continental sites. Although mountain hemlock has been found in northeastern Washington, it is very rare ( Jay Berube, personal communication). A few outlying stands also occur in eastern Oregon away from the Cascades. In the Rocky Mountains of northern Idaho and Montana, mountain hemlock stands can be quite extensive but are also limited to very snowy areas with a maritime climate.

Mountain hemlock is considered the climax species when canopy cover is predicted to be 10% or more in stable stands (300+ years). The Draft Guide used a much more restrictive definition of the Mountain Hemlock Series in that mountain hemlock was restricted to the upper fringe of closed forest and extended into the subalpine parkland only as tree islands. Consequently, in this version, many more stands have been placed in the Series. Mountain hemlock and Pacific silver fir broadly overlap in their ecological distribution in the Washington Cascades so that distinguishing between the two Series can be difficult. In many stands within the Mountain Hemlock Series, when Pacific silver fir is present, it will likely never be excluded, and is essentially a co-dominant even in climax and near-climax stands. Only on the harshest mountain hemlock sites is Pacific silver fir absent or nearly so. As noted above, predicted or actual canopy cover that exceeds 10% in older stands is the convention in this guide for placing stands within this Series.

At the highest elevations, the Mountain Hemlock Series usually grades quickly into subalpine parkland. However, subalpine larch, subalpine fir or whitebark pine Associations can be found at the upper fringe of the Series on some sites. The controlling mechanisms of the ecotone between forest (tree island) and non-forest are complex and still only poorly understood. Snowpack depth and duration, and excess or insufficient soil moisture during the growing season are some of the operating factors. Special communities often develop at the transition between forest and non-forest and may appear as “skirts” around the base of the tree island or along the forest border. At lower elevations, the Mountain Hemlock Series grades into the Pacific Silver Fir Series in a complex fashion, as noted above. At its driest fringe, the Mountain Hemlock Series grades into the Subalpine Fir or Whitebark Pine Series. Similar sites in more continental areas usually support either the Subalpine Larch or Subalpine Fir Series.

Though they may be intense, wildfires are infrequent in these snowy habitats. Fires may start frequently, but conditions seldom favor extensive fires. Generally there will be many small fires and few large ones (Agee 1994). Consequently, some of the oldest stands on the Forest are mountain hemlock stands.

Plant Associations are listed in the tables following this Series introduction. There is one miscellaneous Association with fewer than five sample plots. The highest elevation types within the Series sometimes used more recent plots to augment the earlier ecology plot data. These data sets included Potential Natural Vegetation (PNV) mapping samples and non-forest samples.

VEGETATION: Mountain hemlock is present in the overstory of most stands and averages over 20% cover. Pacific silver fir is shade tolerant, present in more than 65% of the canopies, and is usually dominant where present. Subalpine fir, whitebark pine, subalpine larch and (rarely) lodgepole pine are the only seral species within the higher elevation (often parkland) areas of the Series. The more moderate, closed areas within the Series support a plethora of other seral trees, including western hemlock, western redcedar, subalpine fir, Douglas-fir, western larch and western white pine. Grand fir is notably absent in this zone and Douglas-fir is present in only about 25% of the stands. Subalpine larch occurs only very occasionally in isolated geographic areas. Only stands at the extreme elevational limits of the Series consist of nearly pure canopies of mountain hemlock, with crowns heavily festooned by lichens. These stands often have a uniform size-class structure, giving the false impression of an even-aged stand. Reproduction can be sparse.

Undergrowth varies from dense herbaceous or shrub layers to depauparate conditions characterized by a few scattered plants and deep litter. Dense shrub layers, including such species as Cascade azalea, are characteristic of more mesic habitats within the Series, while beargrass, smooth woodrush or big huckleberry are found in the drier areas.

PRODUCTIVITY/MANAGEMENT: Many sites in the Series are poorly suited for intensive timber management. Short growing seasons and heavy snowpacks are the major limitations. Productivity estimates for mountain hemlock are difficult to obtain. Site trees that meet the exacting requirements of the forest biometrician are difficult to find. Most trees show extended periods of suppressed growth when younger, or have some form of top damage. Site index values (base 100) for Pacific silver fir and mountain hemlock ranged from 56-87 and from 41-67, respectively. TSME/MEFE-VAME and TSME/MEFE-VAAL appear to be the most productive sites and TSME/PHEM-VADE and TSME/LUHI the least. Pacific silver fir becomes more successful on lower elevation sites and indicates that timber productivity is increasing for all tree species.

The Mountain Hemlock Series is cold and wet with lingering snow. Tree ages are generally old, suggesting that fire frequency is generally low. Ridgetop and upper slope locations favor lightning strikes, but conditions seldom favor extensive fires. Usually fires started by lightning will burn briefly and extinguish. Sometimes fires can get established in the duff and burn small areas over extended periods. Typically, catastrophic fires occur only every 300-500+ years, when regional weather conditions are exceptionally favorable for fire.

Primary root diseases include *Annosum* root disease and laminated root rot. *Annosum* root disease attacks subalpine fire, grand fir, Engelmann spruce, Pacific silver fir, western hemlock and mountain hemlock, typically causing root and butt rot at maturity. Laminated root rot can be especially prevalent where mountain hemlock is abundant. *Tomentosus* root disease can be present in lodgepole pine stands. Indian paint fungus is also an agent for heart rot of true firs, western hemlock and mountain hemlock. Western white pine has been drastically affected by white pine blister rust, and there have been dramatic increases in mountain pine beetle attacks on this tree (Hessburg and others 1994). Dwarf mistletoe infections are a major cause of mortality in western larch (Jim Hadfield, personal communication).

Insect pests of note include mountain pine beetle, spruce beetle, western spruce budworm and fir engraver. Of these, only mountain pine beetle has the potential for severe outbreaks in this Series, mainly in the limited areas dominated by lodgepole pine. Douglas-fir tussock moth and western spruce budworm can occur and mainly attack Douglas-fir and grand fir. Grand fir is seldom present in sufficient quantities for extensive budworm mortality.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Mountain Hemlock Series has been described by numerous authors up and down the Cascades, in northern Idaho and Montana, and in northeastern Oregon, either as a unique type or included sometimes in the Pacific Silver Fir Series. Some of these authors include: Daubenmire and Daubenmire 1968; Pfister and others 1977; Hemstrom and others 1982; Brockway and others 1983; Williams and Lillybridge 1983; Hemstrom and others 1987; Johnson and Simon 1987; Franklin and others 1988; John and others 1988; Henderson and others 1992; Cooper and others 1991. A variety of plant Associations have been described, with perhaps the common link being that the Mountain Hemlock Series requires maritime climatic regimes.

## Keys to Plant Associations of the Mountain Hemlock Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

Moss-heather, mountain heath, or Cascade huckleberry ≥ 5% ........ TSME/PHEM-VADE p. 190
(Usually timberline parkland environments)

Rusty menziesia ≥ 5%
- Cascade azalea more abundant than rusty menziesia
  - Alaska or oval-leaf huckleberry ≥ 5% ........ TSME/RHAL-VAAL (M) p. 204
  - Otherwise ........ TSME/RHAL-VAME p. 192
- Alaska or oval-leaf huckleberry ≥ 5% ........ TSME/MEFE-VAAL p. 186
- Otherwise ........ TSME/MEFE-VAME p. 188

Cascade azalea ≥ 5%
- Alaska or oval-leaf huckleberry ≥ 5% ........ TSME/RHAL-VAAL (M) p. 204
- Otherwise ........ TSME/RHAL-VAME p. 192

Smooth woodrush ≥ 1%
- Grouse or low huckleberry ≥ 5% ........ TSME/VASC/LUHI p. 200
- Otherwise ........ TSME/LUHI p. 184

Beargrass ≥ 5% ........ TSME/XETE-VAMY p. 202

Alaska huckleberry and/or five-leaved bramble ≥ 5% ........ TSME/VAAL p. 196

Dwarf bramble ≥ 1% and elevations > 5000' ........ TSME/RULA CT p. 194
(broadleaf arnica usually present)

Big huckleberry ≥ 1% ........ TSME/VAME p. 198

## Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| TSME/LUHI | 2 | 388 | 216 | 11 | 389 | 27 |
| TSME/MEFE-VAAL | 4 | 346 | 272 | 17 | 431 | 13 |
| TSME/MEFE-VAME | 2 | 173 | 304 | 19 | 436 | 18 |
| TSME/PHEM-VADE | 3 | 255 | 205 | 12 | 344 | 126 |
| TSME/RHAL-VAAL (M) | 4 | 150 | 230 | 17 | 342 | 22 |
| TSME/RHAL-VAME | 16 | 336 | 299 | 13 | 491 | 22 |
| TSME/RULA | 3 | 265 | 275 | 15 | 434 | 39 |
| TSME/VAAL | 3 | 567 | 395 | 12 | 684 | 24 |
| TSME/VAME | 5 | 278 | 290 | 14 | 464 | 11 |
| TSME/VASC/LUHI | 7 | 648 | 268 | 10 | 504 | 64 |
| TSME/XETE-VAMY | 5 | 546 | 253 | 10 | 463 | 63 |

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| TSME/LUHI | ABLA2 | 8 | 37 | 8 | 171 | 45 | 153 |
| | TSME | 3 | 50 | 3 | 197 | 43 | 143 |
| TSME/MEFE-VAAL | ABAM | 10 | 81 | 20 | 269 | 95 | 226 |
| | TSME | 1 | 67 | 5 | 280 | 82 | 381 |
| TSME/MEFE-VAME | ABAM | 8 | 87 | 10 | 302 | 116 | 223 |
| TSME/PHEM-VADE | ABLA2 | 8 | 32 | 8 | 161 | 32 | 106 |
| | TSME | 1 | 45 | 3 | 230 | 46 | 281 |
| TSME/RHAL-VAAL | ABAM | 9 | 65 | 14 | 201 | 56 | 245 |
| | TSME | 6 | 52 | 11 | 196 | 46 | 259 |
| TSME/RHAL-VAME | ABAM | 30 | 72 | 32 | 284 | 92 | 170 |
| | ABLA2 | 3 | 56 | 3 | 212 | 83 | 58 |
| | CHNO | 3 | 46 | 4 | 205 | 66 | 224 |
| | LAOC | 4 | 50 | 9 | 373 | 55 | 188 |
| | PICO | 4 | 51 | 4 | 141 | 50 | 75 |
| | PIEN | 11 | 63 | 12 | 263 | 115 | 181 |
| | PIMO | 3 | 46 | 6 | 206 | 68 | 123 |
| | PSME | 16 | 59 | 22 | 272 | 123 | 150 |
| | TSME | 14 | 41 | 32 | 242 | 42 | 295 |
| TSME/RULA | ABAM | 7 | 69 | 10 | 257 | 79 | 240 |
| | PICO | 5 | 46 | 5 | 128 | 41 | 80 |
| TSME/VAAL | ABAM | 13 | 84 | 15 | 444 | 175 | 180 |
| | TSME | 3 | 59 | 3 | 410 | 106 | 144 |
| TSME/VAME | ABAM | 6 | 56 | 13 | 267 | 66 | 251 |
| | TSME | 2 | 43 | 10 | 226 | 38 | 337 |
| TSME/VASC/LUHI | ABLA2 | 15 | 38 | 15 | 210 | 61 | 103 |
| | PICO | 14 | 54 | 14 | 357 | 143 | 70 |
| | TSME | 6 | 48 | 7 | 530 | 112 | 204 |
| TSME/XETE-VAMY | ABAM | 4 | 67 | 4 | 347 | 101 | 152 |
| | LAOC | 4 | 52 | 5 | 142 | 52 | 129 |
| | PICO | 14 | 56 | 15 | 134 | 53 | 108 |
| | PSME | 1 | 51 | 3 | 289 | 103 | 189 |
| | TSME | 5 | 48 | 5 | 245 | 52 | 208 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

## MOUNTAIN HEMLOCK PLANT ASSOCIATION GROUPS

1. Cool Mesic Shrub/Herb PAG
   - TSME/VAME *WEN*
   - TSME/XETE-VAMY
2. Cool Moist Shrub/Herb PAG
   - TSME/MEFE-VAAL
   - TSME/MEFE-VAME
   - TSME/RHAL-VAAL
   - TSME/VAAL *WEN*
3. Cold Mesic Shrub/Herb PAG
   - TSME/PHEM-VADE
   - TSME/RHAL-VAME
   - TSME/RULA
   - TSME/VASC/LUHI
4. Cold Moist Shrub/Herb PAG
   - TSME/LUHI

## MOUNTAIN HEMLOCK PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| TSME/LUHI | CMG221 |
| TSME/MEFE-VAAL | CMS256 |
| TSME/MEFE-VAME | CMS257 |
| TSME/PHEM-VADE | CMS354 |
| TSME/RHAL-VAAL (M) | CMS355 |
| TSME/RHAL-VAME | CMS356 |
| TSME/RULA | CMS122 |
| TSME/VAAL *WEN* | CMS258 |
| TSME/VAME *WEN* | CMS259 |
| TSME/VASC/LUHI | CMS121 |
| TSME/XETE-VAMY | CMF131 |

# TSME/LUHI ASSOCIATION CMG221

*Tsuga mertensiana/Luzula hitchcockii*

mountain hemlock/smooth woodrush

## ENVIRONMENT

Elevation: 5340-6210 (5640) ft.

Aspect: northwest-southeast (easterly)

Slope: 17-59 (39) %

Slope position: ridgetop, U, M 1/3

Special: cold, lingering snow pack

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 100 | 16 |
| ABLA2 | subalpine fir | 83 | 29 |
| ABAM | Pacific silver fir | 33 | 12 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 83 | 6 |
| TSME | mountain hemlock | 67 | 5 |
| ABLA2 | subalpine fir | 50 | 1 |
| CHNO | Alaska yellow cedar | 33 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RULA | dwarf bramble | 67 | 14 |
| VAME | big huckleberry | 60 | 7 |
| VASC | grouse huckleberry | 50 | 2 |
| RHAL | Cascade azalea | 33 | 1 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 100 | 25 |
| ARLA | broadleaf arnica | 100 | 5 |
| VASI | Sitka valerian | 67 | 6 |
| PERA | sickletop pedicularis | 67 | 1 |
| VIGL | pioneer violet | 50 | 1 |
| VIOR2 | round-leaved violet | 33 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

The sample data are very limited for this type. The TSME/LUHI Association occurs at high elevations along the Cascades Crest and on spur ridges to the east. All the sample data are from the Naches District, but field observations suggest that the type also occurs to the north, at least to the Okanogan NF boundary.

Sites lie at high elevations and are cold with lingering snowpacks. Slopes are moderate to steep and aspects are such that snow does not melt off quickly. Microreliefs are flat to concave. The type is often in areas where wind deposits snow from more exposed sites nearby.

Soils are formed from a wide variety of parent materials that include andesite, granite, other igneous extrusive material, and colluvium. Limited data suggest that surface horizons will contain 10-40% gravels and cobbles.

The TSME/LUHI Association grades into the TSME/PHEM-VADE type on more moist sites. The TSME/VASC/LUHI Association occurs on somewhat drier and more exposed sites. TSME/VASC/LUHI, TSME/LUHI, TSME/PHEM-VADE, and alpine meadow/shrublands form a mosaic in much of the near timberline landscape.

VEGETATION: Few sample stands were over 150 years old, so late successional or climax conditions must be inferred from species composition and successional dynamics. Mid seral stands (150+ years) are dominated by mountain hemlock in the overstory, with either mountain hemlock or Pacific silver fir as the major dominant in the regeneration layers. Subalpine fir appears to be a primary seral dominant. Other seral trees are less common in these harsh, deep-snowpack sites. However, some lodgepole pine-dominated stands near Cash Prairie on the Naches District key to the type. Subalpine larch and whitebark pine may occur as seral trees at higher elevations. Alaska yellow cedar may also occur.

Shrubs and subshrubs are variable in constancy and cover. Species that may be important in some stands are dwarf bramble and big huckleberry, and they are especially abundant on the plots with granitic substrates.

The herb layer is characterized by smooth woodrush. Shrubs and other herbs, such as broadleaf arnica, sickletop pedicularis and partridgefoot, may be present but are generally not as abundant. Partridgefoot is more common on disturbed sites with soils formed in tephra or extrusive volcanic flows.

PRODUCTIVITY/MANAGEMENT: Data are limited, but timber productivity is assumed to be low (Appendix C). Some stands may, however, contain considerable basal area of mountain hemlock or subalpine fir. Reforestation is impossible to assure by any known techniques and sites are very slow to reforest. Snow damage to trees is common, and the loss of a single large individual may greatly affect the rest of the stand by modifying snow melt and deposition patterns. Wind damage to tree tops is common. These sites are important for scenic and watershed values.

Fires are infrequent in these cold, moist sites. Snowbanks linger into late summer or, some years, into early fall. Fires that do start (usually from lighting strikes) will typically burn in the duff, stay small, do little damage, and eventually go out on their own. Every few hundred years, however, conditions may be right for a catastrophic stand-replacing fire.

These sites are fragile, but apparently somewhat less so than the TSME/PHEM-VADE type. Smooth woodrush is moderately resistant to trampling and mechanical injury, making these site more suitable for campsites than the TSME/PHEM-VADE Association. All upper timberline forests grow in a highly stressful environment where a small change may result in a stand becoming “non-forest.”

RELATIONSHIPS TO OTHER CLASSIFICATIONS: John and others (1988) describe a TSME/LUHI type for the Yakima Indian Reservation and Pfister and others (1977) describe one for Montana. The Yakima Reservation and Montana plots without much grouse huckleberry are similar to the Wenatchee’s TSME/LUHI. Some of R. and J. Daubenmire’s sample stands that have mountain hemlock as climax dominant, as well as smooth woodrush, may be similar as well (Pfister and others 1977). Both the Mt. Baker-Snoqualmie and Gifford Pinchot NFs (Brockway and others 1983; Henderson and others 1992) have mountain hemlock Associations that contain smooth woodrush, but it has not been used as a type indicator. Some of their samples would likely fit in the Wenatchee TSME/LUHI. The Gifford Pinchot classification acknowledges an undescribed TSME Association with less than 5% big huckleberry that may contain some TSME/LUHI plots. Later, unpublished work on the Gifford-Pinchot and Mt. Hood describe a TSME/LUHI type (Topik and others, in press).

# TSME/MEFE-VAAL ASSOCIATION CMS256

*Tsuga mertensiana/Menziesia ferruginea-Vaccinium alaskaense*
mountain hemlock/rusty menziesia-Alaska huckleberry

## ENVIRONMENT

Elevation: 3040-4230 (3619) ft.
Aspect: NE or sheltered to south
Slope: 1-52 (24) %
Slope position: M, L 1/3, bench, bottom
Special: cold, moist, maritime, sheltered

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 32 |
| TSME | mountain hemlock | 100 | 18 |
| TSHE | western hemlock | 70 | 11 |
| THPL | western redcedar | 20 | 9 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 15 |
| TSME | mountain hemlock | 80 | 3 |
| TSHE | western hemlock | 50 | 2 |
| THPL | western redcedar | 10 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| MEFE | rusty menziesia | 100 | 16 |
| VAAL | Alaska huckleberry | 100 | 13 |
| VAME | big huckleberry | 90 | 16 |
| RUPE | five-leaved bramble | 90 | 8 |
| RULA | dwarf bramble | 90 | 3 |
| OPHO | devil's club | 60 | 2 |
| RUSP | salmonberry | 50 | 2 |
| COCA | bunchberry dogwood | 30 | 4 |
| RHAL | Cascade azalea | 20 | 6 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 90 | 9 |
| MOSS | mosses | 60 | 18 |
| STRO | rosy twistedstalk | 60 | 4 |
| TITRU | coolwort foamflower | 60 | 4 |
| VASI | Sitka valerian | 60 | 2 |
| GYDR | oak fern | 40 | 9 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/MEFE-VAAL Association was sampled only on the Lake Wenatchee District. However, the type is known from the Cle Elum District (PNV data) and may extend farther north along the east slopes of the Cascades.

The TSME/MEFE-VAAL Association has a cool maritime climate with deep snowpacks. Elevations are low for the Mountain Hemlock Series. Slopes vary from flat to moderately steep and lie largely on middle and lower 1/3 slope positions. Most aspects are northerly, or sites are sheltered from the sun, such that snowpacks linger late into the growing season.

All the plots are in areas that were glaciated by valley glaciers and most soils are developed in glacial till or outwash. Consequently, soils are high in gravels and cobbles, though somewhat poorly drained.

TSME/MEFE-VAAL grades into TSME/MEFE-VAME on better drained sites at higher elevation. Sites with a lower snowpack and somewhat warmer temperatures support ABAM/VAAL. The ABAM/OPHO Association occurs on wetter sites. TSME/RHAL-VAME will likely occur on higher elevation sites with residual soils and or other volcanic depositional material.

VEGETATION: Late seral and climax sample stands are fairly common. The average age from four stands was 265 years at breast height, even including one 90-year-old stand. Pacific silver fir may dominate any stage of the tree sere, depending on local seed sources and timing, and type and intensity of disturbance. Late seral stands are dominated by Pacific silver fir in the overstory and understory. Mountain hemlock is typically an important overstory component, but its regeneration is much less abundant than Pacific silver fir. Western hemlock is often a major overstory species in mid seral stands, but in older stands it is much less abundant than Pacific silver fir or mountain hemlock. Western redcedar may be common on warm sites within the type.

The shrub layer is typically dense, with shrubs forming at least two distinct layers. Rusty menziesia, big huckleberry and Alaska huckleberry dominate the tallest shrub layer, while dwarf bramble and five-leaf bramble dominate the low shrub or subshrub layer. The sheltered maritime climate is reflected in the salmonberry being present in about half the samples. A variety of other shrubs may be abundant, but occur irregularly.

The herb layer is more variable in cover and constancy than the shrub layer. Queencup beadlily is the most constant herb and is usually the most abundant. Mosses, rosy twisted stalk, coolwort foamflower and Sitka valerian are present in over half the samples.

PRODUCTIVITY/MANAGEMENT: Timber productivity is moderate (Appendix C). Site index values (base 100) for mountain hemlock and Pacific silver fir average 67 and 81, respectively, and total basal area averages 272 sq.ft./ac. Snow pack and short growing season limit the tree species suitable for timber management. Pacific silver fir or mountain hemlock are the primary ones. Regeneration should not be difficult, if the sites are not degraded and the proper species are selected. Use either planted stock or natural regeneration. Rusty menziesia is not typically a problem in reforestation, and it decreases after burning or scarification (Fielder 1982). Alaska huckleberry, however, can form dense shrubfields in open stands (Henderson and others 1992).

Fire is infrequent in this type, as indicated by the data that show many stands over 250 years old. Fires that do start (usually from lighting strikes) will typically burn in the duff, do little damage, and eventually go out on their own. However, every few hundred years, weather conditions may be right for a catastrophic stand replacing fire.

This type produces little or no forage for livestock (Appendix C), but it has considerable value for wildlife because of the abundance of berry-producing shrubs and multiple shrub and tree layers. The TSME/MEFE-VAAL Association is not suitable for campground or similar uses because of wet, cold conditions, abundant insects and late-melting snow. Recreational berrying is a potential use, especially in early to mid seral stands. Watershed values are high and sites often adjoin streams or lakes.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: TSME/MEFE Associations have been described for northern Idaho (Daubenmire and Daubenmire 1968; Cooper and others 1991) and Montana (Pfister and others 1977). However, none of these support either Alaska or oval-leaf huckleberry. There is additional vegetational dissimilarity between the types from northern Idaho and Montana and the Wenatchee TSME/MEFE-VAAL type, due to the influx of strongly Cascadian species. The Gifford Pinchot classification also includes a TSME/MEFE type (Brockway and others 1983). Brockway's plots with adequate Alaska or oval-leaf huckleberry would key to the Wenatchee TSME/MEFE-VAAL. The classification of Mt. Rainier National Park included some mountain hemlock zone samples (with Alaska huckleberry) in its ABAM/MEFE type (Franklin and others 1988). The Mt. Baker-Snoqualmie classification includes a number of Associations that support both rusty menziesia and Alaska huckleberry but are not identical. The Mt. Hood and Willamette classifications (Hemstrom and others 1982) describe an ABAM/MEFE type in which some of the plots have both mountain hemlock and Alaska huckleberry. Later unpublished work on the Mt. Hood and Gifford Pinchot NFs describe a TSME/MEFE type which supports much more beargrass than the Wenatchee's TSME/MEFE-VAAL type.

# TSME/MEFE-VAME ASSOCIATION CMS257

*Tsuga mertensiana/Menziesia ferruginia-Vaccinium membranaceum*

mountain hemlock/rusty menziesia-big huckleberry

## ENVIRONMENT

Elevation: 3930-4640 (4239) ft.
Aspect: N to E (highest plots SW)
Slope: 22-61 (43) %
Slope position: U, M 1/3, bench
Special: cold, mesic, maritime

## VEGETATION SUMMARY

(Sample size: 9)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 32 |
| TSME | mountain hemlock | 100 | 17 |
| TSHE | western hemlock | 33 | 10 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 18 |
| TSME | mountain hemlock | 78 | 4 |
| TSHE | western hemlock | 22 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| MEFE | rusty menziesia | 100 | 30 |
| VAME | big huckleberry | 100 | 22 |
| RULA | dwarf bramble | 67 | 4 |
| PYSE | sidebells pyrola | 56 | 1 |
| RHAL | Cascade azalea | 44 | 6 |
| **HERBS** | | | |
| MOSS | mosses | 67 | 13 |
| CLUN | queencup beadlily | 56 | 5 |
| STRO | rosy twistedstalk | 33 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/MEFE-VAME Association is best developed on the Lake Wenatchee District in the area of Stevens Pass. One plot from the Okanogan suggests that the type extends farther north along the east slopes of the Cascades. There is one plot from near Snoqualmie Pass as well. Influence of maritime air is important in the distribution of this Association.

The TSME/MEFE-VAME Association has a cool maritime climate with deep snowpacks. Elevations are moderate for the Mountain Hemlock Series. Slopes are moderately steep and lie largely on middle 1/3 slope positions. Most aspects are north or east, or sites are sheltered from the sun, such that snowpacks linger late into the growing season.

Soils typically are well drained. All the plots are in areas glaciated by valley glaciers and most soils are developed in glacial till or outwash. Coarse fragments average nearly 40% by volume and are usually cobbles.

Colder sites are usually in the TSME/RHAL-VAME Association, and sites with a lower snowpack and somewhat warmer temperatures support ABAM/MEFE. The TSME/MEFE-VAAL Association occurs on wetter sites.

VEGETATION: Late seral and near climax stands are fairly common. Late seral stands are dominated by mountain hemlock or Pacific silver fir in their overstory and tree regeneration layers. Mountain hemlock may be an important overstory component in all stands, but is often much less abundant than Pacific silver fir in the tree regeneration layers. Mid seral stands may have western hemlock as a major overstory species, but it is much less abundant in the oldest stands than Pacific silver fir or mountain hemlock. It appears that the type is not sheltered enough for western hemlock to do well. Western white pine was the only other tree in the samples. Other seral trees probably occupy these sites in earlier stages of succession, but heavy snow makes it difficult for them to remain. Pacific silver fir may dominate any stage of the tree sere, depending on local seed sources and timing, type and intensity of disturbance.

The shrub layer is typically dense, with shrubs forming at least two distinct layers. Rusty menziesia and big huckleberry typically dominate the tallest shrub layer. Dwarf bramble or sidebells pyrola, or both, usually make up a low shrub or subshrub layer, although with low cover. Cascade azalea may be fairly abundant in some stands. Few other shrubs are common.

The herb layer is more variable in cover and constancy than the shrub layer. The most abundant and constant “herb” noted was moss. Queencup beadlily is the next most constant herb and is usually the next most abundant. Other herbs are in less than half of the stands and none exceeded 5% cover in the samples.

PRODUCTIVITY/MANAGEMENT: Timber productivity is low (Appendix C). Snow pack and short growing season limit the tree species suitable for timber management. If the sites have not been degraded and the proper species are selected, regeneration should not be difficult, using either planted stock or natural regeneration. Rusty menziesia is not a problem in reforestation and decreases after burning or scarification (Fielder 1982). Watershed values are high and the type serves as a major source of late moisture input to drainages.

Most sample stands were over 250 years old, indicating that fire is infrequent in this type. Fires that do start (usually from lighting strikes) will typically burn in the duff, do little damage, and eventually go out on their own. Every few hundred years, however, weather conditions may be right for a catastrophic stand-replacing fire.

This Association produces little or no forage for livestock (Appendix C). Abundant berry-producing shrubs and multiple shrub and tree layers provide valuable wildlife habitat.

The TSME/MEFE-VAME Association is not suitable for campgrounds or similar uses because of wet, cold conditions, steep slopes, abundant insects and late melting snow. Recreational berrying is a potential use, especially in early to mid-seral stands.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: TSME/MEFE Associations have been described for northern Idaho (Daubenmire and Daubenmire 1968; Cooper and others 1991) and Montana (Pfister and others 1977). There is vegetational dissimilarity between the types from northern Idaho and Montana and the Wenatchee TSME/MEFE-VAAL type, due to the influx of strongly Cascadian species. The Gifford Pinchot classification also includes a TSME/MEFE type (Brockway and others 1983). Brockway’s plots with little Alaska or oval-leaf huckleberry would key to the Wenatchee TSME/MEFE-VAME. The classification of Mt. Rainier National Park included some mountain hemlock zone samples (with Alaska huckleberry) in its ABAM/MEFE type (Franklin and others 1988). The Mt. Baker-Snoqualmie classification includes a number of Associations that support both rusty menziesia and big huckleberry, but are not identical. The Mt. Hood and Willamette classifications (Hemstrom and others 1982) describe an ABAM/MEFE type in which some plots that have both mountain hemlock and big huckleberry, but that lack Alaska huckleberry, would fit the TSME/MEFE-VAME. Later unpublished work on the Gifford Pinchot and Mt. Hood NFs describe a similar mountain hemlock type with more beargrass and fewer moist-site herbs (Topik and others, in press).

# TSME/PHEM-VADE ASSOCIATION CMS354

*Tsuga mertensiana/Phyllodoce empetriformis-Vaccinium deliciosum*

mountain hemlock/red mountain heath-Cascade huckleberry

## ENVIRONMENT

Elevation: 5480-6680 (5995) ft.
Aspect: northeast to southeast
Slope: 8-39 (24) %
Slope position: ridgetop, U 1/3
Special: cold, moist, snowy, maritime,

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 14 |
| TSME | mountain hemlock | 100 | 13 |
| PIAL | whitebark pine | 60 | 3 |
| ABAM | Pacific silver fir | 10 | 25 |
| PICO | lodgepole pine | 10 | 15 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 90 | 10 |
| TSME | mountain hemlock | 90 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VADE | Cascade huckleberry | 70 | 20 |
| PHEM | red mountain heath | 70 | 23 |
| VASC | grouse huckleberry | 60 | 6 |
| RULA | dwarf bramble | 40 | 19 |
| LUPE | partridgefoot | 40 | 17 |
| VAME | big huckleberry | 20 | 13 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 90 | 14 |
| ARLA | broadleaf arnica | 60 | 2 |
| LUPIN | lupines | 30 | 11 |
| VASI | Sitka valerian | 30 | 8 |
| FEVI | green fescue | 20 | 8 |
| ARNIC | arnica spp. | 10 | 45 |

## DISTRIBUTION AND ENVIRONMENT:

Field observations indicate that the TSME/PHEM-VADE Association is limited in acres but extends north and south along the Cascade Crest. The limited sample data are only from the Naches District and indicate both the limited extent of the type and its inaccessibility.

This type is near the limits of the upper continuous tree line. Conditions are cold and maritime. Elevations are high and aspects are easterly. Slopes appear moderate (from the limited samples), but field observations indicate they can be much steeper.

Soils are formed in a variety of parent materials, including andesite, basalt, tephra, and other igneous extrusives. Field observations suggest that coarse fragments and surface rock are common. Most of these sites are in areas of glaciation, suggesting that glacial till or outwash may be present.

More severe sites either lack continuous tree cover and form part of the meadow-forest transition or may support subalpine larch or whitebark pine Associations. More moist sites likely support this type, although the ecological relationships between TSME/LUHI and TSME/PHEM-VADE types are not well understood. These types will be studied in greater detail in future work.

VEGETATION: Late seral and near climax stands are dominated by mountain hemlock in the overstory. Subalpine fir is the major seral tree, although whitebark pine and lodgepole pine were present in one or more plots. Subalpine fir and mountain hemlock are important overstory components in all sample stands. Subalpine fir decreases in importance in the overstory as stands age. Few other trees are adapted to the sites. Initial stages of succession may be started by whitebark pine, but as subalpine fir increases, the highly intolerant whitebark pine is inhibited from regenerating. Mountain hemlock normally enters the sere after subalpine fir is well established. Mountain hemlock and subalpine fir are the most constant and abundant trees in the understory. Alaska yellow cedar dominated the understory and overstory of one sample stand.

Cascade huckleberry is the characteristic shrub and it often extends into adjacent alpine shrub meadows. Other associated shrubs include dwarf bramble, grouse huckleberry, big huckleberry, red mountain heath and other heather, and moss-heather species.

The herb layer is variable. Smooth woodrush is in most stands and indicates the presence of late-melting snowpacks. Other herbs that may be well represented include lupines, broad-leaf arnica, partridgefoot, Sitka valerian and green fescue. Green fescue presence and abundance may be somewhat related to past livestock grazing intensity and timing, although sites with abundant green fescue may be transitional to fescue meadows.

PRODUCTIVITY/MANAGEMENT: Tree growth rates and stocking levels are very low (Appendix C). Site indexes for mountain hemlock and subalpine fir are 45 (base 100) and 32 (base 50), respectively, and total basal area averages 205 sq. ft./ac. Tree form is poor and defects high. These sites are very cold and harsh. They are very slow to reforest after deforestation, and reforestation is impossible to assure by any known techniques. Environmental limitations on plants are such that the sites are fragile and are easily altered by perturbations. Snow damage to trees is common and the loss of a single large individual may alter the snow deposition and melting patterns around it. Relatively small changes in a site have major ecological affects in its ability to support trees or other vegetation. The stands are very important for scenic and watershed values.

Tree age data were limited, but one stand was nearly 300 years old. Fire frequency is probably low in these stands even though lightning strikes are common. Fires that start typically do not burn long and stand-replacement fires are rare. Though fires are infrequent, these upper timberline forests may not recover for decades or even centuries after an intense fire.

Herbage production is the highest of the Mountain Hemlock Series (Appendix C), but the type is really not well suited to much livestock use. The heathers and huckleberries have brittle stems and roots and are especially subject to trampling damage from hikers, livestock or mechanical equipment.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The TSME/PHEM-VADE Association has been described for the Mt. Baker-Snoqualmie, Mt. Hood and Gifford Pinchot NFs (Henderson and others 1992; Topik and others, in press). The mean elevation of the TSME/PHEM-VADE type on the Wenatchee is over 1000 feet higher than described by Henderson and others (1992). This type likely occurs on the Okanogan NF, although it was not described (Williams and Lillybridge 1983).

# TSME/RHAL-VAME ASSOCIATION CMS356

*Tsuga mertensiana/Rhododendron albiflorum-Vaccinium membranaceum*
mountain hemlock/Cascades azalea-big huckleberry

## ENVIRONMENT

Elevation: 4000-5540 (4887) ft.
Aspect: northerly (few east or west)
Slope: 4-69 (28) %
Slope position: ridge, U, M, L 1/3
Special: cold, snowy, maritime

## VEGETATION SUMMARY:

(Sample size: 22)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 95 | 26 |
| ABAM | Pacific silver fir | 77 | 26 |
| PSME | Douglas-fir | 45 | 8 |
| PIMO | western white pine | 45 | 6 |
| PIEN | Engelmann spruce | 41 | 8 |
| LAOC | western larch | 36 | 11 |
| TSHE | western hemlock | 32 | 9 |
| ABLA2 | subalpine fir | 27 | 9 |
| PICO | lodgepole pine | 18 | 13 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 95 | 16 |
| TSME | mountain hemlock | 68 | 8 |
| ABLA2 | subalpine fir | 36 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RHAL | Cascade azalea | 100 | 30 |
| VAME | big huckleberry | 100 | 18 |
| PYSE | sidebells pyrola | 86 | 9 |
| RULA | dwarf bramble | 77 | 12 |
| XETE | beargrass | 59 | 8 |
| VAMY | low huckleberry | 41 | 13 |
| VASC | grouse huckleberry | 27 | 10 |
| **HERBS** | | | |
| ARLA | broadleaf arnica | 64 | 12 |
| GOOB | w. rattlesnake plantain | 45 | 4 |
| PERA | sickletop pedicularis | 27 | 2 |
| ACTR | vanilla leaf | 18 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/RHAL-VAME Association is a widespread type that is most common on the Naches, Cle Elum and Lake Wenatchee Districts. The farther away from the Cascade Crest a stand is, the more likely it is to be on steep, northerly aspects or be part of the Pacific Silver Fir Series. Seldom does the TSME/RHAL-VAME type occupy sites over 15 miles from the Cascade Crest.

Sites are characterized by deep accumulations of snow that remain relatively late into the year. Mountain hemlock requires a strongly maritime climatic pattern with abundant precipitation. Slopes are moderate to steep. Elevations are moderately high and aspects typically northerly.

Soils appear well-drained and are formed in a wide variety of parent materials, often with ash or volcanic depositional material. Few stands are on till or outwash.

The ABAM/RHAL type replaces the TSME/RHAL-VAME on similar sites with less maritime influence. Continental sites in similar environments may support the ABLA2/RHAL type. Warmer and even more maritime sites (usually very near passes) will be occupied by the TSME/RHAL-VAAL Association. More harsh environments will support TSME/PHEM-VADE, TSME/LUHI or TSME/VASC-LUHI Associations. Drier sites often support the TSME/XETE-VAMY type. TSME/MEFE-VAME and TSME/MEFE-VAAL types indicate lower elevations sites on similar aspects on the north end of the Forest.

VEGETATION: Mountain hemlock is at least co-dominant in the overstory of most stands. Pacific silver fir is the most consistent and dominant species in the tree regeneration layer, with mountain hemlock next. Other species may form part of the sere, depending on disturbance history, seed sources and type of disturbance. Early seral species include Douglas-fir, western larch, Engelmann spruce, western white pine, subalpine fir and Alaska yellow cedar. When seral trees are present, several species will often have significant cover, with no one clearly dominant. Sites are usually too harsh for western hemlock to be a dominant stand component. Lower elevational stands in the TSME/RHAL-VAME type may be too warm for mountain hemlock to thrive. However, as site elevations increase it does particularly well. On less frosty sites, Pacific silver fir is often nearly the same age at breast height as other species, indicating that shelter is not necessary for it to regenerate there. However, on frosty sites, the development of a mountain hemlock canopy may be needed for it to regenerate. Subalpine fir is especially important in the sere if site disturbance has been severe.

The dense shrub layer supports a rich variety of species. Cascade azalea is usually the most abundant species but big huckleberry is a close second. Other common shrubs include sidebells pyrola, dwarf bramble and beargrass. Less constant species such as Alaska huckleberry, low huckleberry and pachistima may be well represented in some stands.

Herbs are usually inconspicuous under the dense shrub layer. Broadleaf arnica and western rattlesnake plantain are the most common herbs and may be well represented in some stands.

PRODUCTIVITY/MANAGEMENT: Timber productivity is fairly low (Appendix C). Site index values for mountain hemlock, Pacific silver fir and subalpine fir are 41 and 72 (base 100), and 56 (base 50), respectively. Basal area averages 299 sq. ft./ac. Watershed values are high and the shrubs provide forage and cover for a wide variety of wildlife in the summer. Snowpack and the short growing season limit the tree species suitable for timber management. If sites have not been degraded and the proper species are selected, regeneration should not be difficult, using either planted stock or natural regeneration. Cascade azalea is not normally a problem in reforestation and it decreases after burning or scarification (Fielder 1982). Big huckleberry, however, may form dense stands after burning and canopy removal.

Fire is very infrequent in these stands. Tree ages are commonly over 200 years old in most stands. In fact, of 16 intensive plots, 4 exceeded 300 years old and one was over 500. When lightning strikes occur in these habitats, fires typically do not burn long nor burn much area.

This Association produces little or no forage for livestock (Appendix C). The dense shrub layer and berry-producing species provide both forage and cover for wildlife and recreational opportunities for huckleberry pickers. The cold, wet sites are not desirable for campgrounds and similar uses.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This Association is very similar to the TSME/RHAL-VAME types described for the Mt. Baker-Snoqualmie NF (Henderson and others 1992). A TSME/RHAL type was described for the Gifford Pinchot NF (Brockway and others 1983). Some of the samples included in the ABAM/RHAL Association on the Okanogan NF (Williams and Lillybridge 1983) and for the Yakima Indian Reservation (John and others 1988) are similar to the TSME/RHAL-VAME type described here. Franklin and others (1988) on Mt. Rainier and Hemstrom and others( 1982) on the Mt. Hood and Willamette NFs also described ABAM/RHAL types that had mountain hemlock in their samples. Later unpublished work on the Mt. Hood and Gifford Pinchot NFs describes a TSME/RHAL type that includes the Wenatchee TSME/RHAL-VAME and TSME/RHAL-VAAL types (Topik and others, in press).

# TSME/RULA COMMUNITY TYPE CMS122

*Tsuga mertensiana/Rubus lasiococcus*
mountain hemlock/dwarf bramble

## ENVIRONMENT

Elevation: 5020-5540 (5189) ft.
Aspect: northerly to east
Slope: 7-30 (16) %
Slope position: ridgetops, U 1/3, toe
Special: cold, maritime influence

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 86 | 24 |
| ABAM | Pacific silver fir | 71 | 21 |
| ABLA2 | subalpine fir | 71 | 16 |
| PIEN | Engelmann spruce | 43 | 10 |
| PSME | Douglas-fir | 29 | 15 |
| PICO | lodgepole pine | 29 | 21 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 86 | 12 |
| TSME | mountain hemlock | 86 | 6 |
| ABLA2 | subalpine fir | 71 | 6 |
| PIEN | Engelmann spruce | 43 | 1 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RULA | dwarf bramble | 100 | 13 |
| VASC | grouse huckleberry | 71 | 5 |
| PYSE | sidebells pyrola | 71 | 2 |
| VAMY | low huckleberry | 57 | 13 |
| XETE | beargrass | 57 | 2 |
| VAME | big huckleberry | 43 | 8 |
| **HERBS** | | | |
| ARLA | broadleaf arnica | 57 | 11 |
| HIAL | white hawkweed | 43 | 2 |
| LUHI | smooth woodrush | 43 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/RULA Community Type has been sampled on the Naches District and on Manastash Ridge on the Cle Elum District. All plots are on long ridges leading to subalpine and alpine meadows. The ridges were once used as livestock driveways and the community may reflect past grazing use more than intrinsic environmental conditions.

These sites are cold and maritime. Elevations are moderately high and usually on ridgetops or upper slopes. Most slopes are less than 20%. Aspects are northerly to east. Snowpacks are deep and may last well into summer.

Soils are formed mainly in andesite or glacial outwash. A few sites were listed as granitic or tephra. Surface soil horizons average about 10% gravels. Soil surface litter is usually about 50%.

The successional relationships of some of these stands were unclear. High elevations with dwarf bramble suggested that a number of plots originally placed in ABAM/VAME or ABAM/VAME/CLUN *WEN* types fit better in the TSME/RULA type. Additional data may better define this type. Some of the samples have traces of smooth woodrush, but are below the elevational range of TSME/LUHI, and yet higher than the TSME/VAME type.

VEGETATION: The oldest trees sampled on the type were 250+ year-old mountain hemlocks, but data are very limited. Lodgepole pine can dominate early seral stands that have been burned in the last 100 years. Minor amounts of western larch and Douglas-fir were found in the youngest stands. Subalpine fir is often a major stand component in both the overstory and understory, and as such makes up an important part of the tree sere, entering the stands with or soon after lodgepole pine. Mountain hemlock and Pacific silver fir become more common as the stands become older. In the oldest sample stand mountain hemlock was more than 100 years older than associated subalpine fir. Also, on one plot, Pacific silver fir was 150 years older than associated lodgepole pine. Apparently, short-lived subalpine firs and lodgepole pines may go through more than one generation in the canopy during one lifetime of the longer-lived mountain hemlocks or Pacific silver firs forming the major canopy.

Dwarf bramble is the most consistent shrub or subshrub. Either low or grouse huckleberry was found in every plot and can be well represented. The only other shrubs found in half or more of the plots are sidebells pyrola and beargrass. Big huckleberry is present in some sample stands and never exceeds 10% cover. Other shrubs are uncommon.

Broadleaf arnica, including *Arnica* species (*A. mollis*?), is the only herb that occurs in over half the stands sampled, but it can be abundant. Other herbs occur sporadically and are usually low in cover.

PRODUCTIVITY/MANAGEMENT: These sites are harsh and difficult to reforest. Although data are limited, it appears that timber productivity is very low (Appendix C). To become established, mountain hemlock and Pacific silver fir may need shelter from lodgepole pine or subalpine fir. Snow packs are high and top damage, apparently from snow and ice, is common in the trees. Additionally, the sites are exposed to wind and lightning because of their position on the slope. Succession to trees after deforestation is slow.

High incidence of lightning provides the ignition source for fires, but environmental conditions result in few fires of any extent. The data indicate that some stands are dominated by lodgepole pine, which may cause stands to be more susceptible to fire.

Herbage production in this type is low (Appendix C). Most sites have a history of overgrazing, so it is difficult to know the potential composition and productivity of the shrub and herb layers.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: This type was described in the Wenatchee Draft Guide (Williams and Smith 1991). Re-evaluation of the data and subsequent changes in the classification have changed the Association. Samples in the old TSME/RULA type that contain much smooth woodrush now key to TSME/LUHI or TSME/VASC/LUHI types. The Wenatchee TSME/RULA type is similar to some of the phases of the ABAM/RULA Association described by Franklin and others (1988). Some of the high-elevation samples from the ABAM/VAME/XETE type described on the Willamette and Mt. Hood National Forests (Hemstrom and others 1982) are closely related. The TSME/VAME-RULA described by Henderson and others (1992) is very similar, although the constancy of big huckleberry is less on the Wenatchee, while total cover of all understory plants is higher.

# TSME/VAAL *WEN* ASSOCIATION CMS258

*Tsuga mertensiana/Vaccinium alaskaense*

mountain hemlock/Alaska huckleberry

*Alaska huckleberry (VAAL), an indicator of the TSME/VAAL Association.*

## ENVIRONMENT

Elevation: 3210-4190 (3618) ft.

Aspect: NE to S to NW

Slope: 4-45 (23) %

Slope position: ridgetop, M, L 1/3, bench

Special: cool, rocky; maritime influence

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 38 |
| TSME | mountain hemlock | 100 | 14 |
| TSHE | western hemlock | 67 | 25 |
| PSME | Douglas-fir | 17 | 3 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 14 |
| TSME | mountain hemlock | 67 | 6 |
| TSHE | western hemlock | 33 | 4 |
| PSME | Douglas-fir | 17 | 6 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAAL | Alaska huckleberry | 100 | 5 |
| VAME | big huckleberry | 100 | 12 |
| PYSE | sidebells pyrola | 83 | 2 |
| SOSI | Sitka mountain ash | 83 | 2 |
| RULA | dwarf bramble | 67 | 4 |
| RUPE | five-leaved bramble | 50 | 5 |
| MEFE | rusty menziesia | 50 | 4 |
| **HERBS** | | | |
| CLUN | queencup beadlily | 67 | 5 |
| MOSS | mosses | 50 | 22 |
| STRO | rosy twistedstalk | 50 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/VAAL Association was sampled on the Lake Wenatchee District. It may also be found in other areas near the Cascade Crest, especially in areas of extreme maritime influence, such as in mountain pass corridors. It is normally 5 miles or less east of the Crest.

The TSME/VAAL Association appears to represent sites with ample moisture and cloudy conditions, but on cool slopes with good soil drainage. Elevations are very low for the Mountain Hemlock Series. Most sites are under 4000 feet elevation. Slopes are often moderate (<40%) and aspects are variable.

Soils are formed mainly in mixed glacial drift, with one plot having breccia. Most stands have abundant surface rock and coarse fragments in the surface soil horizons.

Somewhat warmer sites with less snowpack support the closely related ABAM/VAAL type. Sites that are cooler and more moist commonly support the TSME/MEFE-VAAL type. As sites become more continental, Alaska huckleberry will decline and types like TSME/VAME and TSME/RHAL-VAME become more likely. Stands with both rusty menziesia and Alaska huckleberry may better fit the ABAM/MEFE-VAAL type, particularly if they have oak fern or ladyfern as well, and even though they do not have the requisite 5% cover of rusty menziesia.

VEGETATION: Few sample stands were over 150 years old, so late successional or climax conditions must be inferred from species composition and successional dynamics. Late seral and climax stands are dominated by Pacific silver fir in the overstory and regeneration tree layers. Pacific silver fir regeneration may be so dense as to make travel through the stands difficult. Mature stands typically have 65% or greater canopy cover. Western hemlock is co-dominant with Pacific silver fir in some stands, but appears less able to reproduce itself. Mountain hemlock did not dominate the overstory in any sample stand. Douglas-fir is only a minor component in the sample stands. No other trees were present.

Shrubs dominate the undergrowth. Alaska huckleberry is the most characteristic species, although big huckleberry is typically more abundant. Other less conspicuous but common shrubs include dwarf bramble and sidebells pyrola.

Herbs are inconspicuous in the dense tree regeneration and shrub layers. Queencup beadlily is the only herb in more than half of the plots and varies greatly in cover. Moss can be abundant in some stands. Stands with ladyfern, oak fern, or both, were common in a few plots at the wet end of the type but were not prominent enough to define a separate Association.

PRODUCTIVITY/MANAGEMENT: Sites are moist, relatively warm, productive and sheltered. Timber productivity is fairly high for the Mountain Hemlock Series, but generally moderate when compared to other Series. Site index for Pacific silver fir was 84 (base 100) and total basal area averaged 395 sq. ft./ac. (Appendix C). Soils are subject to erosion and soil compaction because of the amount of angular, fine-textured materials in the profile. The abundant Pacific silver fir regeneration suggests that moisture is not limiting to reforestation, even in dense shrub stands. Light may limit Pacific silver fir regeneration more than moisture. Advanced silver fir regeneration will not respond to overstory removal until approximately five years after harvest because the trees need to replace their shade needles with needles suited to open conditions. However, advanced regeneration will release if the trees are healthy. Small Pacific silver firs in the regeneration layers can be over 100 years old. Both huckleberry species resprout after fires if the fire does not destroy the duff layer. However, their brittle stems and shallow rhizomes are easily damaged by heavy equipment or trampling. Most other shrubs also resprout after burning.

Fire is infrequent here, although their moderate elevations make these sites somewhat more fire-susceptible than many of the higher elevation Mountain Hemlock Associations. Fires will typically not be underburns in this type, although the duff layer can burn for long periods without much area being burned or much damage done.

Multi-canopy stands with high shrub and tree regeneration cover and abundant berry-producing shrubs makes these sites valuable for a wide variety of wildlife. Recreational huckleberry picking may be an important use of these sites because of the amount of huckleberries they produce.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Mt. Baker-Snoqualmie classification uses Alaska huckleberry as a major indicator for several plant Associations in the Mountain Hemlock Series (Henderson and others 1992). However, less emphasis is placed on the dominance of Alaska huckleberry than in this classification. Consequently, the types overlap but are not the same. The Gifford Pinchot classification (Brockway and others 1983) does not use Alaska huckleberry as an indicator in the Mountain Hemlock Series. This Wenatchee NF type is somewhat similar to the ABAM/VAAL type described for Mt. Rainier (Franklin and others 1988), except that that type apparently contains little mountain hemlock. Some of the ABAM/VAAL/COCA Association plots in the Mt. Hood and Willamette classifications (Hemstrom and others 1982) are similar.

# TSME/VAME *WEN* ASSOCIATION CMS259

*Tsuga mertensiana/Vaccinium membranaceum*

mountain hemlock/big huckleberry

## ENVIRONMENT

Elevation: 3280-4500 (3925) ft.

Aspect: variable

Slope: 1-58 (18) %

Slope position: <u>ridge</u>, <u>U</u>, <u>M</u>, L 1/3, <u>benches</u>

Special: cold, maritime, relatively dry

## VEGETATION SUMMARY

(Sample size: 15)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 93 | 18 |
| ABAM | Pacific silver fir | 87 | 22 |
| TSHE | western hemlock | 73 | 21 |
| PSME | Douglas-fir | 53 | 10 |
| PIMO | western white pine | 53 | 6 |
| LAOC | western larch | 40 | 9 |
| PICO | lodgepole pine | 27 | 8 |
| **TREE UNDERSTORY LAYER** | | | |
| ABAM | Pacific silver fir | 100 | 10 |
| TSHE | western hemlock | 80 | 4 |
| TSME | mountain hemlock | 67 | 4 |
| PIMO | western white pine | 40 | 2 |
| CHNO | Alaska yellow cedar | 33 | 7 |
| ABLA2 | subalpine fir | 13 | 5 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAME | big huckleberry | 100 | 16 |
| CHUMO | western prince's pine | 67 | 3 |
| GAOV | slender wintergreen | 53 | 7 |
| VASC | grouse huckleberry | 53 | 6 |
| PYSE | sidebells pyrola | 47 | 3 |
| PAMY | pachistima | 47 | 3 |
| LIBOL | twinflower | 40 | 4 |
| **HERBS** | | | |
| MOSS | mosses | 53 | 15 |
| GOOB | w. rattlesnake plantain | 33 | 1 |
| CLUN | queencup beadlily | 20 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/VAME Association has been sampled only on the Naches and Lake Wenatchee Districts. Inspection of the PNV data suggests that this type may also occur on the Cle Elum District and it is logical to assume that the type may be found all along the Cascades. Most stands are within a few miles of the Cascade Crest, but the type is occasionally found over ten map miles away.

This is probably the least maritime-influenced type in the Mountain Hemlock Series and one of the driest. Elevations are third lowest for the Series. Slope positions are variable, but generally suggest well-drained situations without excessive moisture accumulation. Aspects can be south or west, contributing to the dryness of these sites.

Most soils are formed in a variety of extrusive volcanic materials. Some stands had soils developed in glacial tills and outwash, while others formed in basalt or andesite. One plot had an ash surface. Coarse fragments (both cobbles and gravels) average about 25% in the soil surface horizons.

More moist sites will support TSME/VAAL, TSME/MEFE-VAME or TSME/MEFE-VAAL types. Warmer sites will generally support the Pacific Silver Fir Series.

VEGETATION: Mountain hemlock, Pacific silver fir and western hemlock are co-dominants in the overstory of most sample stands. Western hemlock and mountain hemlock tend to increase in stands over 100 years in age. Pacific silver fir and the two hemlocks may be common in stands less than 100 years old, depending on seed sources and disturbance history. Mountain hemlock was often the oldest species found in a given stand. There is often less Pacific silver fir in the overstory of late seral and near climax stands (>300 years old) than in stands between 100 and 300 years old. Yet silver fir normally dominates the regeneration layers of stands from 100 to 300+ years. This decline in overstory composition between 200 and 300 hundred years may reflect the shorter average life-span of individual Pacific silver firs, as compared to western or mountain hemlocks, which live longer than one individual Pacific silver fir life-span. Pacific silver fir may often be as much as 100 years younger than associated hemlocks. Early seral stands often support a variety of conifers, including Douglas-fir, western white pine, western larch, subalpine fir and lodgepole pine, often with no one species clearly dominant. Alaska yellow cedar is found on a few sites.

The shrub layer is characterized by a wide variety of shrubs. Big huckleberry is constant and dominates the understory of most stands. Other common shrubs and subshrubs include western prince's pine, slender wintergreen, grouse huckleberry, sidebells pyrola and pachistima.

Herbs are typically low in cover. Various mosses occurred in over half the stands and dominated the herb layer. No other herb was in more than half of the stands.

PRODUCTIVITY/MANAGEMENT: Tree growth rates are low for the Mountain Hemlock Series, although average basal area is near 300 sq. ft./ac. (Appendix C). Site index values for mountain hemlock and Pacific silver fir are 43 and 56 (base 100), respectively. Frost and high water tables are normally of little concern in the type. Steep southerly slopes will be slow to reforest after clearcutting because of high insolation rates and the potential for shrub and herb competition if the sites are not promptly reforested. To protect tree seedlings, harvest techniques that leave a light to medium overstory are suggested. Burning will probably increase the potential for shrub competition with tree seedlings. Burning favors big huckleberry as long as its shallow rhizomes are not damaged. A wide range of conifers are suitable for the sites.

Although this type appear to be one of the warmest and least maritime of all the mountain hemlock Associations, sample stand ages average 300 years, which suggests long fire-free periods.

Warm slopes and abundant big huckleberry and other shrubs make these sites important for wildlife. Southerly slopes become snow-free sooner than most other types in the Mountain Hemlock Series. Most natural stands provide little suitable forage for domestic livestock (Appendix C). These sites can be important areas for recreational berrying.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A TSME/VAME Association that appears nearly identical has been described on the Yakima Indian Reservation (John and others 1988). Both the Mt. Baker-Snoqualmie and the Gifford Pinchot NFs have described TSHE/VAME types (Henderson and others 1992; Brockway and others 1983). Although not identical to the Wenatchee type, they are similar in some respects. On the Wenatchee, big huckleberry is so ubiquitous that it is used as an indicator late in the key. On the west side of the Cascades, this species has much more indicator value and consequently comes out earlier in the key. The TSME/VAME/XETE and TSME/VAME/Forb types described on the MT. Hood and Gifford Pinchot NFs have much more beargrass and forbs than stands on the Wenatchee. Johnson and Simon (1987) describe a TSME/VAME Association for the Wallowa-Snake Province in northeastern Oregon.

# TSME/VASC/LUHI ASSOCIATION CMS121

*Tsuga mertensiana/Vaccinium scoparium/Luzula hitchcockii*

mountain hemlock/grouse huckleberry/smooth woodrush

*Smooth woodrush (LUHI), an indicator of the TSME/VASC/LUHI Association.*

*PHOTO:*
S.Hahn and M.Reynolds.

## ENVIRONMENT

Elevation: 5300-6480 (5931) ft.
Aspect: northeast-west (NE)
Slope: 7-61 (27) %
Slope position: ridge, U, M 1/3
Special: cold, harsh, maritime

## VEGETATION SUMMARY

(Sample size: 17)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 94 | 30 |
| ABLA2 | subalpine fir | 88 | 19 |
| PICO | lodgepole pine | 29 | 20 |
| ABAM | Pacific silver fir | 29 | 16 |
| **TREE UNDERSTORY LAYER** | | | |
| TSME | mountain hemlock | 100 | 5 |
| ABLA2 | subalpine fir | 76 | 7 |
| ABAM | Pacific silver fir | 53 | 8 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 76 | 20 |
| RULA | dwarf bramble | 65 | 19 |
| VAME | big huckleberry | 41 | 8 |
| VAMY | low huckleberry | 35 | 34 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 100 | 9 |
| ARLA | broadleaf arnica | 88 | 11 |
| CAGE | elk sedge | 59 | 3 |
| VASI | Sitka valerian | 47 | 14 |
| POPU | skunkleaf polemonium | 47 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/VASC/LUHI Association extends north and south along the Cascades Crest and on high elevation spur ridges to the east. The type has been sampled only on the Naches and Lake Wenatchee Districts. The type is limited in extent.

These are cold, harsh and rocky sites in areas of maritime influence. Elevations are some of the highest in the Mountain Hemlock Series. Slopes are variable, but usually under 30% in the sample stands. Aspects are mainly northeast and the sites are in areas of late-melting snowpacks. The stands are often in areas of snow deposition brought by winds from nearby exposed sites.

Tephra and basalt are the usual soil parent materials. Coarse fragments are fairly high on most sites.

The TSME/VASC/LUHI Association is often on ridges above the TSME/LUHI type, in somewhat more exposed and harsh conditions. Snow packs do not endure as long as on the TSME/LUHI type. The TSME/VASC/LUHI, TSME/LUHI, TSME/CAME/LUPE, TSME/PHEM-VADE, and alpine meadow/shrublands form a mosaic in much of the near timberline landscape.

The original sample data are very limited in this type. New un-analyzed data (PNV) and further sampling will better characterize this type and its relationship to adjacent ones.

VEGETATION: No sample stands were over 150 years old, so late successional or climax conditions must be inferred from species composition and successional dynamics. Mid seral stands (150+ years) are typified by mountain hemlock dominating the overstory, with mountain hemlock, Pacific silver fir or subalpine fir as the major components in the regeneration layers. Subalpine fir is the primary seral tree dominant. Pacific silver fir occurred in the overstory of some stands. Other seral trees are less often seen in these harsh, deep snowpack sites. Some lodgepole-pine-dominated stands near Cash Prairie on the Naches District key to the type, but they may be a stage within the sere of the ABAM/VAME Association.

Low huckleberry, grouse huckleberry and dwarf bramble are the dominant shrubs. Shrubs other than these are uncommon. Big huckleberry was abundant in only one stand.

In the herb layer, smooth woodrush is well represented and commonly associated with broadleaf arnica, Sitka valerian, elk sedge and skunkleaf polemonium. Broadleaf arnica, Sitka valerian and smooth woodrush typically dominate the understory. Smooth woodrush is the characteristic herb, but is not usually the most abundant plant.

PRODUCTIVITY/MANAGEMENT: Timber productivity is low (Appendix C). It is impossible to assure regeneration within five years on these sites. Average total basal area is 268 sq. ft./ac., and site index values for subalpine fir, lodgepole pine and mountain hemlock are 38, 54 (base 50) and 48 (base 100) respectively. Reforestation is impossible to assure by any known techniques and sites are very slow to reforest after deforestation. Snow damage to trees is common and the loss of a single large individual may greatly affect the rest of the stand by modifying snow melt and deposition patterns. Wind damage to tree tops is common. These sites are fragile, though somewhat less so than the TSME/PHEM-VADE type. All upper timberline forests grow in a highly stressful environment, where a small change may affect whether a site remains forested.

Fires are infrequent on these sites, which may retain snowbanks into late summer, or even in some years into early fall. Fires that do start (usually from lighting strikes) will typically burn in the duff, do little damage, stay small, and eventually go out on their own. Every few hundred years, however, weather conditions may be right for a catastrophic stand-replacing fire. The data indicate that some stands are dominated by lodgepole pine. This may result in stands being prone to more frequent stand-replacing fire.

Smooth woodrush is moderately resistant to trampling and mechanical injury and these sites are more suitable for campsites than the fragile vegetation characteristic of TSME/PHEM-VADE sites. Scenic and watershed values are important in these TSME/VASC/LUHI stands.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Pfister and others (1977) described a TSME/LUHI/VASC Habitat Type and phase for Montana that is similar. All of the sample stands in the TSME/LUHI type on the Yakima Indian Reservation contain enough low huckleberry to fit the Wenatchee's TSME/VASC/LUHI type and their type appears identical (John and others 1990). Both the Mt. Baker-Snoqualmie, MT. Hood and Gifford Pinchot NFs (Henderson and others 1992; Topik and others, in press; Brockway and others 1983) have mountain hemlock Associations that contain smooth woodrush, but don't list grouse huckleberry in keys or summary tables. Some of their samples may fit the Wenatchee TSME/VASC/LUHI, but are likely to be outliers in their data. The Gifford Pinchot classification acknowledges an undescribed TSME Association with less than 5% big huckleberry that may contain a few TSME/VASC/LUHI plots. The Mt. Hood and Willamette classification (Hemstrom and others 1982) describes a TSME/VASC that appears to characterize a similar environment and Johnson and Simon (1987) describe a TSME/VASC Association for the Wallowa-Snake Province in northeastern Oregon. Neither Hemstrom and others (1982) nor Johnson and Simon (1987) list smooth woodrush in their types.

# TSME/XETE-VAMY ASSOCIATION CMF131

*Tsuga mertensiana/Xerophyllum tenax-Vaccinium myrtilus*

mountain hemlock/beargrass-low huckleberry

## ENVIRONMENT

Elevation: 4300-5680 (5153) ft.

Aspect: N-SW (mostly E to SW)

Slope: 1-40 (19) %

Slope position: <u>ridgetop</u>, <u>U</u>, <u>M</u> 1/3

Special: cold, dry, rocky maritime influence

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| TSME | mountain hemlock | 100 | 29 |
| LAOC | western larch | 75 | 8 |
| PICO | lodgepole pine | 58 | 19 |
| ABAM | Pacific silver fir | 50 | 15 |
| ABLA2 | subalpine fir | 42 | 18 |
| PIMO | western white pine | 33 | 8 |
| PSME | Douglas-fir | 33 | 7 |
| PIEN | Engelmann spruce | 17 | 10 |
| **TREE UNDERSTORY LAYER** | | | |
| TSME | mountain hemlock | 92 | 10 |
| ABLA2 | subalpine fir | 75 | 10 |
| ABAM | Pacific silver fir | 67 | 10 |
| PIMO | western white pine | 33 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| XETE | beargrass | 100 | 19 |
| VAMY | low huckleberry | 67 | 18 |
| PAMY | pachistima | 67 | 4 |
| PYSE | sidebells pyrola | 50 | 5 |
| VAME | big huckleberry | 58 | 14 |
| RULA | dwarf bramble | 42 | 8 |
| VASC | grouse huckleberry | 33 | 5 |
| **HERBS** | | | |
| ARMA3 | bigleaf sandwort | 33 | 6 |
| ARCO | heartleaf arnica | 25 | 9 |
| POPU | skunkleaf polemonium | 25 | 4 |
| VASI | Sitka valerian | 25 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

The TSME/XETE-VAMY Association has been sampled on only the Naches and Cle Elum Districts. The majority of the plots are from the Pinegrass Ridge, Cash Prairie and Timberwolf Lookout areas, on the Naches District. Some of the samples from the Cash Prairie and Timberwolf Lookout areas are floristically richer than most of the other plots included in the type. These may be separated after further analysis.

The sites have heavy snow accumulation, are cool to cold, and are dry for the Mountain Hemlock Series. Elevations are in the middle range for the Series. Aspects are variable and most sites have less than 25% slope. The TSME/XETE-VAMY Association is typically on upper slopes or ridgetops.

The type is commonly found on andesite or basalt flows. One stand occurred on granite and one on tephra. Soils are relatively shallow and well drained. Limited data suggest that the surface horizons contain 10-40% gravels and cobbles.

Colder, higher-elevation sites commonly support the TSME/VASC/LUHI Association. Warmer sites fall within the TSME/VAME or TSME/RULA types, or fall within the ABAM Series. Areas with more moisture will commonly be in TSME/VAAL or TSME/MEFE Associations.

VEGETATION: Few sample stands were over 200 years old, so late successional or climax conditions must be inferred from species composition and successional dynamics. Mountain hemlock dominates most stands, but as the distance east of the Crest increases it is less able to reproduce itself. Pacific silver fir is present in the overstory of only half the stands and is usually subordinate to other seral trees. Western larch, lodgepole pine, and subalpine fir are all important seral species that can dominate the overstory. In early seral stands lodgepole pine or subalpine fir often dominate. Only mountain hemlock, Pacific silver fir and subalpine fir regenerate much in closed stands. Other conifers that may be important in the sere are western white pine, Douglas-fir and Engelmann spruce.

Beargrass is the most common and abundant shrub or subshrub. Other prominent shrubs include low huckleberry, big huckleberry, pachistima and dwarf bramble.

Herbs are highly variable in composition and abundance. Early seral stands, where much of the tree canopy is made up of western larch and lodgepole pine, have more herbs compared to older stands where mountain hemlock is dominant. The crown of mountain hemlock lets through much less light than crowns of western larch or lodgepole. These heavily shaded stands may contain few shrubs and herbs besides beargrass and sidebells pyrola.

PRODUCTIVITY/MANAGEMENT: Timber productivity is fairly low (Appendix C). Site index values for Pacific silver fir and mountain hemlock are 67 and 48 (base 100), respectively. Total basal area averages 253 sq. ft./ac. Mature natural stands with closed canopies are not especially frost-prone, but frost pockets often develop after deforestation. Frost is caused mainly by cold air concentrations, though re-radiation cooling may also be a factor. Careful attention should be paid to local topography and air drainage patterns. Soils are apparently low in nutrients, and subject to compaction by heavy equipment.

Fire frequency is low in this type, although ridgetop positions predispose many stands to lightning strikes. The data also indicate that some stands are dominated by lodgepole pine, which may result in their being more prone to stand-replacement fire.

Gentle slopes and vegetation that is relatively resistant to trampling damage make these sites suitable for campgrounds and similar uses. Mature stands provide little forage for livestock or ungulates.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: A number of workers have described TSME/XETE Associations (Cooper and others 1991; Pfister and others 1977; Daubenmire and Daubenmire 1968). It is, however, difficult to interpret the equivalence of types when spanning hundreds of miles and comparing several physiographic provinces. Elevational ranges for Rocky Mountain samples are quite similar to those found on the Wenatchee, albeit a little higher. In contrast, the fairly floristically similar TSME/VAME/XETE Association described for the Mt. Baker-Snoqualmie NF (Henderson and others 1992) is much lower in mean elevation. The TSME/VAME type on the Gifford Pinchot Forest (Brockway and others 1983) includes a number of stands with enough beargrass to fit the TSME/XETE-VAMY type on the Wenatchee. The ABAM/XETE, TSME phase, described on Mt. Rainier (Franklin and others 1988) and the TSME/VAME/XETE from the Mt. Hood and Willamette NFs (Hemstrom and others 1982) are similar to the Wenatchee TSME/XETE-VAMY type.

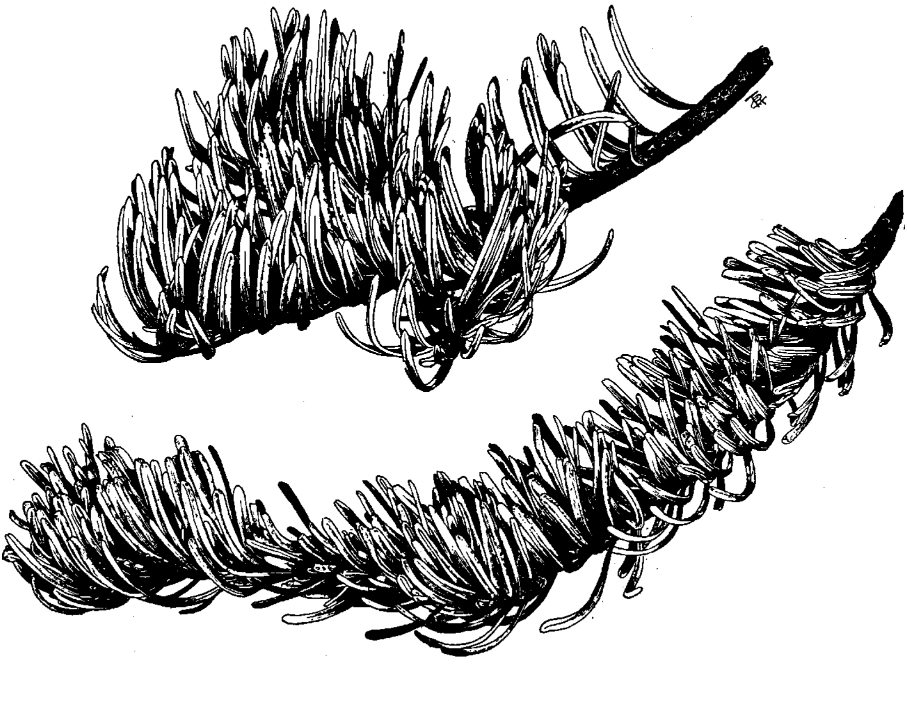
# MISCELLANEOUS MOUNTAIN HEMLOCK ASSOCIATION

(less than 5 Wenatchee sample plots)

## TSME/RHAL-VAAL CMS355

This Association, widely distributed on the Mt. Baker-Snoqualmie National Forest (Henderson and others 1992), is less common on the Wenatchee (only 4 sample stands). The type was sampled near both Snoqualmie and Stevens Passes on upper and middle slopes and benches. The mean elevation for the samples is about 4000 feet, nearly 1000 feet below TSME/RHAL-VAME stands that support little or no Alaska or oval-leaf huckleberry. Slopes range from 10-40% and aspects range from east through north to west. Mountain hemlock and Pacific silver fir dominate all sample stands. The understory is dominated by tall shrubs, and big and Cascade azalea are abundant. The presence of at least 5% cover of both Cascade azalea and Alaska or oval-leaf huckleberry separates this type from all others. Stand ages for the 4 sample stands averaged over 250 years, suggesting a long fire-free period. The location of the samples in pass corridors where precipitation is high and snow is heavy and lingering, also supports this conclusion. A TSME/RHAL type was described for the Gifford Pinchot NF (Brockway and others 1983). Some of the samples included in the ABAM/RHAL Association on the Okanogan NF (Williams and Lillybridge 1983) are similar to the TSME/RHAL-VAAL type described here. Franklin and others (1988) on Mt. Rainier, John and others (1988) on the Yakima Indian Reservation, and Hemstrom and others( 1982) on the Mt. Hood and Willamette NFs, also described ABAM/RHAL types that contained some mountain hemlock in their samples. More recent unpublished work on the Mt. Hood and Gifford Pinchot NFs describes a TSME/RHAL type that includes the Wenatchee TSME/RHAL-VAME and TSME/RHAL-VAAL types (Topik and others, in press). Refer to the Mt. Baker-Snoqualmie classification for a more detailed description of this type.

# SUBALPINE FIR SERIES



# SUBALPINE FIR SERIES

DISTRIBUTION AND ENVIRONMENT: The Subalpine Fir Series includes all forested upland stands potentially dominated at climax by subalpine fir or Engelmann spruce, or both. Single species climax may be difficult to project in part of the area because many stands are young. Given the autecological characteristics of the two species and lacking ancient stands as benchmarks, it is difficult to assume that one species will completely replace the other over time. Subalpine fir is more shade tolerant than Engelmann spruce, but the latter is more disease resistant and longer-lived (Minore 1979). Subalpine fir is better able to establish in litter than is Engelmann spruce (Knapp and Smith 1982). Engelmann spruce bark and litter leachates may also limit reproduction and growth of associated conifers (Taylor and Shaw 1982). Daubenmire and Daubenmire (1968) and Pfister and others (1977) consider Engelmann spruce a persistent seral species or a minor co-climax in their Subalpine Fir Series. We follow tradition in using subalpine fir as the inferred climax dominant, but consider Engelmann spruce of equal value for indicating the Subalpine Fir Series, at least in uplands. However, riparian studies in both Oregon (Kovalchik 1987) and eastern Washington (Kovalchik 1993) show that Engelmann spruce is climax in some riparian zones. Additionally, according to more recent observations, limited uplands areas on the Okanogan NF are clearly spruce climax. Consequently, spruce should be used with care as an upland subalpine fir zone indicator. Subalpine fir becomes the climax dominant when sites are too cold for more shade tolerant species to reproduce. In this Guide, subalpine fir is considered a climax species on all upland forest sites where it or Engelmann spruce occur, if more shade tolerant species such as Pacific silver fir, mountain hemlock, grand fir, western redcedar or western hemlock are absent or unable to reproduce successfully.

The Subalpine Fir Series extends from mid-elevations to upper timberline. Consequently, temperatures are lower than in most other climax tree Series. When the Subalpine Fir Series is found at elevations below Pacific Silver Fir, Western Hemlock, Grand Fir or Douglas-Fir Series, it indicates cold air drainage and frost pockets. In continental areas north of the Entiat River and well east of the Cascade Crest, the Subalpine Fir Series often extends from climax Douglas-fir forests to upper timberline. South of the Entiat River, subalpine fir and Douglas-fir climax forests are normally separated by other climax tree Series, such as Grand Fir, Pacific Silver Fir or Western Hemlock.

The Subalpine Fir Series has been sampled on all Districts on the Wenatchee NF. The Series may be most widely distributed on the Entiat and Chelan Districts. However, there were not enough plots in the Wenatchee Draft classification to adequately describe the Series, especially from the Entiat and Lake Chelan Districts, where recent fires limited the area available for sampling. Therefore, plots were borrowed from the lower Methow and Twisp River drainages (Okanogan NF) to supplement plots from the Wenatchee NF. These and more recent high-elevation samples roughly double the number of plots used in this classification compared to the Draft, which has allowed a more reliable analysis. It also expands the classification into the poorly sampled Districts by using data from similar country immediately to the north.

As in the Douglas-fir and Ponderosa Pine Series, the Subalpine Fir Series has been re-analyzed and restructured to parallel subalpine fir Associations described on the Colville NF. The present classification is somewhat different than the Draft (Williams and others 1991), but the changes that occur will make the classification more satisfying to the user, especially in the northern third of the Forest. Several high-elevation subalpine types have also been added. The use of Okanogan data also begins the development of a uniform subalpine fir classification across eastern Washington. The Wenatchee subalpine fir types are now more similar to the Colville classification, as well as to classifications in the Rocky Mountains. However, there are still many Wenatchee types that are unique to the Cascade Range. Okanogan workers may find the Wenatchee classification more useful than their present classification. Description of riparian subalpine fir Associations is being delayed until the riparian classification is published (about 1997).

Eighteen plant Associations are listed in the tables following this Series introduction. Eight of them have limited occurrence on the Wenatchee NF (generally, these types have fewer than 5 plots actually located on the Wenatchee NF) and are described as miscellaneous types. These poorly defined types are PIEN/EQUIS, ABLA2/LIBOL, ABLA2/PAMY, ABLA2/PAMY/CARU, ABLA2/TRCA3, ABLA2/VACA, ABLA2/VAME, and ABLA2/VASC/CARU. Some of them may be elevated to major status as more data are collected or when a three-Forest classification is developed. The types described include data for, and are also applicable to, the southwestern portion of the Okanogan NF.

VEGETATION: Douglas-fir is an important seral species on warmer, drier environments at mid to lower elevations in the Series. Western larch is more common on sites south of the Entiat River and east of the Chewauk River (Okanogan NF), and it is uncommon on much of Entiat and Chelan Districts. Lodgepole pine is found throughout most types in the Series and is an important component of many stands. It is especially representative of stands burned in the last 100 years. Intensive burns at less than 200 year intervals strongly favor the development of dense lodgepole pine stands. This is a common pattern in parts of the Subalpine Fir Series, especially in ABLA2/VASC, ABLA2/PAMY and ABLA2/RHAL Associations. Ponderosa pine is poorly represented and is not well adapted to subalpine fir sites (Cooper and others 1991). Engelmann spruce is best developed on more moist habitats, is often the stand dominant in more mature stands in ABLA2/LIBOL, ABLA2/RULA and ABLA2/ARLA Associations, and is especially prevalent in the riparian Associations to be described later (Kovalchik 1993). Lodgepole pine is one of the trees most susceptible to spruce litter leachates, while subalpine fir is less affected (Taylor and Shaw 1982). Engelmann spruce is less common on drier habitats in the Series. Whitebark pine and subalpine larch are found in higher-elevation subalpine fir Associations such as ABLA2/VADE, ABLA2/RHAL/LUHI, ABLA2/VASC/LUHI and ABLA2/LUHI. These Associations are more or less capable of forming closed canopies in mature stands. Therefore, shade intolerant whitebark pine and subalpine larch are considered seral trees and depend on occasional stand-replacement fires to maintain their stands in early to mid seral conditions. At or near timberline, stands become open and key to Associations in the Subalpine Larch or Whitebark Pine Series.

Examination of stands with living, mature subalpine fir present before the 1988 White Mountain Fire on the Colville NF, shows near total consumption of relatively large (>12 inches at DBH) subalpine fir. This suggests that in the absence of seed sources, and after subalpine fir is eliminated from extensive areas by intense wildfire, development of a subalpine fir climax may take centuries. Such areas may be dominated by lodgepole pine, western larch or Douglas-fir, with little evidence of either Engelmann spruce or subalpine fir.

PRODUCTIVITY/MANAGEMENT: A cold temperature regime is the major limiting factor to tree growth in the Subalpine Fir Series. Some of the highest elevation Associations are poorly suited for intensive timber management. Slope position and topography are important considerations for frost pocket development. These are discussed in more detail in the specific Association descriptions. Species such as pachistima or pinegrass indicate warm sites, while grouse or low huckleberry indicate colder ones. Species such as whitebark pine, smooth woodrush, red mountain heath and Cascade huckleberry indicate high-elevation sites with extreme snowpack. Seasonal, moderately high water tables are common in Associations such as ABLA2/ARLA-POPU, ABLA2/RHAL and ABLA2/LIBOL.

Plant growth is not normally limited by lack of growing season moisture, though ABLA2/CARU and ABLA2/PAMY are the Associations that could be compared using such a limitation, as described in the Douglas-fir Series. Subalpine fir sites generally have moderate or better timber productivity, due to sites being relatively mesic. The average stand basal area ranged from 180 to 324 sq. ft./ac. The average stand site index for Douglas-fir and lodgepole pine ranged from 36 to 82 and 33 to 59 feet (base 50), respectively. More mesic Associations do not necessarily have faster growth rates, but have higher stocking levels.

Many herbs and shrubs in the Series are rhizomatous and respond quickly to disturbances. Such a vegetative reproduction strategy gives species such as pinegrass, elk sedge, northwestern sedge, common snowberry and shiny-leaf spirea a competitive advantage over species that rely entirely on seeds. Invasion by introduced alien weeds is not normally as serious a problem in the colder and more harsh end of the Subalpine Fir Series, when compared to warmer habitats, such as the Douglas-Fir Series. Observations on the White Mountain Fire and other fires indicate that mixtures of exotic grass seed have germinated and established extremely well in the more moderate sites within the Series. Grass seeding may be successful to help maintain proper stocking in lodgepole pine-dominated stands, but may hinder establishment of native vegetation.

Both Engelmann spruce and subalpine fir are easily killed by fire. Thin, resinous bark, branches close to the ground, and high stand densities all contribute to the species' vulnerability. Lodgepole pine is also easily killed by fire, but its closed, often serotinous cones insure quick re-establishment on severely burned sites. Therefore, many subalpine fir sites are dominated by lodgepole pine communities. Of the common seral species, only Douglas-fir and western larch are resistant to ground fires, due to their thick, fire-resistant bark and they may dominate sites with a past pattern of ground fire. In general, stand-replacement fires may be the rule rather the exception in this Series although some types such as the ABLA2/CARU and ABLA/VASC/CARU can underburn.

Usually, the Associations in the Subalpine Fir Series provide little herbage for livestock. For example, herbage production on the ABLA2/LIBOL, ABLA2/RHAL, ABLA2/RULA and ABLA2/VASC types averaged 37, 79, 76 and 27 lbs./ac., respectively. In contrast, herbage on the ABLA2/ARLA-POPU, ABLA2/CARU and ABLA2/VASC/ARLA types averaged 152, 230 and 106 lbs./ac. Dense, lower-elevation lodgepole pine stands may be important components of Canadian lynx habitat because of the relative abundance of snowshoe hares.

Primary root diseases in the Series include S-group *Annosum* root disease, laminated root rot, Indian paint fungus, brown cubical rot, *Tomentosus* root disease and *Armillaria* root rot (Hessburg and others 1994). These rots were scattered before the era of intensive resource management, but have increased dramatically by attacking through stumps associated with logging, and because of the increase of subalpine fir associated with fire control. Dwarf mistletoe infestations are particularly severe in lodgepole pine, Douglas-fir and western larch, although other species may be infected. Dwarf mistletoe infections are a major cause of mortality in western larch (Jim Hadfield, personal communication). These levels are likely elevated from historical times because lack of wildfires has resulted in denser stands, facilitating the spread of mistletoe.

Bark beetles associated with the Subalpine Fir Series include the western balsam bark beetle, fir engraver, spruce beetle, Douglas-fir beetle and mountain pine beetle (Hessburg and others 1994; Flanagan personal communication). The mountain pine beetle infests lodgepole pine and has killed hundreds of thousands of acres in the Cascades and in the Rocky Mountains in the past 20 years. The spruce beetle and Douglas-fir beetle have the potential for outbreaks in Engelmann spruce and Douglas-fir respectively. Western spruce budworm and Douglas-fir tussock moth infestations have expanded due to the expanded food base associated with fire control. The introduced pest balsam woolly adelgid occasionally kills true firs.

White pine blister rust occurs at higher elevations in the Subalpine Fir Series. Flagging and dead whitebark pine are beginning to appear in the North Cascades (personal observations). In twenty years it appears the Cascade stands will likely be as ravaged as Rocky Mountain whitebark pine stands unless trees genetically resistant to blister rust are developed and introduced to these sites.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Subalpine Fir Series has been described by numerous authors up and down the Cascades and eastward into the northern Rocky Mountains. Some authors from other areas are: Pfister and others 1977 (Montana); Cooper and others 1991 (Idaho); Williams and others 1990 (Colville NF); Williams and Lillybridge 1983 (Okanogan NF); Williams and others 1991 (Wenatchee NF Draft); Clausnitzer and Zamora 1987 (Colville Indian Res.); Zamora 1983 (Spokane Ind. Res.); John and others 1988 (Yakima Ind. Res.); and, Johnson and Clausnitzer 1992 (northeastern Oregon).

## Keys to Plant Associations of the Subalpine Fir Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

| | | |
|---|---|---|
| Cascade huckleberry $\geq$ 5% | ABLA2/VADE | p. 226 |
| Smooth woodrush $\geq$ 1% | | |
|     Cascade azalea $\geq$ 5% | ABLA2/RHAL/LUHI | p. 222 |
|     Grouse or low huckleberry $\geq$ 5% | ABLA2/VASC/LUHI | p. 232 |
|     Not as above | ABLA2/LUHI | p. 218 |
| Common or wood horsetail $\geq$ 5% | PIEN/EQUIS (M) | p. 236 |
| Cascade azalea $\geq$ 5% | ABLA2/RHAL | p. 220 |
| False bugbane $\geq$ 5% | ABLA2/TRCA3 (M) | p. 235 |
| Dwarf bramble $\geq$ 5% | ABLA2/RULA | p. 224 |
| Dwarf huckleberry $\geq$ 5%, cold air drainage on glacial terraces and outwash (use bearberry only if site requirements are met) | ABLA2/VACA (M) | p. 235 |
| Big huckleberry $\geq$ 5% | ABLA2/VAME (M) | p. 235 |
| Twinflower $\geq$ 5% | ABLA2/LIBOL (M) | p. 234 |
| Grouse or low huckleberry $\geq$ 5% | | |
|     Broadleaf arnica or western polemonium $\geq$ 1% | ABLA2/VASC/ARLA | p. 230 |
|     Pinegrass or elk sedge $\geq$ 5% | ABLA2/VASC/CARU (M) | p. 236 |
|     Not as above | ABLA2/VASC | p. 228 |
| Broadleaf arnica, western polemonium, or Sitka valerian $\geq$ 1% (or heartleaf arnica $\geq$ 1% and pinegrass < 5%) | ABLA2/ARLA-POPU | p. 214 |
| Pachistima $\geq$ 5% | | |
|     Pinegrass $\geq$ 5% | ABLA2/PAMY/CARU (M) | p. 235 |
|     Not as above | ABLA2/PAMY (M) | p. 234 |
| Pinegrass $\geq$ 5% | ABLA2/CARU | p. 216 |

# Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| ABLA2/ARLA-POPU | 11 | 719 | 324 | 12 | 594 | 152 |
| ABLA2/CARU | 3 | 497 | 228 | 11 | 409 | 230 |
| ABLA2/LIBOL (M) | 3 | 565 | 267 | 11 | 481 | 37 |
| ABLA2/LUHI | 2 | 284 | 252 | 13 | 418 | 38 |
| ABLA2/PAMY (M) | 2 | 516 | 201 | 9 | 386 | 9 |
| ABLA2/RHAL | 6 | 656 | 242 | 10 | 459 | 79 |
| ABLA2/RHAL/LUHI | 2 | 363 | 180 | 9 | 335 | 61 |
| ABLA2/RULA | 8 | 534 | 301 | 11 | 535 | 76 |
| ABLA2/VAME(M) | 2 | 239 | 294 | 15 | 458 | 47 |
| ABLA2/VASC | 2 | 358 | 214 | 10 | 374 | 27 |
| ABLA2/VASC/ARLA | 7 | 1075 | 255 | 9 | 530 | 106 |
| ABLA2/VASC/LUHI | 3 | 514 | 189 | 9 | 362 | 201 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABLA2/ARLA-POPU | ABAM | 5 | 74 | 5 | 214 | 69 | 102 |
| | ABGR | 8 | 63 | 10 | 348 | 155 | 81 |
| | ABLA2 | 15 | 42 | 15 | 261 | 77 | 124 |
| | LAOC | 7 | 54 | 18 | 238 | 83 | 174 |
| | PICO | 20 | 56 | 20 | 231 | 90 | 88 |
| | PIEN | 18 | 55 | 18 | 318 | 122 | 110 |
| | PSME | 19 | 50 | 25 | 295 | 104 | 167 |
| ABLA2/CARU | ABLA2 | 3 | 46 | 3 | 199 | 64 | 93 |
| | PICO | 10 | 58 | 10 | 143 | 56 | 78 |
| | PSME | 15 | 58 | 15 | 237 | 102 | 131 |
| ABLA2/LIBOL (M) | LAOC | 10 | 58 | 10 | 186 | 80 | 163 |
| | PICO | 10 | 59 | 10 | 160 | 67 | 80 |
| | PIEN | 5 | 62 | 5 | 298 | 129 | 78 |
| | PSME | 7 | 78 | 8 | 325 | 181 | 134 |
| ABLA2/LUHI | ABLA2 | 8 | 42 | 8 | 264 | 89 | 160 |
| | PIEN | 5 | 65 | 5 | 309 | 141 | 193 |
| ABLA2/PAMY (M) | PIEN | 5 | 74 | 5 | 254 | 131 | 67 |
| | PIMO | 3 | 70 | 3 | 439 | 215 | 70 |
| | PIPO | 5 | 124 | 5 | 319 | 173 | 77 |
| | PSME | 10 | 82 | 10 | 216 | 124 | 74 |
| ABLA2/RHAL | ABLA2 | 23 | 32 | 23 | 176 | 40 | 200 |
| | PICO | 4 | 33 | 4 | 173 | 40 | 170 |
| | PIEN | 21 | 33 | 23 | 206 | 50 | 226 |
| | PSME | 8 | 39 | 18 | 184 | 42 | 210 |
| ABLA2/RHAL/LUHI | ABLA2 | 5 | 39 | 5 | 198 | 54 | 116 |
| | PICO | 10 | 41 | 10 | 151 | 45 | 99 |
| ABLA2/RULA | ABGR | 5 | 98 | 5 | 558 | 383 | 58 |
| | ABLA2 | 11 | 57 | 11 | 276 | 112 | 97 |
| | PICO | 13 | 54 | 13 | 167 | 63 | 106 |
| | PIEN | 5 | 57 | 5 | 325 | 129 | 210 |
| | PSME | 3 | 82 | 3 | 477 | 273 | 61 |
| ABLA2/VACA | LAOC | 5 | 62 | 5 | 127 | 55 | 96 |
| | PICO | 5 | 55 | 5 | 96 | 37 | 100 |
| ABLA2/VAME (M) | PSME | 10 | 68 | 10 | 265 | 126 | 108 |
| ABLA2/VASC | LAOC | 5 | 41 | 5 | 97 | 28 | 173 |
| | PSME | 5 | 64 | 5 | 423 | 190 | 102 |
| ABLA2/VASC/ARLA | ABGR | 3 | 45 | 3 | 253 | 80 | 73 |
| | ABLA2 | 15 | 31 | 15 | 249 | 55 | 119 |
| | LAOC | 5 | 51 | 5 | 226 | 80 | 78 |
| | PICO | 18 | 47 | 18 | 193 | 62 | 81 |
| | PSME | 13 | 41 | 18 | 253 | 75 | 146 |
| ABLA2/VASC/CARU (M) | LAOC | 5 | 51 | 5 | 143 | 51 | 120 |
| | PICO | 5 | 35 | 5 | 114 | 28 | 127 |
| | PIEN | 5 | 38 | 5 | 133 | 35 | 125 |
| | PSME | 5 | 36 | 5 | 144 | 37 | 154 |
| ABLA2/VASC/LUHI | ABLA2 | 9 | 42 | 9 | 146 | 44 | 102 |
| | PICO | 5 | 42 | 5 | 175 | 51 | 112 |

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

## SUBALPINE FIR PLANT ASSOCIATION GROUPS

1. Cool Dry Grass PAG
   - ABLA2/CARU
   - ABLA2/PAMY *WEN* (M)
   - ABLA2/PAMY/CARU (M)
2. Cool Mesic Shrub/Herb PAG
   - ABLA2/LIBOL *WEN* (M)
   - ABLA2/VACA (M)
   - ABLA2/VAME *WEN* (M)
3. Cold Dry Shrub/Herb PAG
   - ABLA2/VASC *WEN*
   - ABLA2/VASC/CARU (M)
4. Cold Mesic Shrub/Herb PAG
   - ABLA2/RHAL
   - ABLA2/RHAL/LUHI
   - ABLA2/VADE
   - ABLA2/VASC/ARLA
   - ABLA2/VASC/LUHI
5. Cold Moist Shrub/Herb PAG
   - ABLA2/ARLA-POPU
   - ABLA2/LUHI
   - ABLA2/RULA
6. Wet Shrub/Herb PAG
   - PIEN/EQUIS (M)
   - ABLA2/TRCA3 (M)

## SUBALPINE FIR PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| ABLA2/ARLA-POPU | CEF424 |
| ABLA2/CARU | CEG311 |
| ABLA2/LIBOL *WEN* (M) | CEF222 |
| ABLA2/LUHI *WEN* | CEG121 |
| ABLA2/PAMY *WEN* (M) | CES113 |
| ABLA2/PAMY/CARU (M) | CES112 |
| ABLA2/RHAL | CES211 |
| ABLA2/RHAL/LUHI | CES213 |
| ABLA2/RULA | CES423 |
| ABLA2/TRCA3 (M) | CEF422 |
| ABLA2/VACA (M) | CES422 |
| ABLA2/VADE | CES341 |
| ABLA2/VAME *WEN* (M) | CES342 |
| ABLA2/VASC *WEN* | CES426 |
| ABLA2/VASC/ARLA | CES424 |
| ABLA2/VASC/CARU (M) | CES413 |
| ABLA2/VASC/LUHI | CES425 |
| PIEN/EQUIS (M) | CEM211 |

# ABLA2/ARLA-POPU ASSOCIATION CEF424

*Abies lasiocarpa/Arnica latifolia-Polemonium pulcherimum*

subalpine fir/broadleaf arnica-skunkleaf polemonium

*Broadleaf arnica (ARLA), an indicator of the ABLA2/ARLA-POPU type.*

## ENVIRONMENT

Elevation: 4900-5810 (5362) ft.

Aspect: all aspects

Slope: gentle to moderate

Slope position: ridge, U, M 1/3, bench, bottoms

Special: cool, moist, snow accumulation

## VEGETATION SUMMARY

(Sample size: 22)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 91 | 21 |
| PSME | Douglas-fir | 64 | 27 |
| PICO | lodgepole pine | 59 | 19 |
| LAOC | western larch | 36 | 16 |
| PIEN | Engelmann spruce | 32 | 18 |
| ABGR | grand fir | 27 | 24 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 15 |
| ABGR | grand fir | 41 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 86 | 4 |
| PYSE | sidebells pyrola | 64 | 2 |
| VAMY | low huckleberry | 39 | 2 |
| RIVI | sticky currant | 39 | 2 |
| **HERBS** | | | |
| POPU | skunkleaf polemonium | 86 | 3 |
| LUPIN | lupines | 73 | 6 |
| ARLA | broadleaf arnica | 68 | 7 |
| CAGE | elk sedge | 68 | 6 |
| ARCO | heartleaf arnica | 64 | 4 |
| VASI | Sitka valerian | 36 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

This limited but well-documented Association was sampled only on the Entiat, Leavenworth and Cle Elum Districts. It is most common in the Entiat Ridge and Wenatchee Mountains areas. One plot was on Manastash Ridge. Its status on other districts is unknown.

ABLA2/ARLA-POPU is characterized by moist sites, moderately high snow loads and moderately high elevations. Most slopes are gentle to moderate, but some are over 40%. Aspects and slope positions are variable, but northerly aspects and mid to upper slopes are most common.

Most soils are formed in ash or pumice over basalt, andesite and metamorphic rocks. Soils are generally well-developed and remain relatively moist through the growing season. Surface rock and coarse fragments range from scarce to abundant. Litter is often very abundant.

These moist sites often contain small zones of seeps or swales that better fit types such as ABLA2/TRCA3 or ABLA2/RULA, and which better fit into the coming riparian classification (Kovalchik 1993). Somewhat warmer sites are usually within the Grand Fir Series. This type closely resembles ABLA2/VASC/ARLA and ABLA2/LUHI, but the former has low or grouse huckleberry, or both, well represented, while the latter is at higher elevations and smooth woodrush is at least common.

VEGETATION: Subalpine fir increases in the tree regeneration layer as stands age. Early seral species such as Douglas-fir and western larch may persist for several hundred years, forming an open canopy over a dense, short canopy of subalpine fir and Engelmann spruce. Lodgepole pine often dominates stands that regenerated following stand-replacement fire, but it declines rapidly in importance as stands exceed 125 years of age. Repeated conflagration fires at less than 125-year intervals lead to the development of persistent lodgepole pine-dominated communities. Grand fir may form part of the sere, but appears incapable of consistently reproducing in the relatively cool conditions of closed canopy stands.

ABLA2/ARLA-POPU species composition and abundance is variable. Some of the variation appears related to the amount of ungulate grazing. Some of the sites (such as Table Mountain) have been heavily grazed in the past by domestic sheep and cattle. However, elk and deer use may be the largest current impact on species composition. Shrubs are inconspicuous members of the community except in early seral stands. In general, shrubs are not well represented and only pachistima has high constancy. Broadleaf arnica, skunkleaf polemonium and Sitka valerian characterize the moist herb layer. Heartleaf arnica can also be used to identify the type, as long as pinegrass is poorly represented. Other herbs include asters, lupines, sidebells pyrola and elk sedge.

PRODUCTIVITY/MANAGEMENT: Eleven intensively sampled plots indicate moderate to high tree stocking and growth. These plots averaged 719 trees per acre and 324 sq. ft. total basal area. Site index values averaged 42, 55, 56, 54 and 50 (base 50) for subalpine fir, Engelmann spruce, lodgepole pine, western larch and Douglas-fir (Appendix C). Soils formed in volcanic ash or from basalts are especially subject to compaction. Frost is not a problem in natural stands, but harvest may create frost pockets. Frost is possible nearly any time of the year and may result from either re-radiation cooling or cold air concentrations. Pay attention to topography and air drainage to keep harvest from creating frost pockets. Even though natural stands may have little shrub and herb development, the shrub and herb layers respond vigorously to tree removal. Hood's sedge, elk sedge, Sitka alder, Scouler willow and sticky currant often increase dramatically after logging and broadcast burning. Hood's sedge is not abundant under closed forests, but responds to canopy openings, where it may compete strongly with tree seedlings. Examination of areas with reforestation problems reveals that soil compaction, frost and vegetation competition all hinder reforestation. Soil compaction and frost are the most serious problems. These are compounded by the development through time of dense shrub and herb communities. Unless sites are properly managed for soil and frost protection, efforts to reduce shrub and herb competition rarely succeed.

Fire frequency may be relatively low compared to drier subalpine fir types. Stand composition and ages indicate that ground fires are uncommon, while most stands originated following stand-replacement fires (200-300 year fire frequency). Some mature subalpine fir and Engelmann spruce sample stands are 150 to 200 years old or older.

Two-or even three-tree canopy layers are common in mid and late seral stands, providing a diverse habitat for arboreal species. They also provide thermal and hiding cover for elk and deer. The common occurrence of moist swales also provides wallows for elk. Wildlife values are high in this type because of forest structure, and because non-forest openings are often nearby. ABLA2/ARLA-POPU has been heavily grazed in the past and can provide moderate herbage for livestock. Ten clipped plots averaged 152 pounds of herbage per acre (Appendix C). Soils may be compacted by livestock grazing.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/ARLA-POPU is similar to the ABLA2/ARLA-CAGE Association described in the Wenatchee Draft (Williams and others 1991), except that huckleberries are not well represented in any of the plots described here. The ABLA2/VASI described for the Yakima Indian Reservation (John and others 1988) is also very similar. The type has not been described elsewhere.

# ABLA2/CARU ASSOCIATION CEG311

*Abies lasiocarpa/Calamagrostis rubescens*

subalpine fir/pinegrass

## ENVIRONMENT

Elevation: 5060-5740 (5320) ft.

Aspect: all aspects

Slope: 3-55 (32) %

Slope position: ridge, U, M 1/3, bench

Special: cold, dry sites, pinegrass sod

## VEGETATION SUMMARY

(Sample size: 9)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 67 | 34 |
| PICO | lodgepole pine | 67 | 30 |
| ABLA2 | subalpine fir | 67 | 7 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 67 | 3 |
| PSME | Douglas-fir | 56 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 78 | 4 |
| PYSE | sidebells pyrola | 44 | 2 |
| VAMY | low huckleberry | 44 | 3 |
| **HERBS** | | | |
| CARU | pinegrass | 100 | 33 |
| LULA | broadleaf lupine | 56 | 14 |
| ARCO | heartleaf arnica | 67 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

Five sample plots are located on the Wenatchee NF, on the Chelan and Naches Districts. Four plots were borrowed from Okanogan data in the vicinity of Twisp. The type is considered widespread on the Okanogan, Colville and Wenatchee NFs.

ABLA2/CARU typifies an environment with high insolation rates and wide diurnal temperature ranges. Snow removal by wind is an important environmental characteristic. The type occurs at moderately high elevations on a wide variety of slopes and aspects. It usually occurs on steep, upper slopes with southeast to west exposures, but is also found on gentle, north facing upper slopes and ridges.

The regolith is colluvium derived from a variety of rock types. Basalt is most common south of Entiat Ridge while granites prevail to the north. Soil coarse fragments range from common to abundant. Litter is usually abundant.

This is a relatively dry environment for subalpine fir. ABLA2/CARU grades downslope into the PSME/CARU and PSME/CAGE Associations. It may be bounded by mountain meadows or shrublands containing bunchgrasses, mountain snowberry, or even mountain big sagebrush. Some ABLA2/CARU sites adjoin PIAL/CARU stands.

VEGETATION: Late seral and near climax stands are absent from the data. However, stands of large, old Douglas-fir are not uncommon. Based on the amount of charred bark and fire scars on old Douglas-firs trees, the understory was frequently reduced by frequent ground fire and the stands were open and parklike before the advent of fire control. Now, most stands have one or more different age classes present below the old canopy of Douglas-fir. Presumably, subalpine fir will dominate the tree overstory and understory if sufficient time (2 or 3 centuries) passes between fires. Douglas-fir is a long-lived seral species in the type and it normally dominates the understory and overstory in the plots. Only small amounts of subalpine fir are present in the data. Stands and sites may resemble those of the PSME/CARU or PSME/CAGE Associations. However, the presence of subalpine fir or Engelmann spruce indicates ABLA2 Series sites. It is unlikely that subalpine fir will completely replace Douglas-fir, because dense pinegrass and the dry, exposed nature of the sites limit subalpine fir regeneration. Intense wildfires may remove all evidence of subalpine fir or Engelmann spruce for decades, and these sites will key erroneously to PSME/CARU or possibly ABGR/CARU *WEN*.

Shrubs are normally inconspicuous. Pachistima is common in many of the plots. If Pachistima is well represented, the user should have keyed to the ABLA2/PAMY/CARU type. Low huckleberry, sticky current, Scouler willow, shiny-leaf spirea, and princes-pine were present in one or more stands. Pinegrass dominates the undergrowth, though a large number of other herbs occur that vary in constancy and cover. The most common are asters, raceme pussytoes, sidebells pyrola, lupines, heartleaf arnica, western meadowrue, northwestern sedge, white hawkweed and sweetroot.

PRODUCTIVITY/MANAGEMENT: Tree growth is moderate. Three intensive plots averaged 497 trees per acre and 228 sq. ft./ac. total basal area. Site indexes averaged 46, 58 and 58 (base 50) for subalpine fir, lodgepole pine and Douglas-fir (Appendix C). Basal areas are often fairly high, but site indexes are not exceptional and most trees exhibit considerable stem taper. Tree tops damaged from a combination of wind, snow and winter kill are common. Extremes in environmental conditions make tree regeneration difficult. Problems include large diurnal temperature ranges, heavy pinegrass competition, droughty soils, and winter kill by desiccation. Young trees need shelter from excessive sun, high daytime soil temperatures, and re-radiation frost at night. Pistol-butted trees are common, suggesting snow creep or soil movement. Douglas-fir is the most dependable species for timber management. Expect severe regeneration problems on clearcuts due to lack of shelter and severe pinegrass competition. Broadcast burning may cause mortality to planted trees because blackened soil surfaces may raise air temperatures near the soil surface to lethal levels.

"Fire intervals tend to lengthen to exceed 100 years and fire intensities tend to increase in subalpine fir and mountain hemlock forests" (Agee, 1994). In this type, one of the driest in the Subalpine Fir Series, fire intervals probably are nearer 50-100 years. Repeated low-intensity fire would tend to favor dominance by Douglas-fir, while high intensity fire could lead to lodgepole pine dominance and subsequently increase fire intensities

ABLA2/CARU sites provide moderate grazing values for livestock. Three clipped plots averaged 230 pounds of herbage per acre (Appendix C). Lupines, strawberry, pussytoes, heartleaf arnica and asters increase with heavy grazing. South to west aspects, steep slopes and wind removal of snow make these sites important wintering and forage areas for wildlife. Blue grouse are favored by the occurrence of large, wolfy Douglas-firs and the lack of snowpack. As to recreation potential, pinegrass is relatively resistant to trampling and the grassy sward beneath the trees is attractive, but most sites are too steep.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/CARU is widespread and reported in both the Colville (Williams and others 1990) and Okanogan (Williams and Lillybridge 1983) NFs' classifications, in the Wenatchee Draft (Williams and others 1991), and on the Yakima Indian Reservation (John and others 1988). It is also abundant in northern Idaho (Cooper and others 1991), Montana (Pfister and others 1977), and northeastern Oregon (Johnson and Clausnitzer 1992).

# ABLA2/LUHI *WEN* ASSOCIATION CEG121

*Abies lasiocarpa/Luzula hitchcockii*

subalpine fir/smooth woodrush

## ENVIRONMENT

Elevation: 4930-6540 (5795) ft.

Aspect: north to east (all)

Slope: 2-38 (18) %

Slope position: <u>ridge</u>, <u>U</u>, L 1/3 ,bench

Special: cold, snow accumulation

## VEGETATION SUMMARY

(Sample size: 11)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 40 |
| PIEN | Engelmann spruce | 55 | 18 |
| PICO | lodgepole pine | 27 | 5 |
| PIAL | whitebark pine | 18 | 7 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 91 | 7 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 64 | 3 |
| VAMY | low huckleberry | 36 | 3 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 100 | 21 |
| ARLA | broadleaf arnica | 73 | 8 |
| VASI | Sitka valerian | 73 | 4 |
| POPU | skunkleaf polemonium | 55 | 3 |
| PYSE | sidebells pyrola | 45 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABLA2/LUHI Association is widely distributed but covers limited acreage. It has been sampled on all but the Leavenworth District and occurs on the Okanogan NF. It is found near the Cascade Crest and further east on high ridges and slopes. Plots were located on Manastash and Nason Ridges and on the Wenatchee, Entiat, Chelan and Sawtooth Mountains on the Wenatchee NF, and near Hart's Pass on the Okanogan NF.

Wind and snow deposition by wind are important characteristics of ABLA2/LUHI sites. It is found on a variety of slopes and aspects. All sites are near upper timberline and are in areas of deep snow accumulation. The sample plots are high. Only one stand was located below 5000 feet, in a cold air drainage.

Soils are probably deeper, finer textured and less stony than ABLA2/VASC/LUHI. Surface rock is uncommon, while litter is abundant. Coarse fragments ranged from 10-20 % in the soil surface horizons. The type occurs north of Entiat Ridge on glacial material or residual soils derived from granitic and sandstone rock types. To the south it occurs on basalt, tephra, andesite and schist.

PIAL/VASC/LUHI occurs on more exposed, drier sites. Higher elevation sites support the PIAL or LALY Series. Steep, north slopes often support denser tree canopies and ABLA2/RHAL/LUHI. Sites with more maritime climate or deeper snowpack will support the TSME Series.

VEGETATION: Late seral or near climax stands are characterized by the dominance of subalpine fir in the tree overstory and regeneration layers. Engelmann spruce may co-dominate in some stands. Whitebark pine may form an important early to mid seral dominant. This very long-lived tree may persist as scattered large trees well into subalpine fir dominance. After stand-replacement fires, it may also act as a nurse tree where subalpine fir and spruce regenerate in the lee of whitebark pine until continuous forest cover is re-established. It may be hard to determine the exact boundary between ABLA2/LUHI and the Whitebark Pine and Subalpine Larch Series. ABLA2/LUHI occurs on more-protected sites with the potential to develop closed forest canopies. The PIAL and LALY Series occur on sites too harsh to allow the development of a dense tree canopy. Stands remain open, thus allowing whitebark and subalpine larch to regenerate, even in old stands.

Shrubs are variable in abundance and occurrence. Grouse or low huckleberry, or both, and pachistima are often the most common species, but their cover is low. Dwarf bramble was abundant on two plots transitional to the ABLA2/RULA type. Smooth woodrush is usually well represented and may be abundant. The herb layer often has a wide variety of forbs mixed with the discontinuous sward of smooth woodrush. Common herbs include broadleaf arnica, skunkleaf polemonium, Sitka valerian, bracted pedicularis, round-leaved violet and sidebells pyrola.

PRODUCTIVITY/MANAGEMENT: Even though stocking and growth rates are moderate, these sites are not suitable for timber production because of cold temperatures, heavy snowpacks and short growing seasons. Two intensive plots were very different in production and averaged 284 trees per acre and 252 sq. ft./ac. total basal area. The site index for subalpine fir and Engelmann spruce averaged 42 and 65 feet (base 50), respectively (Appendix C). The subalpine fir site index on one plot averaged only 23 feet at 50 years. The site index for spruce on another intensive plot averaged a surprising 63 feet at 50 years. This productive plot had lots of dwarf bramble, indicating a xero-riparian site perhaps deserving of separate classification. Snow damage to trees is common and openings in the forest may alter snow deposition and melting patterns, thereby changing vegetation development on the sites. Frost is possible any night of the year. No known silvicultural techniques will assure tree regeneration within 5 years.

The lingering snowpack and relatively inflammable understory indicate that this type will burn very infrequently. Fires that burn here would tend to creep slowly through the duff or, when conditions are just right, be intense and replace the stand.

Watershed values are very high and preservation of the tree canopy is essential to maintain snowpacks. Many streams have their headwaters just downslope from this Association. Melting snow from the ABLA2/LUHI type provides late season runoff.

Values for livestock grazing are low. Two clipped plots averaged only 38 pounds of herbage per acre (Appendix C). The sites provide important summer range for both deer and elk.

Scenic values within the stand are generally lower than in the more open habitats that often adjoin the type. However the ABLA2/LUHI Association makes favored campsites for backpackers. Smooth woodrush is moderately tolerant of trampling damage. It is more resistant to such use than most of the associated herbs and shrubs.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/LUHI is similar to the ABLA2/LUHI Association described in the Wenatchee Draft (Williams and others 1991) and to the ABLA2/LUHI described for the Yakima Indian Reservation (John and others 1988). It was not described in the Okanogan and Colville classifications (Williams and Lillybridge 1983; Williams and Lillybridge 1990). However, it has been observed and sampled on the Okanogan NF. ABLA2/LUHI may be a part of the broad ABLA2/LUHI Habitat Type described for northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977).

# ABLA2/RHAL ASSOCIATION CES211

*Abies lasiocarpa/Rhododendron albiflorum*

subalpine fir/Cascade azalea

*Cascade azalea (RHAL), an indicator of the ABLA2/RHAL Association.*

*PHOTO:* R.Harrod

## ENVIRONMENT

Elevation: 4600-6300 (5550) ft.

Aspect: northerly

Slope: 17-68 (42) %

Slope position: U, M 1/3

Special: cold, moist, deep snowpack

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 20 |
| PIEN | Engelmann spruce | 70 | 25 |
| PICO | lodgepole pine | 70 | 9 |
| PSME | Douglas-fir | 40 | 28 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 14 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RHAL | Cascade azalea | 100 | 33 |
| PYSE | sidebells pyrola | 90 | 3 |
| PAMY | pachistima | 70 | 5 |
| VAMY | low huckleberry | 60 | 9 |
| VASC | grouse huckleberry | 50 | 11 |
| VAME | big huckleberry | 30 | 18 |
| **HERBS** | | | |
| LULA | broadleaf lupine | 50 | 5 |
| OSCH | sweetroot | 50 | 1 |
| CACO | northwestrn sedge | 40 | 5 |
| GOOB | w. rattlesnake plantain | 40 | 3 |
| CARU | pinegrass | 30 | 12 |
| ARLA | broadleaf arnica | 30 | 4 |

## DISTRIBUTION AND ENVIRONMENT:

Four Wenatchee ABLA2/RHAL plots were sampled in the Wenatchee, Entiat and Chelan Mountains. Six plots were borrowed from Okanogan data in the Twisp District. It has been seen as far south as the Naches District and is common on both the Okanogan and Colville NFs.

The ABLA2/RHAL Association is typified by cool, moist sites with deep, slow-melting snowpacks. Slopes are moderate to steep (17-68%) and aspects northerly, unless associated with riparian zones. Elevations are high.

Soils often have abundant coarse fragments in the surface horizons. Litter is very abundant. They are formed in a wide variety of parent materials, including tephra, ash and sandstone. Granite is prominent north of Entiat Ridge.

ABLA2/RHAL occupies somewhat colder, drier sites than the ABAM/RHAL Association. It grades into ABLA2/RHAL/LUHI at higher elevations and into the TSME Series in areas of deeper snowpack. Types such as ABLA2/VASC or ABLA2/CARU occur on drier slopes.

VEGETATION: Late seral and near climax stands are typically dominated by subalpine fir (in terms of individuals). Engelmann spruce is a long-lived seral dominant and increases in prominence with elevation (>5700 feet) and stand age. Individual spruce are significantly larger and longer lived than subalpine fir. Species such as western larch, white pine, Douglas-fir and lodgepole pine may be important components of younger stands, but diminish in importance as stands approach 200 years of age. Douglas-fir is restricted to the driest, warmest, low-elevation (<5300 feet) sites.

The undergrowth has a moderate to dense layer of Cascade azalea. Several other shrub species may be important and represent potential phases of ABLA2/RHAL. Big huckleberry was co-dominant with Cascade azalea on two plots. Grouse and low huckleberry had high cover on other stands. There are not enough plots to divide this type into finer Associations at this time. Herbs are poorly represented and no herbs occur in more than half of the plots.

PRODUCTIVITY/MANAGEMENT: Cold temperatures and heavy snow accumulations limit growth rates. Tree production information was available on six plots. These plots averaged 656 trees per acre and 242 sq. ft. total basal area. The average site index was 32, 33, 33 and 39 (base 50) for subalpine fir, lodgepole pine, Engelmann spruce and Douglas-fir (Appendix C). Subalpine fir and Engelmann spruce are adapted to nearly all sites. Engelmann spruce is suggested for higher elevation, wet, or very frosty sites. Lodgepole pine is adapted to all but the wettest sites. Western larch is restricted to warm sites. Douglas-fir is poorly suited to the type and should be considered only on the warmest and best drained sites. Although not usually a problem, shrubs can on occasion compete strongly with tree regeneration. Tree harvest may create swamps on gentler, wetter sites due to reduced evapo-transpiration. These swampy sites reforest very slowly. Ash soils can be compacted when wet. Selective harvest favors subalpine fir and predisposes stands to blowdown. Clearcutting is suggested even though this may increase snowpacks. Similar sites in northern Idaho have a high probably of success with natural regeneration (Cooper and others 1991).

Fires are relatively infrequent in these cold, moist sites. Stand ages and structures indicate very long fire intervals, but with most stands burning before they reached 300 years of age. Cascade azalea decreases with scarification or burning. Moderate burns may cause an increase in huckleberries, while scarification and soil disturbances normally reduce the cover and amounts of huckleberry species. One Colville ABLA2/RHAL plot burned in the White Mountain Fire (1987). It burned very intensely and most trees, shrubs and herbs were completely consumed. One year after the burn, there was little evidence of shrubs or herbs. Eight years later, Cascade azalea and grouse huckleberry were just becoming common in the stand (personal observations).

Many streams headwater in ABLA2/RHAL and watershed and recreation values are high. Moist conditions, heavy snowpacks and susceptibility of shrubs to mechanical damage makes these sites of limited value for recreation developments or trails.

Forage for livestock is low in natural stands. Six clipped plots averaged 79 pounds of herbage per acre (Appendix C). Some use is made of shade and water. Wildlife values are high because of the abundance of shrubs, some of which produce fruits. Elk wallows are common.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/RHAL and ABLA2/RHAL/LUHI are, respectively, the low- and higher-elevation parts of the ABLA2/RHAL Association described in the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) classifications. ABLA2/RHAL is very similar to lower elevation sites (with smooth woodrush absent or uncommon) in the broad ABLA2/RHAL Association described in the Wenatchee Draft (Williams and others 1991). It is somewhat similar to the ABLA2/MEFE Habitat Type described for northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977).

# ABLA2/RHAL/LUHI ASSOCIATION CES213

*Abies lasiocarpa/Rhododendron albiflorum/Luzula hitchcockii*

subalpine fir/Cascade azalea/smooth woodrush


## ENVIRONMENT

Elevation: 5140-6820 (5950) ft.

Aspect: north to east

Slope: 18-70 (46) %

Slope position: U, M, L 1/3

Special: moist soils, heavy snowpack

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 26 |
| PICO | lodgepole pine | 50 | 28 |
| PIEN | Engelmann spruce | 50 | 18 |
| PIAL | whitebark pine | 50 | 3 |
| LALY | subalpine larch | 33 | 1 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 9 |
| PIEN | Engelmann spruce | 50 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RHAL | Cascade azalea | 100 | 38 |
| VASC | grouse huckleberry | 67 | 7 |
| PYSE | sidebells pyrola | 67 | 2 |
| VAMY | low huckleberry | 50 | 35 |
| PHEM | red mountain heath | 50 | 2 |
| PAMY | pachistima | 33 | 7 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 100 | 6 |
| ARLA | broadleaf arnica | 67 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

The limited Wenatchee samples are located in the Entiat and Chelan Mountains. Three additional plots are located in the Pasayten Wilderness Area on the Okanogan NF. The type has been observed on the Colville NF. It is probably found at higher elevations throughout the Wenatchee and Okanogan NFs.

The climate of the ABLA2/RHAL/LUHI Association is characterized by short, cool summers and short growing seasons. Snowfall and snow accumulation surpass those of ABLA2/RHAL. Slopes are steep (>40%), on northerly aspects, with deep, slow-melting snowpacks. Sample plot elevations are high.

Soils are formed in a wide variety of parent materials. The Okanogan soils were derived from granite and the Wenatchee soils were derived from tephra and gneiss. Surface rock and coarse fragments are scarce to well-represented. Litter is very abundant.

Subalpine larch Associations may dominate rocky sites or convex micropositions within ABLA2/RHAL/LUHI stands. The Whitebark Pine Series may dominate southern exposures, while the Subalpine Larch Series may occur at higher elevations. ABLA2/RHAL/LUHI will grade into ABLA2/RHAL at lower elevations. TSME/RHAL occurs in areas with deeper snowpacks or a more maritime climate.

VEGETATION: Late seral and near climax stands are typically dominated by subalpine fir. Douglas-fir, western larch and white pine are usually absent. Engelmann spruce is a long-lived seral dominant and increases in prominence as stands age. It is especially prevalent in colder stands supporting subalpine larch and red mountain heath. Individual spruce are significantly larger than other tree species. Lodgepole pine is generally a seral dominant at lower elevations, but it diminishes in importance as stands exceed 100 years of age. It is apparently absent on colder sites that support subalpine larch and red mountain heath. Because Engelmann spruce and subalpine fir are capable of forming closed canopies, subalpine larch and whitebark pine are both seral trees. Whitebark pine is less frequent on these shady aspects, compared to adjacent south slopes supporting ABLA2/VASC/LUHI. Subalpine larch may drop to unusually low elevations on these sites. Both subalpine larch and whitebark pine are long-lived and will remain as scattered, large trees in old stands of subalpine fir and spruce.

The undergrowth typically has a dense layer of Cascade azalea, but other shrubs such as grouse huckleberry and low huckleberry may also be well represented. Pachistima may be common following wildfire on warmer sites, while red mountain heath is common on colder sites. The herb layer is not diverse (except in wet areas that will be described as ABLA2/RHAL/SETR in the riparian classification; Kovalchik 1993). Smooth woodrush is common. Other herbs include broadleaf arnica and Sitka valerian.

PRODUCTIVITY/MANAGEMENT: Cold temperatures and heavy snow accumulations limit growth rates. Production data is available from two plots that averaged 363 trees per acre and 180 sq. ft./ac. total basal area. The site index for subalpine fir and lodgepole pine averaged 39 and 41 feet (base 50), respectively (Appendix C). Lodgepole pine is restricted to warmer sites. Western larch, Douglas-fir, and western white pine are poorly suited to the type. Engelmann spruce is best adapted to cold, moist, or very frosty sites. High water tables are common in the vicinity of springs and riparian areas, and tree harvest may increase wet areas due to reduced evapo-transpiration. These swampy zones reforest very slowly. Ash soils can be compacted when wet. Partial removal of trees, whether natural or man-caused, will predispose stands to blowdown. Overstory removal will increase snowpacks.

These sites lie in zones of frequent lightning strikes. However, due to the moist nature of these stands, stand-replacement fires are unusual. Stand ages and structures indicate that most stands burn before reaching 300 years of age. Cascade azalea decreases with burning. Moderate burns may cause an increase in huckleberries. Intense fires may totally consume the duff layer and the roots of the shrubs and herbs.

ABLA2/RHAL/LUHI sites lie in zones that have high watershed and scenic values. However, recreationists seldom visit these steep, brushy sites, except along trails. Moist conditions and heavy snowpacks make them of limited value for recreation developments such as campsites or trails.

Wildlife values are high because of the abundance of shrubs, some of which produce fruits. Elk wallows may be common. Forage for livestock is poor in natural stands. Two clipped plots averaged 61 pounds of herbage per acre (Appendix C). Some use is made of this type for shade and water.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/RHAL/LUHI plots were located in the upper elevations of the ABLA2/RHAL Association described in the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs' classifications and the Wenatchee Draft (Williams and others 1991). It is somewhat similar to the ABLA2/LUHI Habitat Type, MEFE Phase, described for northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977).

# ABLA2/RULA ASSOCIATION CES423

*Abies lasiocarpa/Rubus lasiococcus*

subalpine fir/dwarf bramble

*Dwarf bramble (RULA), an indicator of the ABLA2/RULA type.*

## ENVIRONMENT

Elevation: 2580-5420 (5041) ft.

Aspect: east to west

Slope: 7-55 (22) %

Slope position: ridge, U, M 1/3, toeslopes

Special: old, windy, snow accumulation

## VEGETATION SUMMARY

(Sample size: 12)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PSME | Douglas-fir | 83 | 16 |
| ABLA2 | subalpine fir | 75 | 28 |
| PICO | lodgepole pine | 67 | 20 |
| PIEN | Engelmann spruce | 67 | 11 |
| ABGR | grand fir | 58 | 9 |
| PIMO | western white pine | 42 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 92 | 12 |
| ABGR | grand fir | 67 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| RULA | dwarf bramble | 100 | 20 |
| PAMY | pachistima | 100 | 3 |
| PYSE | sidebells pyrola | 73 | 3 |
| VASC | grouse huckleberry | 50 | 14 |
| VAME | big huckleberry | 50 | 7 |
| CHUMO | western prince's pine | 50 | 2 |
| VAMY | low huckleberry | 33 | 14 |
| **HERBS** | | | |
| POPU | skunkleaf polemonium | 83 | 5 |
| ARLA | broadleaf arnica | 73 | 13 |
| VIOR2 | round-leaved violet | 42 | 3 |
| CAGE | elk sedge | 42 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

Most of the Wenatchee plots are located in the upper reaches of the Naches River and along Manastash Ridge. ABLA2/RULA was also sampled on the Cle Elum and Lake Wenatchee Districts.

Elevations of most sample plots ranged from 4700 to 5400 feet. One unusual, low-elevation plot (2580 feet) was located in a cold air drainage along the Chiwawa River. Most plots lie on mid to upper slope positions and wind is an important influence on stand development. Many trees have forked tops and field notes mention wind shear damage to stands. Soil moisture is good, based on the abundance of moist site herbs. Slopes are gentle to moderate, with east to west aspects.

Soils are formed in basalts, or andesite flows with tephra. Tills and outwash from mountain glaciation are also important in the Raven's Roost area. Sites often have considerable microsite variation, in part from the complex pattern of basalt dikes inter-fingering with tephra deposits. Coarse fragments are not abundant. Litter is abundant.

The forb layer indicates sites are somewhat similar to the ABLA2/LUHI Association, except ABLA2/RULA sites appear to be more moist and at slightly lower elevations. It is also similar to ABLA2/ARLA-POPU. More maritime sites may be in the ABAM/RULA or TSME/RULA types.

VEGETATION: Successional patterns are not fully understood, but late seral or near climax stands will apparently be dominated by subalpine fir in the overstory and tree regeneration layers. The oldest stand had relict western larch nearly 500 years old. Younger stands are often dominated by lodgepole pine. Most of the associated lodgepole pine and subalpine fir were between 80 and 120 years old. If fire has been absent for hundreds of years, late seral or near climax stands would be dominated by subalpine fir and Engelmann spruce in the overstory and tree regeneration layers, with scattered relicts of long-lived fire-tolerant species such as western larch, Douglas-fir and western white pine. If perturbations have been absent for centuries, subalpine fir will be virtually the only species present. Stand-replacement fire intervals of less than 200 years favor development of dense stands of lodgepole pine.

Dwarf bramble is the characteristic subshrub species. Other shrubs that may be abundant in early to mid seral stands include pachistima and big, low, and grouse huckleberry. The huckleberries diminish in cover and vigor as stands become more densely shaded through time, until only very shade-tolerant species such as dwarf bramble remain. Common herbs include skunk-leaved polemonium, broadleaf arnica, heartleaf arnica and white hawkweed. These appear to show a similarity between ABLA2/RULA and the ABLA2/LUHI and ABLA2/ARLA-POPU Associations. Moist swales may support such moisture-loving shrubs and herbs as Sitka alder, false bugbane, ladyfern and American false hellebore. These moist swales represent different habitats than ABLA2/RULA and better fit types that will be described in the riparian classification (Kovalchik 1993).

PRODUCTIVITY/MANAGEMENT: Eight intensive plots indicate moderately high timber production. The site index for subalpine fir, lodgepole pine, Engelmann spruce and Douglas-fir averaged 57, 54, 57 and 82 feet (base 50)(Appendix C). These stands averaged 534 trees per acre and a relatively high 301 sq. ft./ac. total basal area. Snow packs are deep and deforestation may lead to development of meadows that persist for years. This may be especially true on steep southerly slopes. Sites on more sheltered aspects are easier to reforest, and tree establishment and growth is rapid. However, most stands have trees with forked tops or other signs of crown damage. Ice, wind or snow appear to be the damaging agents. Charred bark and fire scars are common and some individuals have rotten centers.

Most of common herbs are relatively unpalatable to livestock. Herbage production appears low. Seven clipped plots averaged 76 pounds of herbage per acre (Appendix C). It appears that grazing has not had a significant impact on these sites, except for local damage where livestock use the type for cover and shade.

These sites are important for wildlife cover as well as forage, and the shrub and herb layers may be altered by elk grazing pressure. Elk trails, beds, and other sign were common in or near the plots. Moist microsites may also be used for wallows. Big, low, and grouse huckleberry may be abundant in early seral stands, providing forage and cover for a wide variety of wildlife.

The ABLA2/RULA Association is of limited value for recreation developments because of moist soils, high elevation, and vegetation that is easily damaged by trampling. Huckleberries are well represented and attract berry pickers.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The ABLA2/RULA Association has not been described in other classifications.

# ABLA2/VADE ASSOCIATION CES341

*Abies lasiocarpa/Vaccinium deliciosum*

subalpine fir/Cascade huckleberry

*Cascade huckleberry (VADE), an indicator of the ABLA2/VADE Association.*

## ENVIRONMENT

Elevation: 4700-6240 (5733) ft.

Aspect: east to west

Slope: 8-53 (27) %

Slope position: toe slopes to ridges

Special: cold, moist, maritime climate

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 30 |
| PIAL | whitebark pine | 33 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 9 |
| PIAL | whitebark pine | 33 | 1 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VADE | Cascade huckleberry | 100 | 24 |
| PHEM | red mountain heath | 83 | 21 |
| PAMY | pachistima | 50 | 3 |
| LUPE | partridgefoot | 50 | 1 |
| RULA | dwarf bramble | 33 | 14 |
| CAME | Mertens' moss-heather | 17 | 8 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 50 | 41 |
| HIGR | slender hawkweed | 50 | 1 |
| CAGE | elk sedge | 33 | 8 |
| VASI | Sitka valerian | 33 | 5 |
| POPU | skunkleaf polemonium | 33 | 1 |
| DEAT | mountain hairgrass | 33 | 1 |

## DISTRIBUTION AND ENVIRONMENT:

The ABLA2/VADE Association is found along the more maritime portions of the Cascade Crest from the Naches District north to the Canadian border. Plots were located in the Lake Wenatchee and Leavenworth Districts and near Rainy Pass on the Okanogan NF. The data are somewhat limited, but work is continuing in high elevation subalpine fir habitats. ABLA2/VADE is widely distributed in the relatively broad maritime areas associated with the Wenatchee NF, but on the Okanogan NF it is restricted to the immediate vicinity of the Cascade Crest.

The type is at or above the continuous treeline and it and associated forest communities form woodlands, parklands or islands of trees. The lowest sample plot (4700 ft.) was located in an area of extreme maritime influence near Stevens Pass. ABLA2/VADE occurs on all aspects and on all but the steepest slopes.

The regolith is largely composed of glacial till and drift formed in basalt and granitic rock types, including granodiorite. Granite is most prominent north of Entiat Ridge, while basalt is common to the south. Soils appear to be poorly developed. Coarse fragments, surface rock, litter and bare soil are well represented to abundant.

ABLA2/VASC/LUHI occurs on drier slopes, while ABLA2/RHAL/LUHI may occur on very steep north slopes. The LALY Series occurs at higher elevations and the PIAL Series on more severe, southerly exposures. The TSME Series occurs in more maritime climates or in zones of higher snowpack.

VEGETATION: ABLA2/VADE canopies range from open parklands to closed canopies. The open parklands are dominated by subalpine fir, sometimes mixed with small amounts of mountain hemlock, subalpine larch or whitebark pine. Here, the undergrowth is characterized by Cascade huckleberry and red mountain heath, with small amounts of Mertens' moss-heather and partridgefoot. More moderate sites support relatively dense canopies of subalpine fir, and other conifers are more or less absent, at least in the stands. Here, Cascade huckleberry and smooth woodrush are abundant and the previously mentioned indicators scarce. Two sites were initially assigned to ABLA2/VADE-CAME and ABLA2/VADE/LUHI types following initial analysis, but were later lumped because of insufficient plot numbers. They may be identified in later versions of the classification after more plots are sampled. Pachistima was well represented on two of the drier sites, while dwarf bramble was abundant on one of the smooth-woodrush-dominated sites. Herbs include mountain hairgrass, Sitka valerian and slender hawkweed.

Arno and Habeck (1972) state that red mountain heath indicates sites poor in ions of magnesium and calcium.

PRODUCTIVITY/MANAGEMENT: There are no timber production data available for ABLA2/VADE. Stocking is usually somewhat open, but may be relatively dense in some islands of trees. Harsh sites with cold temperatures and heavy snow accumulation limit growth rates. No known silvicultural techniques will assure tree regeneration. After deforestation, sites may remain in a shrub meadow condition for decades. Productivity is presumed low in the mountain heath variant and moderate in the woodrush variant.

ABLA2/VADE sites are very important for watershed and scenic values. The tree canopy is essential to preserving snowpack, and melting snow from this zone is important to stream maintenance. The sites also provide important forage for wildlife, including blue grouse, ptarmigan, mountain goats, pika and deer. They are favorite areas for berry pickers, hikers, backpackers and horsemen.

ABLA2/VADE stands lie in zones of very frequent lightning strikes. However, stand-replacement fires are rare in the more open stands, identified by the presence red mountain heath. Crown fires are likely somewhat more common in the closed stands with woodrush. In addition, communities in this zone are often interrupted by areas of meadow, riparian conditions and cliff, talus and rock that further restrict the spread of canopy fires. Most fires are restricted to the immediate vicinity of the lightning-struck tree.

Presumably, *Armillaria* root rot will be found in these stands. It is much more likely to occur in closed stands with woodrush.

Cascade huckleberry is moderately resistant to damage by trampling, and severe damage is unusual. Heaths and moss-heathers are very sensitive to trampling. If sites have been denuded of vegetation, they will heal slowly and establishment of tree, shrub and herb cover may take decades. Partridgefoot is the native species that appears best able to colonize disturbed areas on mountain heath sites, while woodrush is probably the best colonizer on woodrush variants. Mountain hairgrass, skunkleaf polemonium, arnicas, asters, lupines and pussytoes are native herbs that may also be useful in revegetation efforts.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/VADE has not been described in previous classifications because the various authors described very broad timberline types. Plots belonging to ABLA2/VADE were not sampled on the Wenatchee and Okanogan NFs until recent excursions into the high country. Wooten and Morrison (unpublished draft) have identified ABLA2/VADE parklands in the North Cascades.

# ABLA2/VASC *WEN* ASSOCIATION CES426

*Abies lasiocarpa/Vaccinium scoparium*

subalpine fir/grouse huckleberry

## ENVIRONMENT

Elevation: 3300-6230 (5048) ft.

Aspect: all aspects

Slope: 6-55 (19) %

Slope position: benches, <u>mid</u>, <u>upper</u>, <u>ridges</u>

Special: cold, dry , shallow soils

## VEGETATION SUMMARY

(Sample size: 11)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PICO | lodgepole pine | 91 | 26 |
| ABLA2 | subalpine fir | 73 | 10 |
| PSME | Douglas-fir | 36 | 26 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 91 | 9 |
| PICO | lodgepole pine | 64 | 2 |
| PSME | Douglas-fir | 45 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VAMY | low huckleberry | 73 | 22 |
| PAMY | pachistima | 45 | 4 |
| SPBEL | shiny-leaf spirea | 45 | 3 |
| VASC | grouse huckleberry | 36 | 34 |
| **HERBS** | | | |
| CACO | northwestrn sedge | 27 | 3 |
| ARLA | broadleaf arnica | 27 | 2 |
| GOOB | w. rattlesnake plantain | 27 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

The ABLA2/VASC Association occurs throughout the Wenatchee and Okanogan NFs. Seven Wenatchee plots were located on the Manastash, Wenatchee, Entiat and Chelan Mountains. Four plots were borrowed from Okanogan data. ABLA2/VASC is also present in higher mountains on the Colville NF.

ABLA2/VASC is typified by cold, relatively dry sites. Most plot elevations ranged from 4300 to almost 6000 feet on slopes, but followed cold drainages down to 3300. Most plots were on northeast or southwest aspects. This is likely an aberration of plot distribution and not a difference between ecological areas. The type should occur on all aspects. Slopes were gentle in valley bottoms and moderate in uplands.

Soils are cold, shallow, droughty and poorly developed. Coarse fragments and litter are usually abundant. Parent materials were largely granite north of Entiat Ridge and schist, cinders and gneiss to the south.

ABLA2/VASC is usually bounded on steep north slopes by ABLA2/RHAL. ABLA2/VASC/CARU or ABLA2/CARU occur on warmer slopes, while ABLA2/VASC/ARLA occupies moist sites. Drier, windy, and otherwise harsh sites may support the PSME or PIAL Series.

VEGETATION: Late seral or near climax stands are unusual. Species compositions and successional patterns indicate that subalpine fir increases in importance as stands age and it typically dominates the regeneration layer in older stands. Engelmann spruce is largely absent on these relatively dry sites. Succession to a subalpine fir climax is slow and most stands burn before reaching 200 years of age. Lodgepole pine is the most common tree and dominates most stands. Sites are generally too harsh for western white pine and western larch. Douglas-fir is found on warmer sites.

The undergrowth is floristically poor. Low or grouse huckleberry, or both, are the dominant, characteristic shrubs. There is considerable debate on whether low huckleberry is an ecological equivalent to big or grouse huckleberries. Generally, low huckleberry has a rather wide elevational range and appears to occupy sites intermediate between grouse and big huckleberry. Big huckleberry represents moderate environments and is not common on sites above 5000 feet, while grouse huckleberry is prominent in harsher, colder environments, flourishes in various high-elevation Associations, and may be found at elevations well in excess of 7000 feet. Low huckleberry is often associated with big huckleberry zones, but also continues with grouse huckleberry to elevations exceeding 7500 feet. In fact, in some areas (such as the Alpine Lakes Wilderness Area) low huckleberry is the prominent huckleberry all the way to the edge of the alpine zone at roughly 7500 feet (recent observations and samples). Other shrubs are relatively uncommon. Herbs are minor components of most stands, except in early seral stages. The most constant herbs are broadleaf arnica, western rattlesnake plantain, northwestern sedge and sidebells pyrola.

PRODUCTIVITY/MANAGEMENT: Timber production is moderate. Two intensive plots averaged 358 trees per acre and 214 sq. ft./ac. total basal area (Appendix C). The average site index for western larch and Douglas-fir was 41 and 64 (base 50). After overstory removal, frost pockets often develop. Frost may occur any day of the year, either from re-radiation cooling or cold air ponding. Lodgepole pine is the most reliable species for timber management, although Douglas-fir and western larch perform well on warmer sites. Clearcutting and burning are not an ecological substitute for the crown fires typical of the Association. Snags give protection from the sun and frost. Burned areas often have excessive regeneration, but harvest units may have little or none. Most roots are concentrated in the upper 20 cm. or less of soil, suggesting low nutrient availability. Disturbance or removal of the upper soil horizons will greatly reduce productivity. Soil scarification may increase frost heaving. Shallow soils can be easily displaced. Stocking level control is needed to maintain reasonable growth rates on lodgepole pine. Unmanaged lodgepole stands often quickly stagnate, so thinning before stagnation is necessary to insure good response.

Fire is typically infrequent but may be catastrophic when it occurs. Stands dominated by lodgepole will often burn hot because of the flammable nature of the trees and the fuels they create. Stands without lodgepole should burn less frequently and have some potential for creeping ground fires.

Natural stands produce relatively little forage for ungulates. Two clipped plots averaged 27 pounds of herbage per acre (Appendix C). Dense lodgepole pine stands in this type are important components of Canadian lynx habitat because of the relative abundance of snowshoe hares. Grouse huckleberry is sensitive to mechanical or trampling damage, so this type is a poor choice for campgrounds if the natural vegetation is to be maintained.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/VASC is widespread. It was described in the Colville (Williams and others 1990) and Okanogan (Williams and Lillybridge 1983) NF classifications, as well as on the Colville Indian Reservation (Clausnitzer and Zamora 1987). It is also described in north Idaho (Cooper and others 1991), Montana (Pfister and others 1977), and northeast Oregon (Johnson and Clausnitzer 1992).

# ABLA2/VASC/ARLA ASSOCIATION CES424

*Abies lasiocarpa/Vaccinium scoparium/Arnica latifolia*

subalpine fir/grouse huckleberry/broadleaf arnica

## ENVIRONMENT

Elevation: 4830-6080 (5399) ft.

Aspect: west to east

Slope: 7-66 (32) %

Slope position: ridges, U, M 1/3

Special: cool, shallow, moist soils

## VEGETATION SUMMARY

(Sample size: 16)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PICO | lodgepole pine | 100 | 27 |
| ABLA2 | subalpine fir | 75 | 20 |
| PSME | Douglas-fir | 50 | 16 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 100 | 17 |
| PICO | lodgepole pine | 25 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 88 | 6 |
| VAMY | low huckleberry | 75 | 16 |
| VASC | grouse huckleberry | 56 | 10 |
| **HERBS** | | | |
| POPU | skunkleaf polemonium | 81 | 5 |
| CAGE | elk sedge | 63 | 13 |
| LUPIN | lupines | 56 | 11 |
| ARLA | broadleaf arnica | 56 | 4 |
| CARU | pinegrass | 31 | 12 |

## DISTRIBUTION AND ENVIRONMENT:

The ABLA2/VASC/ARLA Association is common on the Wenatchee NF. It has not been sampled on the Okanogan NF. The plots were located on the Entiat, Chelan, Wenatchee and Manastash Mountains, and the type occurs on all Districts. It is generally located on moist sites in drier portions of the Forest.

ABLA2/VASC/ARLA is typified by cool, moist slopes at moderately high elevations. Elevations range from 4800 to over 6000 feet but average nearly a thousand feet lower than ABLA2/VASC/LUHI. Slopes are gentle to steep. Most sample plots were on west to east aspects.

Most soils are formed in ash or pumice over basalt, granite, tephra and schist. Surface coarse fragments range from well represented to abundant. However, soils are probably moister, deeper, less stony and finer textured than ABLA2/VASC. Litter is abundant.

ABLA2/VASC is found on drier sites, ABLA2/VASC/CARU on warmer sites, while ABLA2/RHAL occurs on steep north aspects. Drier, warmer sites may support the PSME/CARU or ABLA2/CARU types.

VEGETATION: Sample plots ranged from mid seral stands dominated by lodgepole pine to subalpine fir climax. Late seral or near climax stands are not as rare as in ABLA2/VASC and ABLA2/VASC/CARU, reflecting moister sites with longer intervals between stand-replacement fires. Species composition and successional patterns indicate that subalpine fir increases in importance as stands age. Subalpine fir dominates the regeneration layer in older stands. Succession to a subalpine fir climax is moderately slow, yet some of our stands exceed 200 years of age. For some reason, Engelmann spruce is absent in the plot data. It should occur on these relatively cool moist sites. Lodgepole pine dominates many early to mid seral stands. Western larch and western white pine are common in a few plots. Douglas-fir is found on warmer sites. Whitebark pine and subalpine larch are absent.

The undergrowth represents slightly warmer and slightly moister sites than ABLA2/VASC. Grouse or low huckleberry, or both, are at least well represented. Pachistima was common in many plots, especially young stands of fire origin.

Skunkleaf polemonium and broadleaf arnica are the characteristic herbs. Other herbs include lupines, broadleaf arnica, and elk sedge. Pinegrass is absent on most plots. These cool, moist herbs show a close relationship to the ABLA2/ARLA-POPU and ABLA2/VASC/LUHI Associations.

PRODUCTIVITY/MANAGEMENT: Timber production is moderate. Seven intensive plots averaged 1075 trees per acre and 255 sq. ft./ac. total basal area (Appendix C). Site index values for subalpine fir, western larch, lodgepole pine and Douglas-fir are 31, 51, 47 and 41 feet (base 50). Frost pockets often develop after overstory removal. Frost may occur any day of the year, either from re-radiation cooling or cold air ponding. Lodgepole pine is the most reliable species for timber management. Douglas fir does well on warmer sites. Clearcutting and burning are not an ecological substitute for the stand-replacement fires typical of the Association. Snags give protection from sun and frost. Burned areas often have excessive regeneration, but harvest units may have little or none. Maintaining dead shade, snags or slash will help reduce radiation cooling. Most roots are concentrated in the upper 20 cm. or less of soil, suggesting low nutrient availability. Disturbance or removal of the upper soil horizons will greatly reduce productivity as well as stimulate the growth of pinegrass or elk sedge sod. Soil scarification may increase frost heaving and displacement of the shallow, moist soils. Stocking level control is needed to maintain reasonable growth rates on lodgepole pine.

Fire is typically infrequent, but may be catastrophic when it occurs. Stands dominated by lodgepole pine will often burn hot because of the flammable nature of those trees and the fuels they create. Stands without lodgepole should burn less frequently and have some potential for creeping ground fires.

Natural stands produce low to moderate forage for ungulates. Seven clipped plots averaged 106 pounds of herbage per acre(Appendix C). Grass seeding with standard pasture mixes is usually very successful, especially if combined with fertilizer, but may hinder reestablishment of native plants. Dense lodgepole pine stands in this type are important components of Canadian lynx habitat because of the relative abundance of snowshoe hares. Grouse and low huckleberry are sensitive to mechanical or trampling damage and, when combined with moist soils, make this type a poor choice for campgrounds if natural vegetation is to be maintained.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/VASC/ARLA is the dry end of the ABLA2/ARLA-CAGE described in the Wenatchee Draft (Williams and others 1991). It has not been described elsewhere.

# ABLA2/VASC/LUHI ASSOCIATION CES425

*Abies lasiocarpa/Vaccinium scoparium/Luzula hitchcockii*

Subalpine fir/grouse huckleberry/smooth woodrush

## ENVIRONMENT

Elevation: 5200-7120 (6026) ft.

Aspect: all aspects

Slope: 2-43 (18) %

Slope position: ridge, U, M 1/3

Special: cold, heavy snowpack

## VEGETATION SUMMARY

(Sample size: 10)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 80 | 28 |
| PIEN | Engelmann spruce | 70 | 16 |
| PIAL | whitebark pine | 50 | 10 |
| PICO | lodgepole pine | 50 | 26 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 90 | 9 |
| PIAL | whitebark pine | 50 | 3 |
| PIEN | Engelmann spruce | 50 | 3 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 100 | 25 |
| VAMY | low huckleberry | 30 | 12 |
| RULA | dwarf bramble | 20 | 28 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 100 | 10 |
| LUPIN | lupines | 90 | 13 |
| POPU | skunkleaf polemonium | 90 | 5 |
| ARLA | broadleaf arnica | 70 | 12 |
| VASI | Sitka valerian | 60 | 6 |
| CAGE | elk sedge | 60 | 3 |

## DISTRIBUTION AND ENVIRONMENT:

Seven sample plots were located on the Naches and Cle Elum Districts. Three additional plots were located in the Pasayten Wilderness Area. The ABLA2/VASC/LUHI type has been observed on all Districts on the Okanogan and Wenatchee NFs. It occurs on the Colville NF, but has not been described.

The climate of ABLA2/VASC/LUHI is characterized by short, cool summers, moderately deep snowpacks, and short growing seasons. Plot elevations ranged from 5200 to over 5900 feet on the Wenatchee NF and 6500 to 7120 feet on the Okanogan. It occurs on gentle to moderately steep mid and upper slopes and ridges on all aspects.

Soils are cold, shallow, droughty and poorly developed. Parent materials are largely rocks of volcanic origin on the south end of the Wenatchee NF and granites north of the Entiat Ridge. Soil coarse fragments and surface litter are usually abundant.

ABLA2/VASC/LUHI is at higher elevations, cooler, and has deeper snowpacks when compared to ABLA2/VASC. Moist, north aspects support ABLA2/RHAL/LUHI. Drier, more wind-exposed sites may support the PIAL Series. ABLA2/VASC/CARU occurs on warmer, lower elevation sites. Higher elevation sites often support the PIAL and LALY Series.

VEGETATION: Late seral or near climax stands are unusual, but are typically dominated by subalpine fir and Engelmann spruce, which also typically dominate the regeneration layer. Succession to subalpine fir or Engelmann spruce climax is slow and most stands burn before they are 200 years old. Engelmann spruce is a long-lived seral dominant that increases in importance as stands age. Individual spruce are generally larger than other species, and species composition and successional patterns indicate that it increases in importance as stands age. Sites are generally too harsh for Douglas-fir, western white pine and western larch. Lodgepole pine is a seral dominant at lower elevations but diminishes in importance as stands exceed 100 years of age, and in colder stands where whitebark pine is well represented. Whitebark pine is also a seral dominant on many of the plots, especially at higher elevations. This long-lived tree will remain as scattered, large trees in old stands of subalpine fir and spruce. It is sometimes difficult to distinguish the boundary between ABLA2/VASC/LUHI and PIAL/VASC/LUHI. Stands of PIAL/VASC/LUHI are similar in species composition, but the canopy stays open, allowing permanent dominance by whitebark pine.

Grouse huckleberry or low huckleberry, or both, are the dominant, characteristic shrubs. Shrubs other than grouse or low huckleberry are relatively uncommon. Dwarf bramble was well represented in three plots that are transitional to ABLA2/RULA. Smooth woodrush is common to well represented, but if absent or uncommon, whitebark pine helps identify the type. Other herbs include skunkleaf polemonium, broadleaf arnica, Sitka valerian and elk sedge. These forbs indicate a relatively moist site that has similarities with the ABLA2/VASC/ARLA and ABLA2/ARLA-POPU Associations.

PRODUCTIVITY/MANAGEMENT: Cold temperatures, deep snow and a short growing season limit growth rates and regeneration success. Timber production data are limited. Three intensive plots averaged 514 trees per acre and 189 sq. ft./ac. total basal area (Appendix C). The average site index for subalpine fir and lodgepole pine were both 42 feet (base 50).

Fire is typically infrequent, but may be catastrophic when it occurs. Stands dominated by lodgepole will often burn hot because of the flammable nature of those trees and the fuels they create. Stands without lodgepole should burn less frequently, and have some potential for creeping ground fires.

ABLA2/VASC/LUHI lies in zones that have high watershed and scenic values. The relatively open nature of the stands and their low undergrowth make them favorite recreation areas, as well as good sites for trails. However, grouse and low huckleberry are sensitive to mechanical or trampling damage, so the type is a poor choice for campgrounds. Smooth woodrush is moderately tolerant of trampling. Dense, lower-elevation lodgepole pine stands may be important components of Canadian lynx habitat because of the relative abundance of snowshoe hares. Whitebark pine is prevalent at higher elevations, where its seeds are important food for Clark's nutcrackers, grizzly bears and squirrels. The berries of huckleberries are important food for birds and mammals.

Natural stands produce moderate forage for ungulates. Three clipped plots averaged 201 pounds of herbage per acre. Most stands in ABLA2/VASC/LUHI lie outside existing grazing allotments. When grazed, damage is largely associated with livestock trailing and bedding.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: ABLA2/VASC/LUHI lies in the upper elevations of the ABLA2/VASC Association described in previous eastern Washington classifications (Williams and others 1991; Williams and Lillybridge 1983; Williams and others 1990). It is similar to the ABLA2/LUHI Association, VASC phase, described for northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977). A similar ABLA2/VAMY/LUHI community is described in the Enchantment Lakes Basin (del Moral unpublished draft).

# MISCELLANEOUS SUBALPINE FIR ASSOCIATIONS

(less than 5 Wenatchee sample plots)

## ABLA2/LIBOL *WEN* CEF222

The ABLA2/LIBOL Association is represented by one plot on the Wenatchee NF located on Manastash Ridge on the Cle Elum District. The data are supplemented with eight plots borrowed from the Twisp District. The type described in this Guide differs from the ABLA2/LIBOL type in the Okanogan NF classification. As described here, ABLA2/LIBOL describes moist stands with twinflower well represented. It is probably most common north of the Entiat Mountains. The type occurs mostly on lower, north slopes, but may also occur on toeslopes, benches and river terraces with different aspects. Slopes are usually less than 30%. Soils are relatively deep, moist, and well-drained. Coarse fragments range from uncommon to abundant. Surface rock is uncommon, while litter is very abundant. The regolith on the Okanogan plots is generally glacial material derived from granite. Stand composition and known successional relationships indicate that mature stands are characterized by Engelmann spruce and subalpine fir dominating both the overstory and understory. Engelmann spruce is often the major tree in older stands, while early to mid seral stands are dominated by western larch, lodgepole pine and Douglas-fir. Larch and Douglas-fir are long-lived and may persist for centuries over an understory dominated by subalpine fir and spruce. Regeneration is often sparse, apparently because of the dense shade characteristic of many stands. The undergrowth is characterized as sparse, and is composed mainly of shrubs and subshrubs such as twinflower, pachistima, prickly current or sidebells pyrola. Low huckleberry is prominent on several plots. The exact composition of the shrubs depends on stand history, stand density, and the type, timing and amount of disturbance. The herb layer is also sparse, and includes species such as pinegrass, western rattlesnake plantain, white hawkweed and strawberries.

## ABLA2/PAMY *WEN* CES113

Two plots were located on the Entiat District of the Wenatchee NF. Nine additional plots were borrowed from Okanogan data in the Twisp River drainage. The ABLA2/PAMY Association has been observed north of Lake Chelan and is very common in the Twisp River Drainage of the Okanogan NF. Additional field work may confirm that it is common on the Chelan and Entiat Districts. It may not occur south of the Entiat Mountains. ABLA2/PAMY represents one of the warmest habitats in the Subalpine Fir Series. Elevations range from under 2800 feet on north aspects to more than 5700 feet on warm south to west slopes. Most slopes are moderate, but some sites have slopes over 50%. Surface rock and soil coarse fragments range from common to abundant. Litter is abundant. Some sites may have a surface layer of fine pumice or coarse volcanic ash. The stands are often difficult to tell from PSME/PAMY stands, especially when Douglas-fir dominates and subalpine fir is poorly represented. Some ABLA2/PAMY stands with weak subalpine fir may be misclassified as PSME/PAMY. Late seral or near climax compositions must be based on current species compositions and successional dynamics in the tree strata. Subalpine fir is the most shade-tolerant species on the site and is the indicated climax species. Subalpine fir dominates the tree regeneration layer in the oldest stands. Engelmann spruce, Douglas-fir, lodgepole pine, western white pine, quaking aspen and ponderosa pine may form part of the tree sere. This and the ABLA2/PAMY/CARU type are the only Associations in the Subalpine Fir Series in which ponderosa pine is more than a minor stand component, but this occurs only on the warmest sites. The undergrowth is a mixture of shrubs. Pachistima is often abundant and may exceed two feet or more in height. Other shrubs rarely dominate stands, but include shiny-leaf spirea, Scouler willow, serviceberry, russet buffaloberry, big huckleberry and baldhip rose. The herbaceous layer is sparse. Only sidebells pyrola is present in more than half of the plots.

## ABLA2/PAMY/CARU CES112

Two ABLA2/PAMY/CARU plots were sampled on the Wenatchee NF, in the Sawtooth and Entiat Mountains. An additional four plots were borrowed from Okanogan data in the Twisp River drainage. This type is common on the Okanogan NF. Additional field work may confirm that it is also common on the Chelan and Entiat Districts, but it may not occur south of the Entiat Mountains. This type represents one of the warmest habitats in the Subalpine Fir Series. Elevations range from under 2800 feet on north aspects to more than 5700 feet on warm south to west slopes. Slopes are gentle to moderate. Sites are most often on mid and upper slopes. On the Okanogan, soils are typically formed in sedimentary deposits, often in glacial outwash or glacial till. Many sites also have a surface layer of fine pumice or coarse volcanic ash. Coarse fragments and surface rock range from common to abundant. Litter is often abundant. Late seral or climax compositions must be based on current species compositions and successional dynamics in the tree strata. Subalpine fir is the most shade-tolerant species capable of reproducing on the sites, and is the indicated climax species. The site may be too warm and dry for Engelmann spruce. Douglas-fir, lodgepole pine and ponderosa pine may form part of the tree sere. This and the ABLA2/PAMY Association are the only types in the Subalpine Fir Series warm enough for ponderosa pine to be more than a minor stand component. Most stands contain a variety of conifers, most of which are capable of dominating, depending on age, disturbance history and seed sources. Pachistima is often abundant and over two feet tall. Other shrubs include Scouler willow, shiny-leaf spiraea, serviceberry, big huckleberry and Douglas maple. Pinegrass is well represented. Of other herbs, only sidebells pyrola and western prince's pine are present in half of the plots.

## ABLA2/TRCA3 CEF422

This type is common on the east half of the Okanogan NF and on all of the Colville NF (Kovalchik 1993; Williams and others 1990; Williams and Lillybridge 1983). Only one of the three plots assigned to this type in the Wenatchee Draft remain in this Association. ABLA2/TRCA3 is reported here only because it was described in the Wenatchee Draft, and may be reported in the Wenatchee NF riparian classification. Sites are typically at moderately high elevations, within narrow stringers along streams, and in swales. Soils are seasonally saturated. Young stands are usually dominated by lodgepole pine, while subalpine fir dominates old stands. The undergrowth is characteristically dominated by false bugbane and other moisture-loving herbs.

## ABLA2/VACA CES422

This type is common on the Okanogan and Colville NFs (Kovalchik 1993; Williams and others 1990), but has not been sampled on the Wenatchee NF. It has been reported from the Lake Chelan District. It is associated with gentle slopes and cold air drainage on glacial outwash terraces slopes. Young stands are usually dominated by lodgepole pine and western larch. We have few old stands, but stand composition and seral relationships suggest they will be dominated by subalpine fir and Engelmann spruce. Dwarf huckleberry characterizes the undergrowth. Bearberry can be used as an indicator only if the site is associated with cold air drainage. Other common shrubs and herbs include twinflower, low and grouse huckleberry, pachistima and pinegrass. Sites with bunchberry dogwood or five-leaved bramble key to ABLA2/COCA.

## ABLA2/VAME *WEN* CES342

Three plots were sampled in the Entiat Mountains. An additional three plots were borrowed from Okanogan data. The type should be somewhat common on the Lake Chelan, Lake Wenatchee and Entiat Districts, but its status further south is unknown. It is also found on the Okanogan and Colville NFs. The site is typified by cool, moderate sites within the Subalpine Fir Series. Elevations ranged from 2950 feet on a northeast slope to 4810 feet on a west slope. Most of the sample plots are on moderate to steep slopes on east to west aspects. Soils north of the Entiat Ridge are derived largely from granite. Soil coarse fragments and litter are abundant. None of the sample stands were more than 200 years old. Species composition and successional relationships indicate mature stands will be dominated by subalpine fir and Engelmann spruce in the overstory and understory. Subalpine fir increases in prominence as stands exceed 100 years of age, but this pattern is variable, depending on types and intensity of past disturbance. Lodgepole pine commonly dominates early to mid seral stands (<100 years old), especially those that originated after stand-replacement fires. Long-lived seral species such as western white pine and Douglas-fir may be seral dominants. In the absence of ground fire, they eventually form an open canopy of large, old individuals over a much denser canopy of subalpine fir and spruce. In other cases, ground fire may result in a younger layer of lodgepole pine under these old, parklike stands. Ponderosa pine is not generally suited to this type. The undergrowth of ABLA2/VAME is characterized by a shrub layer with pachistima and big huckleberry as the most constant and abundant species. Species richness is better than many other subalpine fir types. A wide variety of other shrubs may be common, including Douglas maple, baldhip rose, western prince's pine, sidebells pyrola and shiny-leaf spirea. The presence of low huckleberry indicates somewhat cooler sites transitional to the ABLA2/VASC Association. Common herbs include pinegrass, whitevein pyrola, western rattlesnake plantain, queencup beadlilly, pathfinder, raceme pussytoes, white hawkweed, starry solomonplume and yellow violet. Stands may superficially resemble the ABLA2/VASC Association, but differ in being generally at lower elevations, on deeper soils, dominated by big huckleberry, and floristically richer.

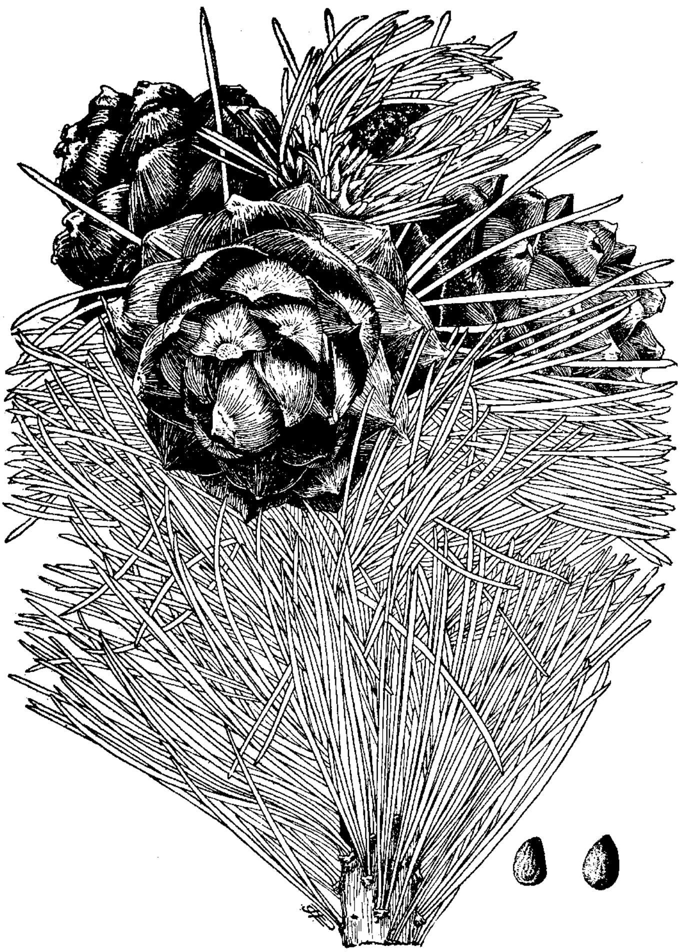
## ABLA2/VASC/CARU CES413

Though five plots may indicate ABLA2/VASC/CARU is less common than ABLA2/VASC and ABLA2/VASC/ARLA, this type is well documented throughout the Pacific Northwest and is common on the Okanogan NF (Williams and Lillybridge 1983). The ABLA2/VAMY type described for the Yakima Indian Reservation (John and others 1988) appears identical. The only Wenatchee plot was from the northeast corner of the Leavenworth District. The type has been seen on the Leavenworth District and is likely to occur on the Entiat and Lake Chelan Districts. ABLA2/VASC/CARU is typified by cool, well-drained slopes at moderate elevations. They average over a thousand feet lower than ABLA2/VASC/LUHI and 600 feet lower than ABLA2/VASC/ARLA. Slopes are generally moderate and most sample plots were on west to east aspects. Soils are generally cool, shallow, droughty and poorly developed. However, they are probably deeper, less stony and finer textured compared to ABLA2/VASC. Coarse fragments range from common to abundant. Litter is usually abundant. Late seral or near climax stands are rare. Subalpine fir increases in importance as stands age, usually dominating the regeneration layer in older stands. Succession to a subalpine fir climax is slow and most stands burn before reaching 200 years of age. Engelmann spruce is much less important in this type, compared to ABLA2/VASC/LUHI. Douglas-fir and lodgepole pine are the most common trees and dominate most stands. Western larch was found in the Okanogan plots east of the Chewuch River and can be expected in stands south of the Entiat River. Whitebark pine and subalpine larch are absent. The undergrowth represents slightly warmer and drier sites than ABLA2/VASC and ABLA2/VASC/ARLA. Grouse or low huckleberry, or both, and pinegrass are at least well represented. Pachistima and buffaloberry are common on many plots, indicating young stands of fire origin, although buffaloberry is not often found on the Wenatchee plots. Other herbs include heartleaf arnica, western rattlesnake plantain, hawkweed and raceme pussytoes. These cold, dry site herbs indicate sites drier than ABLA2/ARLA.

## PIEN/EQUIS CEM211

Only two plots have been sampled in the North Cascades and both of these were on the Okanogan NF. The Association has been reported on the Lake Chelan District. This wetland type will be described in detail in the riparian classification (Kovalchik 1993) and is reported here only because it was described in the Wenatchee Draft. It is associated with flat, wet sites along streams or seeps, on gentle, sub-irrigated slopes. Engelmann spruce usually dominates the open overstory. In these plots, subalpine fir is nearly co-dominant with spruce. Lodgepole may be a seral dominant. Common or wood horsetail and moisture-loving herbs and shrubs characterize the undergrowth.

# WHITEBARK PINE SERIES



# WHITEBARK PINE SERIES

DISTRIBUTION AND ENVIRONMENT: Whitebark pine is distributed over a wide geographic area. It is found throughout the Wenatchee NF and continues north through the Okanogan NF into Canada. The PIAL Series is very limited in extent on the Colville NF, but is common in the northern Rocky Mountains, where it has a great north-south as well as east-west range.

It is restricted to upper slopes, ridges and mountain tops on exposed sites, at or near upper timberline where stands do not form closed canopies. The Series indicates sites where the combination of cold, wind, late summer drought, and snow removal by wind creates conditions too severe to form a closed forest. Most aspects are south or west, but the Series can occur on northerly aspects in drier mountain ranges. Frost is possible any night of the year and diurnal temperature ranges are great. On the exposed slopes typical of the Series, insolation rates are very high on sunny days. Elevations range from 5600 feet on the Wenatchee NF to over 7000 ft. near the Canadian border. Very recent sampling in the Enchantment Basin (not in this report) included whitebark pine plots ranging from 5600 by Colchuck Lake to well over 7500 feet near Asgaard Pass.

Snow movement and removal by wind are important characteristics of sites within PIAL/CARU, PIAL/JUCO4 and PIAL/FEVI Associations. Conversely PIAL/VASC and PIAL/CAME-LUPE types occur in areas where snow accumulates, or at least is slower to melt. In comparison, sites in the Subalpine Larch and Mountain Hemlock Series accumulate more snow than any site in the Whitebark Pine Series.

Soils are coarse-textured and very rocky. Litter layers are abundant to thin or absent. Rock, gravel and exposed soil are common on many sites. Most soils are formed in granites and basalts. Nutrients and moisture-holding capacity are low.

A limited number of whitebark pine plots were available during the writing of the Wenatchee Draft (twelve plots), allowing the description of only two very broad plant Associations. Additional plots have been added from more recent data from both the Okanogan and Wenatchee NFs, increasing plot numbers to 27 for the PIAL Series, and allowing full descriptions for four major types. Two other plant Associations are described as miscellaneous, due to limited plot numbers (PIAL/DROC and PIAL/CAME-LUPE). Both types may be elevated to major status after more data are collected. The PIAL/LUHI Association is no longer described (Wenatchee Draft 1991). Most of the plots in that broad type were dominated by grouse huckleberry and have been moved to the new PIAL/VASC/LUHI Association. Other plots have been moved to ABLA2/LUHI and ABLA2/VASC/LUHI. Additional field work may show a PIAL/LUHI type without the presence of grouse or low huckleberry. The whitebark pine classification is usable throughout the Wenatchee and Okanogan NFs.

VEGETATION: Open-grown whitebark pine typify the tree layer. Subalpine larch, if present, is clearly subordinate to whitebark pine. Lodgepole pine, Douglas-fir or rare ponderosa pines may be present in drier PIAL Associations. Subalpine fir, Engelmann spruce and mountain hemlock may be present, especially on moister PIAL types, but are also clearly subordinate to whitebark pine. Conifers other than whitebark pine and subalpine larch are near their upper elevation limits and are minor stand components. They are almost invariably deformed by the cold, windy environment. Whitebark pine is generally the only tree capable of establishing on the sites without shelter from other trees. It often forms the base of a tree island, with less hardy species growing in the shelter of established pines. Seed caches buried by Clark's nutcracker are important in establishing these trees and these seed-eating birds may be an essential part of the ecology of whitebark pine stands.

The Whitebark Pine Series is often adjacent to the Subalpine Larch Series in the northern Cascades. Subalpine larch is not found south of the Mt. Stewart area and whitebark pine may occupy sites similar to those which subalpine larch dominates to the north. Whitebark pine is often considered characteristic of south and westerly slopes and subalpine larch of northerly aspects. While true in a general sense, especially at lower elevations in the timberline Series, this is partly an artifact of the limited plot numbers in earlier classifications and not necessarily true when looking at the whole range of subalpine larch and whitebark pine. Subalpine larch types have been observed on all aspects at higher elevations where whitebark pine dominates only the most dry southerly exposures. The two species tend to be complementary in distribution rather than competitive, because whitebark pine can grow on droughty sites while subalpine larch does not tolerate soil drought. Whitebark pine is less able to endure the high snow packs associated with subalpine larch. Whitebark pine is also less tolerant of damage from wind and ice. Timberline mountain hemlock Associations become frequent in areas of higher snowfall or more maritime climates.

PRODUCTIVITY/MANAGEMENT: Tree growth rates and stocking are very low. The average stand basal area for the various whitebark pine Associations ranged from 41 to 69 sq. ft./ac. (Appendix C). The site index for subalpine fir, lodgepole pine and Douglas-fir for the only type with tree growth data ( PIAL/VASC/LUHI) averaged 29, 32 and 44 feet (base 50), respectively. Sites are too harsh to manage for timber production, as no known technique will assure reforestation.

Whitebark pine wood is highly flammable, even when green, and the upper slope locations are frequently struck by lightning. Only the discontinuous nature of the vegetation and the rocky sites limit the extent of wildfire and allow stands to develop to maturity. Otherwise, frequent fires would preclude the development of mature forests in these lightning-prone environments. Fire frequency is higher in the PIAL Series than in any other subalpine community (Agee 1994).

Whitebark pine sites often adjoin or are intimately intermixed with subalpine and alpine shrublands and meadows. Mountain big sagebrush and green fescue stands are often ringed by open woodlands dominated by whitebark. The great diversity of plant communities and habitats associated with this mix of communities makes these sites very important for a variety of wildlife.

Whitebark pines have edible seeds (pine nuts) that is important forage for animals, including Clark's nutcrackers and grizzly bears. Whitebark pine stands may become snow-free early in the spring (June), thus providing early forage for ungulates, other mammals or birds.

Herb cover and composition are quite variable among Associations. Herbage production ranged from a low of 22 pounds per acre in the PIAL/VASC/LUHI type to a high of 204 pounds per acre on PIAL/CARU (Appendix C). Species richness is especially high on the dry, grassy PIAL/CARU and PIAL/FEVI types, in part because many stands were subject to intensive grazing in the past. These stands are often located on old stock driveways and may have fed sheep in the hundreds of thousands each year. Because of shallow rocky soils, drought, and the short growing season, these sites are slow to recover after abusive grazing.

Sites are sufficiently harsh that management should concentrate on limiting site disturbance from recreation use. Resistance to trampling of the herb layer is also variable. The severe PIAL/DROC site is extremely sensitive to disturbance by both hikers and horses. Recovery may take centuries. The soil of both the PIAL/JUCO4 and PIAL/FEVI types is easily displaced by trampling. Grouse and low huckleberry (in PIAL/VASC/LUHI) are very sensitive to trampling and soil compaction and are quickly obliterated in areas of concentrated trail or camping use. PIAL/CARU is the only type in the Whitebark Pine Series where the herb layer is relatively resistant to trampling damage from recreation or horse use.

White pine blister rust (secondarily aggravated by mountain pine beetle) is causing severe damage to stands of whitebark pine in the Rocky Mountains (Keane and Arno 1993). Comparable damage extends westward through the Colville NF (personal observations). Trees with dead limbs (flagging) and dead trees are beginning to appear all through the northern

Cascades. It is likely that in twenty years the Cascade stands will be as damaged as Colville NF stands, unless genetically resistant trees are developed and introduced.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Whitebark Pine Series has been described by numerous authors up and down the Cascades and east into the northern Rocky Mountains. Some of the authors are: Pfister and others 1977 (Montana); Cooper and others 1991 (Idaho); Williams and others 1990 (Colville NF); Williams and Lillybridge 1983 (Okanogan NF); Williams and others 1991 (Wenatchee NF Draft); Johnson and Clausnitzer 1992 (northeast Oregon); Clausnitzer and Zamora 1987 (Colville Ind. Res.); del Moral unpublished draft (Enchantment Lakes); and Wooten and Morrison unpublished draft (North Cascades).

## Keys to Plant Associations of the Whitebark Pine Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

Western dryad ≥ 5% ............................................ PIAL/DROC (M) p. 250

Moss-heathers or partridgefoot ≥ 5% ..................... PIAL/CAME-LUPE (M) p. 250

Grouse huckleberry or low huckleberry ≥ 5% .......... PIAL/VASC/LUHI p. 248

Common juniper ≥ 5% ........................................ PIAL/JUCO4 p. 246

Pinegrass or elk sedge ≥ 5% ................................ PIAL/CARU p. 242

Green fescue, Idaho fescue or mountain big sagebrush ≥ 5% ................................................ PIAL/FEVI p. 244

### Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| PIAL/CARU | 3 | 202 | 69 | 9 | 129 | 204 |
| PIAL/FEVI | 2 | 143 | 41 | 8 | 84 | 115 |

[1] Type = Plant Association or Community Type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| PIAL/VASC/LUHI | ABLA2 | 3 | 29 | 3 | 65 | 13 | 101 |
| | PICO | 3 | 32 | 3 | 48 | 11 | 78 |
| | PSME | 3 | 45 | 3 | 89 | 28 | 74 |

[2] Type = Plant Association or Community Type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and SI is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100-See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

### WHITEBARK PINE PLANT ASSOCIATION GROUPS

1. Cold Dry Shrub/Herb PAG
   - PIAL/CARU
   - PIAL/DROC (M)
   - PIAL/FEVI
   - PIAL/JUCO4
2. Cold Mesic Shrub/Herb PAG
   - PIAL/CAME-LUPE (M)
   - PIAL/VASC/LUHI

### WHITEBARK PINE PLANT ASSOCIATIONS AND ECOCLASS CODES

| | |
|---|---|
| PIAL/CAME-LUPE (M) | CAS221 |
| PIAL/CARU | CAG112 |
| PIAL/DROC (M) | CAF321 |
| PIAL/FEVI | CAG221 |
| PIAL/JUCO4 | CAS421 |
| PIAL/VASC/LUHI | CAS311 |

# PIAL/CARU ASSOCIATION CAG112

*Pinus albicaulis/Calamagrostis rubescens*

whitebark pine/pinegrass

## ENVIRONMENT

Elevation: 5720-6510 (6190) ft.

Aspect: southeast to southwest

Slope: 19-68 (40)%

Slope position: upper slopes and ridges

Special: hot, dry sites, difficult to regenerate

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIAL | whitebark pine | 100 | 14 |
| ABLA2 | subalpine fir | 71 | 4 |
| **TREE UNDERSTORY LAYER** | | | |
| PIAL | whitebark pine | 100 | 2 |
| ABLA2 | subalpine fir | 57 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| PAMY | pachistima | 71 | 8 |
| VASC, VAMY | grouse & low huckleberry | 57 | 3 |
| **HERBS** | | | |
| ACMI | yarrow | 86 | 4 |
| CARU | pinegrass | 57 | 28 |
| CAGE | elk sedge | 57 | 25 |
| FEVI | green fescue | 57 | 1 |
| CARO | Ross' sedge | 43 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

Wenatchee plots were located on the Entiat, Lake Wenatchee and Naches Districts. The type will occur elsewhere on the Wenatchee NF. Data from two Okanogan NF plots are used to help describe the type. It is also found on the Colville NF.

PIAL/CARU defines sites towards the lower elevational range of the PIAL Series, on dry, windswept slopes and southerly exposures. Severe insolation, winter desiccation and net snow removal by wind and evaporation are characteristics of these sites. Elevations of sample plots ranged from 5700 to over 6500 feet. The moderate to steep slopes face southeast to southwest.

Soil data are unavailable for these plots, but soils appear to be moderately well-developed and well-drained, relative to the rest of the PIAL Series. They are largely derived from granite north of Entiat Ridge and from basalt and igneous parent materials to the south. Coarse fragments are well represented and litter is usually abundant.

PIAL/CARU is often mixed with or adjacent to mountain big sagebrush, green fescue or Idaho fescue grasslands. At lower elevations the type may grade into ABLA2/CARU or PSME/CARU. PIAL/VASC/LUHI, ABLA2/RHAL/LUHI or ABLA2/VASC/LUHI may occur on sites where snow accumulates.

VEGETATION: Because of the harsh environment, stands rarely develop a closed canopy. Multi-stemmed whitebark pine trees are common. Conditions are often so severe that even near-climax stands of whitebark pine have open canopies. Whitebark pine dominates most stands, and most other tree species develop in their shelter. Snow accumulations are greater and melting is delayed on the lee side of existing whitebark trees, thereby creating more favorable microsites than the stand as a whole. Although whitebark pine is the dominant tree, subalpine fir, Engelmann spruce, Douglas-fir and lodgepole pine may be present, depending on local conditions and elevations. Of these trees, subalpine fir is most common. Douglas-fir and lodgepole pine are common only on warmer, lower sites. On parts of the Forest, Whitebark pine is best represented by old burned skeletons on the tops of some of the higher peaks, while living trees are scarce or absent. As in other PIAL Associations, forest development on high-elevation, windswept slopes often requires hardy whitebark pines to form sheltered microsites for other conifers. Individual subalpine firs are not as stunted as on more severe PIAL Associations, but they still reproduce mainly by layering. Many PIAL/CARU stands are rather uniform (less than the normal heterogeneity associated with woodlands) with a rather continuous undergrowth of pinegrass or elk sedge, or both. In other cases, the whitebark pine may occur in "islands" within mountain shrubland and grassland. These mixed communities form complex mosaics with high community diversity.

Shrubs are relatively scarce and most individuals are sheltered by rocks. Pachistima, low huckleberry and grouse huckleberry are the only constant (but low-canopy cover) shrubs. The herb layer can be quite rich. The diversity is explained in part by the intergradation of the mosaic of communities that may exist on these sites and by past livestock grazing. Pinegrass or elk sedge, or both, are the more prominent herbs and characterize the ground layer. Other herbs are variable in constancy and cover, with Idaho fescue, green fescue, western yarrow, lupines, asters and Ross' sedge being most common.

PRODUCTIVITY/MANAGEMENT: Site index information is not available. Tree growth and stocking appear to be low to very low. One plot supported 202 trees per acre and 69 sq. ft./ac. total basal area (Appendix C). These sites are not recommended for timber production as no techniques are known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and alters snow pack patterns and melting regimes.

Whitebark pines have edible seeds (pine nuts) which serve as important forage for a wide variety of wildlife, including grizzly bears and Clark's nutcrackers. These slopes are among the first to green up in the spring (June), making them important forage areas for many wildlife species.

Whitebark pine wood is highly flammable even when green, and the dry, windswept, upper slope locations are predisposed to lightning strikes. In fact, whitebark pine forests appear to have the shortest fire-return intervals of eastside subalpine forests (Agee 1994). Although fire frequency may be high, stand-replacement fires are very unusual because of the sparse, discontinuous cover typical of the habitat.

Three clipped plots averaged 204 pounds of herbage per acre (Appendix C). Livestock, if present, may make moderate use of the grasses, sedges and herbs typical of the type. Sites are slow to recover from damage caused by grazing because of shallow, rocky soils, drought and the short growing season.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PIAL/CARU is widespread. The type is part of the PIAL/CARU and PIAL types described for the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) NFs. It is also part of the broad PIAL Habitat Type described in Montana (Pfister and others 1977). Wooten and Morrison (unpublished draft) describe a PIAL/CARU community for the North Cascades.

# PIAL/FEVI ASSOCIATION CAG221

*Pinus albicaulis/Festuca viridula*

whitebark pine/green fescue

*A typical green fescue (FEVI) understory.*

*PHOTO:* J. Engle

## ENVIRONMENT

Elevation: 6440-7340 (6930) ft.

Aspect: south to west

Slope: 11-48 (33) %

Slope position: upper, ridges

Special: hot, dry, poor regeneration

## VEGETATION SUMMARY

(Sample size: 6)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIAL | whitebark pine | 100 | 8 |
| ABLA2 | subalpine fir | 50 | 6 |
| **TREE UNDERSTORY LAYER** | | | |
| PIAL | whitebark pine | 83 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 50 | 1 |
| ARTRV | mountain big sagebrush | 33 | 25 |
| **HERBS** | | | |
| FEVI | green fescue | 83 | 22 |
| ACMI | yarrow | 83 | 3 |
| LUPIN | lupines | 67 | 17 |
| LUHI | smooth woodrush | 67 | 2 |
| ARENA | sandworts | 67 | 4 |
| CARU | pinegrass | 50 | 3 |
| SEDUM | stonecrops | 50 | 1 |
| CARO | Ross' sedge | 33 | 5 |
| FEID | Idaho fescue | 17 | 8 |

## DISTRIBUTION AND ENVIRONMENT:

The dry PIAL/FEVI Association occurs from the Naches District north into the Okanogan NF. Wenatchee sample plots were on Sawtooth Ridge, the Entiat Mountains and near Rimrock Lake. Three plots were borrowed from Okanogan data. The type should be widely distributed on high, dry mountain ranges on both the Wenatchee and Okanogan NFs, but cover limited areas. It has not been seen or sampled on the Colville NF.

PIAL/FEVI is most often found at high elevations on exposed, dry, windblown slopes with south to west aspects. Slopes are gentle to moderate (11-48%). Insolation rates and diurnal temperature ranges are great. Wind and removal of snow are important site characteristics. Most snow is blown onto more protected sites that support more mesic types. Some snow collects in the lee of whitebark pines, creating a more mesic microsite. Even the death of a single tree can alter a site significantly.

Soil plots are not available, but soils appear moderately well-developed and well-drained. Parent materials are largely granite north of Entiat Ridge, while Basalt and other metamorphic rocks are prominent to the south. Coarse fragments, bare soil and litter are well-represented to abundant.

PIAL/FEVI often occurs in mosaic patterns within communities dominated by mountain big sagebrush or green fescue, or both. PIAL/CARU occurs on similar but more moderate sites. ABLA2/VASC/LUHI or PIAL/VASC/LUHI may be on adjoining north to east aspects. Steep north slopes may support ABLA2/RHAL/LUHI.

VEGETATION: Whitebark pine is the species that best defines the tree layer and the conditions associated with it. It is the first tree species found on sites after deforestation from fire or some other agent. Seed caches buried by Clark's nutcracker are important in initially establishing whitebark pine stands. After a discontinuous cover of whitebark pine is established, less hardy species such as subalpine fir regenerate in the shelter of the established pines. Sometimes the regeneration of subalpine fir exceeds that of whitebark pine. The subalpine firs often increase in cover because of layering of the limbs of established trees. However, sites are too harsh to ever develop a closed canopy, and most stands are composed of little clumps or islands (atolls) of trees within mountain big sagebrush and green fescue meadows. Many of the plots in PIAL/FEVI barely qualify as forest. These clumps may have the oldest whitebark pines in the center, with younger pines or subalpine firs or other species gathered around them. The oldest stands may have dead whitebark pine in their centers. Species composition of sites is quite variable because of the close mosaic of PIAL/FEVI with meadow communities. Early seral stands may not support trees for a long period and will closely resemble big mountain sagebrush or green fescue communities. Additional work will be done in subalpine timberlines to add to our understanding of these complex environments.

Undergrowth is characterized by green fescue, although one plot had Idaho fescue instead. Mountain big sagebrush was abundant on two plots. Present plot numbers do not justify creating a separate PIAL/ARTRV Association. Shrubs such as grouse huckleberry are scarce, and sheltered by trees or large rocks. Smooth woodrush and pinegrass may be locally common in snow deposition areas, such as in the shelter of trees, but they are not good indicators of the site as a whole. Other common herbs include yarrow, sandworts, lupines, Ross' sedge and stonecrops.

PRODUCTIVITY/MANAGEMENT: Tree growth and stocking appear very low. Timber production data is available from one intensive plot with 143 trees per acre and 41 sq. ft/ac. total basal area (Appendix C). No site index information is available. These sites are not recommended for timber production as no technique is known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and these alter snow pack patterns and melting regimes.

Whitebark pine wood is highly flammable even when green and the dry, and windswept upper slope locations are predisposed to lightning strikes. Fire frequency is high (Agee 1990) but stand-replacement fires are very rare because of the sparse, discontinuous cover typical of the habitat.

Whitebark pines have edible seeds (pine nuts) which serve as important forage for a wide variety of wildlife, including grizzly bears and Clark's nutcrackers. These slopes are among the first to green up in the spring (May and June), making them important forage areas for many species of wildlife.

Livestock, if present, will make heavy use of the grasses, sedges and herbs typical of the PIAL/FEVI type. Herbage production is moderately low. Two clipped plots averaged 115 pounds of herbage per acre (Appendix C). Sites are slow to recover from heavy grazing because of the shallow, rocky soils, drought and the short growing season. The unstable soils are easily raveled by trampling.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The PIAL/FEVI type is part of the broad PIAL/CARU Association previously described in the Okanogan classification (Williams and Lillybridge 1983) and Wenatchee Draft (Williams and others 1991). The broad PIAL HabitatType in Montana (Pfister and others 1977) has similar stands, with Idaho or sheep fescue in the undergrowth.

# PIAL/JUCO4 ASSOCIATION CAS421

*Pinus albicaulis/Juniperus communis*

whitebark pine/common juniper

## ENVIRONMENT

Elevation: 6820-7860 (7200) ft.

Aspect: southeast to southwest

Slope: 30-65 (51)%

Slope position: mid to upper

Special: high, rocky, dry, snow removal

## VEGETATION SUMMARY

(Sample size: 4)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIAL | whitebark pine | 100 | 25 |
| **TREE UNDERSTORY LAYER** | | | |
| PIAL | whitebark pine | 75 | 4 |
| **SHRUBS AND SUBSHRUBS** | | | |
| JUCO4 | common juniper | 100 | 20 |
| ARTRV | mountain big sagebrush | 50 | 3 |
| VASC, VAMY | grouse & low huckleberry | 50 | 3 |
| **HERBS** | | | |
| ACMI | yarrow | 75 | 2 |
| CARO | Ross' sedge | 50 | 5 |
| CARU | pinegrass | 50 | 4 |
| CACO | northwestern sedge | 50 | 4 |
| PENST | penstemon spp. | 50 | 4 |
| FEID | Idaho fescue | 50 | 3 |
| HECY | roundleaf alumroot | 50 | 2 |
| SELA | lance-leaved stonecrop | 50 | 2 |

## DISTRIBUTION AND ENVIRONMENT:

Although all four PIAL/JUCO4 sample plots are located on the Okanogan NF, this type probably occurs on the Entiat and Chelan Districts, as well as on dry high mountain ranges to the south. For instance, it has recently been observed to be very common in the Enchantment Basin area. This question will be resolved with additional sampling in timberline environments. Sample plots were located near Tiffany Mt. in the "Meadows" area and on the Chelan-Sawtooth divide.

Sites are steep, dry and windswept, with south to west exposure. Severe solar insolation, winter desiccation, summer drought and snow removal by wind are characteristic of the sites.

Soil data are not available. Soils appear to be poorly developed and excessively well-drained. Surface rock, coarse fragments and litter are abundant. One plot was located where bedrock was prominent, with deep soil layered between bands of rock. Large stones and boulders mixed with deep layers of sand or glacial flour typify the other plots. The regolith is granite.

PIAL/JUCO4 plots sampled to date are on harsh, dry sites scattered within the subalpine larch zone. On less harsh sites, they may be bounded by LALY/CAME-LUPE or LALY/VASC/LUHI. PIAL/DROC occurs on even more severe sites, while mountain big sagebrush, green fescue, Washington dryad, black alpine sedge and Cascade willow communities are seen on non-forest sites.

VEGETATION: Stands develop a very open canopy because of the harsh conditions. Three plots were dominated by old, large, multi-stemmed whitebark pine. Whitebark pine saplings dominated the other plot and based on site similarities and vegetation, in time they will become tree-size. Most other tree species are scarce. Subalpine fir, Engelmann spruce, Douglas-fir and lodgepole pine may be present, depending on local conditions and elevations. At extreme elevations individual subalpine firs are often stunted and reproduce mainly by layering. Subalpine fir were scarce on the plots, except at Oval Peak, where there were dense patches of subalpine fir krumholz under the protection of large whitebark pine. Occasional spruce and subalpine firs may have developed into erect trees under the protection of large whitebark nurse trees. Only the lowest elevation plot had a few Douglas-fir and lodgepole pine.

Snow accumulations, shade and delayed melting of snow on the lee side of existing whitebark pine create favorable microsites for common juniper and other ground cover. Between trees, ground vegetation is significantly less, and rock and bare soil abundant. Common juniper is the dominant shrub. Other shrubs are relatively scarce. Herbs are variable in constancy and cover. They include pinegrass, roundleaf alumroot, Idaho fescue, lance-leaf stonecrop, penstemons, Ross' sedge and northwestern sedge. Other than yarrow, no single herb occurs on more than half the plots.

PRODUCTIVITY/MANAGEMENT: Tree growth and stocking are very low. Trees are stunted and wind-deformed. One intensive plot had 252 trees per acre and 56 sq. ft./ac. total basal area (Appendix C). Site index information is not available but height growth is assumed to be extremely slow. These sites are not recommended for timber production as no techniques are known to assure reforestation. Frost is possible any night of the year. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and alters snow pack patterns and melting regimes.

Whitebark pines have edible seeds (pine nuts) which serve as important forage for a wide variety of wildlife, including grizzly bears and Clark's nutcrackers. These slopes are among the first to green up in the spring (June) making them important forage areas for many wildlife species. Common juniper is not favored forage, although the fruits are likely important for small birds and mammals. Both livestock and other ungulate use is low, except perhaps for cover and shade. However, in the Enchantment Basin area mountain goats make heavy use of these sites for both forage and escape cover.

Livestock make little use of the relatively sparse grass, sedge and herb cover typical of the type. One clipped plot had only 53 pounds of herbage per acre (Appendix C). If damaged, these sites are very slow to recover from grazing because of shallow, rocky soil, drought, and the short growing season.

Whitebark pine wood is highly flammable, even when green, and the dry and windswept upper slope locations are predisposed to lightning strikes. However, because of the sparse, discontinuous cover and surface rock typical of the PIAL/JUCO4 type, stand-replacement fires are extremely rare. Sites may be relatively free of wildfire compared to PIAL/VASC/LUHI, PIAL/FEVI and PIAL/CARU. If burned, these severe sites may remain virtually free of living trees for decades, while old snags give mute evidence of former wooded stands.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The PIAL/JUCO4 type has been previously described only by Wooten and Morrison (unpublished draft) for the North Cascades. It appears that part of the PIAL Habitat Type described in Montana (Pfister and others 1977) may be dominated by common juniper in the undergrowth. They also described a PIFL/JUCO4 (limber pine/common juniper) Habitat Type that is similar to PIAL/JUCO4 in terms of environment and JUCO4 undergrowth, but occupies limestone soils. A PIAL/JUCO4/PEDA community has been described in the Enchantment Basin (del Moral unpublished draft).

# PIAL/VASC/LUHI ASSOCIATION CAS311

*Pinus albicaulis/Vaccinium scoparium/Luzula hitchcockii*

whitebark pine/grouse huckleberry/smooth woodrush

## ENVIRONMENT

Elevation: 5600-7400 (6400) ft.

Aspect: north to southeast (west)

Slope: 9-58 (7)%

Slope position: upper slopes, ridges

Special: high, cold, windswept, snow accumulation

## VEGETATION SUMMARY

(Sample size: 8)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| PIAL | whitebark pine | 100 | 29 |
| ABLA2 | subalpine fir | 88 | 6 |
| TSME | mountain hemlock | 38 | 3 |
| PICO | lodgepole pine | 38 | 6 |
| PSME | Douglas-fir | 38 | 8 |
| PIEN | Engelmann spruce | 25 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 88 | 3 |
| PIAL | whitebark pine | 63 | 3 |
| TSME | mountain hemlock | 38 | 2 |
| PIEN | Engelmann spruce | 25 | 7 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 88 | 36 |
| VAMY | low huckleberry | 38 | 11 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 50 | 15 |

## DISTRIBUTION AND ENVIRONMENT:

The PIAL/VASC/LUHI Association is widely distributed on the east slopes of the Cascades and extends eastward to the Rocky Mountains. It has been sampled from the southwest end of the Naches District northward to the Canadian border. It is especially common in the numerous wilderness areas located on the Wenatchee and Okanogan NFs.

It is most often found on moderate to steep slopes with north to southeast aspects. Only one plot had gentle slopes on a west aspect. Elevations range from 5600 ft. in maritime areas of the Naches District to over 7300 ft. near the Canadian border. Insolation rates are high and diurnal temperature ranges great. Severe wind, winter desiccation, and snow deposition are important site characteristics. PIAL/VASC/LUHI tends to accumulate the snow blown off more exposed communities on the south and west sides of its ridges. Snow deposition in the lee of the trees is an important site characteristic, and the site may be altered by the death or removal of an individual tree.

Data are unavailable, but soils appear to be shallow and moderately well drained. They are largely derived from granite north of the Entiat Ridge, while basalt and igneous rocks are common to the south. Surface rock, coarse fragments, and litter range from well represented to abundant.

The PIAL/CARU, PIAL/JUCO4 and PIAL/FEVI Associations occupy more southerly, wind-blown exposures. The LALY Series occurs at higher elevations, or on adjacent sites with more snow accumulation. The TSME Series occurs in areas with more maritime climate.

VEGETATION: Whitebark pine is the species that best defines the tree layer and the conditions associated with it. Seed caches buried by Clark's nutcracker are important in the initial establishment of whitebark pine stands, and whitebark pine is the first tree found on the sites after deforestation by fire or some other agent. After a discontinuous cover of whitebark pine is established, less hardy species such as subalpine fir and spruce regenerate in the shelter of the pines. Under this shelter, subalpine fir cover often increases because of layering of the limbs on the established trees. On PIAL/VASC/LUHI, the regeneration of subalpine fir and spruce often exceeds that of whitebark pine. Where present, Engelmann spruce has the ability to assume a normal tree shape as it grows through the whitebark canopy. These sites are too harsh to ever develop a closed canopy and most stands are composed of open woodlands or islands of trees. The oldest whitebark pines often occur at the center of these clumps, with younger pines and other conifers gathered around them. Sometimes the oldest pines may be dead and the center of the stand may have an opening in it.

The understory is not very diverse. Grouse huckleberry or low huckleberry, or both, are usually abundant and characterize the site. Smooth woodrush is common on half the plots in snow deposition areas (where snow melts slowly), and is often only on the sheltered sides of trees or tree clumps. It is absent on other plots, perhaps reflecting slightly drier and more continental sites. An additional (and nearly equivalent) PIAL/VASC Association could have been described, but limited data and need precluded this.

PRODUCTIVITY/MANAGEMENT: There is little data available on tree production. In general, tree growth and stocking appear low. The one intensive plot had 185 trees per acre and 88 sq. ft./ac. total basal area (Appendix C). The average site index for subalpine fir, lodgepole pine and Douglas-fir were 29, 32 and 45 feet (base 50). These sites are not recommended for timber production as no techniques are known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and alters snow pack patterns and melting regimes.

Whitebark pines have edible seeds (pine nuts), which serve as important forage for a wide variety of wildlife, including grizzly bears and Clark's nutcrackers. These sites green up later than other whitebark pine types but are still very important forage areas for many wildlife species.

Whitebark pine wood is highly flammable, even when green, and the dry, windswept upper slope locations are predisposed to lightning strikes. Fire frequency is high (Agee 1990), but stand-replacement fires are rare. Only the sparse, discontinuous cover typical of the habitat allows stands to reach maturity.

Livestock are no longer present in many of the timberline sites, although use in the past was heavy, especially by sheep. Herbage production is generally low. One clipped plot had only 22 pounds of herbage per acre. Therefore, when grazing allotments include the PIAL/VASC/LUHI type, livestock seldom make heavy use of the shrubs and herbs typical of the type. However, livestock may use the type for shade and bedding and can affect the sites severely with trampling and soil compaction. Heavy horse and foot traffic near trails and campsites also damage the undergrowth. Because of drought, shallow soils and the short growing season, sites are very slow to recover from these abuses.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: PIAL/VASC/LUHI is part of the PIAL/LUHI Association described in the Wenatchee Draft (Williams and others 1991). It is also part of the very broad PIAL/CARU and PIAL Associations in the Okanogan (Williams and Lillybridge 1983) and Colville (Williams and others 1990) classifications. PIAL/VASC/LUHI is part of the PIAL and PIAL-ABLA2 Habitat Types in Montana (Pfister and others 1977). A similar PIAL-ABLA2/VAMY community is described in the Enchantment Lakes Basin (del Moral unpublished draft).

## MISCELLANEOUS WHITEBARK PINE ASSOCIATIONS

(less than 5 Wenatchee sample plots)

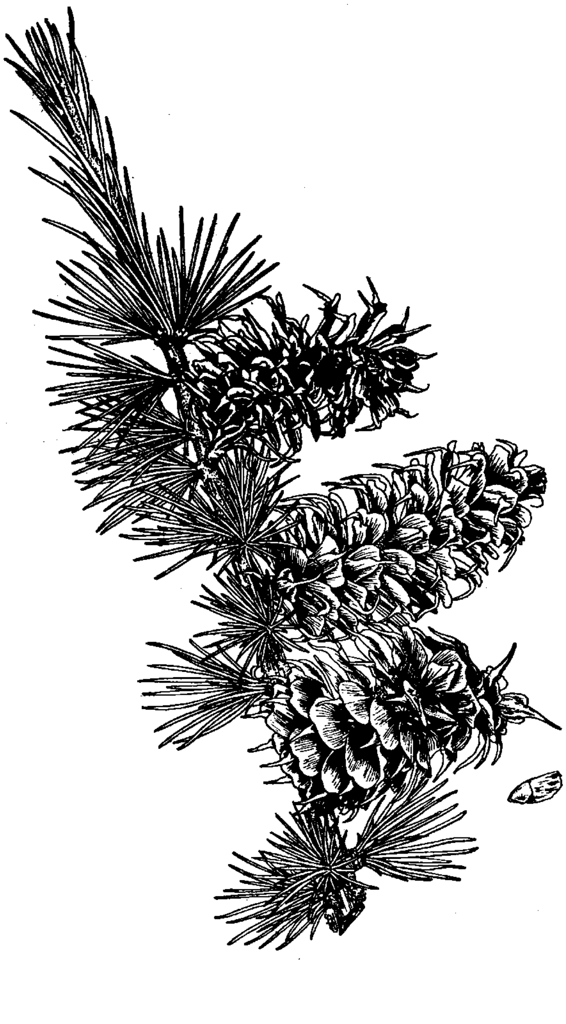
### PIAL/CAME-LUPE CAS221

The one plot in this Association was located on an east-facing, upper slope near Little Bald Mountain on the Naches District. The tree layer is dominated by open whitebark pine and subalpine fir, while the undergrowth closely resembles the LALY/CAME-LUPE type. However, the plot is well south of the distribution of subalpine larch, and whitebark pine is occupying a site that, to the north, would otherwise be dominated by subalpine larch. The undergrowth in this plot is dominated by partridgefoot, one of the indicators used for the high, cold CAME-LUPE zone. Grouse huckleberry and smooth woodrush are barely well-represented in this plot.

### PIAL/DROC CAF321

Only one plot has been assigned to this plant Association. However, it has been recognized by Wooten and Morrison (unpublished draft) for the North Cascades. The site is a very severe windswept ridge at 7310 feet in the Pasayten Wilderness Area. The overstory was a wind-deformed mix of whitebark pine, Engelmann spruce and subalpine fir. Its Washington dryad undergrowth closely resembles a fellfield. Additional plots are needed to understand both forest and non-forest Associations in timberline and alpine environments.

# SUBALPINE LARCH SERIES



# SUBALPINE LARCH SERIES

DISTRIBUTION AND ENVIRONMENT: The Subalpine Larch Series extends from the Mount Stuart area northward along the Cascade Range through the Okanogan NF into Canada. The Series is absent on the Colville NF, but is common in the northern Rocky Mountains, where it has a greater north-south range and total extent.

The Series is restricted to high-elevation sites at or above the upper limits of continuous forest cover. Sites are very harsh with deep snowpacks, high winds, high insolation, poor soils and a very short growing season. Abrasion by wind-driven snow and ice is an important winter feature. The deciduous nature of subalpine larch protects it over winter from foliage damage from ice and snow. Subalpine larch is more resistant to damage than whitebark pine and maintains tree form long after other species become prostrate. Diurnal temperature ranges are great and frost is possible any night of the year. Insolation rates are high on clear, sunny days in the thin air of these high elevation sites.

Elevations of sample plots range from 6600 to 7600 feet (average, 7330 ft.) on the relatively dry mountains of the Okanogan NF. Sample plots elevations are somewhat lower on the the Wenatchee NF, ranging from 5800 to 7340 feet (average, 6640 ft.). Very recent sampling (not used here) in the Enchantment Lakes Basin included subalpine larch plots from under 6000 feet to over 7800 feet. Subalpine larch appears restricted to acid substrates and is found primarily on granitic rock types. There are huge areas on the Okanogan NF, in the Pasayten Wilderness and vicinity, in which subalpine larch communities are abundant on the many high peaks and plateaus. To the south, it is restricted a little more to the vicinity of the Cascade Crest, although it does extend to the east on high ridges.

The number of subalpine larch plots was limited in the Wenatchee Draft (seven plots), allowing the description of only two very broad plant Associations. Additional plots have been added from more recent data from both the Okanogan and Wenatchee NFs, increasing the plot number to 28 for the LALY Series, and allowing full descriptions for three major types. Two additional plant Associations are described as miscellaneous Associations: LALY/DROC and LALY/JUCO4. The types are listed in the tables following this Series introduction. The subalpine larch Associations are usable throughout the Wenatchee and Okanogan NFs. Work is still continuing and that recent sampling near the Enchantments confirmed the existence of LALY/RHAL and LALY/LUHI Associations there.

VEGETATION: Subalpine larch sites are diverse and variable. Some stands are located on cliffs or talus and show little if any development of shrubs and herbs. At the other extreme are meadow-like sites with a rich assemblage of herbaceous species. Subalpine larch maintains its erect tree form better than any other tree in these areas. At lower elevations in the Series, Engelmann spruce and whitebark pine can maintain tree form. Subalpine fir is found throughout lower elevations, while mountain hemlock and Pacific silver fir are associates in zones with heavy more maritime climates. At higher elevations, many of these associated trees, if present at all, are represented as stunted, shrub-like individuals (krumholz) because they are unable to grow erect except where sheltered from wind-driven ice and snow.

The Whitebark Pine Series is often found adjacent to the Subalpine Larch Series. At lower elevations, whitebark pine is generally characteristic of dry south and westerly slopes, while subalpine larch is restricted to more mesic sites. However, at the highest elevations, subalpine larch can be found on all aspects and whitebark pine dominates only extremely dry sites. The two species tend to be complementary in distribution rather than competitive because whitebark pine can grow on droughty sites while subalpine larch does not tolerate soil drought. Whitebark pine is less able to endure high snow packs and is much more subject to damage from wind and ice than subalpine larch.

Subalpine larch is extremely long-lived (500-1000 years) and may outlive several generations of associated species, such as subalpine fir. The largest individual subalpine larch is reported to be from the Chelan Mountains above upper Lake Chelan (Arno and Habeck 1972). Subalpine larch regeneration is absent most years and regeneration may occur in waves, every few decades or even centuries, when conditions and seed crops combine to initiate new stands. Once subalpine larch is established and tree-sized, it is common for less hardy but more competitive species such as subalpine fir and Engelmann spruce to establish in the lee of the larch. Presence or absence of a single tree may profoundly affect plant succession in certain areas. However, there are many examples in the data where other conifers are essentially absent.

Many sites have an understory of fragile shrubs and herbs and are easily damaged by recreational traffic and livestock. Degraded sites heal very slowly because of the severe cold, frost and wind, and high insolation rates. Establishment of vegetation cover may require centuries or, if soils have been lost, never.

PRODUCTIVITY/MANAGEMENT: Tree production data are not available for the Subalpine Larch Series, but natural conditions are so harsh that timber production should be very low and management should concentrate on limiting any form of site disturbance. Destruction of vegetation cover may initiate erosion that may continue for decades after the disturbing agents are removed. Examination of areas within the Series that were used as sheep bed grounds revealed that erosion is still common, even though the sites have not had sheep on them for decades. The short growing season further limits vegetation recovery. Some years may be so cold that plants do not have time to fully complete their life cycles.

Subalpine larch stands lie in zones of very frequent lightning strikes. However, stand-replacement fires are extremely rare because of the open nature of the larch stands. In addition, stands are often interrupted by vast areas of cliff, talus and rock. Most fires are restricted to the immediate vicinity of the lightning-struck tree.

Subalpine larch is relatively disease-free compared to other trees. No known threats exist for subalpine larch stands. Associated whitebark pine is presently threatened by blister rust and mountain pine beetles.

Subalpine larch forms a distinctive zone of open forests at upper treeline. Heavy, late-melting snowpacks form the headwaters of many streams. Summer recreational use is often high because of the rugged beauty of this country, with subalpine larch being an attractive feature of these landscapes. Watershed and recreation values are extremely high, but these fragile and valuable habitats need to be carefully managed to protect their soils and vegetation.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: The Subalpine Larch Series has been described by numerous authors up and down the Cascades and east into the northern Rocky Mountains. Some of the authors are: Pfister and others 1977 (Montana); Cooper and others 1991 (Idaho); Williams and Lillybridge 1983 (Okanogan NF); Williams and others 1991 (Wenatchee NF Draft); del Moral unpublished draft (Enchantment Lakes); Wooten and Morrison unpublished draft (North Cascades).

# Keys to Plant Associations of the Subalpine Larch Series

Before using the key, the field form in Appendix E should be completed. Refer to the "Using the Keys" section in the introduction for more information on key use and if the stand does not key. Note: **(M)** refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

| | | |
|---|---|---|
| Western dryad ≥ 5% ............................................ | LALY/DROC (M) | p. 262 |
| Cascade huckleberry ≥ 5% .................................... | LALY/VADE-CAME | p. 258 |
| Moss-heathers, mountain heaths, or partridgefoot ≥ 5% .............................................. | LALY/CAME-LUPE | p. 256 |
| Grouse huckleberry or low huckleberry ≥ 5% ........... | LALY/VASC/LUHI | p. 260 |
| Common juniper ≥ 5% ........................................ | LALY/JUCO4 (M) | p. 262 |

Plant Associations Groups (PAGs) are arranged so that similar ecological sites are grouped on a temperature and moisture scale. Temperature values (from hot to cold) are hot, warm, cool and cold while moisture values are (from dry to wet) dry, mesic, moist and wet. *WEN* is used to indentify Wenatchee plant Associations that are considered ecologically different from like-named Associations described elsewhere. (M) refers to miscellaneous plant Associations that are described elsewhere but were uncommon or undersampled, or both, on the Wenatchee NF.

SUBALPINE LARCH
PLANT ASSOCIATION
GROUPS

1. Cold Dry Shrub/Herb PAG
   - LALY/DROC (M)
   - LALY/JUCO4 (M)
2. Cold Mesic Shrub/Herb PAG
   - LALY/CAME-LUPE
   - LALY/VADE-CAME
   - LALY/VASC/LUHI

SUBALPINE LARCH
PLANT ASSOCIATIONS
AND ECOCLASS CODES

| | |
|---|---|
| LALY/CAME-LUPE | CAC111 |
| LALY/DROC (M) | CAC112 |
| LALY/JUCO4 (M) | CAC113 |
| LALY/VADE-CAME | CAC114 |
| LALY/VASC/LUHI | CAC115 |

# LALY/CAME-LUPE ASSOCIATION CAC111

*Larix lyalli/Cassiope mertensiana-Lutkea pectinata*

subalpine larch/Mertens' moss-heather-partridgefoot

## ENVIRONMENT

Elevation: 6330-7600 (6830) ft.

Aspect: all aspects

Slope: 1-75+ %

Slope position: toeslopes to ridges

Special: high, cold sites

## VEGETATION SUMMARY

(Sample size: 11)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| LALY | subalpine larch | 73 | 21 |
| ABLA2 | subalpine fir | 64 | 7 |
| PIAL | whitebark pine | 45 | 3 |
| PIEN | Engelmann spruce | 36 | 10 |
| **TREE UNDERSTORY LAYER** | | | |
| LALY | subalpine larch | 100 | 7 |
| ABLA2 | subalpine fir | 73 | 5 |
| PIEN | Engelmann spruce | 55 | 4 |
| PIAL | whitebark pine | 36 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| LUPE | partridgefoot | 73 | 20 |
| PHEM | red mountain heath | 73 | 8 |
| VASC | grouse huckleberry | 73 | 8 |
| CATE2 | four-angled moss-heather | 45 | 44 |
| LEGL | labrador tea | 45 | 7 |
| CAME | Mertens' moss-heather | 36 | 29 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 82 | 8 |
| CANI2 | black alpine sedge | 82 | 4 |
| DEAT | mountain hairgrass | 55 | 1 |
| VASI | Sitka valerian | 45 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The LALY/CAME-LUPE Association is widespread in the subalpine larch zone. Sample plots were on the Sawtooth-Chelan Divide, Entiat Mountains and Alpine Lakes Wilderness Area on the Wenatchee NF. Six plots in the Chelan-Sawtooth and Pasayten Wilderness Areas and near Tiffany Mt. were borrowed from the Okanogan NF. This type is characterized by sites with somewhat lower snowpacks than LALY/VADE and tends to be more prominent in drier mountain ranges in the North Cascades. It is by no means absent in the vicinity of LALY/VADE-CAME, where it simply occupies slightly drier sites. Field observations suggest a relatively wide geographic distribution.

Sites are harsh, with high winds, short summers, and deep snowpacks. Plot elevations ranged from 6880 to 7600 feet on the Okanogan NF and 6330 to 6720 ft. on the Wenatchee. Recent samples in the Enchantment Basin are over 7200 feet. The type occurs on all aspects, especially at higher elevations. Slopes ranged from 1% on plots transitional to wetlands to over 75% on cirque headwalls.

Soils are poorly developed, and formed in granitic rock types. Soils associated with the riparian plots are deeper, finer textured, and have less rock. Litter is generally abundant on all plots. Surface rock and coarse fragments within the soil are very abundant on steep slopes and cirque headwalls.

LALY/VADE-CAME is more prominent in maritime areas, while LALY/VASC/LUHI occupies more moderate slopes. Dry, harsh sites may support the PIAL Series.

VEGETATION: Stands of LALY/CAME-LUPE develop open canopies. Dominance of subalpine larch is based on its superior hardiness instead of its competitive ability. Sites are characterized by open stands of subalpine larch over a prostrate, shrub-and herb-dominated forest floor. At higher elevations, other conifers, especially subalpine fir, may be represented by stunted individuals, or krumholz, or be completely absent. At lower elevations these conifers may develop into short trees, but are widely scattered compared to subalpine larch. Sites of this type are so harsh that subalpine fir or mountain hemlock can never form a closed canopy of tall trees, which helps distinguish this type from lower elevation types, such as ABLA2/VASC/LUHI. A few plots, especially those on the edges of riparian zones, do not have any trees over 5 inches DBH. The stands are composed of numerous, old, small-stemmed, short, yet erect trees. Subalpine larch is very long-lived and regeneration needs to occur only every few hundred years for the sites to remain forested.

The undergrowth is dominated by heaths, heathers and partridgefoot. Heaths and heathers include Mertens moss-heather, four-angled moss-heather and red mountain heath. Although not on the sample plots, Alaska moss-heather and cream mountain heath can also be used to identify the type. Other common herbs include smooth woodrush, black alpine sedge, mountain hairgrass, Sitka valerian and slender hawkweed. Some caution must be used when the plot has only red mountain heath as an indicator. Moss-heathers and partridgefoot best characterize CAME-LUPE, whereas red mountain heath occurs in small amounts at lower elevations in many of the high-elevation, but potentially closed-forest types such as ABLA2/VASC/LUHI.

PRODUCTIVITY/MANAGEMENT: Tree production data are not available for LALY/CAME-LUPE, but tree growth and stocking are assumed to be very low. For instance, on recent samples in the Enchantment Basin, just three inches of core (the trees had rotten centers) were ranging from 150 to 200 years in age. These sites are not recommended for timber production as no techniques are known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and these alter snowpack patterns and melting regimes. Snow deposition in the lee of the trees is an important site characteristic, and sites may be altered by the death or removal of an individual subalpine larch.

LALY/CAME-LUPE sites are important for watershed and scenic values. They are favorite areas for energetic hikers, climbers, backpackers and horsemen. The type also provides habitat for a variety of wildlife species, including deer, mountain goats, ptarmigan, blue grouse, pika and marmots.

Subalpine larch stands lie in zones of very frequent lightning strikes. However, stand-replacement fires are extremely rare in LALY/CAME-LUPE because of the open nature of the larch stands. In addition, the stands are often interrupted by vast areas of cliff, talus and rock that further restrict the spread of canopy fires. Most fires are limited to the immediate vicinity of the lightning-struck tree. Subalpine larch is relatively disease-free compared to other trees. No known threats exist for these stands except for the potential removal of associated whitebark pine by blister rust.

Heathers associated with LALY/CAME-LUPE sites are rather intolerant of trampling. Once damaged, it will take centuries for the site to recover. Sites that have been denuded of vegetation heal very slowly, and reestablishment of tree, shrub and herb cover may take centuries. Partridgefoot is the native species that appears best able to colonize disturbed areas. Alpine timothy, mountain hairgrass, alpine bluegrass, arnicas, asters, lupines and wooly pussytoes are native herbs which may be useful in revegetation efforts.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: LALY/CAME-LUPE has not been previously described because earlier classifications treated timberline sites so broadly. Plots belonging to this type were located in both the LALY/LUHI and LALY/VADE types described in the Wenatchee Draft (Williams and others 1991). It is also a major part of the LALY Association in the Okanogan classification (Williams and Lillybridge 1983). It may also be part of the very general LALY-ABLA2 Habitat Types discussed in the north Idaho (Cooper and others 1991) and Montana (Pfister and others 1977) classifications, and may be similar to the LALY-PIEN/PHEM/LUHI type described by Wooten and Morrison (unpublished draft). It is similar to the LALY/CAME and LALY-ABLA2/CAME-LEGL communities described in the Enchantment Lakes Basin (del Moral unpublished draft).

# LALY/VADE-CAME ASSOCIATION CAC114

*Larix lyalli/Vaccinium deliciosum-Cassiope mertensiana*

subalpine larch/Cascade huckleberry-Mertens moss-heather

## ENVIRONMENT

Elevation: 6020-7580 (6875) ft.

Aspect: all aspects

Slope: 10-70 (35) %

Slope position: lower slopes to ridges

Special: cold, moist, maritime climate

## VEGETATION SUMMARY

(Sample size: 7)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| LALY | subalpine larch | 100 | 15 |
| ABLA2 | subalpine fir | 86 | 4 |
| PIAL | whitebark pine | 43 | 3 |
| PIEN | Engelmann spruce | 43 | 4 |
| TSME | mountain hemlock | 29 | 2 |
| **TREE UNDERSTORY LAYER** | | | |
| ABLA2 | subalpine fir | 86 | 7 |
| LALY | subalpine larch | 71 | 3 |
| PIAL | whitebark pine | 57 | 2 |
| TSME | mountain hemlock | 29 | 1 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VADE | Cascade huckleberry | 100 | 16 |
| CAME | Mertens' moss-heather | 100 | 12 |
| PHEM | red mountain heath | 86 | 14 |
| LUPE | partridgefoot | 86 | 12 |
| VASC | grouse huckleberry | 71 | 20 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 71 | 16 |
| CANI2 | black alpine sedge | 57 | 4 |
| DEAT | mountain hairgrass | 43 | 5 |

## DISTRIBUTION AND ENVIRONMENT:

The LALY/VADE-CAME Association is found from the Mount Stuart area north to the Canadian border. It is widely distributed in the more maritime climates found on the Leavenworth and Lake Wenatchee Districts, but is restricted to the immediate vicinity of the Cascade Crest on the Okanogan NF. Plots were in the Alpine Lakes Wilderness Area, Entiat Mountains, and on the Okanogan NF near Hart's Pass. The type is at or above the continuous treeline, and it forms woodlands, parklands or islands of trees. Plot data are somewhat limited, but work is continuing in the subalpine and alpine habitats that support subalpine larch.

LALY/VADE-CAME is characterized by harsh, windy, high-elevation sites with deeper snowpacks than LALY/CAME-LUPE. Plot elevations range from 6000 to nearly 7600 feet. It occurs on all slopes and aspects. Gentler plots were adjacent to wetlands or on benches.

The regolith north of the Entiat Ridge is composed of relatively acid materials formed in granitic rock types, including granodiorite. No soil data are available, but soils are poorly developed. Coarse fragments, litter and surface rock are usually abundant, except on gentle slopes in the vicinity of wetlands.

LALY/CAME-LUPE is more prominent on slopes with less snowpack or in areas away from maritime climates. LALY/VASC/LUHI occurs on more moderate slopes. The PIAL Series may occur on extreme south to west slopes.

VEGETATION: Stands of LALY/VADE-CAME develop open canopies. Dominance of subalpine larch is based on its superior hardiness instead of its competitive ability. Open stands of subalpine larch are often mixed with stunted subalpine fir, Engelmann spruce, mountain hemlock and whitebark pine. Sites are sufficiently harsh that conifers other than subalpine larch may have difficulty in maintaining erect growth form and may be better represented by stunted, or krumholz, individuals. This is especially true of subalpine fir, although at lower elevations it, mountain hemlock, spruce and whitebark pine often maintain some semblance of tree form. Subalpine larch is extremely long-lived (500 to 1000 years) and may outlive several generations of species such as subalpine fir. On more moderate, lower-elevation sites, subalpine fir or other conifers can form a closed canopy, and both subalpine larch and whitebark pine are seral dominants that are shaded out as other species attain climax.

The general appearance of the ground vegetation is a low shrub layer, covering up to 50% of the ground surface. The rest of the cover is provided by herbs, grasses and grass-like plants. LALY/VADE-CAME is characterized by the constant presence of Cascade huckleberry, red mountain heath, Mertens' moss-heather and partridgefoot. Four-angled moss-heather and creamy mountain heath were not found on the plots, but may help characterize the type elsewhere. Arno and Habeck (1972) state that red mountain heath indicates sites poor in ions of magnesium and calcium. Other herbs include smooth woodrush, mountain hairgrass, black alpine sedge, green fescue, fan-leaf potentilla, Sitka valerian and slender hawkweed.

PRODUCTIVITY/MANAGEMENT: Tree production data are not available for LALY/VADE-CAME, but tree growth and stocking are assumed to be very low. These sites are not recommended for timber production as no techniques are known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and these alter snow pack patterns and melting regimes. Snow deposition in the lee of the trees is an important site characteristic, and sites may be altered by the death or removal of an individual subalpine larch or whitebark pine.

The shrubs are very brittle and easily damaged by trampling. Sites that have been denuded of vegetation heal very slowly and establishment of tree, shrub and herb cover may take centuries. Partridgefoot is the native species that appears best able to colonize disturbed areas. Alpine timothy, mountain hairgrass, alpine bluegrass, arnicas, asters, lupines and wooly pussytoes are native herbs which may be useful in revegetation efforts.

Subalpine larch stands lie in zones of very frequent lightning strikes. However, stand-replacement fires are extremely rare because of the open nature of the larch stands. Stands are often interrupted by vast areas of cliff, talus and rock that help restrict the spread of canopy fires. Most fires are limited to the immediate vicinity of the lightning-struck tree.

Subalpine larch is relatively disease-free compared to other trees. No known threats exist for these stands, except for the potential removal of whitebark pine by blister rust. However, the larch case bearer is infesting alpine larch in stands below 6000 feet on slopes above Colchuck Lake (personal observations).

LALY/VADE-CAME sites are very important for watershed and scenic values. Sites would not support erect trees if it were not for the very hardy nature of subalpine larch. The type also provides important forage for wildlife, including blue grouse, ptarmigan, mountain goats, pika and deer. They are favorite areas for energetic berry pickers, climbers, hikers, backpackers and equestrians.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: Plots belonging to this type were located in the LALY/VADE Association described in the Wenatchee Draft (Williams and others 1990). It is also a minor part of the LALY Association in the Okanogan classification (Williams and Lillybridge 1983). It is not described by Wooten and Morrison (unpublished draft), nor does it occur in north Idaho or Montana (Cooper and others 1991; Pfister and others 1977).

# LALY/VASC/LUHI ASSOCIATION CAC115

*Larix layalii/Vaccinium scoparium/Luzula hitchcockii*

subalpine larch/grouse huckleberry/smooth woodrush

## ENVIRONMENT

Elevation: 6600-7400 (7066) ft.

Aspect: all aspects

Slope: 10-54 (29)%

Slope position: lower to mid slopes

Special: high elev., cold, snow accumulation

## VEGETATION SUMMARY

(Sample size: 5)

| | | CON | COV |
|---|---|---|---|
| **TREE OVERSTORY LAYER** | | | |
| LALY | subalpine larch | 100 | 30 |
| PIEN | Engelmann spruce | 100 | 13 |
| PIAL | whitebark pine | 40 | 7 |
| ABLA2 | subalpine fir | 40 | 8 |
| PICO | lodgepole pine | 20 | 5 |
| **TREE UNDERSTORY LAYER** | | | |
| LALY | subalpine larch | 100 | 2 |
| PIEN | Engelmann spruce | 60 | 1 |
| ABLA2 | subalpine fir | 40 | 8 |
| PIAL | whitebark pine | 40 | 2 |
| **SHRUBS AND SUBSHRUBS** | | | |
| VASC | grouse huckleberry | 80 | 31 |
| PHEM | red mountain heath | 60 | 3 |
| VAMY | low huckleberry | 40 | 1 |
| **HERBS** | | | |
| LUHI | smooth woodrush | 80 | 15 |

## DISTRIBUTION AND ENVIRONMENT:

The LALY/VASC/LUHI Association is represented by five plots on the Okanogan NF. It is widely distributed on the east side of the Cascades and is common in the Rocky Mountains. It was sampled in the Chelan-Sawtooth and Pasayten Wilderness areas, and near Tiffany Mt. The type should occur in the similar dry, largely-granitic mountain ranges on the Entiat and Chelan Districts and has been observed in the Enchantment Basin area.

High winds, intense insolation, large diurnal temperature ranges, and moderately deep snow are characteristic of the site. LALY/VASC/LUHI is most often found at high elevations on moderate to steep slopes and occurs on all aspects.

Soil data are not available, but soils should be relatively shallow and well-drained. Coarse fragments and surface rock are not as abundant as on LALY/CAME-LUPE and LALY/VADE-CAME. Parent materials are glacial till or colluvium derived largely from granite.

This type is generally more moderate than LALY/VADE-CAME and LALY/CAME-LUPE. They generally have shorter summers and deeper snowpack. ABLA2/RHAL/LUHI can occur on adjacent steep north slopes. The PIAL Series may occur on severe south to west exposures. TSME types occur in areas with more maritime climate.

VEGETATION: Stands of LALY/VASC/LUHI do not develop dense canopies, and dominance of subalpine larch is based on its superior hardiness instead of its competitive ability. Open stands of subalpine larch are often mixed with subalpine fir, Engelmann spruce, mountain hemlock (in its range) and whitebark pine. In our experience, sites are less harsh than LALY/VADE-CAME and LALY/CAME-LUPE sites, and these conifers often attain erect growth, although subalpine fir certainly exhibits layering. Engelmann spruce is a very prominent feature of these stands, when compared to other subalpine larch Associations. Krumholz probably occurs only on the most severe sites. It is somewhat difficult to say where to draw the line between open subalpine larch Associations and closed subalpine fir or mountain hemlock types. For instance, a plot at 6600 feet was near the lower elevation of subalpine larch, and larch cover was significantly less than spruce. However, even in this old-growth stand it was likely that closed canopies would never occur and larch would always maintain its status in the stand. It could have been judged either way. Subalpine larch is extremely long-lived (500 to 1000 years) and may outlive several generations of species such as subalpine fir. In more moderate, lower-elevation types such as ABLA2/VASC/LUHI, subalpine fir or other conifers can form a closed canopy where subalpine larch and whitebark pine are seral dominants but are shaded out as other species gain dominance.

The general appearance of the ground vegetation is a rather continuous, though open, low shrub layer dominated by grouse huckleberry. Although not in the data, low huckleberry was very recently observed to dominate this type near the Enchantment Lakes Basin. The rest of the cover is provided by herbs, grasses and grass-like plants. Cascade huckleberry, red mountain heath, Mertens' moss-heather and partridgefoot are scarce. However, red mountain heath can be found through much of this type. Smooth woodrush is the most dominant herb on most sites. It and pussytoes may increase in cover on disturbed sites. Other common herbs include broadleaf arnica, lupines and Ross' sedge. Mountain hairgrass, black alpine sedge, alpine bluegrass, fan-leaf potentilla and slender hawkweed, common on the LALY/VADE-CAME and LALY/VADE-CAME types, are apparently uncommon on this type.

PRODUCTIVITY/MANAGEMENT: There are no data available for tree production, but tree growth and stocking are assumed very low. These sites are not recommended for timber production as no techniques are known to assure reforestation. Overstory removal increases the potential for severe frost heaving, winter desiccation and drought, and alters snow pack patterns and melting regimes. Snow deposition in the lee of the trees is an important site characteristic that may be altered by the death or removal of an individual subalpine larch or whitebark pine.

These sites are very important for their watershed and scenic values. The type also provides important forage for wildlife, including blue grouse, ptarmigan, mountain goats, pika and deer. Data is not available on herbage production but it is assumed to be very low. Livestock, where present, use these sites for shade and bedding. They are favorite areas for hikers, climbers, backpackers and horse riders. The shrubs are very brittle and easily damaged by trampling. Damage is especially severe in areas of long-term campsite use. Sites that have been denuded of vegetation heal very slowly, and establishment of tree, shrub and herb cover may take decades, if not centuries. Smooth woodrush, alpine timothy, arnicas, asters, lupines and pussytoes are native herbs which may be useful in revegetation efforts.

Subalpine larch stands lie in zones of very frequent lightning strikes. Stand-replacement fires are unusual because of the open nature of the stands and the relatively non-flammable undergrowth. However, such fires may be more frequent on LALY/VASC/LUHI than on LALY/VADE-CAME and LALY/CAME-LUPE. Still, most fires are restricted to the immediate vicinity of the lightning-struck tree.

RELATIONSHIPS TO OTHER CLASSIFICATIONS: LALY/VASC/LUHI has not been described in previous classifications because they treat timberline sites so broadly. Plots fitting this type were a major part of the LALY Association in the Okanogan classification (Williams and Lillybridge 1983) and of the very general LALY-ABLA2 Habitat Types described for northern Idaho (Cooper and others 1991) and Montana (Pfister and others 1977). It is also a likely part of the LALY-PIEN/PHEM/LUHI community described by Wooten and Morrison (unpublished draft). It may be similar to the LALY/PHEM/LUHI community described for the Enchantment Basin (del Moral unpublished draft).

# MISCELLANEOUS SUBALPINE LARCH ASSOCIATIONS
(less than 5 Wenatchee sample plots)

## LALY/DROC CAC112
Two plots on the Okanogan NF have been assigned to this plant Association. They are very inaccessible, but similar sites occur on the Chelan-Sawtooth Ridge and the Entiat Mountains to the south and it seems reasonable that this type is present elsewhere in the northern Cascades. In fact, this type was very recently sampled in the Enchantment Lakes Basin (not in the data). The two plots were located on very severe windswept ridges at 7400 to 7700 feet in the vicinity of Mt. Tiffany. The overstory is a wind-deformed mix of subalpine larch, whitebark pine and Engelmann spruce. The Washington dryad undergrowth averages 35% cover and closely resembles a fellfield. Additional plots are needed to understand both forest and non-forest Associations in very high timberline and alpine environments.

## LALY/JUCO4 CAC113
Three plots in this Association were located near Mt. Tiffany and Oval Peak on the Okanogan NF. We presume it can occur on similar high, dry mountain ranges on the Entiat and Chelan Districts and perhaps in the Enchantment Lakes area. Sites are very steep, windy, mid to upper slopes with very dry, extremely well drained soils. The tree layer is dominated by open subalpine larch. Whitebark pine, Engelmann spruce and subalpine fir are scattered. Common juniper is well represented to abundant and the undergrowth closely resembles PIAL/JUCO4.

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# GLOSSARY

**Abundant** When relating to plant canopy cover in association descriptions or key, any species with 25% or more cover (after Pfister and others 1977).

**Accidental** A species unusual in a particular habitat and present only because of accident or fluke of establishment.

**Allelopathy** The influence on one plant from products of another plant's metabolism. "Chemical warfare of plants."

**Alluvium** A soil that has been deposited by water transport.

**Alpine** A Zone: the part of a mountain above the tree line. Also refers to plants that grow in that environment. By definition there is no such thing as an alpine tree because alpine means "above the tree line."

**Annual** A plant that grows, matures, produces seed and dies each year.

**Ash** (volcanic) Fine pyroclastic fragments under 4.0 mm diameter, usually produced by explosive, aerial ejection from a volcanic vent, i.e., an eruption.

**Association a.** A unit of a vegetation classification based on the projected climax community type.; **b.** A group of plants growing together in a climax state; **c.** An assemblage of species defined and recognized by certain characteristic dominants; **d.** "…a particular combination of climax tree and understory dominants…." (Daubenmire 1968).

**Biennial** A plant that completes its life cycle in two years and then dies.

**Bunchgrass** A grass that grows in a bunch or clump (see caespitose). Contrast with rhizomatous.

**Caespitose** (also cespitose) Growing in dense tufts, e.g., bunchgrass.

**Climax** A self-replacing association or species; with no evidence of replacement by other plants.

**Climax community** The stable community in an ecological succession which, in the absence of disturbance, is able to reproduce itself indefinitely under existing environmental conditions. Accepted as the final stage or end-point in plant succession for a site. The climax community develops and maintains itself in steady state conditions (without disturbance). **Often termed the association.**

**Climax species** Species that in the absence of disturbance are self perpetuating, with no evidence of replacement by other species. Usually considered the most shade tolerant and competitive species.

**Climax vegetation** The pattern or complex of climax communities in a landscape, corresponding to the pattern of environmental gradients or habitats (Gabriel and Talbot 1984).

**Colluvium** Unconsolidated earth material deposited on or at the base of steep slopes by mass wasting (direct gravitational action) and local unconcentrated runoff.

**Common** When used in association descriptions or keys, any species with 1% or more cover in the stand [several individuals present] (after Pfister and others 1977). Often might include species with cover values somewhat less than 1%, since "trace" was not recorded in the Colville NF data.

**Community** A general term for an assemblage of plants living together and interacting in a specific location; no particular ecological status is implied.

**Community type** A conceptual synthesis of all plant communities with similar structure and floristic composition. A unit of vegetation within a classification with no particular successional status implied.

**Constancy** The number of occurrences of a species in a series of same-size plots divided by the total number of plots (expressed as a percentage). IFor instance, if a particular association has 10 plots and a species is found in 8 of the 10, its constancy is 80%.

**Cover** Usually meant as canopy cover, which is the gross outline of the foliage of an individual plant or group of plants within a stand or plot. Expressed as a percent of the total area of the plot and may exceed 100% if more than one vegetation layer is considered.

**Depauperate** Poorly developed in terms of both species and cover of individuals.

**Dominant** A taxon or group of taxa which by their collective size, mass, or numbers exert the most influence on other components of the ecosystem (Daubenmire 1978).

**Ecotone** The boundary or transition zone between plant communities.

**Ephemeral** Lasting only a short time.

**Evergreen** Foliage remains green throughout the year; not deciduous.

**Forb** An herb. Any herbaceous plant that is not grasslike.

**Genus** A taxonomic class below a family and above a species (e.g., all pines are of one genus).

**Graminoid** Refers to an herb with long narrow leaves such as grasses and grass-like plants (sedges and rushes).

**Grass** Any member of the family Gramineae.

**Grasslike** Includes plants such as sedges and rushes that resemble grasses in gross morphology but are not part of the family Gramineae. See graminoid.

**Habitat** The area or type of environment in which an organism or population normally lives or occurs.

**Habitat type** Defined originally by R. Daubenmire (1968) to mean: "All the area that now supports, or within recent time has supported, and presumably is still capable of supporting, one plant association...." An aggregation of all land areas capable of supporting similar plant communities at climax (Pfister and others 1977).

**Herb** A plant with a fleshy stem that dies back to ground level each year. A non-woody plant.

**Herbaceous** Leaflike in color and texture; non-woody.

**Hydric** A relative term used with xeric and mesic to denote the wetness of a site. Xeric-mesic-hydric indicates dry to wet. Hygric is a synonymous term that is probably more appropriate (or correct).

**Hygric** See hydric.

**Increaser** A native plant that increases under disturbance (usually grazing). It carries a negative connotation for determination of range condition.

**Indicator species** A species which is sensitive to important environmental feature of a site, such that its constancy or abundance reflect significant changes in environmental factors. A plant whose presence indicates specific site conditions or a type.

**Invader** An introduced plant that increases after its introduction into a site, generally after some type of disturbance. As used in range management, the term carries the connotation of being undesirable for grazing.

**Layering** The ability of a plant to form roots where its stem comes in contact with the ground. (e.g. Western redcedar or Pacific yew.)

**Loess** Fine grained, wind-deposited material predominantly of silt-size particles.

**Mesic** A relative term used with xeric and hydric to denote the wetness of a site. Xeric-mesic-hydric indicates dry to wet.

**Meso-, Mes-** A prefix used to indicate a middle or intermediate condition, such as mesic (intermediate in terms of moisture or temperature; or along a gradient of riparian conditions such as riparian, meso-riparian, xero-riparian to non-riparian communities or species.)

**Microsite** A small area (usually only a few square feet) of different site or habitat conditions from that surrounding it. (E.g., a small concave area within a larger area of convex slope.)

**Moderate** Used in the context of not extreme in terms of temperature, elevation and moisture.

**Plant Association** A unit of a vegetation classification based on the projected climax community type.

**Plant Community** A general term for an assemblage of plants living together and interacting among themselves in a specific location; no particular successional status implied.

**Plant Community Type** An conceptual synthesis of all plant communities with similar structure and floristic composition. A unit of vegetation within a classification, with no particular ecological status implied.

**Plot** A **measured,** circumscribed sampling area for vegetation (Lincoln and others 1982).

**Poorly represented** When relating to plant coverage in association descriptions or keys, includes any species with less than 5% cover, including absent. In practice, often indicates species that are not especially apparent (after Pfister and others 1977).

**Presence** The state or fact of being present; or, similar to constancy except that all the plots need not be the same size.

**Present** Found in the plot [but not obviously restricted to atypical microsites] (after Pfister and others 1977).

**Principal layer** The layer which defines the characteristic physiognomy of the vegetation (at any geographic or classification scale) being considered.

**Prostrate** Growing flat along the ground.

**Regolith** "All loose earth material above the underlying solid rock; more or less equivalent to the term soil…" (Lincoln and others 1982).

**Reproducing successfully** An evaluation of the reproductive success of trees, when a species appears capable of reproducing itself under current conditions (mainly applied to closed canopy conditions). Generally, 10 or more individuals per acre is used as an arbitrary starting point for evaluation. Other items normally considered include the health and vigor of individuals, the species concerned is not restricted to atypical microsites, and individuals are usually in more than one size class in the understory (after Pfister and others 1977).

**Residuum** A soil that has developed in place from the local geologic formation. Usually, residual soils have been formed from weathering and have not been significantly transported from the parent location.

**Rhizomatous** Having rhizomes.

**Rhizome** A root-like underground stem that sends out shoots from its upper surface and roots from the under surface.

**Riparian** relating to that land, next to water, where plants dependent on a perpetual source of water occur (Kovalchik 1987).

**Riparian ecosystem** Interacting system between aquatic and terrestrial conditions, identified by soil characteristics and distinctive vegetation that requires or tolerates free or unbound water (Youngblood and others 1985).

**Riparian species** Plant species occurring within a riparian zone. **Obligate** species require the environmental conditions within the riparian zone; **facultative** species tolerate the conditions and therefore may also occur away from the riparian zone (Youngblood and others 1985).

**Riparian zone** A geographically delineated portion of the riparian ecosystem (Youngblood and others 1985).

**Rosette** A basal cluster of leaves, flowers, etc., arranged in a circle or disc.

**Rush** Grasslike plants of the family Juncaceae, with hollow or pithy, round stems without nodes.

**Scarce** When relating to plant coverage in association descriptions or keys, includes any species absent or with less than 1% cover [only one or two small plants].

**Sedge** A grasslike plant of the family Cyperaceae that resembles a grass but has solid (often triangular) stems without nodes.

**Seral** A species or plant community that is replaced by another as succession progresses. See **sere**.

**Sere** The complete sequence of ecological communities successively occupying an area.

**Series** A conceptual synthesis of taxonomically related associations that takes the name of the climax species that dominates the principal layer (Driscoll and others 1984). A group of associations or habitat types with the same dominant climax species.

**Shrub** A woody perennial that differs from trees in that it is typically smaller in stature and has multiple stems from the ground. Shrubs tend to be categorized as follows: Low shrubs are up to 2 feet tall; Medium shrubs are 2 to 6 feet high; and Tall shrubs are more than 6 feet tall. See also subshrub.

**Site** An area delimited by fairly uniform climatic and soil conditions. Similar to habitat.

**Species** A taxonomic class below that of genus; generally refers to organisms capable of interbreeding.

**Stable** The condition of little or no perceived change; used for plant communities that are in relative equilibrium with existing environmental conditions. Describes persistent but not necessarily culminating stages [climax] in plant succession (Youngblood and others 1985).

**Stand** Vegetation occupying a specific area and sufficiently uniform in species composition, age arrangement, structure and condition to be distinguished from the vegetation in adjoining areas. Stands are real entities and can be sampled. Compare association, habitat type, community.

**Stolon** A creeping stem above the ground that roots at the nodes. Compare to rhizome.

**Stoloniferous** Having or bearing stolons.

**Subalpine** A forested zone just below the treeless (alpine) zone. See alpine.

**Subshrub** A very low (usually less than 1 foot tall) and semi-woody plant with a persistent, somewhat woody base. Some consider them as woody herbs. PYSE, CHUMO and LIBOL are examples of subshrubs. (Suffrutescent is the proper botanical term for semi-shrubby plants.)

**Succession** The replacement of one type of community or species by another. (Often given the connotation of leading towards the climax, but this is not necessarily so in all uses.)

**Timberline** The upper or lower limit above which trees do not grow. The lower timberline is usually related to drought and the upper to low temperatures. See tree line.

**Trailing** Prostrate, but not rooting.

**Tree** A woody plant with a single stem (usually) and more than eight feet tall.

**Tree line** The limit beyond which trees do not grow except perhaps in a stunted form. Compare with timberline.

**Type** A general term for class, synonymous with any classified unit, and used in the text to facilitate readability.

**Ungulate** Cloven-hoofed animals

**Undergrowth** A generalized term that refers to the plants under a taller canopy of vegetation, such as shrubs under a canopy of trees. See understory.

**Understory** Sometimes has the same meaning as undergrowth but usually carries the connotation of being small trees.

**Well represented** When relating to plant coverage in association descriptions or keys, any species with more than 5% canopy cover [readily apparent] (after Pfister and others 1977).

**Wintergreen** Green throughout the year. Evergreen, but without the connotation evergreen carries of being specific to tree foliage.

**Xero-** A Greek prefix meaning dry. E.g., xerophyte = a dryness-enduring or drought-tolerant plant. Compare with mesic and hydric (hygric).

**Xeric** Characterized by or adapted to a dry habitat. See explanation under hydric.

**Zone** The geographic area of uniform macroclimate where the climatic associations share the same characteristic species of the principal layer. Note: the zone has been used by Daubenmire (1978) to describe the geographical area over which one association is climatic climax. His definition is more specific than the definition given above. The definition as used herein approximates the geographical area of a Series, or possibly portions of other Series, rather than the area of one Association.

# APPENDIX A

## LIST OF ABBREVIATIONS
## SCIENTIFIC AND COMMON NAMES
## OF
## TREES, SHRUBS, SUBSHRUBS AND HERBS

# APPENDIX B

## MEAN COVER AND CONSTANCY
## OF
## IMPORTANT SPECIES BY TYPE

# APPENDIX A

Species alphabetized by code

## TREES

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ABAM | *Abies amabilis* | silver fir |
| ABGR | *Abies grandis* | grand fir |
| ABLA2 | *Abies lasiocarpa* | subalpine fir |
| ABPR | *Abies procera* | noble fir |
| ACMA | *Acer macrophyllum* | bigleaf maple |
| ALRU | *Alnus rubra* | red alder |
| BEOC | *Betula occidentalis* | western water birch |
| BEPA | *Betula papyrifera* | paper birch |
| CHNO | *Chamaecyparis nootkatensis* | Alaska yellow cedar |
| LALY | *Larix lyalli* | subalpine larch |
| LAOC | *Larix occidentalis* | western larch |
| PIEN | *Picea engelmannii* | Engelmann spruce |
| PIGL | *Picea glauca* | white spruce |
| PIAL | *Pinus albicaulis* | whitebark pine |
| PICO | *Pinus contorta* | lodgepole pine |
| PIMO | *Pinus monticola* | western white pine |
| PIPO | *Pinus ponderosa* | ponderosa pine |
| POTR | *Populus tremuloides* | quaking aspen |
| POTR2 | *Populus trichocarpa* | black cottonwood |
| PSME | *Pseudotsuga menziesii* | Douglas-fir |
| QUGA | *Quercus garryana* | Oregon white oak |
| THPL | *Thuja plicata* | western redcedar |
| TSHE | *Tsuga heterophylla* | western hemlock |
| TSME | *Tsuga mertensiana* | mountain hemlock |

## SHRUBS AND SUBSHRUBS

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ACCI | *Acer circinatum* | vine maple |
| ACGLD | *Acer glabrum* var. *douglasii* | Douglas maple |
| ALSI | *Alnus sinuata* | Sitka alder |
| AMAL | *Amelanchier alnifolia* | serviceberry |
| ARNE | *Arctostaphylos nevadensis* | pinemat manzanita |
| ARTRV | *Artemisia tridentata vaseyana* | mountain big sagebrush |
| ARUV | *Arctostaphylos uva-ursi* | bearberry |
| BEAQ | *Berberis aquifolium* | Oregon grape |
| BENE | *Berberis nervosa* | Cascade Oregon grape |
| CAME | *Cassiope mertensiana* | Mertens' moss-heather |
| CATR2 | *Cassiope tetrogona* | four-angled moss-heather |
| CESA | *Ceanothus sanguineus* | redstem ceanothus |
| CEVE | *Ceanothus velutinus* | snowbrush ceanothus |
| CHME | *Chimaphila menziesii* | little prince's pine |
| CHUMO | *Chimaphila umbellata* var. *occidentalis* | western prince's pine |
| COCA | *Cornus canadensis* | bunchberry dogwood |

## SHRUBS AND SUBSHRUBS cont'd

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| COCO2 | *Corylus cornuta* | California hazel |
| COST | *Cornus stolonifera* | red-osier dogwood |
| DROC | *Dryas octapetela* | Washington dryad |
| GAOV | *Gaultheria ovatifolia* | slender wintergreen |
| HODI | *Holodiscus discolor* | ocean-spray |
| JUCO4 | *Juniperus communis* | common juniper |
| LEGL | *Ledum glandulosum* | Labrador tea |
| LIBOL | *Linnaea borealis* var. *longiflora* | twinflower |
| LOCI | *Lonicera ciliosa* | trumpet honesuckle |
| LOIN | *Lonicera involucrata* | bearberry honeysuckle |
| LOUT | *Lonicera utahensis* | Utah honeysuckle |
| LUPE | *Luetkea pectinata* | partridgefoot |
| MEFE | *Menziesia ferruginea* | rusty menziesia |
| OPHO | *Oplopanax horridum* | devil's club |
| PAMY | *Pachistima myrsinities* | pachistima |
| PEFR3 | *Penstemon fruiticosus* | shrubby penstemon |
| PHLE2 | *Philadelphus lewisii* | mockorange |
| PHEM | *Phyllodoce empetriformis* | red mountain heath |
| PHMA | *Physocarpus malvaceus* | ninebark |
| PREM | *Prunus emarginata* | bitter cherry |
| PRVI | *Prunus virginiana* | chokecherry |
| PUTR | *Purshia tridentata* | bitterbrush |
| PYAS | *Pyrola asarifolia* | alpine pyrola |
| PYCH | *Pyrola chlorantha* | green pyrola |
| PYPI | *Pyrola picta* | whitevein pyrola |
| PYSE | *Pyrola secunda* | sidebells pyrola |
| PYUN | *Pyrola uniflora* | woodnymph pyrola |
| RHAL | *Rhododendron albiflorum* | Cascade azalea |
| RICE | *Ribes cereum* | wax currant |
| RILA | *Ribes lacustre* | prickly currant |
| RIVI | *Ribes viscosissimum* | sticky currant |
| ROGY | *Rosa gymnocarpa* | baldhip rose |
| RONUH | *Rosa nutkana* var. *hispida* | bristly nootka rose |
| ROSA | *Rosa* spp. | rose species |
| ROWO | *Rosa woodsii* | Wood's rose |
| RULA | *Rubus lasiococcus* | dwarf bramble |
| RUPA | *Rubus parviflorus* | western thimbleberry |
| RUPE | *Rubus pedatus* | five-leaved bramble |
| RUSP | *Rubus spectabalis* | salmonberry |
| RUUR | *Rubus ursinus* | Pacific blackberry |
| SACE | *Sambucus cerulea* | blue elderberry |
| SALIX | *Salix* spp. | willow species |
| SASC | *Salix scouleriana* | Scouler willow |
| SHCA | *Shepherdia canadensis* | russet buffaloberry |
| SOSC2 | *Sorbus scopulina* | mountain ash |
| SOSI | *Sorbus sitchensis* | Sitka mountain ash |

## SHRUBS AND SUBSHRUBS cont'd

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| SPBEL | *Spirea betulifolia* var. *lucida* | shiny-leaf spirea |
| SYAL | *Symphoricarpos albus* | common snowberry |
| SYMOH | *Symphoricarpos mollis* var. *hesperius* | creeping snowberry |
| SYOR | *Symphoricarpos oreophilus* | mountain snowberry |
| TABR | *Taxus brevifolia* | Pacific yew |
| VAAL | *Vaccinium alaskaense* | Alaska huckleberry |
| VACA | *Vaccinium caespitosum* | dwarf huckleberry |
| VADE | *Vaccinium deliciosum* | Cascade huckleberry |
| VACCI | *Vaccinium* spp. | huckleberry species |
| VAME | *Vaccinium membranaceum* | big huckleberry |
| VAMY | *Vaccinium myrtillus* | low huckleberry |
| VAOV | *Vaccinium ovatifolium* | oval-leaf huckleberry |
| VAPA | *Vaccinium parvifolium* | red huckleberry |
| VASC | *Vaccinium scoparium* | grouse huckleberry |
| XETE | *Xerophyllum tenax* | beargrass |

## HERBS

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ACTR | *Achylys triphylla* | vanilla leaf |
| ACMI | *Achillea millefolium* | yarrow |
| ACRU | *Actaea rubra* | baneberry |
| ADBI | *Adenocaulon bicolor* | pathfinder |
| AGSP | *Agropyron spicatum* | bluebunch wheatgrass |
| AGIN | *Agropyron spicatum* var. *inerme* | beardless bluebunch wheatgrass |
| ALLIU | *Allium* spp. | onion species |
| ANOR | *Anemone oregana* | Oregon anemone |
| ANTEN | *Antennaria* spp. | pussytoes species |
| ANAN | *Antennaria anaphaloides* | tall pussytoes |
| ANLA | *Antennaria lanata* | woolly pussytoes |
| ANMI | *Antennaria microphylla* | rose pussytoes |
| ANRA | *Antennaria racemosa* | raceme pussytoes |
| ANUM | *Antennaria umbrinella* | umber pussytoes |
| APAN | *Apocynum androsaemifolium* | spreading dogbane |
| AQUIL | *Aquilegia* spp. | columbine species |
| ARNU3 | *Aralia nudicaulis* | wild sarsaparilla |
| ARMA3 | *Arenaria macrophyllum* | bigleaf sandwort |
| ARENA | *Arenaria* spp. | sandwort species |
| ARNIC | *Arnica* spp. | arnica species |
| ARCO | *Arnica cordifolia* | heartleaf arnica |
| ARLA | *Arnica latifolia* | broadleaf arnica |
| ASCA3 | *Asarum caudatum* | wild ginger |
| ASDE | *Aspidotis densa* | podfern |
| ASMI | *Astragalus miser* | starved milkvetch |
| ASCO | *Aster conspicuus* | showy aster |
| ASTER | *Aster* spp. | aster species |

## HERBS cont'd

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ATFI | *Athyrium filix-femina* | ladyfern |
| BACA | *Balsamorhiza careyana* | Carey balsamroot |
| BADE | *Balsamorhiza deltoidea* | Puget balsamroot |
| BAHO | *Balsamorhiza hookeri* | Hooker balsamroot |
| BASA | *Balsamorhiza sagittata* | arrowleaf balsamroot |
| BRHY | *Brodiaea hycinthina* | hycinth brodiaea |
| BROMU | *Bromus* spp. | bromegrass species |
| BRTE | *Bromus tectorum* | cheatgrass |
| BRSU | *Bromus suksdorfii* | Suksdorf brome |
| BRVU | *Bromus vulgaris* | Columbia brome |
| CABI | *Caltha biflora* | white marshmarigold |
| CACO | *Carex concinnoides* | northwestern sedge |
| CAGE | *Carex geyeri* | elk sedge |
| CAHO | *Carex hoodii* | Hood sedge |
| CAREX | *Carex* spp. | sedge species |
| CANI2 | *Carex nigricans* | black alpine sedge |
| CARO | *Carex rossii* | Ross sedge |
| CACA | *Calamagrostis canadensis* | bluejoint reedgrass |
| CARU | *Calamagrostis rubescens* | pinegrass |
| CASTI | *Castilleja* spp. | paintbrush species |
| CEDI | *Centaurea diffusa* | diffuse knapweed |
| CIAL | *Circaea alpina* | circaea |
| CLLA | *Claytonia lanceolata* | lanceleaf springbeauty |
| CLCO | *Clematis columbiana* | rock clematis |
| CLUN | *Clintonia uniflora* | queencup beadlily |
| COGR | *Collinsia grandiflora* | bluetips collinsia |
| COPA | *Collinsia parviflora* | little flower collinsia |
| COGR2 | *Collomia grandiflora* | large-flowered collomia |
| CRAT | *Crepis atrabarba* | slender hawksbeard |
| DEDE | *Delphinium depauperatum* | slim or dwarf larkspur |
| DENU3 | *Delphinium nuttallianum* | upland larkspur |
| DEAT | *Deschampsia atropurpurea* | mountain hairgrass |
| DIHO | *Disporum hookeri* | Hooker fairybells |
| DITR | *Disporum trachycarpum* | wartberry fairybells |
| ELGL | *Elymus glaucus* | blue wildrye |
| EPAN | *Epilobium angustifolium* | fireweed |
| EQUIS | *Equisetum* spp. | horsetail species |
| EQAR | *Equisetum arvense* | common horsetail |
| EQSC | *Equisetum scirpoides* | sedgelike horsetail |
| ERCO5 | *Eriogonum compositum* | northern buckwheat |
| ERHE | *Eriogonum heracleoides* | Wyeth buckwheat |
| ERGR | *Erythronium grandiflorum* | glacier lily |
| ERMO | *Erythronium montanum* | avalanche lilly |
| FEID | *Festuca idahoensis* | Idaho fescue |
| FEOC | *Festuca occidentalis* | western fescue |
| FEVI | *Festuca viridula* | green fescue |

## HERBS cont'd

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| FRAGA | *Fragaria* spp. | strawberry species |
| FRSP | *Frasera speciosa* | showy frasera |
| GAMU | *Galium multiflorum* | many-flowered bedstraw |
| GATR | *Galium triflorum* | sweetscented bedstraw |
| GIAG | *Gilia aggregata* | scarlet gilia |
| GOOB | *Goodyera oblongifolia* | w. rattlesnake plantain |
| GYDR | *Gymnocarpium dryopteris* | oak fern |
| HECY | *Heuchera cylindrica* | roundleaf alumroot |
| HIAL | *Hieracium albiflorum* | white hawkweed |
| HIERA | *Hieracium* spp. | hawkweed species |
| HICY | *Hieracium cynoglossoides* | houndstongue hawkweed |
| HIGR | *Hieracium gracile* | slender hawkweed |
| HISC | *Hieracium scouleri* | woolly hawkweed |
| HYCA | *Hydrophyllum capitatum* | ballhead waterleaf |
| HYMO | *Hypopitys monotropa* | pinesap |
| KOCR | *Koeleria cristata* | prairie junegrass |
| LAPA2 | *Lathyrus pauciflorus* | few-flowered peavine |
| LICHE | Lichen spp. | lichen species |
| LIPA | *Lithophragma parviflora* | smallflower fringecup |
| LIRU | *Lithospermum ruderale* | wayside gromwell |
| LODI | *Lomatium dissectum* | fern-leaved lomatium |
| LOMA2 | *Lomatium martindalei* | Martindale's lomatium |
| LONU | *Lomatium nudicaule* | barestem lomatium |
| LOTR | *Lomatium triternatum* | nine-leaf lomatium |
| LUHI | *Luzula hitchcockii* | smooth woodrush |
| LUNA2 | *Luina nardosima* | silvercrown luina |
| LUST | *Luina stricta* | tongue-leaf luina |
| LUPIN | *Lupinus* spp. | lupine species |
| LUCA | *Lupinus caudatus* | tailcup lupine |
| LULA | *Lupinus latifolius* | broadleaf lupine |
| LULAP | *Lupinus laxiflorus* var. *pseudoparviflorus* | spurred lupine |
| LULE2 | *Lupinus lepidus* | prairie lupine |
| LUPOB | *Lupinus polyphyllus* var. *burkeii* | bigleaf lupine |
| LUSE | *Lupinus sericeus* | silky lupine |
| LUSUS | *Lupinus suphureus* var. *subsaccatus* | sulfur lupine |
| LUWY | *Lupinus wyethii* | Wyeth lupine |
| LYAM | *Lysichitum americanum* | skunk cabbage |
| MITEL | *Mitella* spp. | miterwort species |
| MOPE | *Montia perfoliata* | miner's lettuce |
| OSCH*O* | *smorhiza chilensis* | sweetroot |
| OSOC*O* | *smorhiza occidentalis* | western sweetroot |
| OSPU*O* | *smorhiza purpurea* | purple sweetroot |
| PEBR | *Pedicularis bracteosa* | bracted pedicularis |
| PENST | *Penstemon* spp. | penstemon species |
| PERA | *Pedicularis racemosa* | sickletop pedicularis |
| PEPR2 | *Penstemon pruinosus* | prickleaf penstemon |

## HERBS cont'd

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| PHHA | *Phacelia hastata* | silverleaf phacelia |
| PHLOX | *Phlox* spp. | phlox |
| PHSP | *Phlox speciosa* | showy phlox |
| POA | *Poa* spp. | bluegrass species |
| POCU | *Poa cusickii* | Cusick bluegrass |
| PONE | *Poa nervosa* | Wheeler bluegrass |
| POPR | *Poa pratensis* | Kentucky bluegrass |
| POSA3 | *Poa sandbergii* | Sandberg bluegrass |
| POPU | *Polemonium pulcherrimum* | skunkleaf polemonium |
| POLO2 | *Polystichum lonchitis* | mountain hollyfern |
| POMU | *Polystichum munitum* | western swordfern |
| POTEN | *Potentilla* spp. | cinquefoil |
| POFL2 | *Potentilla flabellifolia* | fan-leaf cinquefoil |
| PTAQ | *Pteridium aquilinum* | bracken fern |
| SAXIF | *Saxifraga* spp. | saxifrage |
| SEDUM | *Sedum* spp. | stonecrop |
| SEIN | *Senecio integerrimus* | western groundsel |
| SELA | *Sedum lanceolatum* | lance-leaved stonecrop |
| SETR | *Senecio triangularis* | arrowleaf groundsel |
| SIHY | *Sitanion hystrix* | bottlebrush squirreltail |
| SMRA | *Smilacina racemosa* | feather solomonplume |
| SMST | *Smilacina stellata* | starry solomonplume |
| STAM | *Streptopus amplexifolius* | claspleaf twistedstalk |
| STRO | *Streptopus roseus* | rosy twistedstalk |
| TAOF | *Taraxacum officinale* | common dandelion |
| THOC | *Thalictrum occidentale* | western meadowrue |
| TITRU | *Tiarella trifoliata* var. *unifoliata* | coolwort foamflower |
| TRCA3 | *Trautvetteria caroliniensis* | false bugbane |
| TRLA2 | *Trientalis latifolia* | western starflower |
| TROV | *Trillium ovatum* | trillium |
| VASI | *Valeriana sitchensis* | Sitka valerian |
| VECA | *Veratrum californicum* | California false hellebore |
| VEVI | *Veratrum viride* | American false hellebore |
| VIAD | *Viola adunca* | Hook violet |
| VIGL | *Viola glabrella* | pioneer violet |
| VIOR2 | *Viola orbiculata* | round-leaved violet |
| VIPU | *Viola purpurea* | goosefoot violet |
| VITR2 | *Viola trinervata* | three-nerved violet |
| ZIVE | *Zigadenus venenosus* | meadow death-camas |

# APPENDIX B

## MEAN COVER AND CONSTANCY
## OF
## IMPORTANT SPECIES BY TYPE

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | QUGA/AGSP 6 Plots | | QUGA/CARU-CAGE 6 Plots | | QUGA/COCO2-SYAL 6 Plots | | PIPO/AGSP 7 Plots | | PIPO/CARU-AGSP 7 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | . | . | . | . | . | . |
| PIEN | Engelmann spruce | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | . | . | . | . | . | . | . | . |
| PIMO | western white pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | ponderosa pine | 17 | 5 | 100 | 5 | 67 | 20 | 100 | 29 | 100 | 33 |
| POTR | quaking aspen | . | . | . | . | 17 | 20 | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | 17 | 2 | . | . | . | . |
| PSME | Douglas-fir | . | . | 83 | 13 | 67 | 17 | 14 | 1 | 29 | 2 |
| QUGA | Oregon white oak | 100 | 25 | 100 | 20 | 83 | 50 | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | 33 | 3 | 17 | 1 | 57 | 5 | 86 | 2 |
| PSME | Douglas-fir | . | . | 50 | 1 | 17 | 5 | . | . | 43 | 1 |
| QUGA | Oregon white oak | 100 | 7 | 100 | 6 | 83 | 13 | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | 14 | 2 | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | 14 | 1 |
| BEAQ | Oregon grape | . | . | 50 | 3 | 33 | 1 | 14 | 1 | . | . |
| BENE | Cascade Oregon grape | . | . | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 50 | 5 | . | . | 14 | 1 | 29 | 1 |
| CHUMO | western prince's pine | . | . | . | . | . | . | . | . | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | 83 | 17 | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | 17 | 1 | 33 | 4 | 50 | 3 | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | . | . | . | . | . | . | . | . | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 17 | 1 | . | . | 33 | 1 | . | . | . | . |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | 100 | 4 | 67 | 2 | . | . | 71 | 3 | 57 | 3 |
| PYSE | sidebells pyrola | . | . | . | . | . | . | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | QUGA/AGSP 6 Plots CON | QUGA/AGSP COV | QUGA/CARU-CAGE 6 Plots CON | QUGA/CARU-CAGE COV | QUGA/COCO2-SYAL 6 Plots CON | QUGA/COCO2-SYAL COV | PIPO/AGSP 7 Plots CON | PIPO/AGSP COV | PIPO/CARU-AGSP 7 Plots CON | PIPO/CARU-AGSP COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | 17 | 10 | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | 83 | 4 | 17 | 5 | . | . | 14 | 1 |
| SYAL | common snowberry | 17 | 5 | 50 | 2 | 83 | 47 | 14 | 1 | 14 | 1 |
| SYMOH | creeping snowberry | . | . | . | . | 17 | 3 | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAMY | low huckleberry | . | . | . | . | . | . | . | . | . | . |
| VASC | grouse huckleberry | . | . | . | . | . | . | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | 100 | 17 | 67 | 5 | 17 | 1 | 86 | 23 | 86 | 22 |
| ARCO | heartleaf arnica | . | . | 50 | 4 | . | . | . | . | 14 | 4 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | 14 | 3 |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | 17 | 5 | 17 | 8 | . | . | 71 | 6 | 57 | 4 |
| BRTE | cheatgrass | 100 | 16 | 83 | 9 | 50 | Tr | 71 | 4 | 14 | 2 |
| CACO | northwestern sedge | . | . | . | . | . | . | . | . | . | . |
| CAGE | elk sedge | 17 | 6 | 100 | 12 | 67 | 4 | . | . | 57 | 11 |
| CARO | Ross sedge | . | . | . | . | . | . | 29 | 2 | 29 | 2 |
| CARU | pinegrass | . | . | 100 | 19 | 33 | 8 | 43 | 2 | 86 | 21 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | 17 | 3 | . | . | . | . | 57 | 13 | 43 | 14 |
| FEOC | western fescue | . | . | . | . | . | . | . | . | 14 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 17 | 2 | 50 | 23 | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | 17 | 3 | . | . | . | . | 14 | 1 |
| LUSE | silky lupine | . | . | . | . | . | . | 29 | 6 | 43 | 4 |
| LUPIN | lupine species | . | . | 17 | 5 | 17 | Tr | 29 | 2 | 43 | 8 |
| LUSU | sulfur lupine | 100 | 8 | 50 | 8 | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | . | . | 14 | 1 | . | . |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | . | . | . | . | . | . |
| SMST | starry solomonplume | . | . | . | . | 17 | 10 | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PIPO/PUTR/AGSP | | PSME/AGSP | | PSME/AGSP-ASDE | | PSME/ARUV | |
|---|---|---|---|---|---|---|---|---|---|
| | | 13 Plots | | 10 Plots | | 3 Plots | | 5 Plots | |
| | | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | | . | . | . |
| ABGR | grand fir | . | . | . | . | | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | | . | . | . |
| ABPR | noble fir | . | . | . | . | | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | | . | . | . |
| CHNO | yellow cedar | . | . | . | . | | . | . | . |
| LALY | subalpine larch | . | . | . | . | | . | . | . |
| LAOC | western larch | . | . | . | . | | . | 40 | 7 |
| PIEN | Engelmann spruce | . | . | . | . | | . | . | . |
| PIAL | whitebark pine | . | . | . | . | | . | . | . |
| PICO | lodgepole pine | . | . | . | . | | . | 80 | 11 |
| PIMO | western white pine | . | . | . | . | | . | 20 | 3 |
| PIPO | ponderosa pine | 100 | 29 | 80 | 17 | 100 | 9 | 60 | 10 |
| POTR | quaking aspen | . | . | . | . | | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | | . | . | . |
| PSME | Douglas-fir | 46 | 1 | 100 | 19 | 100 | 10 | 100 | 26 |
| QUGA | Oregon white oak | . | . | . | . | | . | . | . |
| THPL | western redcedar | . | . | . | . | | . | . | . |
| TSHE | western hemlock | . | . | . | . | | . | . | . |
| TSME | mountain hemlock | . | . | . | . | | . | . | . |
| **Tree Understory Layer** | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | | . | . | . |
| ABGR | grand fir | . | . | . | . | | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | | . | . | . |
| LALY | subalpine larch | . | . | . | . | | . | . | . |
| PIAL | whitebark pine | . | . | . | . | | . | 40 | 2 |
| PIPO | pinus ponderosa | 38 | 5 | 30 | 5 | 33 | 1 | . | . |
| PSME | Douglas-fir | 23 | 1 | 60 | 2 | 67 | 1 | 100 | 5 |
| QUGA | Oregon white oak | . | . | . | . | | . | . | . |
| TSHE | western hemlock | . | . | . | . | | . | . | . |
| TSME | mountain hemlock | . | . | . | . | | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | | . | . | . |
| ARUV | bearberry | 8 | 1 | 10 | 1 | | . | 100 | 21 |
| BEAQ | Oregon grape | 8 | 3 | 10 | 2 | 33 | 1 | . | . |
| BENE | Cascade Oregon grape | 8 | 2 | 10 | 1 | | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 10 | 1 | | . | 40 | 4 |
| CHUMO | western prince's pine | . | . | . | . | | . | 20 | 20 |
| COCA | bunchberry dogwood | . | . | . | . | | . | . | . |
| COCO2 | California hazel | . | . | . | . | | . | . | . |
| DROC | Washington dryad | . | . | . | . | | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | | . | . | . |
| HODI | oceanspray | . | . | . | . | | . | . | . |
| JUCO4 | common juniper | . | . | 10 | 5 | | . | 40 | 3 |
| LIBOL | twinflower | . | . | . | . | | . | . | . |
| LUPE | partridgfoot | . | . | . | . | | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | | . | . | . |
| OPHO | devil's club | . | . | . | . | | . | . | . |
| PAMY | pachistima | 8 | 3 | 20 | 2 | | . | 80 | 7 |
| PEFR3 | shrubby penstemon | . | . | 10 | 1 | | . | . | . |
| PHEM | red mountain heath | . | . | . | . | | . | . | . |
| PUTR | bitterbrush | 100 | 19 | 50 | 3 | 33 | 1 | . | . |
| PYSE | sidebells pyrola | . | . | . | . | | . | 20 | 5 |
| RHAL | Cascade azalea | . | . | . | . | | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PIPO/PUTR/AGSP 13 Plots CON | COV | PSME/AGSP 10 Plots CON | COV | PSME/AGSP-ASDE 3 Plots CON | COV | PSME/ARUV 5 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | . | . | . | . |
| ROWOU | Wood's rose | 8 | 3 | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | 10 | 1 | 67 | 6 | 60 | 4 |
| SYAL | common snowberry | 15 | 3 | 20 | 3 | . | . | . | . |
| SYMOH | creeping snowberry | . | . | 10 | 2 | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | . | . | . | . | . | . |
| VAMY | low huckleberry | . | . | . | . | . | . | . | . |
| VASC | grouse huckleberry | . | . | . | . | . | . | 20 | 1 |
| XETE | beargrass | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | 77 | 19 | 70 | 19 | 100 | 28 | . | . |
| ARCO | heartleaf arnica | . | . | . | . | . | . | 20 | 7 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | 100 | 3 | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | 77 | 9 | 50 | 7 | 67 | 10 | . | . |
| BRTE | cheatgrass | 62 | 10 | 40 | 6 | 33 | 4 | . | . |
| CACO | northwestern sedge | . | . | . | . | . | . | 40 | 2 |
| CAGE | elk sedge | 15 | 6 | 30 | 2 | . | . | . | . |
| CARO | Ross sedge | 23 | 2 | 30 | 2 | . | . | 40 | 2 |
| CARU | pinegrass | 46 | 13 | 30 | 3 | . | . | 60 | 2 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | 46 | 23 | 50 | 13 | . | . | . | . |
| FEOC | western fescue | . | . | 20 | 6 | . | . | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | . | . | 10 | 4 | . | . | . | . |
| LULA | broadleaf lupine | . | . | . | . | . | . | . | . |
| LUSE | silky lupine | 46 | 3 | 20 | 1 | 33 | 15 | . | . |
| LUPIN | lupine species | 23 | 6 | 20 | 9 | 33 | 10 | 20 | 1 |
| LUSU | sulfur lupine | . | . | 20 | 6 | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | . | . | . | . |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | . | . | . | . | 67 | 10 | . | . |
| SMRA | feather solomonplume | . | . | . | . | . | . | . | . |
| SMST | starry solomonplume | . | . | . | . | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | 33 | 2 | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | PSME/ARUV-PUTR | | PSME/ARUV/CARU | | PSME/CAGE | | PSME/CARU | | PSME/CARU-AGSP | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 Plots | | 27 Plots | | 12 Plots | | 76 Plots | | 12 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | 1 | 2 | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | 8 | 5 |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | 37 | 15 | . | . | 21 | 17 | . | . |
| PIEN | Engelmann spruce | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | 50 | 18 | 63 | 8 | . | . | 22 | 17 | . | . |
| PIMO | western white pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | ponderosa pine | 100 | 31 | 85 | 14 | 92 | 12 | 68 | 16 | 100 | 17 |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 12 | 100 | 27 | 100 | 45 | 96 | 31 | 100 | 15 |
| QUGA | Oregon white oak | . | . | . | . | . | . | 4 | 8 | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | 1 | 2 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | 50 | 1 | 33 | 2 | 17 | 6 | 26 | 2 | 58 | 3 |
| PSME | Douglas-fir | 100 | 5 | 100 | 6 | 83 | 3 | 86 | 5 | 75 | 3 |
| QUGA | Oregon white oak | . | . | . | . | . | . | 5 | 3 | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | 1 | 1 | 17 | 3 |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | 100 | 15 | 100 | 16 | . | . | 18 | 2 | . | . |
| BEAQ | Oregon grape | . | . | . | . | 42 | 2 | 16 | 2 | 8 | 2 |
| BENE | Cascade Oregon grape | . | . | . | . | 8 | 1 | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 50 | 4 | 44 | 6 | . | . | 9 | 3 | 50 | 3 |
| CHUMO | western prince's pine | . | . | 4 | 3 | . | . | 5 | 1 | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | 4 | 2 | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | 25 | 2 | 25 | 3 | 17 | 1 |
| JUCO4 | common juniper | . | . | 22 | 1 | . | . | 1 | 1 | . | . |
| LIBOL | twinflower | . | . | . | . | . | . | 3 | 1 | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 83 | 1 | 81 | 3 | 25 | 1 | 57 | 3 | 25 | 2 |
| PEFR3 | shrubby penstemon | 17 | 1 | 15 | 1 | 8 | 3 | 7 | 1 | 8 | 1 |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | 100 | 15 | 26 | 2 | 17 | 2 | 14 | 2 | 67 | 3 |
| PYSE | sidebells pyrola | . | . | . | . | . | . | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PSME/ARUV-PUTR 6 Plots | | PSME/ARUV/CARU 27 Plots | | PSME/CAGE 12 Plots | | PSME/CARU 76 Plots | | PSME/CARU-AGSP 12 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | 8 | 3 | 4 | 3 | . | . |
| ROWOU | Wood's rose | . | . | . | . | 8 | 2 | 1 | 2 | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 50 | 1 | 78 | 4 | 58 | 3 | 51 | 3 | 33 | 8 |
| SYAL | common snowberry | . | . | 7 | 1 | 58 | 2 | 20 | 2 | 50 | 3 |
| SYMOH | creeping snowberry | . | . | . | . | 8 | 1 | 1 | 1 | . | . |
| SYOR | mountain snowberry | . | . | 4 | 2 | 8 | 1 | 4 | 3 | 8 | 5 |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | 4 | 1 | . | . | . | . | . | . |
| VAMY | low huckleberry | . | . | 22 | 3 | . | . | 9 | 1 | . | . |
| VASC | grouse huckleberry | . | . | . | . | . | . | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | 50 | 8 | . | . | 17 | 1 | 1 | 1 | 100 | 18 |
| ARCO | heartleaf arnica | 17 | 2 | 63 | 5 | 58 | 5 | 83 | 8 | 8 | 4 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | 8 | 3 | 14 | 2 | 92 | 7 |
| BRTE | cheatgrass | . | . | . | . | . | . | 3 | 2 | 33 | 5 |
| CACO | northwestern sedge | 67 | 1 | 52 | 4 | . | . | 18 | 3 | . | . |
| CAGE | elk sedge | . | . | . | . | 100 | 11 | 43 | 12 | 75 | 16 |
| CARO | Ross sedge | 50 | 2 | 37 | 2 | . | . | 21 | 2 | 17 | 2 |
| CARU | pinegrass | 100 | 18 | 100 | 20 | 50 | 2 | 100 | 38 | 58 | 23 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | 7 | 1 | 8 | 1 | 3 | 3 | 17 | 6 |
| FEOC | western fescue | . | . | . | . | 8 | 2 | 8 | 2 | 8 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | . | . | . | . | 42 | 8 | 13 | 3 | 8 | 7 |
| LULA | broadleaf lupine | . | . | 4 | 15 | 8 | 1 | 28 | 11 | . | . |
| LUSE | silky lupine | . | . | 4 | 4 | . | . | 11 | 6 | 33 | 5 |
| LUPIN | lupine species | . | . | 7 | 6 | 33 | 2 | 24 | 6 | 42 | 6 |
| LUSU | sulfur lupine | . | . | . | . | 17 | 4 | 16 | 6 | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | . | . | . | . | . | . |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | 1 | 1 | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | 1 | 3 | . | . |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | 17 | 1 | 8 | 1 | 8 | 1 |
| SMST | starry solomonplume | . | . | . | . | . | . | 1 | 1 | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | 17 | 2 | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PSME/PAMY 2 Plots CON | PSME/PAMY COV | PSME/PAMY/CARU 8 Plots CON | PSME/PAMY/CARU COV | PSME/PEFR3 4 Plots CON | PSME/PEFR3 COV | PSME/PUTR 4 Plots CON | PSME/PUTR COV | PSME/PUTR/AGSP 10 Plots CON | PSME/PUTR/AGSP COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | 25 | 1 | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | . | . | . | . | . | . |
| PIEN | Engelmann spruce | . | . | 13 | 2 | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | 100 | 20 | 50 | 13 | . | . | . | . | . | . |
| PIMO | western white pine | . | . | . | . | 25 | 1 | . | . | . | . |
| PIPO | ponderosa pine | . | . | 50 | 14 | 100 | 16 | 100 | 16 | 100 | 23 |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 38 | 100 | 35 | 100 | 11 | 100 | 10 | 100 | 14 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | 100 | 1 | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | 13 | 1 | 50 | 3 | 75 | 2 | 60 | 2 |
| PSME | Douglas-fir | 50 | 1 | 88 | 4 | 100 | 2 | 100 | 3 | 70 | 3 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | 13 | 3 | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | 13 | 2 | 100 | 1 | 75 | 1 | 20 | 3 |
| BENE | Cascade Oregon grape | . | . | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 38 | 6 | 100 | 7 | . | . | 30 | 4 |
| CHUMO | western prince's pine | . | . | . | . | . | . | . | . | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | 25 | 3 | 75 | 2 | 25 | 2 | 10 | 1 |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | . | . | . | . | . | . | . | . | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 100 | 25 | 100 | 24 | 50 | 1 | 25 | 1 | 10 | 6 |
| PEFR3 | shrubby penstemon | . | . | 25 | 1 | 100 | 4 | 75 | 1 | 10 | 1 |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | 100 | 23 | 100 | 15 |
| PYSE | sidebells pyrola | 50 | 2 | 13 | 1 | . | . | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PSME/PAMY 2 Plots CON | PSME/PAMY 2 Plots COV | PSME/PAMY/CARU 8 Plots CON | PSME/PAMY/CARU 8 Plots COV | PSME/PEFR3 4 Plots CON | PSME/PEFR3 4 Plots COV | PSME/PUTR 4 Plots CON | PSME/PUTR 4 Plots COV | PSME/PUTR/AGSP 10 Plots CON | PSME/PUTR/AGSP 10 Plots COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | 13 | 3 | 25 | 1 | 25 | 1 | . | . |
| ROWOU | Wood's rose | . | . | . | . | 25 | 1 | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | 25 | 2 | 75 | 2 | 50 | 2 | 20 | 3 |
| SYAL | common snowberry | 50 | 1 | 13 | 1 | 50 | 3 | . | . | 20 | 3 |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | 25 | 3 | . | . | . | . | 10 | 2 |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAMY | low huckleberry | . | . | . | . | . | . | . | . | . | . |
| VASC | grouse huckleberry | . | . | . | . | . | . | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | 25 | 2 | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | 25 | 5 | 25 | 1 | 70 | 21 |
| ARCO | heartleaf arnica | 50 | 2 | 38 | 6 | . | . | . | . | 20 | 2 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | 25 | 1 | 100 | 3 | 50 | 3 | 90 | 10 |
| BRTE | cheatgrass | . | . | . | . | . | . | 75 | 2 | 40 | 13 |
| CACO | northwestern sedge | . | . | 13 | 2 | . | . | . | . | . | . |
| CAGE | elk sedge | . | . | 38 | 15 | 75 | 2 | 50 | 1 | 30 | 17 |
| CARO | Ross sedge | . | . | . | . | . | . | . | . | 40 | 2 |
| CARU | pinegrass | 100 | 2 | 88 | 21 | 25 | 3 | . | . | 70 | 8 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | 40 | 4 |
| FEOC | western fescue | . | . | . | . | . | . | . | . | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | 10 | 3 |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | . | . | 25 | 7 | 25 | 1 | . | . | . | . |
| LULA | broadleaf lupine | . | . | 25 | 5 | . | . | . | . | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | 20 | 7 |
| LUPIN | lupine species | . | . | 25 | 11 | . | . | . | . | 50 | 5 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | . | . | 25 | 5 | . | . |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | 25 | 2 | . | . | 10 | 1 |
| SMST | starry solomonplume | . | . | 13 | 1 | . | . | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | PSME/PUTR/CARU | | PSME/SPBEL | | PSME/SPBEL/CARU | | PSME/SYAL | | PSME/SYAL/AGSP | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 7 Plots | | 11 Plots | | 38 Plots | | 16 Plots | | 7 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | 11 | 12 | . | . | . | . |
| PIEN | Engelmann spruce | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | 27 | 4 | . | . | 6 | 10 | . | . |
| PIMO | western white pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | ponderosa pine | 100 | 34 | 100 | 9 | 95 | 21 | 69 | 21 | 86 | 24 |
| POTR | quaking aspen | . | . | 9 | 10 | . | . | 31 | 5 | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | 19 | 4 | . | . |
| PSME | Douglas-fir | 86 | 12 | 100 | 38 | 100 | 28 | 94 | 53 | 100 | 12 |
| QUGA | Oregon white oak | . | . | . | . | 3 | 1 | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 14 | 1 | . | . | 13 | 1 | . | . | . | . |
| ABLA2 | subalpine fir | . | . | 27 | 1 | 3 | 2 | 6 | 1 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | 86 | 2 | 18 | 1 | 29 | 2 | 19 | 1 | 71 | 3 |
| PSME | Douglas-fir | 100 | 5 | 100 | 4 | 87 | 4 | 63 | 3 | 71 | 3 |
| QUGA | Oregon white oak | . | . | . | . | . | . | 6 | 1 | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | 8 | 1 | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | 14 | 3 |
| ARUV | bearberry | 29 | 3 | . | . | 8 | 2 | . | . | . | . |
| BEAQ | Oregon grape | 43 | 2 | 45 | 2 | 42 | 3 | 75 | 3 | 57 | 6 |
| BENE | Cascade Oregon grape | . | . | 18 | 2 | 5 | 1 | 6 | 1 | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 43 | 3 | 9 | 1 | 18 | 10 | . | . | 29 | 2 |
| CHUMO | western prince's pine | . | . | 18 | 1 | 5 | 1 | 6 | 1 | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | 3 | 1 | 6 | 2 | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | 43 | 1 | 18 | 3 | 45 | 4 | 19 | 3 | 29 | 8 |
| JUCO4 | common juniper | . | . | . | . | 3 | 1 | . | . | . | . |
| LIBOL | twinflower | . | . | . | . | . | . | . | . | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 43 | 1 | 91 | 28 | 63 | 10 | 69 | 5 | 14 | 2 |
| PEFR3 | shrubby penstemon | . | . | . | . | 5 | 1 | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | 100 | 9 | . | . | 5 | 1 | . | . | 57 | 8 |
| PYSE | sidebells pyrola | . | . | 27 | 1 | 3 | 1 | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | PSME/PUTR/CARU 7 Plots | | PSME/SPBEL 11 Plots | | PSME/SPBEL/CARU 38 Plots | | PSME/SYAL 16 Plots | | PSME/SYAL/AGSP 7 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 14 | 2 | 18 | 2 | 26 | 3 | 25 | 5 | . | . |
| ROWOU | Wood's rose | 14 | 3 | . | . | 5 | 3 | 6 | 4 | 14 | 2 |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 43 | 3 | 100 | 19 | 97 | 12 | 50 | 5 | 43 | 2 |
| SYAL | common snowberry | 43 | 2 | 36 | 3 | 13 | 3 | 100 | 39 | 100 | 10 |
| SYMOH | creeping snowberry | . | . | . | . | 3 | 5 | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | 11 | 4 | 13 | 1 | 14 | 2 |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | 9 | 2 | 3 | 2 | . | . | . | . |
| VAMY | low huckleberry | . | . | . | . | . | . | . | . | . | . |
| VASC | grouse huckleberry | . | . | . | . | . | . | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | 43 | 2 | . | . | 3 | 3 | . | . | 71 | 13 |
| ARCO | heartleaf arnica | 57 | 1 | 9 | 1 | 47 | 4 | 44 | 3 | 14 | 1 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | 6 | Tr | . | . |
| BASA | arrowleaf balsamroot | 71 | 2 | . | . | 24 | 3 | 13 | 1 | 71 | 10 |
| BRTE | cheatgrass | 14 | 1 | . | . | . | . | . | . | 14 | 20 |
| CACO | northwestern sedge | . | . | . | . | 16 | 3 | 6 | 1 | . | . |
| CAGE | elk sedge | 57 | 15 | . | . | 66 | 8 | 19 | 2 | 57 | 3 |
| CARO | Ross sedge | 29 | 2 | 9 | 3 | 8 | 2 | . | . | 14 | 2 |
| CARU | pinegrass | 100 | 21 | 91 | 2 | 92 | 23 | 38 | 2 | 57 | 10 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | 6 | 1 | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | 3 | 2 | . | . | 14 | 7 |
| FEOC | western fescue | . | . | 18 | 1 | 3 | 2 | 13 | 3 | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 14 | 2 | . | . | 32 | 6 | 25 | 2 | 29 | 3 |
| LULA | broadleaf lupine | 14 | 3 | 27 | 1 | 24 | 6 | . | . | . | . |
| LUSE | silky lupine | . | . | . | . | 8 | 6 | 13 | 11 | 14 | 15 |
| LUPIN | lupine species | 43 | 1 | . | . | 24 | 4 | 6 | 2 | 29 | 2 |
| LUSU | sulfur lupine | . | . | . | . | 3 | 3 | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | 5 | 2 | . | . | . | . |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | . | . | . | . | 8 | 7 | 6 | 4 | . | . |
| SMRA | feather solomonplume | 14 | 1 | 9 | 1 | 11 | 2 | 31 | 3 | . | . |
| SMST | starry solomonplume | 14 | 1 | 18 | 1 | 3 | 1 | 31 | Tr | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | 3 | 3 | 6 | 1 | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | 3 | 1 | 19 | 3 | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PSME/SYAL/CARU 11 Plots CON | COV | PSME/SYOR 7 Plots CON | COV | PSME/VACA 3 Plots CON | COV | PSME/VAMY 6 Plots CON | COV | PSME/VAMY/CARU 17 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | 100 | 22 | 50 | 27 | 71 | 25 |
| PIEN | Engelmann spruce | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | . | . | 100 | 29 | 67 | 19 | 88 | 8 |
| PIMO | western white pine | . | . | . | . | . | . | 17 | 1 | . | . |
| PIPO | ponderosa pine | 91 | 14 | 86 | 28 | 67 | 1 | 50 | 24 | 24 | 7 |
| POTR | quaking aspen | . | . | . | . | 33 | 2 | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 49 | 86 | 27 | 100 | 22 | 100 | 8 | 100 | 25 |
| QUGA | Oregon white oak | 9 | 3 | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | 14 | 1 | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | 36 | 2 | 71 | 2 | 33 | 1 | . | . | 12 | 1 |
| PSME | Douglas-fir | 64 | 6 | 57 | 2 | 100 | 18 | 83 | 16 | 100 | 7 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | 9 | 2 | 29 | 7 | . | . | 17 | 2 | . | . |
| ARTRV | mountain big sagebrush | . | . | 57 | 9 | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | 100 | 9 | 50 | 17 | 88 | 10 |
| BEAQ | Oregon grape | 64 | 2 | 29 | 6 | . | . | 17 | 1 | 6 | 2 |
| BENE | Cascade Oregon grape | . | . | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | 33 | 2 | 12 | 1 |
| CHUMO | western prince's pine | 9 | 3 | . | . | 33 | 2 | 33 | 2 | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | 9 | 2 | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | 73 | 2 | 43 | 1 | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | 17 | 1 | 12 | 3 |
| LIBOL | twinflower | . | . | . | . | 67 | 7 | . | . | 12 | 3 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 18 | 1 | 14 | 6 | 100 | 8 | 83 | 4 | 88 | 6 |
| PEFR3 | shrubby penstemon | 9 | 1 | 14 | 4 | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | 9 | 2 | 43 | 5 | . | . | . | . | . | . |
| PYSE | sidebells pyrola | . | . | . | . | . | . | 33 | 2 | 6 | 3 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PSME/SYAL/CARU 11 Plots | | PSME/SYOR 7 Plots | | PSME/VACA 3 Plots | | PSME/VAMY 6 Plots | | PSME/VAMY/CARU 17 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 18 | 2 | . | . | . | . | 17 | 2 | . | . |
| ROWOU | Wood's rose | 9 | 1 | 29 | 1 | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 36 | 4 | . | . | 100 | 6 | 83 | 6 | 94 | 5 |
| SYAL | common snowberry | 82 | 11 | . | . | 33 | 2 | . | . | . | . |
| SYMOH | creeping snowberry | 27 | 12 | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | 100 | 11 | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | 100 | 2 | . | . | 6 | 1 |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | . | . | 33 | 3 | 17 | 5 | 12 | 9 |
| VAMY | low huckleberry | . | . | . | . | 100 | 8 | 83 | 26 | 94 | 14 |
| VASC | grouse huckleberry | . | . | . | . | . | . | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 9 | 2 | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | 18 | 2 | 57 | 6 | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 36 | 3 | 14 | 2 | 33 | 2 | 17 | 8 | 41 | 7 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | 18 | 2 | 71 | 10 | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | 14 | 1 | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | 67 | 4 | 17 | 3 | 53 | 3 |
| CAGE | elk sedge | 82 | 11 | 57 | 7 | . | . | . | . | 12 | 10 |
| CARO | Ross sedge | . | . | 14 | 2 | . | . | 33 | 1 | 35 | 3 |
| CARU | pinegrass | 64 | 7 | 43 | 4 | 100 | 37 | 100 | 2 | 100 | 24 |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | 29 | 4 | . | . | . | . | . | . |
| FEOC | western fescue | 9 | 2 | 14 | 1 | . | . | 17 | 1 | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 36 | 2 | 43 | 5 | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | . | . | . | . | 17 | 15 | . | . |
| LUSE | silky lupine | . | . | 14 | 5 | 33 | 5 | . | . | . | . |
| LUPIN | lupine species | 9 | 1 | 57 | 4 | 33 | 1 | 17 | 3 | 18 | 12 |
| LUSU | sulfur lupine | . | . | 14 | 5 | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | 33 | 5 | . | . | . | . |
| PEBR | bracted pedicularis | . | . | . | . | 67 | 3 | . | . | 6 | 2 |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | 9 | 1 | . | . | . | . | 17 | 3 | . | . |
| SMRA | feather solomonplume | . | . | 29 | 3 | . | . | . | . | . | . |
| SMST | starry solomonplume | . | . | . | . | . | . | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | ABGR/ACCI 13 Plots | | ABGR/ACCI-CHUM 12 Plots | | ABGR/ACCI/CLUN 21 Plots | | ABGR/ACTR 43 Plots | | ABGR/ARCO 24 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 77 | 13 | 92 | 19 | 95 | 36 | 95 | 31 | 96 | 37 |
| ABLA2 | subalpine fir | . | . | . | . | 5 | 1 | 2 | 5 | 8 | 3 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | 8 | 15 | . | . | 10 | 2 | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | . | . | 40 | 8 | 63 | 5 |
| PIEN | Engelmann spruce | . | . | 25 | 10 | 10 | 2 | 9 | 18 | 8 | 13 |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | 50 | 9 | 19 | 3 | 16 | 12 | 8 | 4 |
| PIMO | western white pine | . | . | 33 | 4 | 19 | 2 | 30 | 4 | 13 | 5 |
| PIPO | ponderosa pine | 54 | 12 | 75 | 11 | 33 | 8 | 26 | 6 | 58 | 11 |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 48 | 100 | 31 | 95 | 36 | 91 | 31 | 100 | 24 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 8 | 5 | 8 | 1 | 14 | 4 | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | 5 | 1 | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 77 | 3 | 100 | 6 | 71 | 4 | 98 | 9 | 100 | 13 |
| ABLA2 | subalpine fir | . | . | 8 | 2 | 5 | 1 | 7 | 2 | 4 | 1 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | 8 | 4 | . | . | . | . | 4 | 1 |
| PSME | Douglas-fir | 23 | 1 | 42 | 3 | 10 | 1 | 37 | 2 | 54 | 5 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | 5 | 1 | 5 | 1 | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 100 | 43 | 100 | 36 | 100 | 43 | 12 | 11 | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | 2 | 2 | 8 | 2 |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | 62 | 4 | 50 | 3 | 29 | 2 | 35 | 2 | 38 | 2 |
| BENE | Cascade Oregon grape | 69 | 4 | 67 | 4 | 100 | 5 | 84 | 9 | 17 | 1 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 8 | 3 | . | . | . | . | . | . |
| CHUMO | western prince's pine | 15 | 2 | 100 | 5 | 43 | 3 | 79 | 4 | 50 | 3 |
| COCA | bunchberry dogwood | . | . | . | . | 5 | 1 | 5 | 3 | . | . |
| COCO2 | California hazel | 38 | 3 | . | . | 5 | 2 | 23 | 3 | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | 8 | 2 | . | . | 2 | 2 | . | . |
| HODI | oceanspray | 38 | 5 | 17 | 5 | 19 | 1 | 30 | 2 | 4 | 2 |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | . | . | 50 | 6 | 38 | 3 | 63 | 11 | 17 | 3 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | 5 | 1 | . | . | . | . |
| PAMY | pachistima | 77 | 5 | 100 | 9 | 81 | 4 | 67 | 3 | 63 | 3 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | 8 | 1 |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 15 | 2 | 50 | 3 | 38 | 3 | 60 | 2 | 54 | 1 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABGR/ACCI 13 Plots CON | COV | ABGR/ACCI-CHUM 12 Plots CON | COV | ABGR/ACCI/CLUN 21 Plots CON | COV | ABGR/ACTR 43 Plots CON | COV | ABGR/ARCO 24 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 92 | 4 | 92 | 3 | 81 | 3 | 86 | 7 | 33 | 2 |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | 4 | 4 |
| RULA | dwarf bramble | . | . | . | . | . | . | 7 | 2 | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 54 | 5 | 100 | 6 | 38 | 2 | 58 | 4 | 50 | 3 |
| SYAL | common snowberry | 15 | 3 | 8 | 2 | 14 | 1 | 33 | 4 | 4 | 1 |
| SYMOH | creeping snowberry | 54 | 6 | 8 | 5 | 19 | 3 | 51 | 5 | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | 4 | 1 |
| TABR | Pacific yew | . | . | . | . | . | . | 2 | 2 | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | 17 | 4 | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | 58 | 11 | 29 | 1 | 37 | 6 | 4 | 2 |
| VAMY | low huckleberry | 8 | 15 | 8 | 7 | 5 | 1 | 12 | 2 | 42 | 3 |
| VASC | grouse huckleberry | . | . | . | . | . | . | 7 | 8 | 13 | 1 |
| XETE | beargrass | . | . | . | . | . | . | 2 | 2 | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | 8 | 1 | 10 | 2 | 100 | 14 | 8 | 1 |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 23 | 4 | 17 | 1 | 5 | 2 | 40 | 4 | 96 | 3 |
| ARLA | broadleaf arnica | . | . | . | . | . | . | 14 | 7 | 17 | 3 |
| ASCA3 | wild ginger | . | . | . | . | 38 | 4 | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | 5 | 1 | 5 | 6 | 4 | 1 |
| BASA | arrowleaf balsamroot | 15 | 3 | . | . | . | . | . | . | 4 | 2 |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | 17 | 2 | 5 | 2 | 9 | 3 | 33 | 2 |
| CAGE | elk sedge | 23 | 5 | 25 | 2 | 5 | 2 | 40 | 3 | 100 | 5 |
| CARO | Ross sedge | . | . | 8 | 1 | . | . | 2 | 1 | 8 | 1 |
| CARU | pinegrass | 54 | 8 | 50 | 11 | 5 | 10 | 30 | 5 | 46 | 3 |
| CLUN | queencup beadlily | . | . | 58 | 8 | 86 | 7 | 44 | 3 | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | 8 | 1 | 8 | 3 | . | . | 2 | 2 | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | 23 | 2 | . | . | 10 | 3 | 16 | 1 | 33 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | 2 | 3 | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | 2 | 1 | . | . |
| LUNA2 | silvercrown luina | 31 | 3 | . | . | . | . | 12 | 8 | 42 | 7 |
| LULA | broadleaf lupine | . | . | . | . | . | . | . | . | 4 | 4 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 8 | 5 | 17 | 4 | 5 | 1 | 5 | 1 | 38 | 5 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 15 | 3 | 17 | 3 | . | . | 30 | 12 | 13 | 10 |
| PEBR | bracted pedicularis | . | . | . | . | . | . | 2 | 5 | 13 | 2 |
| PERA | sickletop pedicularis | . | . | . | . | . | . | 12 | 1 | 4 | 1 |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | 2 | 2 | 21 | 2 |
| PTAQ | bracken fern | 31 | 2 | 100 | 4 | 43 | 3 | 7 | 4 | . | . |
| SMRA | feather solomonplume | 23 | 2 | 33 | 2 | 67 | 4 | 35 | 1 | 21 | 1 |
| SMST | starry solomonplume | . | . | 92 | 5 | 71 | 6 | 40 | 3 | 13 | 2 |
| STRO | rosy twistedstalk | . | . | 8 | 1 | 5 | 1 | 5 | 2 | . | . |
| TITRU | coolwort foamflower | . | . | . | . | 5 | 1 | 9 | 2 | 4 | 2 |
| TRCA3 | false bugbane | . | . | . | . | . | . | 2 | 2 | . | . |
| TRLA2 | western starflower | 85 | 4 | 67 | 4 | 38 | 3 | 47 | 4 | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | 5 | 3 | 8 | 1 |
| VIGL | pioneer violet | 8 | 1 | 17 | 2 | 33 | 2 | 19 | 2 | 8 | 1 |
| VIOR2 | round-leaved violet | . | . | . | . | 5 | 1 | 9 | 2 | 4 | 1 |

# APPENDIX B

## SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | ABGR/ARNE 10 Plots | | ABGR/BENE 66 Plots | | ABGR/BENE/CARU 28 Plots | | ABGR/CARU 32 Plots | | ABGR/CARU-LUPIN 28 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 60 | 7 | 95 | 25 | 86 | 14 | 66 | 10 | 61 | 10 |
| ABLA2 | subalpine fir | 10 | 2 | 5 | 9 | 4 | 5 | 6 | 3 | 14 | 3 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | 3 | 3 | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | 40 | 5 | 39 | 13 | 50 | 9 | 6 | 3 | 36 | 15 |
| PIEN | Engelmann spruce | 10 | 2 | 3 | 4 | 4 | 5 | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | 40 | 6 | 30 | 10 | 54 | 18 | 22 | 15 | 50 | 18 |
| PIMO | western white pine | 10 | 2 | 35 | 5 | 25 | 4 | 3 | 6 | 4 | 3 |
| PIPO | ponderosa pine | 70 | 19 | 35 | 6 | 43 | 15 | 91 | 16 | 61 | 13 |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | 2 | 2 | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 22 | 100 | 34 | 100 | 24 | 97 | 31 | 100 | 23 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | 6 | 1 | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | 2 | 5 | 4 | 1 | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | 2 | 1 | . | . | . | . | . | . |
| ABGR | grand fir | 90 | 5 | 97 | 8 | 100 | 8 | 94 | 5 | 96 | 4 |
| ABLA2 | subalpine fir | 20 | 2 | 9 | 1 | 11 | 2 | 13 | 2 | 14 | 2 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | 20 | 2 | . | . | . | . | 25 | 4 | 14 | 1 |
| PSME | Douglas-fir | 90 | 3 | 23 | 2 | 64 | 5 | 75 | 5 | 93 | 5 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | 17 | 1 | . | . | 3 | 1 | . | . |
| TSME | mountain hemlock | . | . | . | . | 4 | 1 | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | 15 | 2 | 7 | 2 | 13 | 2 | . | . |
| ARNE | pinemat manzanita | 80 | 28 | 3 | 2 | 7 | 4 | 22 | 2 | 18 | 2 |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | 20 | 15 | . | . | 7 | 5 | 3 | 3 | 11 | 3 |
| BEAQ | Oregon grape | 20 | 3 | 23 | 1 | 54 | 3 | 59 | 3 | 11 | 2 |
| BENE | Cascade Oregon grape | 40 | 2 | 100 | 13 | 100 | 6 | 3 | 1 | 18 | 1 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 10 | 1 | 2 | 1 | 4 | 2 | 19 | 4 | 11 | 2 |
| CHUMO | western prince's pine | 30 | 3 | 76 | 4 | 61 | 3 | 44 | 4 | 71 | 4 |
| COCA | bunchberry dogwood | . | . | 3 | 4 | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | 5 | 2 | . | . | 3 | 5 | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 20 | 1 | . | . | . | . | . | . | . | . |
| HODI | oceanspray | 30 | 2 | 32 | 3 | 18 | 2 | 47 | 2 | 21 | 2 |
| JUCO4 | common juniper | . | . | 2 | 1 | 4 | 1 | . | . | . | . |
| LIBOL | twinflower | 30 | 4 | 48 | 8 | 29 | 13 | 6 | 3 | 7 | 4 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 60 | 3 | 85 | 5 | 75 | 4 | 63 | 6 | 82 | 8 |
| PEFR3 | shrubby penstemon | 20 | 2 | . | . | . | . | 6 | 1 | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | 3 | 5 | . | . |
| PYSE | sidebells pyrola | . | . | 48 | 2 | 21 | 2 | 9 | 1 | 39 | 3 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABGR/ARNE 10 Plots | | ABGR/BENE 66 Plots | | ABGR/BENE/CARU 28 Plots | | ABGR/CARU 32 Plots | | ABGR/CARU-LUPIN 28 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 40 | 2 | 92 | 7 | 86 | 6 | 44 | 5 | 14 | 6 |
| ROWOU | Wood's rose | . | . | . | . | 7 | 3 | 9 | 3 | . | . |
| RULA | dwarf bramble | . | . | 3 | 2 | 4 | 1 | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 70 | 4 | 82 | 4 | 82 | 5 | 78 | 9 | 54 | 3 |
| SYAL | common snowberry | 10 | 2 | 21 | 9 | 7 | 3 | 19 | 2 | 7 | 1 |
| SYMOH | creeping snowberry | 10 | 3 | 41 | 4 | 57 | 4 | . | . | 7 | 2 |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | 4 | 2 |
| TABR | Pacific yew | . | . | 2 | 10 | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | 20 | 13 | . | . | . | . | 3 | 3 | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 40 | 10 | 41 | 4 | 43 | 5 | 3 | 3 | 7 | 4 |
| VAMY | low huckleberry | 10 | 2 | 17 | 2 | 25 | 7 | 16 | 6 | 50 | 13 |
| VASC | grouse huckleberry | . | . | 3 | 2 | 14 | 14 | 6 | 40 | 7 | 3 |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | 64 | 2 | 25 | 2 | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | 9 | 2 | . | . |
| ARCO | heartleaf arnica | 30 | 1 | 24 | 2 | 46 | 5 | 50 | 5 | 64 | 6 |
| ARLA | broadleaf arnica | . | . | 3 | 3 | . | . | 3 | 1 | 4 | 1 |
| ASCA3 | wild ginger | . | . | 2 | 2 | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | 4 | 1 | . | . | . | . |
| BASA | arrowleaf balsamroot | 30 | 2 | . | . | . | . | 25 | 2 | 11 | 3 |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 20 | 1 | 14 | 2 | 14 | 2 | 9 | 3 | 18 | 3 |
| CAGE | elk sedge | 70 | 6 | 38 | 2 | 64 | 5 | 81 | 8 | 54 | 9 |
| CARO | Ross sedge | 20 | 2 | 3 | 2 | 7 | 2 | 3 | 2 | 7 | 1 |
| CARU | pinegrass | 80 | 23 | 50 | 2 | 100 | 17 | 100 | 23 | 100 | 36 |
| CLUN | queencup beadlily | . | . | 18 | 3 | 14 | 2 | . | . | 7 | 1 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | 10 | 1 | 2 | 1 | . | . | . | . | . | . |
| FEOC | western fescue | 80 | 2 | 30 | 1 | 32 | 3 | 19 | 2 | 18 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 10 | 2 | 17 | 1 | 18 | 11 | 31 | 4 | 14 | 1 |
| LULA | broadleaf lupine | . | . | . | . | 18 | 2 | 6 | 2 | 36 | 13 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 60 | 5 | 11 | 2 | 46 | 4 | 28 | 3 | 64 | 11 |
| LUSU | sulfur lupine | . | . | . | . | . | . | 3 | 2 | . | . |
| MOSS | Undifferentiated Moss | . | . | 20 | 7 | 25 | 14 | 3 | 15 | 21 | 7 |
| PEBR | bracted pedicularis | 30 | 1 | 5 | 1 | 11 | 1 | 6 | 3 | 29 | 2 |
| PERA | sickletop pedicularis | 10 | 1 | 6 | 1 | 14 | 2 | . | . | 21 | 3 |
| POPU | skunkleaf polemonium | . | . | . | . | 4 | 4 | 3 | 1 | 4 | 1 |
| PTAQ | bracken fern | 30 | 3 | 14 | 4 | 18 | 6 | 6 | 7 | . | . |
| SMRA | feather solomonplume | . | . | 20 | 1 | 11 | 1 | 13 | 2 | 14 | 2 |
| SMST | starry solomonplume | 10 | 2 | 23 | 2 | 14 | 2 | 9 | 1 | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | 3 | 2 | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | 10 | 2 | 27 | 3 | 11 | 2 | 3 | 1 | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | 4 | 3 |
| VIGL | pioneer violet | . | . | 3 | 2 | 18 | 2 | . | . | 4 | 2 |
| VIOR2 | round-leaved violet | . | . | 15 | 1 | 18 | 2 | . | . | 4 | 2 |

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABGR/HODI/CARU 10 Plots | | ABGR/SPBEL/PTAQ 30 Plots | | ABGR/SYAL/CARU 42 Plots | | ABGR/SYOR 5 Plots | | TSHE/ACCI/ACTR 10 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 90 | 15 | 67 | 9 | 83 | 14 | 40 | 3 | 60 | 16 |
| ABLA2 | subalpine fir | . | . | 10 | 1 | . | . | . | . | 20 | 10 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | 20 | 4 | . | . | 24 | 8 | . | . | 20 | 12 |
| PIEN | Engelmann spruce | . | . | 10 | 2 | 5 | 23 | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | 43 | 12 | 2 | 5 | . | . | 20 | 15 |
| PIMO | western white pine | 10 | 5 | 50 | 4 | 5 | 5 | . | . | 40 | 7 |
| PIPO | ponderosa pine | 70 | 14 | 80 | 15 | 74 | 15 | 100 | 29 | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 100 | 32 | 100 | 36 | 98 | 40 | 100 | 29 | 100 | 24 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | 3 | 1 | . | . | . | . | 50 | 10 |
| TSHE | western hemlock | . | . | 3 | 1 | . | . | . | . | 80 | 23 |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | 10 | 1 | . | . | . | . | 30 | 1 |
| ABGR | grand fir | 100 | 6 | 97 | 4 | 88 | 5 | 60 | 2 | 60 | 7 |
| ABLA2 | subalpine fir | . | . | 33 | 2 | 2 | 1 | . | . | 20 | 6 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | 40 | 1 | 7 | 3 | 2 | 1 | 60 | 3 | . | . |
| PSME | Douglas-fir | 50 | 3 | 77 | 4 | 67 | 3 | 100 | 2 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | 3 | 1 | . | . | . | . | 80 | 5 |
| TSME | mountain hemlock | . | . | 3 | 1 | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | 17 | 2 | 5 | 2 | . | . | 100 | 20 |
| ARNE | pinemat manzanita | . | . | 7 | 4 | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | 3 | 1 | . | . | . | . | . | . |
| BEAQ | Oregon grape | 70 | 4 | 40 | 2 | 71 | 4 | 100 | 2 | 10 | 1 |
| BENE | Cascade Oregon grape | 10 | 1 | 50 | 2 | 36 | 2 | . | . | 90 | 8 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 20 | 3 | 2 | 1 | . | . | . | . |
| CHUMO | western prince's pine | 30 | 2 | 93 | 5 | 31 | 2 | . | . | 80 | 3 |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | 20 | 4 |
| COCO2 | California hazel | 10 | 8 | . | . | 14 | 3 | . | . | 30 | 2 |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | 7 | 2 | . | . | . | . | 40 | 3 |
| HODI | oceanspray | 100 | 10 | 13 | 2 | 64 | 6 | 20 | 1 | . | . |
| JUCO4 | common juniper | . | . | . | . | 2 | 1 | . | . | . | . |
| LIBOL | twinflower | 10 | 1 | 13 | 5 | 10 | 5 | . | . | 80 | 9 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | 10 | 3 |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 40 | 4 | 97 | 8 | 40 | 2 | . | . | 90 | 8 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | 20 | 1 | . | . |
| PYSE | sidebells pyrola | 20 | 1 | 73 | 3 | 2 | 2 | . | . | 70 | 2 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABGR/HODI/CARU | | ABGR/SPBEL/PTAQ | | ABGR/SYAL/CARU | | ABGR/SYOR | | TSHE/ACCI/ACTR | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 Plots | | 30 Plots | | 42 Plots | | 5 Plots | | 10 Plots | |
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 100 | 12 | 60 | 3 | 83 | 5 | 20 | 3 | 100 | 4 |
| ROWOU | Wood's rose | 10 | 2 | . | . | 12 | 4 | 40 | 3 | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | 30 | 3 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 80 | 10 | 100 | 7 | 71 | 5 | 40 | 9 | 40 | 3 |
| SYAL | common snowberry | 10 | 1 | 7 | 1 | 69 | 8 | 60 | 9 | . | . |
| SYMOH | creeping snowberry | . | . | . | . | 48 | 7 | . | . | 60 | 3 |
| SYOR | mountain snowberry | . | . | . | . | . | . | 100 | 5 | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | 50 | 4 |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | 20 | 2 |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 20 | 1 | 43 | 2 | 5 | 2 | . | . | 90 | 8 |
| VAMY | low huckleberry | 10 | 1 | 27 | 5 | . | . | . | . | 10 | 2 |
| VASC | grouse huckleberry | . | . | . | . | 2 | 2 | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | 40 | 5 |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 20 | 1 | 7 | 2 | 26 | 2 | . | . | 100 | 4 |
| AGSP | bluebunch wheatgrass | . | . | . | . | 2 | 1 | 20 | 1 | . | . |
| ARCO | heartleaf arnica | 60 | 4 | 13 | 2 | 55 | 3 | 80 | 4 | . | . |
| ARLA | broadleaf arnica | 10 | 5 | 3 | 1 | . | . | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | 20 | 1 | 3 | 6 | 14 | 3 | 80 | 5 | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 10 | 1 | 7 | 4 | 2 | 1 | . | . | . | . |
| CAGE | elk sedge | 80 | 9 | 23 | 5 | 79 | 6 | 100 | 8 | . | . |
| CARO | Ross sedge | . | . | 10 | 1 | 2 | 2 | . | . | . | . |
| CARU | pinegrass | 90 | 10 | 73 | 18 | 86 | 9 | 60 | 6 | 10 | 2 |
| CLUN | queencup beadlily | . | . | 17 | 10 | 5 | 1 | . | . | 50 | 6 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | 2 | 1 | . | . | . | . |
| FEOC | western fescue | 30 | 2 | 3 | 1 | 38 | 2 | 40 | 2 | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | 20 | 2 | . | . | 55 | 5 | 80 | 7 | . | . |
| LULA | broadleaf lupine | 20 | 5 | . | . | 2 | 6 | 20 | 10 | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | 20 | 2 | 14 | 2 | 60 | 5 | . | . |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 20 | 4 | . | . | 5 | 2 | . | . | 40 | 21 |
| PEBR | bracted pedicularis | 10 | 1 | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | 2 | 1 | . | . | 10 | 1 |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | . | . |
| PTAQ | bracken fern | 20 | 2 | 100 | 8 | 19 | 2 | . | . | 80 | 3 |
| SMRA | feather solomonplume | 10 | 2 | 27 | 1 | 33 | 2 | . | . | 10 | 1 |
| SMST | starry solomonplume | . | . | 33 | 4 | 14 | 3 | . | . | 30 | 2 |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | 20 | 1 |
| TITRU | coolwort foamflower | . | . | . | . | 2 | 1 | . | . | 10 | 2 |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | 20 | 4 | 10 | 2 | 29 | 2 | . | . | 60 | 6 |
| VASI | Sitka valerian | 10 | 1 | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | . | . | 7 | 2 | 5 | 1 | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | 3 | 2 | 2 | 1 | . | . | 50 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSHE/ACCI/ASCA3 9 Plots CON | COV | TSHE/ACCI/CLUN 7 Plots CON | COV | TSHE/ACTR 41 Plots CON | COV | TSHE/ARNE 6 Plots CON | COV | TSHE/ASCA3 12 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 11 | 2 | . | . | 10 | 2 | 17 | 1 | 33 | 2 |
| ABGR | grand fir | 78 | 22 | 86 | 33 | 73 | 21 | 33 | 4 | 83 | 21 |
| ABLA2 | subalpine fir | 11 | 1 | . | . | 12 | 8 | 50 | 4 | 8 | 2 |
| ABPR | noble fir | . | . | . | . | 2 | 1 | . | . | . | . |
| ACMA | bigleaf maple | 11 | 8 | . | . | . | . | . | . | 8 | 15 |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | 29 | 10 | 61 | 10 | 33 | 13 | 25 | 6 |
| PIEN | Engelmann spruce | 11 | 5 | 29 | 4 | 22 | 7 | . | . | 33 | 9 |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | 14 | 2 | 27 | 5 | 83 | 15 | 8 | 2 |
| PIMO | western white pine | 56 | 3 | 86 | 4 | 54 | 6 | 67 | 5 | 25 | 5 |
| PIPO | ponderosa pine | . | . | . | . | 5 | 6 | 17 | 2 | 8 | 10 |
| POTR | quaking aspen | 11 | 1 | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | 2 | 10 | . | . | 25 | 12 |
| PSME | Douglas-fir | 100 | 27 | 100 | 11 | 95 | 21 | 83 | 18 | 92 | 21 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 78 | 15 | 86 | 19 | 54 | 11 | . | . | 100 | 32 |
| TSHE | western hemlock | 89 | 12 | 86 | 17 | 85 | 18 | 67 | 7 | 75 | 11 |
| TSME | mountain hemlock | . | . | . | . | 2 | 2 | 17 | 1 | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 33 | 2 | 14 | 1 | 29 | 2 | 17 | 1 | 25 | 3 |
| ABGR | grand fir | 89 | 2 | 71 | 8 | 80 | 8 | 33 | 4 | 50 | 2 |
| ABLA2 | subalpine fir | 11 | 1 | 14 | 1 | 17 | 3 | 50 | 5 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | 17 | 1 | . | . |
| PIPO | pinus ponderosa | . | . | . | . | 2 | 1 | . | . | . | . |
| PSME | Douglas-fir | . | . | 14 | 1 | 20 | 3 | 33 | 7 | 8 | 6 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 78 | 4 | 71 | 6 | 88 | 4 | 67 | 3 | 58 | 6 |
| TSME | mountain hemlock | 11 | 1 | . | . | 5 | 2 | 33 | 2 | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 100 | 23 | 100 | 25 | 20 | 4 | . | . | 33 | 1 |
| ARNE | pinemat manzanita | . | . | . | . | 2 | 2 | 100 | 28 | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | 22 | 1 | 14 | 1 | . | . | . | . | 8 | 1 |
| BENE | Cascade Oregon grape | 89 | 5 | 86 | 7 | 98 | 9 | 67 | 4 | 92 | 4 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 67 | 3 | 71 | 6 | 88 | 3 | 83 | 5 | 58 | 2 |
| COCA | bunchberry dogwood | 22 | 3 | 43 | 14 | 5 | 5 | . | . | 42 | 3 |
| COCO2 | California hazel | 22 | 2 | . | . | 2 | 5 | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 33 | 2 | 57 | 2 | 29 | 4 | 67 | 8 | 33 | 2 |
| HODI | oceanspray | . | . | 14 | 1 | 5 | 1 | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | 17 | 4 | . | . |
| LIBOL | twinflower | 67 | 5 | 100 | 11 | 95 | 8 | 67 | 9 | 50 | 6 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | 14 | 2 | . | . | . | . | 42 | 1 |
| OPHO | devil's club | 33 | 2 | . | . | . | . | . | . | 42 | 2 |
| PAMY | pachistima | 67 | 2 | 86 | 6 | 80 | 5 | 83 | 3 | 50 | 2 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 67 | 2 | 43 | 2 | 73 | 2 | 17 | 1 | 50 | 2 |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSHE/ACCI/ASCA3 9 Plots CON | COV | TSHE/ACCI/CLUN 7 Plots CON | COV | TSHE/ACTR 41 Plots CON | COV | TSHE/ARNE 6 Plots CON | COV | TSHE/ASCA3 12 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 67 | 2 | 86 | 3 | 85 | 5 | 67 | 2 | 42 | 4 |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | 33 | 3 | 14 | 1 | 39 | 3 | 17 | 1 | 17 | 7 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 22 | 2 | 43 | 3 | 34 | 3 | 83 | 4 | 8 | 1 |
| SYAL | common snowberry | 22 | 3 | . | . | 15 | 2 | . | . | 8 | 2 |
| SYMOH | creeping snowberry | 44 | 8 | 14 | 2 | 54 | 4 | . | . | 8 | 2 |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | 33 | 3 | . | . | 24 | 2 | 33 | 3 | 17 | 2 |
| VAAL | Alaska huckleberry | 11 | 2 | . | . | 2 | 1 | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 56 | 2 | 71 | 2 | 76 | 4 | 83 | 16 | 42 | 3 |
| VAMY | low huckleberry | . | . | 29 | 2 | 12 | 2 | 17 | 15 | 8 | 1 |
| VASC | grouse huckleberry | . | . | . | . | 10 | 3 | 33 | 5 | . | . |
| XETE | beargrass | 11 | 1 | . | . | 10 | 7 | 33 | 4 | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 78 | 16 | . | . | 100 | 10 | 17 | 3 | 33 | 13 |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | 17 | 15 | . | . |
| ARCO | heartleaf arnica | . | . | . | . | 12 | 5 | . | . | . | . |
| ARLA | broadleaf arnica | . | . | . | . | 5 | 3 | . | . | . | . |
| ASCA3 | wild ginger | 100 | 2 | . | . | . | . | . | . | 100 | 5 |
| ASDE | podfern | . | . | . | . | . | . | 17 | 2 | . | . |
| ATFI | ladyfern | 11 | 2 | . | . | 2 | 1 | . | . | 42 | 3 |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 11 | 1 | 14 | 3 | 10 | 2 | . | . | . | . |
| CAGE | elk sedge | . | . | 29 | 3 | 15 | 1 | . | . | . | . |
| CARO | Ross sedge | . | . | . | . | 2 | 1 | 17 | 1 | . | . |
| CARU | pinegrass | . | . | 14 | 2 | 12 | 2 | 67 | 6 | . | . |
| CLUN | queencup beadlily | 89 | 5 | 100 | 9 | 59 | 5 | 17 | 2 | 92 | 4 |
| EQUIS | horsetail species | 22 | 1 | . | . | 2 | 2 | . | . | 8 | 1 |
| EQAR | common horsetail | . | . | 14 | 1 | 5 | 4 | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | 11 | 2 | . | . | 12 | 1 | . | . | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | 11 | 1 | 14 | 3 | . | . | . | . | 17 | 4 |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | . | . |
| LUNA2 | silvercrown luina | . | . | . | . | 5 | 1 | . | . | . | . |
| LULA | broadleaf lupine | . | . | . | . | 5 | 9 | . | . | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | 14 | 1 | 5 | 8 | . | . | . | . |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 11 | 10 | 14 | 10 | 29 | 14 | 17 | 1 | 25 | 6 |
| PEBR | bracted pedicularis | . | . | . | . | 2 | 2 | . | . | . | . |
| PERA | sickletop pedicularis | 22 | 1 | 14 | 1 | 20 | 1 | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | 2 | 2 | . | . | . | . |
| PTAQ | bracken fern | 78 | 3 | 57 | 2 | 32 | 3 | 50 | 12 | 33 | 3 |
| SMRA | feather solomonplume | 56 | 1 | 57 | 2 | 12 | 1 | . | . | 17 | 2 |
| SMST | starry solomonplume | 100 | 3 | 71 | 4 | 34 | 2 | . | . | 100 | 3 |
| STRO | rosy twistedstalk | 11 | 3 | 14 | 1 | . | . | . | . | . | . |
| TITRU | coolwort foamflower | 56 | 2 | 29 | 2 | 24 | 2 | . | . | 50 | 4 |
| TRCA3 | false bugbane | 11 | 2 | . | . | 2 | 2 | . | . | 8 | 2 |
| TRLA2 | western starflower | 67 | 4 | . | . | 29 | 3 | . | . | 33 | 2 |
| VASI | Sitka valerian | . | . | . | . | 5 | 1 | . | . | 17 | 2 |
| VIGL | pioneer violet | 22 | 2 | . | . | 22 | 2 | . | . | 58 | 4 |
| VIOR2 | round-leaved violet | 22 | 4 | 43 | 2 | 34 | 3 | . | . | 25 | 3 |

# APPENDIX B

## SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSHE/BENE 31 Plots CON | COV | TSHE/PAMY/CLUN 12 Plots CON | COV | THPL/OPHO 10 Plots CON | COV | ABAM/ACCI 24 Plots CON | COV | ABAM/ACTR 56 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 16 | 3 | 8 | 1 | 20 | 1 | 88 | 19 | 80 | 18 |
| ABGR | grand fir | 61 | 19 | 83 | 13 | 80 | 24 | 8 | 25 | 21 | 12 |
| ABLA2 | subalpine fir | 6 | 2 | 25 | 3 | . | . | 8 | 3 | 30 | 10 |
| ABPR | noble fir | 3 | 5 | . | . | . | . | 8 | 6 | 13 | 14 |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | 21 | 7 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | 29 | 9 | 42 | 12 | . | . | . | . | 36 | 12 |
| PIEN | Engelmann spruce | 23 | 5 | 42 | 6 | 30 | 17 | 4 | 1 | 45 | 5 |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PICO | lodgepole pine | 29 | 8 | 17 | 2 | . | . | . | . | 9 | 9 |
| PIMO | western white pine | 65 | 5 | 58 | 4 | 30 | 4 | 25 | 1 | 45 | 7 |
| PIPO | ponderosa pine | 10 | 2 | 8 | 15 | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | 10 | 1 | . | . | . | . |
| POTR2 | black cottonwood | 3 | 3 | . | . | 10 | 5 | . | . | . | . |
| PSME | Douglas-fir | 94 | 18 | 100 | 24 | 80 | 14 | 100 | 26 | 93 | 20 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 45 | 8 | 50 | 6 | 90 | 28 | 42 | 7 | 30 | 10 |
| TSHE | western hemlock | 77 | 32 | 58 | 13 | 60 | 15 | 88 | 23 | 79 | 19 |
| TSME | mountain hemlock | . | . | . | . | . | . | 4 | 2 | 7 | 4 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 32 | 2 | 33 | 2 | 10 | 1 | 96 | 13 | 95 | 12 |
| ABGR | grand fir | 55 | 6 | 58 | 8 | 30 | 2 | 8 | 2 | 34 | 3 |
| ABLA2 | subalpine fir | 16 | 1 | 25 | 2 | . | . | 8 | 3 | 25 | 4 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 23 | 2 | 17 | 2 | 10 | 1 | . | . | 18 | 2 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 84 | 4 | 50 | 2 | 40 | 3 | 79 | 5 | 84 | 6 |
| TSME | mountain hemlock | 3 | 1 | 8 | 2 | . | . | 4 | 1 | 16 | 2 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 32 | 5 | 42 | 2 | 90 | 15 | 100 | 19 | 5 | 3 |
| ARNE | pinemat manzanita | 3 | 1 | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | 3 | 1 | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | 6 | 2 | 8 | 1 | . | . | . | . | . | . |
| BENE | Cascade Oregon grape | 100 | 6 | 75 | 10 | 80 | 3 | 79 | 7 | 71 | 8 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 81 | 4 | 75 | 6 | 40 | 2 | 88 | 3 | 66 | 4 |
| COCA | bunchberry dogwood | . | . | 8 | 5 | 30 | 2 | 17 | 4 | 27 | 9 |
| COCO2 | California hazel | 6 | 3 | . | . | . | . | 4 | 4 | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 32 | 2 | 25 | 2 | 20 | 3 | 50 | 3 | 20 | 6 |
| HODI | oceanspray | 3 | 5 | 17 | 3 | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | 8 | 1 | . | . | . | . | . | . |
| LIBOL | twinflower | 77 | 7 | 58 | 15 | 40 | 4 | 79 | 7 | 68 | 7 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | 10 | 2 | 8 | 3 | 30 | 1 | 25 | 3 | 14 | 2 |
| OPHO | devil's club | . | . | . | . | 80 | 13 | 13 | 1 | 5 | 2 |
| PAMY | pachistima | 74 | 3 | 100 | 10 | 20 | 1 | 79 | 3 | 79 | 6 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 71 | 2 | 83 | 2 | 50 | 2 | 75 | 4 | 86 | 4 |
| RHAL | Cascade azalea | . | . | . | . | . | . | 4 | 2 | 13 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSHE/BENE 31 Plots CON | COV | TSHE/PAMY/CLUN 12 Plots CON | COV | THPL/OPHO 10 Plots CON | COV | ABAM/ACCI 24 Plots CON | COV | ABAM/ACTR 56 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 55 | 4 | 92 | 5 | 60 | 3 | 71 | 3 | 59 | 4 |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | 10 | 1 | 75 | 2 | 20 | 6 | 88 | 4 | 84 | 6 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | 13 | 1 | 5 | 3 |
| SPBEL | shiny-leaf spirea | 39 | 2 | 67 | 4 | . | . | 13 | 2 | 16 | 2 |
| SYAL | common snowberry | 3 | 10 | . | . | 10 | 2 | 4 | 3 | 4 | 3 |
| SYMOH | creeping snowberry | 19 | 8 | 33 | 7 | 30 | 4 | 21 | 2 | 13 | 4 |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | 19 | 6 | 17 | 2 | 30 | 2 | 42 | 3 | 5 | 4 |
| VAAL | Alaska huckleberry | 3 | 2 | . | . | 10 | 2 | 25 | 3 | 16 | 2 |
| VACA | dwarf huckleberry | 3 | 1 | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 77 | 3 | 92 | 9 | 40 | 3 | 100 | 9 | 89 | 13 |
| VAMY | low huckleberry | 19 | 2 | . | . | . | . | 4 | 3 | 14 | 8 |
| VASC | grouse huckleberry | 16 | 1 | . | . | . | . | . | . | 9 | 3 |
| XETE | beargrass | 6 | 6 | . | . | . | . | 46 | 4 | 14 | 4 |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | 50 | 14 | 79 | 8 | 100 | 9 |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 10 | 1 | . | . | . | . | . | . | 2 | 2 |
| ARLA | broadleaf arnica | . | . | 8 | 1 | . | . | 4 | 2 | 32 | 3 |
| ASCA3 | wild ginger | . | . | . | . | 90 | 8 | . | . | 13 | 2 |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | 6 | 2 | . | . | 80 | 9 | 4 | 2 | 5 | 2 |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 13 | 1 | 8 | 1 | . | . | . | . | 2 | 1 |
| CAGE | elk sedge | 6 | 2 | 25 | 2 | . | . | . | . | 7 | 3 |
| CARO | Ross sedge | 6 | 1 | 8 | 2 | . | . | 4 | 1 | 5 | 2 |
| CARU | pinegrass | 10 | 4 | 8 | 3 | . | . | . | . | 2 | 1 |
| CLUN | queencup beadlily | . | . | 100 | 4 | 90 | 4 | 83 | 7 | 89 | 7 |
| EQUIS | horsetail species | . | . | 8 | 1 | 30 | 8 | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | 10 | 1 | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | 10 | 2 | 17 | 1 | . | . | . | . | 9 | 1 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | 3 | 3 | . | . | 50 | 3 | . | . | 9 | 6 |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | 2 | 1 |
| LUNA2 | silvercrown luina | . | . | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | 3 | 4 | 8 | 5 | . | . | . | . | 2 | 8 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 10 | 8 | 17 | 4 | . | . | 4 | 2 | 20 | 3 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 26 | 12 | 25 | 12 | 10 | 40 | 46 | 15 | 27 | 15 |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | 2 | 2 |
| PERA | sickletop pedicularis | . | . | 17 | 2 | 10 | 1 | 17 | 1 | 20 | 2 |
| POPU | skunkleaf polemonium | . | . | . | . | . | . | . | . | 5 | 2 |
| PTAQ | bracken fern | 23 | 1 | 92 | 6 | 40 | 3 | 54 | 2 | 16 | 2 |
| SMRA | feather solomonplume | 16 | 2 | 33 | 2 | 30 | 3 | 17 | 2 | 9 | 1 |
| SMST | starry solomonplume | 26 | 4 | 67 | 2 | 100 | 6 | 38 | 4 | 39 | 4 |
| STRO | rosy twistedstalk | . | . | 8 | 1 | 30 | 4 | 13 | 1 | 13 | 2 |
| TITRU | coolwort foamflower | 6 | 2 | 17 | 6 | 80 | 4 | 42 | 5 | 45 | 5 |
| TRCA3 | false bugbane | 3 | 3 | 8 | 4 | 40 | 4 | 4 | 3 | 4 | 2 |
| TRLA2 | western starflower | 13 | 3 | 33 | 3 | 50 | 7 | 17 | 3 | 11 | 2 |
| VASI | Sitka valerian | . | . | 8 | 1 | . | . | 4 | 1 | 14 | 5 |
| VIGL | pioneer violet | 13 | 2 | 8 | 1 | 90 | 3 | 4 | 2 | 11 | 3 |
| VIOR2 | round-leaved violet | 26 | 2 | 42 | 2 | 10 | 2 | 71 | 2 | 70 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABAM/MEFE 27 Plots CON | COV | ABAM/OPHO 11 Plots CON | COV | ABAM/RHAL-VAME 12 Plots CON | COV | ABAM/RULA 7 Plots CON | COV | ABAM/TITRU 9 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 93 | 25 | 100 | 31 | 83 | 26 | 86 | 20 | 89 | 26 |
| ABGR | grand fir | . | . | . | . | 17 | 2 | 29 | 4 | . | . |
| ABLA2 | subalpine fir | 7 | 2 | . | . | 50 | 23 | 100 | 11 | 22 | 13 |
| ABPR | noble fir | 7 | 5 | . | . | 8 | 35 | . | . | 22 | 10 |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | 15 | 21 | . | . | 33 | 11 | 14 | 5 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | 4 | 3 | . | . | 17 | 10 | . | . | 22 | 8 |
| PIEN | Engelmann spruce | 4 | 5 | . | . | 25 | 15 | 57 | 10 | 44 | 18 |
| PIAL | whitebark pine | . | . | . | . | 8 | 1 | . | . | . | . |
| PICO | lodgepole pine | . | . | . | . | 17 | 4 | 57 | 14 | 22 | 4 |
| PIMO | western white pine | 7 | 4 | . | . | 42 | 2 | 57 | 7 | 33 | 2 |
| PIPO | ponderosa pine | . | . | . | . | . | . | 14 | 1 | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | 11 | 2 |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 44 | 10 | 36 | 15 | 67 | 8 | 71 | 20 | 56 | 18 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 26 | 9 | 64 | 15 | . | . | . | . | 56 | 6 |
| TSHE | western hemlock | 89 | 31 | 91 | 23 | 50 | 19 | 14 | 10 | 78 | 29 |
| TSME | mountain hemlock | 19 | 5 | 18 | 3 | . | . | 14 | 5 | 22 | 2 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 14 | 100 | 8 | 83 | 16 | 86 | 4 | 100 | 9 |
| ABGR | grand fir | . | . | . | . | . | . | 14 | 1 | . | . |
| ABLA2 | subalpine fir | . | . | . | . | 42 | 6 | 71 | 8 | 33 | 7 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | . | . | . | . | 14 | 2 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 81 | 4 | 64 | 6 | 50 | 4 | 29 | 1 | 67 | 4 |
| TSME | mountain hemlock | 22 | 3 | 9 | 2 | 25 | 3 | 14 | 2 | 11 | 2 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 7 | 2 | 27 | 7 | . | . | . | . | 11 | 3 |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | . | . | . | . | . | . | . | . |
| BENE | Cascade Oregon grape | 30 | 3 | . | . | 17 | 4 | . | . | 44 | 4 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 37 | 2 | . | . | 25 | 1 | 43 | 1 | 44 | 2 |
| COCA | bunchberry dogwood | 33 | 5 | 18 | 10 | . | . | . | . | 44 | 4 |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 44 | 3 | . | . | 8 | 7 | . | . | 33 | 2 |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | 59 | 4 | 36 | 3 | 17 | 4 | . | . | 33 | 5 |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | 100 | 14 | 45 | 3 | 8 | 2 | . | . | 44 | 3 |
| OPHO | devil's club | 4 | 1 | 100 | 33 | . | . | . | . | 22 | 3 |
| PAMY | pachistima | 33 | 2 | 9 | 1 | 58 | 3 | 71 | 4 | 56 | 2 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | 8 | 1 | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 81 | 3 | 73 | 3 | 92 | 3 | 71 | 3 | 89 | 3 |
| RHAL | Cascade azalea | 48 | 11 | . | . | 100 | 25 | 29 | 1 | 11 | 1 |

# SPECIES COMPARISON BY TYPE

(COV=mean relative cover; CON=mean constancy)

| Species | | ABAM/MEFE 27 Plots CON | COV | ABAM/OPHO 11 Plots CON | COV | ABAM/RHAL-VAME 12 Plots CON | COV | ABAM/RULA 7 Plots CON | COV | ABAM/TITRU 9 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 7 | 2 | 27 | 1 | 8 | 1 | . | . | 33 | 2 |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | 74 | 3 | 82 | 4 | 75 | 10 | 100 | 16 | 78 | 7 |
| RUPE | five-leaved bramble | 41 | 4 | 36 | 8 | 8 | 8 | 14 | 1 | 22 | 3 |
| SPBEL | shiny-leaf spirea | . | . | . | . | . | . | . | . | . | . |
| SYAL | common snowberry | 4 | 2 | . | . | . | . | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | 22 | 6 | 9 | 1 | 8 | 5 | . | . | 22 | 4 |
| VAAL | Alaska huckleberry | 67 | 8 | 55 | 4 | 25 | 5 | . | . | 33 | 2 |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 89 | 11 | 73 | 3 | 75 | 14 | 100 | 14 | 100 | 6 |
| VAMY | low huckleberry | 19 | 10 | 18 | 1 | 50 | 3 | 29 | 2 | 33 | 2 |
| VASC | grouse huckleberry | 4 | 2 | . | . | 17 | 2 | 29 | 9 | . | . |
| XETE | beargrass | 33 | 12 | . | . | 25 | 4 | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 22 | 4 | 27 | 11 | 33 | 11 | . | . | 11 | 1 |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 4 | 1 | . | . | 8 | 2 | . | . | . | . |
| ARLA | broadleaf arnica | . | . | . | . | 50 | 4 | 100 | 15 | 33 | 5 |
| ASCA3 | wild ginger | . | . | 55 | 5 | . | . | . | . | 11 | 2 |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | 91 | 6 | . | . | . | . | 11 | 3 |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | . | . | . | . | . | . |
| CAGE | elk sedge | . | . | . | . | 8 | 1 | 14 | 2 | . | . |
| CARO | Ross sedge | . | . | . | . | . | . | 14 | 1 | . | . |
| CARU | pinegrass | . | . | . | . | . | . | . | . | . | . |
| CLUN | queencup beadlily | 74 | 5 | 100 | 11 | 33 | 9 | 14 | 5 | 89 | 5 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | 4 | 1 | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | . | . | . | . | 43 | 1 | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | 15 | 4 | 100 | 10 | 8 | 6 | . | . | 44 | 3 |
| LUHI | smooth woodrush | . | . | . | . | . | . | 14 | 1 | . | . |
| LUNA2 | silvercrown luina | . | . | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | . | . | . | . | 57 | 3 | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | . | . | 17 | 3 | . | . | 11 | 5 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 67 | 27 | 27 | 13 | 50 | 11 | 57 | 8 | 11 | 10 |
| PEBR | bracted pedicularis | . | . | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | 4 | 1 | . | . | . | . | 43 | 1 | 11 | 2 |
| POPU | skunkleaf polemonium | . | . | . | . | 8 | 1 | 86 | 3 | 11 | 3 |
| PTAQ | bracken fern | 7 | 1 | . | . | . | . | . | . | 33 | 2 |
| SMRA | feather solomonplume | 4 | 1 | 18 | 2 | 8 | 1 | . | . | 11 | 3 |
| SMST | starry solomonplume | 11 | 3 | 55 | 8 | 17 | 2 | . | . | 67 | 3 |
| STRO | rosy twistedstalk | 33 | 3 | 64 | 6 | 17 | 8 | . | . | 33 | 4 |
| TITRU | coolwort foamflower | 44 | 3 | 100 | 12 | 33 | 4 | . | . | 89 | 4 |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | 56 | 10 |
| TRLA2 | western starflower | 4 | 1 | 27 | 5 | . | . | . | . | . | . |
| VASI | Sitka valerian | 11 | 3 | 18 | 2 | 17 | 2 | 43 | 6 | 67 | 2 |
| VIGL | pioneer violet | 4 | 4 | 73 | 4 | . | . | . | . | 33 | 3 |
| VIOR2 | round-leaved violet | 19 | 2 | 36 | 4 | 58 | 3 | 100 | 4 | 56 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABAM/VAAL 22 Plots CON | COV | ABAM/VAME-PYSE 40 Plots CON | COV | ABAM/VAME/CLUN 30 Plots CON | COV | TSME/LUHI 6 Plots CON | COV | TSME/MEFE-VAME 9 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 91 | 24 | 83 | 16 | 70 | 15 | 33 | 12 | 100 | 32 |
| ABGR | grand fir | . | . | 8 | 6 | 23 | 9 | . | . | . | . |
| ABLA2 | subalpine fir | . | . | 13 | 3 | 30 | 16 | 83 | 29 | . | . |
| ABPR | noble fir | 9 | 8 | 3 | 2 | 3 | 20 | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | 13 | 3 | 3 | 15 | 17 | 3 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | 15 | 11 | 13 | 11 | . | . | . | . |
| PIEN | Engelmann spruce | 14 | 13 | 3 | 3 | 30 | 10 | 17 | 5 | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | 17 | 5 | . | . |
| PICO | lodgepole pine | . | . | 5 | 13 | 13 | 24 | 17 | 5 | . | . |
| PIMO | western white pine | 14 | 5 | 38 | 5 | 47 | 4 | . | . | 11 | 1 |
| PIPO | ponderosa pine | . | . | . | . | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | 3 | 1 | . | . | . | . |
| PSME | Douglas-fir | 59 | 15 | 75 | 14 | 77 | 19 | . | . | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 36 | 10 | 18 | 7 | 50 | 6 | . | . | . | . |
| TSHE | western hemlock | 100 | 32 | 95 | 38 | 63 | 36 | . | . | 33 | 10 |
| TSME | mountain hemlock | 14 | 3 | 15 | 5 | 3 | 5 | 100 | 16 | 100 | 17 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 20 | 95 | 9 | 97 | 9 | 83 | 6 | 100 | 18 |
| ABGR | grand fir | . | . | 10 | 6 | 17 | 9 | . | . | . | . |
| ABLA2 | subalpine fir | . | . | 18 | 5 | 43 | 6 | 50 | 1 | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | 3 | 5 | . | . | . | . | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 73 | 4 | 78 | 5 | 60 | 5 | . | . | 22 | 3 |
| TSME | mountain hemlock | 14 | 1 | 23 | 2 | 10 | 4 | 67 | 5 | 78 | 4 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | 23 | 2 | 18 | 2 | 13 | 2 | . | . | . | . |
| ARNE | pinemat manzanita | . | . | 5 | 8 | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | . | . | . | . | . | . | . | . |
| BENE | Cascade Oregon grape | 36 | 3 | 70 | 4 | 57 | 6 | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 41 | 2 | 80 | 3 | 63 | 3 | . | . | . | . |
| COCA | bunchberry dogwood | 27 | 4 | 5 | 3 | 13 | 2 | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 36 | 4 | 65 | 4 | 30 | 2 | . | . | 11 | 1 |
| HODI | oceanspray | . | . | . | . | 3 | 2 | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | 55 | 2 | 78 | 5 | 63 | 6 | . | . | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | 17 | 45 | . | . |
| MEFE | rusty menziesia | 59 | 3 | 15 | 2 | 13 | 2 | 17 | 1 | 100 | 30 |
| OPHO | devil's club | 9 | 3 | . | . | . | . | . | . | 11 | 1 |
| PAMY | pachistima | 36 | 4 | 60 | 3 | 77 | 5 | . | . | 11 | 1 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | 7 | 2 | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 95 | 3 | 73 | 2 | 83 | 3 | 17 | 1 | 56 | 1 |
| RHAL | Cascade azalea | 18 | 1 | 3 | 1 | 7 | 3 | 33 | 1 | 44 | 6 |

## SPECIES COMPARISON BY TYPE

(COV=mean relative cover; CON=mean constancy)

| Species | | ABAM/VAAL 22 Plots CON | COV | ABAM/VAME-PYSE 40 Plots CON | COV | ABAM/VAME/CLUN 30 Plots CON | COV | TSME/LUHI 6 Plots CON | COV | TSME/MEFE-VAME 9 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | 15 | 2 | 50 | 3 | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | 82 | 2 | 30 | 3 | 60 | 7 | 67 | 14 | 67 | 4 |
| RUPE | five-leaved bramble | 18 | 2 | 3 | 3 | 3 | 1 | . | . | 22 | 2 |
| SPBEL | shiny-leaf spirea | 5 | 1 | 15 | 2 | 7 | 3 | . | . | . | . |
| SYAL | common snowberry | . | . | . | . | 7 | 2 | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | 3 | 1 | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | 14 | 3 | 25 | 5 | 20 | 3 | . | . | . | . |
| VAAL | Alaska huckleberry | 100 | 11 | 10 | 2 | 3 | 1 | . | . | 33 | 2 |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 100 | 9 | 98 | 9 | 97 | 15 | 50 | 7 | 100 | 22 |
| VAMY | low huckleberry | 14 | 1 | 15 | 2 | 13 | 2 | . | . | . | . |
| VASC | grouse huckleberry | . | . | 20 | 6 | 3 | 15 | 50 | 2 | . | . |
| XETE | beargrass | 23 | 10 | 28 | 6 | 10 | 4 | 17 | 1 | 11 | 1 |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | 41 | 4 | 15 | 1 | 17 | 1 | . | . | 11 | 5 |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | . | . | 3 | 1 | 3 | 2 | . | . | . | . |
| ARLA | broadleaf arnica | 9 | 2 | . | . | 7 | 2 | 100 | 5 | 22 | 2 |
| ASCA3 | wild ginger | . | . | . | . | 3 | 1 | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | 9 | 2 | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | 3 | 2 | . | . | . | . |
| CAGE | elk sedge | . | . | . | . | . | . | 17 | 2 | . | . |
| CARO | Ross sedge | . | . | . | . | 3 | 1 | . | . | . | . |
| CARU | pinegrass | . | . | . | . | . | . | . | . | . | . |
| CLUN | queencup beadlily | 86 | 4 | . | . | 100 | 5 | . | . | 56 | 5 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | . | . | 3 | 2 | . | . | . | . |
| FEVI | green fescue | . | . | . | . | . | . | 17 | 4 | . | . |
| GYDR | oak fern | 9 | 6 | . | . | . | . | . | . | 11 | 2 |
| LUHI | smooth woodrush | . | . | . | . | . | . | 100 | 25 | . | . |
| LUNA2 | silvercrown luina | . | . | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | 3 | 1 | . | . | . | . | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | . | . | 23 | 4 | . | . | 11 | 2 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 59 | 36 | 53 | 20 | 40 | 13 | 17 | 10 | 67 | 13 |
| PEBR | bracted pedicularis | . | . | . | . | 3 | 2 | . | . | . | . |
| PERA | sickletop pedicularis | . | . | 8 | 1 | 23 | 2 | 67 | 1 | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | 3 | 7 | 50 | 2 | . | . |
| PTAQ | bracken fern | 14 | 2 | 23 | 2 | 27 | 3 | . | . | 11 | 1 |
| SMRA | feather solomonplume | . | . | 3 | 1 | 13 | 2 | . | . | . | . |
| SMST | starry solomonplume | 14 | 2 | 3 | 1 | 37 | 4 | . | . | . | . |
| STRO | rosy twistedstalk | 18 | 2 | . | . | . | . | . | . | 33 | 2 |
| TITRU | coolwort foamflower | 23 | 3 | 8 | 2 | 37 | 2 | 17 | 4 | 11 | 2 |
| TRCA3 | false bugbane | 5 | 15 | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | 3 | 1 | 10 | 3 | . | . | . | . |
| VASI | Sitka valerian | 9 | 4 | . | . | 10 | 17 | 67 | 6 | 22 | 2 |
| VIGL | pioneer violet | . | . | . | . | 20 | 3 | 50 | 1 | . | . |
| VIOR2 | round-leaved violet | 18 | 2 | 18 | 1 | 33 | 2 | 33 | 4 | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSME/MEFE-VAAL 10 Plots CON | COV | TSME/PHEM-VADE 10 Plots CON | COV | TSME/RHAL-VAME 22 Plots CON | COV | TSME/RHAL-VAAL 4 Plots CON | COV | TSME/RULA 7 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 32 | 10 | 25 | 77 | 26 | 100 | 43 | 71 | 21 |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | . | . | 100 | 14 | 27 | 9 | 25 | 3 | 71 | 16 |
| ABPR | noble fir | . | . | . | . | 5 | 5 | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | 10 | 70 | 9 | 20 | . | . | 14 | 5 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | . | . | 36 | 11 | . | . | 57 | 3 |
| PIEN | Engelmann spruce | 10 | 1 | 10 | 1 | 41 | 8 | . | . | 43 | 10 |
| PIAL | whitebark pine | . | . | 60 | 3 | . | . | . | . | . | . |
| PICO | lodgepole pine | . | . | 10 | 15 | 18 | 13 | . | . | 29 | 21 |
| PIMO | western white pine | 10 | 1 | . | . | 45 | 6 | . | . | 14 | 10 |
| PIPO | ponderosa pine | . | . | . | . | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | . | . | 45 | 8 | . | . | 29 | 15 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | 20 | 9 | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 70 | 11 | . | . | 32 | 9 | . | . | . | . |
| TSME | mountain hemlock | 100 | 18 | 100 | 13 | 95 | 26 | 100 | 31 | 86 | 24 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 15 | 20 | 5 | 95 | 16 | 100 | 10 | 86 | 12 |
| ABGR | grand fir | . | . | . | . | 9 | 1 | . | . | 14 | 1 |
| ABLA2 | subalpine fir | . | . | 90 | 7 | 36 | 5 | . | . | 71 | 6 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | 50 | 1 | 5 | 1 | . | . | 14 | 1 |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | . | . | 5 | 2 | . | . | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 50 | 2 | . | . | 23 | 3 | 25 | 5 | 14 | 1 |
| TSME | mountain hemlock | 80 | 3 | 90 | 5 | 68 | 8 | 75 | 6 | 86 | 6 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | . | . | 5 | 1 | . | . | . | . |
| BENE | Cascade Oregon grape | . | . | . | . | 9 | 3 | . | . | 14 | 1 |
| CAME | Mertens' moss-heather | . | . | 30 | 14 | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | 10 | 3 | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | . | . | . | . | 9 | 5 | . | . | 14 | 1 |
| COCA | bunchberry dogwood | 30 | 4 | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | 18 | 3 | . | . | . | . |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | . | . | . | . | . | . |
| LIBOL | twinflower | . | . | . | . | 9 | 4 | . | . | . | . |
| LUPE | partridgfoot | . | . | 40 | 17 | . | . | . | . | . | . |
| MEFE | rusty menziesia | 100 | 16 | . | . | 23 | 5 | . | . | . | . |
| OPHO | devil's club | 60 | 2 | . | . | . | . | . | . | . | . |
| PAMY | pachistima | . | . | . | . | 41 | 5 | . | . | 29 | 6 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | 70 | 23 | . | . | 25 | 5 | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 20 | 2 | 20 | 2 | 86 | 9 | 25 | 5 | 71 | 2 |
| RHAL | Cascade azalea | 20 | 6 | 10 | 2 | 100 | 30 | 100 | 13 | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | TSME/MEFE-VAAL | | TSME/PHEM-VADE | | TSME/RHAL-VAME | | TSME/RHAL-VAAL | | TSME/RULA | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 Plots | | 10 Plots | | 22 Plots | | 4 Plots | | 7 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | 10 | 1 | . | . | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | 90 | 3 | 40 | 19 | 77 | 12 | 50 | 5 | 100 | 13 |
| RUPE | five-leaved bramble | 90 | 8 | . | . | 5 | 4 | 50 | 13 | . | . |
| SPBEL | shiny-leaf spirea | . | . | . | . | . | . | . | . | . | . |
| SYAL | common snowberry | . | . | . | . | . | . | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | 10 | 2 | 10 | 1 | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | 100 | 13 | . | . | 5 | 1 | 100 | 30 | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | 70 | 20 | . | . | . | . | . | . |
| VAME | big huckleberry | 90 | 16 | 20 | 13 | 100 | 18 | 100 | 45 | 43 | 8 |
| VAMY | low huckleberry | 20 | 4 | . | . | 41 | 13 | . | . | 57 | 13 |
| VASC | grouse huckleberry | . | . | 60 | 6 | 27 | 10 | . | . | 71 | 5 |
| XETE | beargrass | . | . | 20 | 3 | 59 | 8 | . | . | 57 | 2 |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | 18 | 5 | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ARLA | broadleaf arnica | 10 | 2 | 60 | 2 | 64 | 12 | . | . | 57 | 11 |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | 20 | 3 | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | . | . | . | . | . | . |
| CAGE | elk sedge | . | . | 20 | Tr | 5 | 1 | . | . | 29 | 2 |
| CARO | Ross sedge | . | . | . | . | . | . | . | . | . | . |
| CARU | pinegrass | . | . | . | . | . | . | . | . | . | . |
| CLUN | queencup beadlily | 90 | 9 | . | . | 14 | 7 | 75 | 5 | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | . | . | . | . | . | . | 29 | 1 |
| FEVI | green fescue | . | . | 20 | 8 | . | . | . | . | . | . |
| GYDR | oak fern | 40 | 9 | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | 90 | 14 | 9 | 2 | . | . | 43 | 1 |
| LUNA2 | silvercrown luina | . | . | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | . | . | 5 | 8 | . | . | 14 | 3 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | 30 | 11 | 18 | 12 | . | . | 14 | 2 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 60 | 18 | . | . | 18 | 7 | . | . | 29 | 15 |
| PEBR | bracted pedicularis | . | . | . | . | 9 | 2 | . | . | 14 | 1 |
| PERA | sickletop pedicularis | . | . | 10 | 1 | 27 | 2 | . | . | 14 | 1 |
| POPU | skunkleaf polemonium | . | . | 10 | Tr | 18 | 3 | . | . | 29 | 7 |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | . | . | . | . | 14 | 1 |
| SMST | starry solomonplume | 30 | 4 | . | . | . | . | 50 | 1 | . | . |
| STRO | rosy twistedstalk | 60 | 4 | . | . | 9 | 4 | 25 | 3 | 14 | 1 |
| TITRU | coolwort foamflower | 60 | 4 | . | . | 5 | 7 | . | . | 14 | 2 |
| TRCA3 | false bugbane | 20 | 3 | . | . | . | . | . | . | 14 | 4 |
| TRLA2 | western starflower | 10 | 4 | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | 60 | 2 | 30 | 8 | 27 | 2 | . | . | 29 | 4 |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | 10 | 1 | . | . | 9 | 2 | . | . | 29 | 4 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | Species | TSME/VAAL 6 Plots | | TSME/VAME 15 Plots | | TSME/VASC/LUHI 17 Plots | | TSME/XETE-VAMY 12 Plots | | ABLA2/ARLA-POPU 22 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 38 | 87 | 22 | 29 | 16 | 50 | 15 | . | . |
| ABGR | grand fir | . | . | 13 | 5 | 6 | 1 | 17 | 4 | 27 | 24 |
| ABLA2 | subalpine fir | . | . | 7 | 15 | 88 | 19 | 42 | 18 | 91 | 21 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | 13 | 6 | 12 | 28 | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | 40 | 9 | 6 | 7 | 75 | 8 | 36 | 16 |
| PIEN | Engelmann spruce | . | . | . | . | 12 | 13 | 17 | 10 | 32 | 18 |
| PIAL | whitebark pine | . | . | . | . | 35 | 7 | . | . | 5 | 1 |
| PICO | lodgepole pine | . | . | 27 | 8 | 29 | 20 | 58 | 19 | 59 | 19 |
| PIMO | western white pine | . | . | 53 | 6 | . | . | 33 | 8 | 5 | 1 |
| PIPO | ponderosa pine | . | . | . | . | . | . | . | . | 5 | 5 |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 17 | 3 | 53 | 10 | 18 | 1 | 33 | 7 | 64 | 27 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 67 | 25 | 73 | 21 | . | . | 8 | 10 | . | . |
| TSME | mountain hemlock | 100 | 14 | 93 | 18 | 94 | 30 | 100 | 29 | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | 100 | 14 | 100 | 10 | 53 | 8 | 67 | 10 | . | . |
| ABGR | grand fir | . | . | 7 | 2 | 6 | 2 | 33 | 2 | 41 | 4 |
| ABLA2 | subalpine fir | . | . | 13 | 5 | 76 | 7 | 75 | 10 | 100 | 15 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | . | . | 47 | 1 | . | . | . | . |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 17 | 6 | 7 | 1 | . | . | 8 | 6 | 23 | 6 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 33 | 4 | 80 | 4 | . | . | 8 | 1 | . | . |
| TSME | mountain hemlock | 67 | 6 | 67 | 4 | 100 | 5 | 92 | 10 | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | 7 | 1 | 6 | 12 | 8 | 2 | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | . | . | . | . | 8 | 1 | . | . |
| BENE | Cascade Oregon grape | . | . | 33 | 4 | . | . | 8 | 2 | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 17 | 1 | 67 | 3 | 6 | 1 | 25 | 2 | 23 | 1 |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 33 | 5 | 53 | 7 | . | . | 8 | 3 | . | . |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | 12 | 1 | 8 | 3 | . | . |
| LIBOL | twinflower | 17 | 1 | 40 | 4 | . | . | 17 | 6 | . | . |
| LUPE | partridgfoot | . | . | . | . | 12 | 9 | . | . | . | . |
| MEFE | rusty menziesia | 50 | 4 | 13 | 3 | . | . | . | . | . | . |
| OPHO | devil's club | 33 | 3 | . | . | . | . | . | . | . | . |
| PAMY | pachistima | . | . | 47 | 3 | 18 | 3 | 67 | 4 | 86 | 4 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | 6 | 3 | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 83 | 2 | 47 | 3 | 18 | 4 | 50 | 5 | 64 | 2 |
| RHAL | Cascade azalea | . | . | . | . | 24 | 1 | . | . | 9 | 4 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | TSME/VAAL 6 Plots CON | TSME/VAAL COV | TSME/VAME 15 Plots CON | TSME/VAME COV | TSME/VASC/LUHI 17 Plots CON | TSME/VASC/LUHI COV | TSME/XETE-VAMY 12 Plots CON | TSME/XETE-VAMY COV | ABLA2/ARLA-POPU 22 Plots CON | ABLA2/ARLA-POPU COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | 7 | 2 | . | . | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | 8 | 2 | . | . |
| RULA | dwarf bramble | 67 | 4 | 13 | 3 | 65 | 19 | 42 | 8 | 5 | 3 |
| RUPE | five-leaved bramble | 50 | 5 | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | . | . | . | . | . | . | . | . |
| SYAL | common snowberry | . | . | . | . | . | . | . | . | 9 | 2 |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | 100 | 5 | 13 | 2 | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 100 | 12 | 100 | 16 | 41 | 8 | 58 | 14 | . | . |
| VAMY | low huckleberry | 33 | 2 | 13 | 9 | 35 | 34 | 67 | 18 | 41 | 3 |
| VASC | grouse huckleberry | . | . | 53 | 6 | 76 | 20 | 33 | 5 | 23 | 2 |
| XETE | beargrass | . | . | 27 | 3 | 29 | 6 | 100 | 19 | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | . | . | . | . | 6 | Tr | 25 | 9 | 64 | 4 |
| ARLA | broadleaf arnica | 17 | 2 | . | . | 88 | 11 | . | . | 68 | 7 |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | 33 | 3 | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | 6 | Tr | . | . | 41 | 2 |
| CAGE | elk sedge | . | . | . | . | 59 | 3 | 25 | 2 | 68 | 6 |
| CARO | Ross sedge | . | . | . | . | . | . | 17 | 2 | 5 | 1 |
| CARU | pinegrass | . | . | . | . | 12 | 1 | 25 | 2 | 27 | 17 |
| CLUN | queencup beadlily | 67 | 5 | 20 | 4 | 6 | 1 | 8 | 4 | 5 | 2 |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | . | . | . | . | . | . | 14 | 1 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | . | . |
| GYDR | oak fern | 33 | 3 | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | 100 | 9 | 17 | 2 | 18 | 2 |
| LUNA2 | silvercrown luina | . | . | . | . | 6 | 1 | 8 | 2 | 9 | 2 |
| LULA | broadleaf lupine | . | . | 7 | 25 | 12 | 6 | 8 | 10 | . | . |
| LUSE | silky lupine | . | . | . | . | 6 | Tr | . | . | . | . |
| LUPIN | lupine species | . | . | . | . | 18 | 3 | 17 | 4 | 73 | 6 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 50 | 22 | 53 | 15 | 12 | 8 | 17 | 4 | 36 | 3 |
| PEBR | bracted pedicularis | . | . | . | . | 12 | 2 | . | . | 18 | 1 |
| PERA | sickletop pedicularis | 33 | 2 | . | . | 41 | 1 | . | . | 36 | 2 |
| POPU | skunkleaf polemonium | . | . | . | . | 47 | 5 | 25 | 4 | 86 | 3 |
| PTAQ | bracken fern | 17 | 1 | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | 6 | Tr | . | . | 9 | 1 |
| SMST | starry solomonplume | . | . | . | . | . | . | . | . | 5 | 2 |
| STRO | rosy twistedstalk | 50 | 3 | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | 33 | 4 | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | 17 | 2 | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | 33 | 3 | . | . | 47 | 14 | 25 | 4 | 36 | 3 |
| VIGL | pioneer violet | 17 | 2 | . | . | 12 | 1 | 8 | 15 | 5 | 4 |
| VIOR2 | round-leaved violet | 17 | 2 | 7 | 1 | 29 | 3 | 8 | 2 | 27 | 2 |

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABLA2/CARU 9 Plots CON | COV | ABLA2/LIBOL 10 Plots CON | COV | ABLA2/LUHI 11 Plots CON | COV | ABLA2/PAMY 11 Plots CON | COV | ABLA2/PAMY/CARU 5 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | 9 | 5 | . | . |
| ABGR | grand fir | 11 | 2 | 10 | 1 | . | . | 9 | 5 | . | . |
| ABLA2 | subalpine fir | 67 | 7 | 60 | 6 | 100 | 40 | 73 | 14 | 40 | 5 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | 11 | 5 | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | 9 | 3 | . | . | . | . |
| LAOC | western larch | 11 | 5 | 60 | 25 | 9 | 10 | . | . | . | . |
| PIEN | Engelmann spruce | 33 | 12 | 90 | 11 | 55 | 18 | 45 | 12 | . | . |
| PIAL | whitebark pine | . | . | . | . | 18 | 7 | . | . | . | . |
| PICO | lodgepole pine | 67 | 30 | 80 | 17 | 27 | 5 | 45 | 24 | 80 | 30 |
| PIMO | western white pine | 11 | 5 | . | . | . | . | 18 | 2 | 20 | 1 |
| PIPO | ponderosa pine | 33 | 2 | . | . | . | . | 27 | 4 | 40 | 10 |
| POTR | quaking aspen | 11 | 1 | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 67 | 34 | 90 | 13 | . | . | 91 | 26 | 100 | 16 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | 9 | 5 | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | 10 | 1 | . | . | 9 | 1 | . | . |
| ABGR | grand fir | 11 | 5 | 20 | 4 | . | . | 9 | 4 | . | . |
| ABLA2 | subalpine fir | 67 | 3 | 60 | 6 | 91 | 7 | 91 | 4 | 100 | 3 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | 11 | 2 | 20 | 1 | 18 | 3 | 9 | 1 | . | . |
| PIPO | pinus ponderosa | 11 | 1 | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 56 | 4 | 70 | 8 | . | . | 55 | 1 | 60 | 4 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 11 | 1 | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | 11 | 1 | . | . | . | . | . | . | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | 11 | 8 | . | . | . | . | . | . | 20 | 1 |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | 11 | 1 | 20 | 2 | . | . | 9 | 3 | 20 | 1 |
| BEAQ | Oregon grape | . | . | 10 | 2 | . | . | 9 | 5 | 20 | 4 |
| BENE | Cascade Oregon grape | 11 | 1 | 30 | 3 | . | . | 27 | 2 | 20 | 1 |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 11 | 1 | . | . | . | . | . | . | 20 | 1 |
| CHUMO | western prince's pine | 33 | 2 | 40 | 5 | 18 | 1 | 36 | 7 | 80 | 6 |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | . | . | 9 | 3 | . | . |
| JUCO4 | common juniper | . | . | 10 | 1 | . | . | . | . | . | . |
| LIBOL | twinflower | . | . | 100 | 12 | . | . | 9 | 2 | . | . |
| LUPE | partridgfoot | . | . | . | . | 9 | 1 | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 78 | 4 | 90 | 3 | 27 | 3 | 100 | 29 | 100 | 21 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | 9 | 1 | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 44 | 2 | 80 | 3 | 45 | 2 | 64 | 2 | 40 | 2 |
| RHAL | Cascade azalea | . | . | . | . | 9 | 2 | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABLA2/CARU 9 Plots CON | COV | ABLA2/LIBOL 10 Plots CON | COV | ABLA2/LUHI 11 Plots CON | COV | ABLA2/PAMY 11 Plots CON | COV | ABLA2/PAMY/CARU 5 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 11 | 6 | 20 | 5 | . | . | 55 | 4 | 20 | 3 |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | 18 | 25 | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 22 | 11 | 30 | 2 | . | . | 73 | 7 | 60 | 12 |
| SYAL | common snowberry | . | . | 10 | 1 | . | . | . | . | 40 | 5 |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | 11 | 2 | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 11 | 4 | 10 | 1 | 18 | 7 | 45 | 2 | 60 | 3 |
| VAMY | low huckleberry | 44 | 3 | 70 | 12 | 36 | 3 | 18 | 2 | 20 | 1 |
| VASC | grouse huckleberry | . | . | 10 | 1 | 64 | 3 | . | . | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 67 | 5 | 30 | 3 | 9 | 2 | 45 | 2 | 20 | 2 |
| ARLA | broadleaf arnica | . | . | . | . | 82 | 7 | . | . | . | . |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 22 | 3 | 30 | 2 | 9 | 3 | . | . | . | . |
| CAGE | elk sedge | 11 | 15 | . | . | 27 | 2 | . | . | . | . |
| CARO | Ross sedge | 11 | 2 | . | . | 18 | 2 | 9 | 1 | . | . |
| CARU | pinegrass | 100 | 33 | 50 | 6 | . | . | 55 | 2 | 100 | 14 |
| CLUN | queencup beadlily | . | . | 10 | 2 | . | . | 9 | 1 | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | 9 | 1 | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | 10 | 2 | 9 | 2 | . | . | 20 | 4 |
| FEVI | green fescue | . | . | . | . | 9 | 3 | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | 9 | Tr | . | . |
| LUHI | smooth woodrush | . | . | . | . | 100 | 21 | . | . | . | . |
| LUNA2 | silvercrown luina | 11 | 1 | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | 56 | 14 | 10 | 35 | 18 | 8 | 9 | 10 | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 22 | 2 | . | . | 27 | 12 | 9 | 20 | . | . |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | 45 | 7 | . | . | . | . |
| PEBR | bracted pedicularis | . | . | . | . | 27 | 2 | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | 18 | 2 | . | . | . | . |
| POPU | skunkleaf polemonium | . | . | . | . | 55 | 3 | . | . | . | . |
| PTAQ | bracken fern | 11 | 5 | 10 | 2 | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | . | . | . | . | . | . |
| SMST | starry solomonplume | . | . | 20 | 2 | . | . | 18 | 1 | 20 | 1 |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | 10 | 1 | . | . | 9 | Tr | . | . |
| TRCA3 | false bugbane | . | . | . | . | 18 | 11 | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | 73 | 4 | . | . | . | . |
| VIGL | pioneer violet | . | . | . | . | 9 | 2 | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | 20 | 1 | 45 | 2 | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | ABLA2/RHAL | | ABLA2/RHAL/LUHI | | ABLA2/RULA | | ABLA2/VACA | | ABLA2/VADE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 Plots | | 6 Plots | | 12 Plots | | 2 Plots | | 6 Plots | |
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | 8 | 1 | . | . | . | . |
| ABGR | grand fir | . | . | . | . | 58 | 9 | . | . | . | . |
| ABLA2 | subalpine fir | 100 | 20 | 100 | 26 | 75 | 28 | 50 | 5 | 100 | 30 |
| ABPR | noble fir | . | . | . | . | 8 | 3 | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | 33 | 1 | . | . | . | . | . | . |
| LAOC | western larch | 10 | 15 | . | . | 25 | 15 | 50 | 40 | . | . |
| PIEN | Engelmann spruce | 70 | 25 | 50 | 18 | 67 | 11 | . | . | 17 | Tr |
| PIAL | whitebark pine | 10 | 3 | 50 | 3 | . | . | . | . | 33 | 4 |
| PICO | lodgepole pine | 70 | 9 | 50 | 28 | 67 | 20 | 100 | 25 | . | . |
| PIMO | western white pine | . | . | . | . | 42 | 5 | . | . | . | . |
| PIPO | ponderosa pine | . | . | . | . | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | 8 | 1 | . | . | . | . |
| PSME | Douglas-fir | 40 | 28 | 17 | 3 | 83 | 16 | 100 | 5 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | 10 | 3 | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | 8 | 2 | . | . | 17 | 2 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | 17 | 2 | . | . | . | . |
| ABGR | grand fir | . | . | . | . | 67 | 2 | . | . | . | . |
| ABLA2 | subalpine fir | 100 | 14 | 100 | 9 | 92 | 12 | 100 | 16 | 100 | 9 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | 20 | 1 | 17 | 5 | . | . | . | . | 33 | 1 |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 10 | 1 | . | . | 42 | 2 | 100 | 3 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | . | . | . | . | 17 | Tr |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | 100 | 3 | . | . |
| BEAQ | Oregon grape | 10 | 1 | . | . | 8 | 1 | . | . | . | . |
| BENE | Cascade Oregon grape | . | . | . | . | 8 | 1 | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | 17 | 8 |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 20 | 2 | . | . | 50 | 2 | . | . | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | 8 | 1 | . | . | . | . |
| JUCO4 | common juniper | 10 | 1 | . | . | 8 | 1 | 50 | 2 | . | . |
| LIBOL | twinflower | . | . | . | . | . | . | 50 | 15 | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | 50 | 1 |
| MEFE | rusty menziesia | . | . | . | . | 8 | 1 | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 70 | 5 | 33 | 8 | 100 | 3 | 100 | 4 | 50 | 3 |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | . | . | 50 | 2 | . | . | . | . | 83 | 21 |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 90 | 3 | 67 | 2 | 75 | 3 | 50 | 2 | . | . |
| RHAL | Cascade azalea | 100 | 33 | 100 | 38 | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | ABLA2/RHAL 10 Plots | | ABLA2/RHAL/LUHI 6 Plots | | ABLA2/RULA 12 Plots | | ABLA2/VACA 2 Plots | | ABLA2/VADE 6 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | 25 | 3 | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | 100 | 20 | . | . | 33 | 14 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 20 | 5 | . | . | 17 | 6 | 50 | 5 | . | . |
| SYAL | common snowberry | . | . | . | . | 17 | 4 | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | 17 | 3 |
| VACA | dwarf huckleberry | . | . | . | . | . | . | 50 | 10 | . | . |
| VADE | Cascade huckleberry | . | . | 17 | 3 | . | . | . | . | 100 | 24 |
| VAME | big huckleberry | 30 | 18 | 33 | 7 | 50 | 7 | . | . | . | . |
| VAMY | low huckleberry | 60 | 9 | 50 | 35 | 33 | 14 | 100 | 4 | . | . |
| VASC | grouse huckleberry | 50 | 11 | 67 | 7 | 50 | 14 | 50 | 30 | . | . |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | 17 | 1 | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 20 | 1 | . | . | 75 | 7 | 50 | 4 | . | . |
| ARLA | broadleaf arnica | 30 | 4 | 67 | 3 | 67 | 13 | . | . | 17 | 3 |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | 17 | Tr |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 40 | 5 | . | . | . | . | . | . | . | . |
| CAGE | elk sedge | 10 | 2 | 33 | 4 | 42 | 3 | . | . | 33 | 8 |
| CARO | Ross sedge | . | . | . | . | 17 | 2 | . | . | . | . |
| CARU | pinegrass | 30 | 12 | . | . | . | . | 100 | 18 | . | . |
| CLUN | queencup beadlily | . | . | . | . | 33 | 6 | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | 10 | 5 | . | . | 17 | 2 | . | . | . | . |
| FEVI | green fescue | . | . | . | . | . | . | . | . | 17 | Tr |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | 100 | 6 | . | . | . | . | 50 | 41 |
| LUNA2 | silvercrown luina | 10 | 1 | . | . | 25 | 10 | . | . | . | . |
| LULA | broadleaf lupine | 50 | 5 | 17 | 5 | 25 | 3 | 100 | 6 | . | . |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | 17 | 3 | . | . | . | . | . | . |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 40 | 23 | 17 | 15 | 17 | 5 | . | . | . | . |
| PEBR | bracted pedicularis | 10 | 1 | . | . | 17 | 1 | . | . | 17 | Tr |
| PERA | sickletop pedicularis | 50 | 2 | . | . | 42 | 3 | . | . | . | . |
| POPU | skunkleaf polemonium | 30 | 2 | . | . | 83 | 5 | . | . | 33 | Tr |
| PTAQ | bracken fern | . | . | . | . | 8 | 3 | . | . | 17 | Tr |
| SMRA | feather solomonplume | . | . | . | . | 8 | 2 | . | . | . | . |
| SMST | starry solomonplume | . | . | . | . | 33 | 5 | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | 10 | 4 | . | . | 17 | 3 | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | 8 | 15 | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | 17 | 4 | . | . | . | . |
| VASI | Sitka valerian | 10 | 3 | 33 | 4 | 25 | 1 | . | . | 33 | 5 |
| VIGL | pioneer violet | . | . | . | . | 42 | 3 | . | . | 17 | Tr |
| VIOR2 | round-leaved violet | 10 | 1 | 17 | 2 | 42 | 3 | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABLA2/VAME | | ABLA2/VASC | | ABLA2/VASC/ARLA | | ABLA2/VASC/CARU | | ABLA2/VASC/LUHI | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 Plots | | 11 Plots | | 16 Plots | | 5 Plots | | 10 Plots | |
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | 17 | 5 | 9 | 1 | 13 | 8 | . | . | . | . |
| ABLA2 | subalpine fir | 67 | 7 | 73 | 10 | 75 | 20 | 60 | 3 | 80 | 28 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| LAOC | western larch | . | . | 18 | 10 | 19 | 14 | 60 | 17 | 10 | 1 |
| PIEN | Engelmann spruce | 50 | 12 | 9 | 5 | 13 | 3 | 20 | 5 | 70 | 16 |
| PIAL | whitebark pine | . | . | 18 | 8 | . | . | . | . | 50 | 10 |
| PICO | lodgepole pine | 50 | 16 | 91 | 26 | 100 | 27 | 80 | 20 | 50 | 26 |
| PIMO | western white pine | 33 | 15 | 18 | 9 | 19 | 5 | . | . | . | . |
| PIPO | ponderosa pine | 33 | 6 | 9 | 1 | . | . | 40 | 4 | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 83 | 31 | 36 | 26 | 50 | 16 | 100 | 17 | 10 | 1 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | 9 | 2 | . | . | . | . | 20 | 5 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | 9 | 1 | . | . | . | . | 10 | 1 |
| ABGR | grand fir | 33 | 4 | 18 | 5 | 25 | 2 | 20 | 3 | . | . |
| ABLA2 | subalpine fir | 100 | 6 | 91 | 9 | 100 | 17 | 100 | 4 | 90 | 9 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | 18 | 2 | 6 | 5 | . | . | 50 | 3 |
| PIPO | pinus ponderosa | . | . | . | . | . | . | 20 | 1 | . | . |
| PSME | Douglas-fir | 50 | 4 | 45 | 4 | 25 | 2 | 80 | 9 | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | 10 | 1 |
| TSME | mountain hemlock | 17 | 2 | . | . | . | . | . | . | 10 | 1 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | 17 | 1 | 9 | 10 | 6 | 1 | 20 | 15 | 10 | 15 |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | 17 | 2 | 9 | 35 | . | . | 80 | 8 | . | . |
| BEAQ | Oregon grape | 17 | 3 | . | . | 6 | 1 | . | . | . | . |
| BENE | Cascade Oregon grape | 33 | 3 | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | 17 | 1 | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | 67 | 4 | 36 | 3 | 25 | 2 | 20 | 2 | 10 | 1 |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | 17 | 1 | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | 9 | 4 | 6 | 1 | . | . | 10 | 1 |
| LIBOL | twinflower | 17 | 1 | . | . | . | . | 20 | 5 | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 100 | 23 | 45 | 4 | 88 | 6 | 80 | 4 | 40 | 4 |
| PEFR3 | shrubby penstemon | . | . | . | . | 6 | 1 | . | . | . | . |
| PHEM | red mountain heath | . | . | . | . | . | . | . | . | 10 | 2 |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 33 | 3 | 27 | 2 | 50 | 3 | 20 | 1 | 20 | 3 |
| RHAL | Cascade azalea | . | . | 18 | 2 | 6 | 2 | . | . | 10 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | ABLA2/VAME 6 Plots CON | ABLA2/VAME COV | ABLA2/VASC 11 Plots CON | ABLA2/VASC COV | ABLA2/VASC/ARLA 16 Plots CON | ABLA2/VASC/ARLA COV | ABLA2/VASC/CARU 5 Plots CON | ABLA2/VASC/CARU COV | ABLA2/VASC/LUHI 10 Plots CON | ABLA2/VASC/LUHI COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | 50 | 3 | . | . | . | . | 20 | 1 | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | 9 | 1 | . | . | . | . | 20 | 28 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | 83 | 4 | 45 | 3 | . | . | 20 | 2 | . | . |
| SYAL | common snowberry | 33 | 21 | . | . | . | . | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | . | . | 20 | 5 | 20 | 2 |
| VADE | Cascade huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAME | big huckleberry | 100 | 19 | 18 | 3 | . | . | 20 | 3 | 10 | 20 |
| VAMY | low huckleberry | 17 | 6 | 73 | 22 | 75 | 16 | 80 | 25 | 30 | 12 |
| VASC | grouse huckleberry | . | . | 36 | 34 | 56 | 10 | 40 | 8 | 100 | 25 |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | 9 | 2 | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 17 | 1 | 27 | 2 | 31 | 3 | 40 | 3 | 10 | 1 |
| ARLA | broadleaf arnica | 17 | 2 | . | . | 56 | 4 | . | . | 70 | 12 |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | 27 | 3 | 25 | 2 | 20 | 8 | . | . |
| CAGE | elk sedge | 17 | 5 | 9 | 1 | 63 | 13 | 20 | 10 | 60 | 3 |
| CARO | Ross sedge | 17 | Tr | 18 | 1 | 19 | 3 | 40 | 3 | 20 | 2 |
| CARU | pinegrass | 83 | 3 | 18 | 3 | 31 | 12 | 100 | 24 | . | . |
| CLUN | queencup beadlily | 50 | 6 | 9 | 1 | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | 33 | 1 | . | . | 44 | 3 | 20 | 2 | 30 | 2 |
| FEVI | green fescue | . | . | . | . | . | . | . | . | 30 | 2 |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | . | . | . | . | . | . | 100 | 10 |
| LUNA2 | silvercrown luina | . | . | . | . | 19 | 1 | . | . | 30 | 1 |
| LULA | broadleaf lupine | 17 | 1 | 9 | 15 | 13 | 10 | 20 | 15 | 40 | 7 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 17 | 2 | 18 | 1 | 56 | 11 | 20 | 7 | 50 | 10 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | 25 | 4 | . | . | 10 | 5 |
| PEBR | bracted pedicularis | . | . | . | . | 19 | 5 | . | . | 50 | 1 |
| PERA | sickletop pedicularis | . | . | 9 | 2 | 19 | 3 | 20 | 1 | 60 | 1 |
| POPU | skunkleaf polemonium | . | . | . | . | 81 | 5 | . | . | 90 | 5 |
| PTAQ | bracken fern | 17 | 2 | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | 17 | 2 | 9 | 1 | . | . | . | . | . | . |
| SMST | starry solomonplume | 33 | 2 | . | . | 6 | 4 | . | . | . | . |
| STRO | rosy twistedstalk | 17 | 1 | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | 31 | 2 | . | . | 60 | 6 |
| VIGL | pioneer violet | 33 | 4 | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | 17 | 4 | . | . | 13 | 2 | . | . | 30 | 2 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PIEN/EQUIS 2 Plots CON | COV | PIAL/CARU 7 Plots CON | COV | PIAL/FEVI 6 Plots CON | COV | PIAL/JUCO4 4 Plots CON | COV | PIAL/VASC/LUHI 8 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | 13 | Tr |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | 100 | 18 | 71 | 4 | 50 | 6 | 25 | 5 | 88 | 6 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | 17 | Tr | . | . | . | . |
| LALY | subalpine larch | . | . | . | . | . | . | 25 | 2 | . | . |
| LAOC | western larch | . | . | . | . | . | . | . | . | . | . |
| PIEN | Engelmann spruce | 100 | 45 | 14 | 5 | . | . | 25 | Tr | 25 | 5 |
| PIAL | whitebark pine | . | . | 100 | 14 | 100 | 8 | 100 | 25 | 100 | 29 |
| PICO | lodgepole pine | . | . | 29 | 9 | 17 | 5 | 25 | 8 | 38 | 6 |
| PIMO | western white pine | . | . | . | . | . | . | . | . | 13 | 2 |
| PIPO | ponderosa pine | . | . | 14 | 1 | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | 50 | 25 | 43 | 4 | . | . | 25 | 1 | 38 | 8 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | 17 | 7 | . | . | 38 | 3 |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | 13 | Tr |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | 50 | 10 | 57 | 2 | 33 | Tr | 25 | 35 | 88 | 3 |
| LALY | subalpine larch | . | . | . | . | . | . | . | . | . | . |
| PIAL | whitebark pine | . | . | 100 | 2 | 83 | 2 | 75 | 4 | 63 | 3 |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | 14 | 1 | . | . | . | . | 25 | 1 |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | . | . | . | . | 17 | 1 | . | . | 38 | 2 |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | 25 | 3 | 13 | 25 |
| ARTRV | mountain big sagebrush | . | . | . | . | 33 | 25 | 50 | 3 | . | . |
| ARUV | bearberry | . | . | 14 | 50 | . | . | . | . | 13 | 8 |
| BEAQ | Oregon grape | 50 | Tr | . | . | . | . | . | . | . | . |
| BENE | Cascade Oregon grape | . | . | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | . | . | . | . | . | . | . | . | . | . |
| CATR | four-angled moss-heather | . | . | . | . | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | 14 | Tr | . | . | . | . | . | . |
| CHUMO | western prince's pine | . | . | . | . | . | . | . | . | 13 | 2 |
| COCA | bunchberry dogwood | 50 | 5 | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | . | . | . | . | . | . | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | . | . | 17 | Tr | 100 | 20 | 25 | 4 |
| LIBOL | twinflower | 50 | 3 | . | . | . | . | . | . | . | . |
| LUPE | partridgfoot | . | . | . | . | . | . | . | . | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | 50 | Tr | 71 | 8 | 17 | 1 | . | . | 13 | 5 |
| PEFR3 | shrubby penstemon | . | . | 14 | 1 | . | . | . | . | 13 | 2 |
| PHEM | red mountain heath | . | . | . | . | 17 | 1 | . | . | . | . |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | 100 | 1 | . | . | 17 | 1 | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | 13 | 1 |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | PIEN/EQUIS 2 Plots CON | COV | PIAL/CARU 7 Plots CON | COV | PIAL/FEVI 6 Plots CON | COV | PIAL/JUCO4 4 Plots CON | COV | PIAL/VASC/LUHI 8 Plots CON | COV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | . | . | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | 25 | 9 |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | . | . | . | . | . | . | . | . |
| SYAL | common snowberry | 50 | 12 | . | . | . | . | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | . | . | . | . | 17 | 4 | . | . | . | . |
| VADE | Cascade huckleberry | . | . | 14 | 5 | . | . | . | . | . | . |
| VAME | big huckleberry | . | . | 14 | 3 | . | . | . | . | . | . |
| VAMY | low huckleberry | 50 | 2 | 29 | 1 | . | . | 25 | Tr | 38 | 11 |
| VASC | grouse huckleberry | . | . | 29 | 6 | 50 | 1 | 25 | 5 | 88 | 36 |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | 14 | Tr | . | . | . | . | . | . |
| ARCO | heartleaf arnica | 50 | Tr | 29 | 3 | 17 | 2 | . | . | 13 | 3 |
| ARLA | broadleaf arnica | . | . | 14 | 2 | 17 | 1 | 25 | Tr | 63 | 3 |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | . | . | . | . | . | . | 50 | 4 | 13 | 1 |
| CAGE | elk sedge | . | . | 57 | 25 | . | . | . | . | 38 | 6 |
| CARO | Ross sedge | . | . | 43 | 5 | 33 | 5 | 50 | 5 | 38 | 5 |
| CARU | pinegrass | . | . | 57 | 28 | 50 | 3 | 50 | 4 | . | . |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | 100 | 35 | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | 14 | 8 | 17 | 8 | 50 | 3 | . | . |
| FEOC | western fescue | . | . | 14 | 1 | . | . | . | . | . | . |
| FEVI | green fescue | . | . | 57 | 1 | 83 | 22 | . | . | . | . |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | . | . | 14 | 8 | 67 | 2 | 25 | Tr | 50 | 15 |
| LUNA2 | silvercrown luina | . | . | 29 | 6 | . | . | . | . | . | . |
| LULA | broadleaf lupine | . | . | 29 | 14 | 33 | 20 | . | . | 25 | 7 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | . | . | 57 | 7 | 17 | 5 | 25 | 6 | 25 | 8 |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | . | . | . | . | . | . | . | . | . | . |
| PEBR | bracted pedicularis | . | . | 14 | Tr | . | . | . | . | 13 | Tr |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | 13 | Tr |
| POPU | skunkleaf polemonium | . | . | 14 | 10 | 33 | 1 | . | . | 13 | 2 |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | 50 | 1 | . | . | . | . | . | . | . | . |
| SMST | starry solomonplume | 100 | 2 | . | . | . | . | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | . | . | . | . | . | . | . | . | . | . |
| VIGL | pioneer violet | 50 | 2 | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | 13 | 3 |

APPENDIX B

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| Species | | LALY/CAME-LUPE | | LALY/DROC | | LALY/JUCO4 | | LALY/VADE-CAME | | LALY/VASC/LUHI | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 11 Plots | | 2 Plots | | 3 Plots | | 7 Plots | | 5 Plots | |
| | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Tree Overstory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | 64 | 7 | . | . | 33 | Tr | 86 | 4 | 40 | 8 |
| ABPR | noble fir | . | . | . | . | . | . | . | . | . | . |
| ACMA | bigleaf maple | . | . | . | . | . | . | . | . | . | . |
| CHNO | yellow cedar | . | . | . | . | . | . | . | . | . | . |
| LALY | subalpine larch | 73 | 21 | 100 | 5 | 100 | 22 | 100 | 15 | 100 | 30 |
| LAOC | western larch | . | . | . | . | . | . | . | . | . | . |
| PIEN | Engelmann spruce | 36 | 10 | 100 | 8 | 100 | 3 | 43 | 4 | 100 | 13 |
| PIAL | whitebark pine | 45 | 3 | 50 | 13 | 33 | Tr | 43 | 3 | 40 | 7 |
| PICO | lodgepole pine | . | . | . | . | . | . | . | . | 20 | 5 |
| PIMO | western white pine | . | . | . | . | . | . | . | . | . | . |
| PIPO | ponderosa pine | . | . | . | . | . | . | . | . | . | . |
| POTR | quaking aspen | . | . | . | . | . | . | . | . | . | . |
| POTR2 | black cottonwood | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | . | . | . | . | . | . | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| THPL | western redcedar | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | 18 | 3 | . | . | . | . | 29 | 2 | . | . |
| **Tree Understory Layer** | | | | | | | | | | | |
| ABAM | silver fir | . | . | . | . | . | . | . | . | . | . |
| ABGR | grand fir | . | . | . | . | . | . | . | . | . | . |
| ABLA2 | subalpine fir | 73 | 5 | . | . | 67 | 2 | 86 | 7 | 40 | 8 |
| LALY | subalpine larch | 100 | 7 | 100 | 4 | 100 | 2 | 71 | 3 | 100 | 2 |
| PIAL | whitebark pine | 36 | 2 | 50 | 6 | 67 | 1 | 57 | 2 | 40 | 2 |
| PIPO | pinus ponderosa | . | . | . | . | . | . | . | . | . | . |
| PSME | Douglas-fir | . | . | . | . | . | . | . | . | . | . |
| QUGA | Oregon white oak | . | . | . | . | . | . | . | . | . | . |
| TSHE | western hemlock | . | . | . | . | . | . | . | . | . | . |
| TSME | mountain hemlock | 18 | Tr | . | . | . | . | 29 | 1 | . | . |
| **Shrubs and Subshrubs** | | | | | | | | | | | |
| ACCI | vine maple | . | . | . | . | . | . | . | . | . | . |
| ARNE | pinemat manzanita | . | . | . | . | . | . | . | . | . | . |
| ARTRV | mountain big sagebrush | . | . | . | . | . | . | . | . | . | . |
| ARUV | bearberry | . | . | . | . | . | . | . | . | . | . |
| BEAQ | Oregon grape | . | . | . | . | . | . | . | . | . | . |
| BENE | Cascade Oregon grape | . | . | . | . | . | . | . | . | . | . |
| CAME | Mertens' moss-heather | 36 | 29 | . | . | . | . | 100 | 12 | 20 | 1 |
| CATR | four-angled moss-heather | 45 | 44 | 100 | 12 | . | . | . | . | . | . |
| CEVE | snowbrush ceanothus | . | . | . | . | . | . | . | . | . | . |
| CHUMO | western prince's pine | . | . | . | . | . | . | . | . | . | . |
| COCA | bunchberry dogwood | . | . | . | . | . | . | . | . | . | . |
| COCO2 | California hazel | . | . | . | . | . | . | . | . | . | . |
| DROC | Washington dryad | 18 | 3 | 100 | 35 | 33 | 2 | . | . | . | . |
| GAOV | slender wintergreen | . | . | . | . | . | . | . | . | . | . |
| HODI | oceanspray | . | . | . | . | . | . | . | . | . | . |
| JUCO4 | common juniper | . | . | 50 | 4 | 100 | 11 | . | . | 20 | 1 |
| LIBOL | twinflower | . | . | . | . | . | . | . | . | . | . |
| LUPE | partridgfoot | 73 | 20 | . | . | . | . | 86 | 12 | . | . |
| MEFE | rusty menziesia | . | . | . | . | . | . | . | . | . | . |
| OPHO | devil's club | . | . | . | . | . | . | . | . | . | . |
| PAMY | pachistima | . | . | . | . | . | . | . | . | . | . |
| PEFR3 | shrubby penstemon | . | . | . | . | . | . | . | . | . | . |
| PHEM | red mountain heath | 73 | 8 | . | . | . | . | 86 | 14 | 60 | 3 |
| PUTR | bitterbrush | . | . | . | . | . | . | . | . | . | . |
| PYSE | sidebells pyrola | . | . | . | . | . | . | . | . | . | . |
| RHAL | Cascade azalea | . | . | . | . | . | . | . | . | . | . |

# SPECIES COMPARISON BY TYPE

(COV = mean relative cover; CON = mean constancy)

| | | LALY/CAME-LUPE 11 Plots | | LALY/DROC 2 Plots | | LALY/JUCO4 3 Plots | | LALY/VADE-CAME 7 Plots | | LALY/VASC/LUHI 5 Plots | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | | CON | COV | CON | COV | CON | COV | CON | COV | CON | COV |
| **Shrubs and Subshrubs cont'd.** | | | | | | | | | | | |
| ROGY | baldhip rose | . | . | . | . | . | . | . | . | . | . |
| ROWOU | Wood's rose | . | . | . | . | . | . | . | . | . | . |
| RULA | dwarf bramble | . | . | . | . | . | . | . | . | . | . |
| RUPE | five-leaved bramble | . | . | . | . | . | . | . | . | . | . |
| SPBEL | shiny-leaf spirea | . | . | . | . | . | . | . | . | . | . |
| SYAL | common snowberry | . | . | . | . | . | . | . | . | . | . |
| SYMOH | creeping snowberry | . | . | . | . | . | . | . | . | . | . |
| SYOR | mountain snowberry | . | . | . | . | . | . | . | . | . | . |
| TABR | Pacific yew | . | . | . | . | . | . | . | . | . | . |
| VAAL | Alaska huckleberry | . | . | . | . | . | . | . | . | . | . |
| VACA | dwarf huckleberry | 27 | 6 | . | . | . | . | . | . | . | . |
| VADE | Cascade huckleberry | 18 | 2 | . | . | . | . | 100 | 16 | . | . |
| VAME | big huckleberry | . | . | . | . | . | . | . | . | . | . |
| VAMY | low huckleberry | . | . | . | . | . | . | . | . | 40 | Tr |
| VASC | grouse huckleberry | 73 | 8 | . | . | 67 | 2 | 29 | 13 | 100 | 31 |
| XETE | beargrass | . | . | . | . | . | . | . | . | . | . |
| **Herbs** | | | | | | | | | | | |
| ACTR | vanilla leaf | . | . | . | . | . | . | . | . | . | . |
| AGSP | bluebunch wheatgrass | . | . | . | . | . | . | . | . | . | . |
| ARCO | heartleaf arnica | . | . | . | . | . | . | . | . | . | . |
| ARLA | broadleaf arnica | 36 | 3 | . | . | 33 | Tr | 14 | 3 | 40 | Tr |
| ASCA3 | wild ginger | . | . | . | . | . | . | . | . | . | . |
| ASDE | podfern | . | . | . | . | . | . | . | . | . | . |
| ATFI | ladyfern | . | . | . | . | . | . | . | . | . | . |
| BASA | arrowleaf balsamroot | . | . | . | . | . | . | . | . | . | . |
| BRTE | cheatgrass | . | . | . | . | . | . | . | . | . | . |
| CACO | northwestern sedge | 9 | 7 | . | . | . | . | . | . | . | . |
| CAGE | elk sedge | . | . | . | . | . | . | . | . | . | . |
| CARO | Ross sedge | 9 | Tr | . | . | 67 | 2 | . | . | 40 | 2 |
| CARU | pinegrass | . | . | . | . | . | . | . | . | . | . |
| CLUN | queencup beadlily | . | . | . | . | . | . | . | . | . | . |
| EQUIS | horsetail species | . | . | . | . | . | . | . | . | . | . |
| EQAR | common horsetail | . | . | . | . | . | . | . | . | . | . |
| FEID | Idaho fescue | . | . | . | . | . | . | . | . | . | . |
| FEOC | western fescue | . | . | . | . | . | . | . | . | . | . |
| FEVI | green fescue | 18 | 8 | . | . | . | . | 29 | 5 | 20 | 5 |
| GYDR | oak fern | . | . | . | . | . | . | . | . | . | . |
| LUHI | smooth woodrush | 82 | 8 | . | . | . | . | 71 | 16 | 80 | 15 |
| LUNA2 | silvercrown luina | . | . | . | . | . | . | . | . | . | . |
| LULA | broadleaf lupine | 9 | Tr | . | . | . | . | 14 | 15 | 60 | 2 |
| LUSE | silky lupine | . | . | . | . | . | . | . | . | . | . |
| LUPIN | lupine species | 9 | 2 | . | . | . | . | . | . | . | . |
| LUSU | sulfur lupine | . | . | . | . | . | . | . | . | . | . |
| MOSS | Undifferentiated Moss | 9 | 2 | . | . | . | . | 14 | 5 | . | . |
| PEBR | bracted pedicularis | 27 | 1 | . | . | . | . | . | . | . | . |
| PERA | sickletop pedicularis | . | . | . | . | . | . | . | . | . | . |
| POPU | skunkleaf polemonium | 9 | Tr | . | . | . | . | 14 | 3 | . | . |
| PTAQ | bracken fern | . | . | . | . | . | . | . | . | . | . |
| SMRA | feather solomonplume | . | . | . | . | . | . | . | . | . | . |
| SMST | starry solomonplume | . | . | . | . | . | . | . | . | . | . |
| STRO | rosy twistedstalk | . | . | . | . | . | . | . | . | . | . |
| TITRU | coolwort foamflower | . | . | . | . | . | . | . | . | . | . |
| TRCA3 | false bugbane | . | . | . | . | . | . | . | . | . | . |
| TRLA2 | western starflower | . | . | . | . | . | . | . | . | . | . |
| VASI | Sitka valerian | 45 | 5 | . | . | . | . | 29 | 5 | . | . |
| VIGL | pioneer violet | . | . | . | . | . | . | . | . | . | . |
| VIOR2 | round-leaved violet | . | . | . | . | . | . | . | . | . | . |

# APPENDIX C

C1 - AVERAGE PRODUCTIVITY ESTIMATES
C2 - SITE INDEX, GROWTH BASAL AREA,
GBA VOLUME ESTIMATES

# APPENDIX D

SERAL CHARACTERISTICS OF
SELECTED SPECIES AFTER FIRE

# APPENDIX E

FIELD FORM

## APPENDIX C1

# Average Summary Productivity Estimates by Type[1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| ABAM/ACCI | 9 | 343 | 356 | 17 | 544 | 25 |
| ABAM/ACTR | 28 | 412 | 291 | 13 | 490 | 37 |
| ABAM/MEFE | 7 | 276 | 346 | 17 | 529 | 13 |
| ABAM/OPHO | 4 | 116 | 316 | 25 | 414 | 178 |
| ABAM/RHAL-VAME | 3 | 987 | 288 | 13 | 542 | 62 |
| ABAM/TITRU | 6 | 289 | 279 | 15 | 441 | 79 |
| ABAM/VAAL | 8 | 294 | 349 | 17 | 532 | 23 |
| ABAM/VAME/CLUN | 13 | 344 | 264 | 12 | 445 | 48 |
| ABAM/VAME-PYSE | 17 | 326 | 290 | 14 | 474 | 6 |
| ABGR/ACCI | 4 | 359 | 228 | 12 | 401 | 151 |
| ABGR/ACCI-CHUM | 5 | 257 | 246 | 14 | 401 | 23 |
| ABGR/ACCI/CLUN | 11 | 324 | 280 | 15 | 443 | 20 |
| ABGR/ACTR | 19 | 380 | 262 | 13 | 447 | 66 |
| ABGR/ARCO | 15 | 726 | 282 | 11 | 531 | 35 |
| ABGR/ARNE | 7 | 282 | 161 | 11 | 284 | 161 |
| ABGR/BENE | 39 | 483 | 237 | 11 | 431 | 25 |
| ABGR/BENE/CARU | 11 | 528 | 251 | 11 | 463 | 150 |
| ABGR/CARU | 16 | 356 | 185 | 11 | 332 | 193 |
| ABGR/CARU-LUPIN | 12 | 368 | 198 | 12 | 354 | 505 |
| ABGR/HODI/CARU | 2 | 255 | 212 | 12 | 357 | 164 |
| ABGR/SPBEL/PTAQ | 16 | 267 | 223 | 14 | 368 | 123 |
| ABGR/SYAL/CARU | 22 | 362 | 236 | 12 | 410 | 58 |
| ABGR/SYOR | 4 | 192 | 209 | 15 | 328 | 200 |
| ABLA2/ARLA-POPU | 11 | 719 | 324 | 12 | 594 | 152 |
| ABLA2/CARU | 3 | 497 | 228 | 11 | 409 | 230 |
| ABLA2/LIBOL (M) | 3 | 565 | 267 | 11 | 481 | 37 |
| ABLA2/LUHI | 2 | 284 | 252 | 13 | 418 | 38 |
| ABLA2/PAMY (M) | 2 | 516 | 201 | 9 | 386 | 9 |
| ABLA2/RHAL | 6 | 656 | 242 | 10 | 459 | 79 |
| ABLA2/RHAL/LUHI | 2 | 363 | 180 | 9 | 335 | 61 |
| ABLA2/RULA | 8 | 534 | 301 | 11 | 535 | 76 |
| ABLA2/VAME(M) | 2 | 239 | 294 | 15 | 458 | 47 |
| ABLA2/VASC | 2 | 358 | 214 | 10 | 374 | 27 |
| ABLA2/VASC/ARLA | 7 | 1075 | 255 | 9 | 530 | 106 |
| ABLA2/VASC/LUHI | 3 | 514 | 189 | 9 | 362 | 201 |
| PIAL/CARU | 3 | 202 | 69 | 9 | 129 | 204 |
| PIAL/FEVI | 2 | 143 | 41 | 8 | 84 | 115 |
| PIPO/AGSP | 3 | 40 | 71 | 21 | 101 | 236 |
| PIPO/CARU-AGSP | 2 | 32 | 88 | 23 | 116 | 313 |
| PIPO/PUTR/AGSP | 7 | 66 | 62 | 15 | 101 | 178 |

1 Type = Plant association or community type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

# Average Summary Productivity Estimates by Type [1]

| TYPE | # INTENSIVE PLOTS | #TREES/ ACRE | TBA | QUAD MEAN DIAM. | STAND DENSITY INDEX | HERBAGE |
|---|---|---|---|---|---|---|
| PSME/AGSP | 2 | 50 | 76 | 18 | 112 | 201 |
| PSME/AGSP-ASDE (M) | 2 | 25 | 60 | 21 | 82 | 279 |
| PSME/ARUV-PUTR (M) | 4 | 101 | 88 | 13 | 146 | 124 |
| PSME/ARUV/CARU (M) | 11 | 152 | 137 | 14 | 223 | 84 |
| PSME/CAGE | 6 | 325 | 208 | 12 | 357 | 88 |
| PSME/CARU | 18 | 324 | 169 | 14 | 289 | 262 |
| PSME/CARU-AGSP | 7 | 242 | 124 | 14 | 222 | 421 |
| PSME/PAMY/CARU (M) | 4 | 169 | 206 | 16 | 317 | 244 |
| PSME/PEFR3 (M) | 3 | 83 | 92 | 16 | 141 | 44 |
| PSME/PUTR (M) | 3 | 169 | 95 | 12 | 164 | 59 |
| PSME/PUTR/AGSP | 6 | 224 | 96 | 13 | 176 | 244 |
| PSME/PUTR/CARU | 4 | 261 | 138 | 10 | 253 | 106 |
| PSME/SPBEL (M) | 2 | 297 | 165 | 10 | 302 | 10 |
| PSME/SPBEL/CARU | 11 | 238 | 197 | 14 | 326 | 143 |
| PSME/SYAL | 8 | 250 | 178 | 12 | 304 | 75 |
| PSME/SYAL/AGSP | 4 | 61 | 92 | 18 | 137 | 318 |
| PSME/SYAL/CARU | 4 | 306 | 233 | 12 | 396 | 261 |
| PSME/SYOR | 6 | 129 | 117 | 13 | 193 | 347 |
| PSME/VACA (M) | 3 | 619 | 135 | 9 | 285 | 137 |
| PSME/VAMY/CARU (M) | 7 | 517 | 235 | 10 | 437 | 91 |
| THPL/OPHO | 6 | 134 | 340 | 23 | 454 | 176 |
| TSHE/ACCI/ACTR | 2 | 322 | 244 | 12 | 412 | 14 |
| TSHE/ACCI/ASCA3 | 4 | 257 | 347 | 16 | 525 | 36 |
| TSHE/ACCI/CLUN | 6 | 402 | 239 | 13 | 413 | 40 |
| TSHE/ACTR | 12 | 482 | 252 | 11 | 454 | 94 |
| TSHE/ARNE | 4 | 370 | 167 | 11 | 295 | 242 |
| TSHE/ASCA3 | 7 | 363 | 406 | 16 | 630 | 40 |
| TSHE/BENE | 11 | 328 | 275 | 13 | 454 | 19 |
| TSHE/PAMY/CLUN | 2 | 139 | 252 | 18 | 364 | 265 |
| TSME/LUHI | 2 | 388 | 216 | 11 | 389 | 27 |
| TSME/MEFE-VAAL | 4 | 346 | 272 | 17 | 431 | 13 |
| TSME/MEFE-VAME | 2 | 173 | 304 | 19 | 436 | 18 |
| TSME/PHEM-VADE | 3 | 255 | 205 | 12 | 344 | 126 |
| TSME/RHAL-VAAL (M) | 4 | 150 | 230 | 17 | 342 | 22 |
| TSME/RHAL-VAME | 16 | 336 | 299 | 13 | 491 | 22 |
| TSME/RULA | 3 | 265 | 275 | 15 | 434 | 39 |
| TSME/VAAL | 3 | 567 | 395 | 12 | 684 | 24 |
| TSME/VAME | 5 | 278 | 290 | 14 | 464 | 11 |
| TSME/VASC/LUHI | 7 | 648 | 268 | 10 | 504 | 64 |
| TSME/XETE-VAMY | 5 | 546 | 253 | 10 | 463 | 63 |

[1] Type = Plant association or community type (in alphabetical order); # Intensive plots indicates the number of plots used to derive the values; # Trees/ac is the number of trees per acre; TBA is the total basal area in square feet per acre based on prism counts; Quadratic mean diameter is the diameter to the nearest inch of a tree of average basal area; Stand density index is from Reineke 1933; and Herbage is the pounds per acre of air dry herbaceous vegetation at the time of sampling as derived from a double-sampling technique.

## Site index, growth basal area, and GBA volume estimates by species and type [2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABAM/ACCI | ABAM | 30 | 90 | 34 | 306 | 124 | 164 |
| | ABPR | 3 | 94 | 3 | 305 | 126 | 171 |
| | PSME | 2 | 73 | 24 | 334 | 255 | 252 |
| ABAM/ACTR | ABAM | 30 | 97 | 32 | 294 | 130 | 126 |
| | ABLA2 | 20 | 58 | 20 | 227 | 95 | 90 |
| | ABPR | 13 | 122 | 13 | 323 | 174 | 78 |
| | LAOC | 33 | 66 | 33 | 124 | 58 | 86 |
| | PICO | 5 | 65 | 5 | 149 | 68 | 84 |
| | PIEN | 11 | 81 | 11 | 278 | 160 | 152 |
| | PIMO | 7 | 58 | 7 | 183 | 75 | 84 |
| | PSME | 61 | 73 | 93 | 277 | 139 | 156 |
| | TSHE | 6 | 67 | 34 | 292 | 133 | 203 |
| ABAM/MEFE | ABAM | 23 | 72 | 26 | 342 | 110 | 215 |
| ABAM/OPHO | ABAM | 19 | 114 | 20 | 384 | 191 | 156 |
| | THPL | 8 | 73 | 10 | 297 | 151 | 227 |
| ABAM/RHAL-VAME | ABLA2 | 5 | 24 | 5 | 268 | 44 | 224 |
| | PIEN | 4 | 52 | 4 | 243 | 88 | 172 |
| ABAM/TITRU | ABAM | 8 | 122 | 8 | 447 | 238 | 117 |
| | ABPR | 3 | 118 | 3 | 269 | 140 | 60 |
| | LAOC | 4 | 62 | 4 | 197 | 86 | 159 |
| | PIEN | 10 | 75 | 10 | 337 | 186 | 136 |
| | PSME | 10 | 80 | 14 | 269 | 158 | 121 |
| ABAM/VAAL | ABAM | 24 | 90 | 28 | 316 | 125 | 178 |
| | PIEN | 5 | 73 | 5 | 513 | 263 | 250 |
| | PSME | 1 | 90 | 8 | 279 | 195 | 258 |
| | TSME | 3 | 103 | 3 | 340 | 154 | 106 |
| ABAM/VAME-PYSE | ABAM | 16 | 58 | 19 | 241 | 64 | 227 |
| | PICO | 3 | 59 | 3 | 118 | 49 | 116 |
| | PSME | 14 | 58 | 32 | 303 | 136 | 201 |
| | TSHE | 6 | 53 | 55 | 262 | 78 | 224 |
| ABAM/VAME/CLUN | ABAM | 5 | 69 | 5 | 254 | 76 | 210 |
| | ABGR | 3 | 84 | 3 | 308 | 181 | 64 |
| | ABLA2 | 5 | 82 | 5 | 438 | 252 | 82 |
| | ABPR | 3 | 128 | 3 | 175 | 99 | 64 |
| | PICO | 13 | 53 | 13 | 123 | 45 | 104 |
| | PIEN | 5 | 84 | 5 | 623 | 365 | 108 |
| | PSME | 20 | 72 | 31 | 238 | 123 | 120 |
| | TSHE | 4 | 62 | 18 | 477 | 144 | 177 |
| ABGR/ACCI | ABGR | 3 | 96 | 3 | 511 | 343 | 63 |
| | PIPO | 3 | 108 | 3 | 292 | 139 | 55 |
| | PSME | 20 | 80 | 20 | 336 | 190 | 72 |
| ABGR/ACCI-CHUM | ABGR | 10 | 86 | 10 | 393 | 236 | 79 |
| | PIMO | 3 | 69 | 3 | 399 | 194 | 73 |
| | PSME | 24 | 79 | 25 | 242 | 139 | 104 |
| ABGR/ACCI/CLUN | ABGR | 33 | 90 | 46 | 395 | 263 | 81 |
| | PIPO | 3 | 135 | 4 | 411 | 244 | 136 |
| | PSME | 40 | 84 | 40 | 299 | 185 | 79 |
| ABGR/ACTR | ABGR | 24 | 72 | 40 | 349 | 173 | 100 |
| | LAOC | 8 | 63 | 8 | 204 | 89 | 85 |
| | PSME | 64 | 78 | 78 | 274 | 159 | 125 |

[2] Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

# Site index, growth basal area, and GBA volume estimates by species and type[2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABGR/ARCO | ABGR | 25 | 59 | 50 | 272 | 112 | 109 |
| | LAOC | 4 | 64 | 4 | 363 | 163 | 70 |
| | PIPO | 2 | 89 | 14 | 230 | 71 | 186 |
| | PSME | 38 | 60 | 46 | 272 | 113 | 121 |
| ABGR/ARNE | PICO | 3 | 42 | 3 | 135 | 39 | 126 |
| | PIPO | 14 | 88 | 18 | 154 | 58 | 117 |
| | PSME | 14 | 44 | 21 | 156 | 59 | 175 |
| ABGR/BENE | ABGR | 45 | 64 | 74 | 249 | 113 | 98 |
| | LAOC | 43 | 61 | 45 | 169 | 74 | 99 |
| | PICO | 10 | 58 | 10 | 124 | 50 | 103 |
| | PIMO | 3 | 56 | 3 | 191 | 75 | 87 |
| | PIPO | 8 | 102 | 13 | 250 | 70 | 128 |
| | PSME | 153 | 67 | 159 | 218 | 104 | 93 |
| ABGR/BENE/CARU | ABGR | 8 | 70 | 12 | 242 | 114 | 90 |
| | LAOC | 6 | 62 | 6 | 390 | 173 | 91 |
| | PICO | 8 | 57 | 8 | 157 | 62 | 89 |
| | PIPO | 11 | 105 | 20 | 172 | 78 | 119 |
| | PSME | 40 | 66 | 43 | 261 | 120 | 115 |
| ABGR/CARU | ABGR | 3 | 70 | 3 | 175 | 86 | 66 |
| | PICO | 8 | 57 | 8 | 111 | 42 | 75 |
| | PIPO | 28 | 107 | 37 | 211 | 105 | 104 |
| | PSME | 60 | 66 | 69 | 212 | 102 | 110 |
| ABGR/CARU-LUPIN | LAOC | 10 | 60 | 10 | 159 | 65 | 76 |
| | PICO | 13 | 53 | 13 | 171 | 63 | 85 |
| | PIPO | 6 | 90 | 13 | 183 | 77 | 153 |
| | PSME | 45 | 52 | 46 | 214 | 79 | 118 |
| ABGR/HODI/CARU | PIPO | 3 | 95 | 6 | 194 | 79 | 147 |
| | PSME | 15 | 69 | 15 | 258 | 122 | 111 |
| ABGR/SPBEL/PTAQ | ABGR | 3 | 60 | 3 | 215 | 89 | 81 |
| | PICO | 13 | 60 | 13 | 190 | 80 | 78 |
| | PIMO | 3 | 62 | 3 | 247 | 107 | 73 |
| | PIPO | 34 | 113 | 36 | 214 | 106 | 106 |
| | PSME | 77 | 82 | 77 | 283 | 164 | 77 |
| ABGR/SYAL/CARU | ABGR | 11 | 61 | 17 | 260 | 111 | 93 |
| | LAOC | 9 | 66 | 9 | 150 | 70 | 98 |
| | PIPO | 17 | 110 | 17 | 202 | 99 | 94 |
| | PSME | 101 | 69 | 103 | 249 | 121 | 89 |
| ABGR/SYOR | PIPO | 14 | 94 | 14 | 268 | 110 | 83 |
| | PSME | 10 | 69 | 10 | 233 | 111 | 73 |
| ABLA2/ARLA-POPU | ABAM | 5 | 74 | 5 | 214 | 69 | 102 |
| | ABGR | 8 | 63 | 10 | 348 | 155 | 81 |
| | ABLA2 | 15 | 42 | 15 | 261 | 77 | 124 |
| | LAOC | 7 | 54 | 18 | 238 | 83 | 174 |
| | PICO | 20 | 56 | 20 | 231 | 90 | 88 |
| | PIEN | 18 | 55 | 18 | 318 | 122 | 110 |
| | PSME | 19 | 50 | 25 | 295 | 104 | 167 |
| ABLA2/CARU | ABLA2 | 3 | 46 | 3 | 199 | 64 | 93 |
| | PICO | 10 | 58 | 10 | 143 | 56 | 78 |
| | PSME | 15 | 58 | 15 | 237 | 102 | 131 |

[2] Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

## Site index, growth basal area, and GBA volume estimates by species and type[2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| ABLA2/LIBOL (M) | LAOC | 10 | 58 | 10 | 186 | 80 | 163 |
| | PICO | 10 | 59 | 10 | 160 | 67 | 80 |
| | PIEN | 5 | 62 | 5 | 298 | 129 | 78 |
| | PSME | 7 | 78 | 8 | 325 | 181 | 134 |
| ABLA2/LUHI | ABLA2 | 8 | 42 | 8 | 264 | 89 | 160 |
| | PIEN | 5 | 65 | 5 | 309 | 141 | 193 |
| ABLA2/PAMY (M) | PIEN | 5 | 74 | 5 | 254 | 131 | 67 |
| | PIMO | 3 | 70 | 3 | 439 | 215 | 70 |
| | PIPO | 5 | 124 | 5 | 319 | 173 | 77 |
| | PSME | 10 | 82 | 10 | 216 | 124 | 74 |
| ABLA2/RHAL | ABLA2 | 23 | 32 | 23 | 176 | 40 | 200 |
| | PICO | 4 | 33 | 4 | 173 | 40 | 170 |
| | PIEN | 21 | 33 | 23 | 206 | 50 | 226 |
| | PSME | 8 | 39 | 18 | 184 | 42 | 210 |
| ABLA2/RHAL/LUHI | ABLA2 | 5 | 39 | 5 | 198 | 54 | 116 |
| | PICO | 10 | 41 | 10 | 151 | 45 | 99 |
| ABLA2/RULA | ABGR | 5 | 98 | 5 | 558 | 383 | 58 |
| | ABLA2 | 11 | 57 | 11 | 276 | 112 | 97 |
| | PICO | 13 | 54 | 13 | 167 | 63 | 106 |
| | PIEN | 5 | 57 | 5 | 325 | 129 | 210 |
| | PSME | 3 | 82 | 3 | 477 | 273 | 61 |
| ABLA2/VACA | LAOC | 5 | 62 | 5 | 127 | 55 | 96 |
| | PICO | 5 | 55 | 5 | 96 | 37 | 100 |
| ABLA2/VAME (M) | PSME | 10 | 68 | 10 | 265 | 126 | 108 |
| ABLA2/VASC | LAOC | 5 | 41 | 5 | 97 | 28 | 173 |
| | PSME | 5 | 64 | 5 | 423 | 190 | 102 |
| ABLA2/VASC/ARLA | ABGR | 3 | 45 | 3 | 253 | 80 | 73 |
| | ABLA2 | 15 | 31 | 15 | 249 | 55 | 119 |
| | LAOC | 5 | 51 | 5 | 226 | 80 | 78 |
| | PICO | 18 | 47 | 18 | 193 | 62 | 81 |
| | PSME | 13 | 41 | 18 | 253 | 75 | 146 |
| ABLA2/VASC/CARU (M) | LAOC | 5 | 51 | 5 | 143 | 51 | 120 |
| | PICO | 5 | 35 | 5 | 114 | 28 | 127 |
| | PIEN | 5 | 38 | 5 | 133 | 35 | 125 |
| | PSME | 5 | 36 | 5 | 144 | 37 | 154 |
| ABLA2/VASC/LUHI | ABLA2 | 9 | 42 | 9 | 146 | 44 | 102 |
| | PICO | 5 | 42 | 5 | 175 | 51 | 112 |
| PIAL/VASC/LUHI | ABLA2 | 3 | 29 | 3 | 65 | 13 | 101 |
| | PICO | 3 | 32 | 3 | 48 | 11 | 78 |
| | PSME | 3 | 45 | 3 | 89 | 28 | 74 |
| PIPO/AGSP | PIPO | 2 | 81 | 13 | 67 | 30 | 184 |
| PIPO/CARU-AGSP | PIPO | 3 | 49 | 9 | 65 | 13 | 213 |
| PIPO/PUTR/AGSP | PIPO | 30 | 75 | 33 | 86 | 30 | 96 |

[2] Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

## Site index, growth basal area, and GBA volume estimates by species and type[2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| PSME/AGSP | PIPO | 7 | 61 | 8 | 60 | 16 | 132 |
| | PSME | 8 | 29 | 8 | 79 | 17 | 128 |
| PSME/AGSP-ASDE | PIPO | 3 | 70 | 3 | 50 | 15 | 75 |
| | PSME | 4 | 52 | 4 | 68 | 25 | 145 |
| PSME/ARUV | LAOC | 5 | 42 | 5 | 144 | 42 | 126 |
| | PICO | 5 | 39 | 5 | 140 | 39 | 114 |
| | PSME | 2 | 27 | 5 | 173 | 33 | 236 |
| PSME/ARUV-PUTR | PICO | 5 | 37 | 5 | 62 | 16 | 121 |
| | PIPO | 4 | 85 | 19 | 69 | 33 | 164 |
| | PSME | 9 | 44 | 10 | 67 | 22 | 110 |
| PSME/ARUV/CARU | LAOC | 12 | 47 | 13 | 86 | 29 | 168 |
| | PIPO | 12 | 70 | 29 | 101 | 26 | 213 |
| | PSME | 27 | 31 | 49 | 103 | 21 | 185 |
| PSME/CAGE | PIPO | 3 | 137 | 3 | 276 | 167 | 81 |
| | PSME | 27 | 64 | 28 | 220 | 99 | 101 |
| PSME/CARU | LAOC | 28 | 51 | 29 | 110 | 40 | 161 |
| | PICO | 13 | 44 | 13 | 130 | 42 | 103 |
| | PIPO | 8 | 73 | 16 | 120 | 41 | 139 |
| | PSME | 73 | 50 | 81 | 168 | 60 | 130 |
| PSME/CARU-AGSP | PIPO | 23 | 85 | 26 | 151 | 57 | 107 |
| | PSME | 19 | 55 | 19 | 115 | 44 | 90 |
| PSME/PAMY/CARU | PIPO | 5 | 72 | 8 | 138 | 55 | 162 |
| | PSME | 20 | 50 | 20 | 173 | 60 | 126 |
| PSME/PEFR3 | PIPO | 8 | 74 | 12 | 84 | 27 | 139 |
| | PSME | 9 | 51 | 10 | 83 | 30 | 107 |
| PSME/PUTR | PIPO | 3 | 57 | 11 | 72 | 20 | 212 |
| | PSME | 11 | 42 | 12 | 101 | 31 | 115 |
| PSME/PUTR/AGSP | PIPO | 12 | 74 | 20 | 86 | 27 | 118 |
| | PSME | 21 | 56 | 21 | 145 | 59 | 88 |
| PSME/PUTR/CARU | PIPO | 12 | 83 | 19 | 132 | 60 | 127 |
| | PSME | 12 | 51 | 13 | 153 | 58 | 94 |
| PSME/SPBEL | PSME | 10 | 63 | 10 | 151 | 68 | 70 |
| PSME/SPBEL/CARU | PIPO | 26 | 95 | 40 | 157 | 67 | 124 |
| | PSME | 47 | 60 | 48 | 177 | 77 | 104 |
| PSME/SYAL (WEN) | PIPO | 13 | 98 | 14 | 231 | 108 | 134 |
| | PSME | 40 | 76 | 40 | 244 | 139 | 71 |
| PSME/SYAL/AGSP | PIPO | 2 | 105 | 10 | 146 | 98 | 159 |
| | PSME | 13 | 62 | 13 | 123 | 52 | 78 |
| PSME/SYAL/CARU | PIPO | 1 | 83 | 6 | 120 | 68 | 220 |
| | PSME | 18 | 74 | 18 | 208 | 100 | 76 |
| PSME/SYOR | PIPO | 19 | 70 | 22 | 133 | 47 | 123 |
| | PSME | 21 | 51 | 21 | 149 | 56 | 76 |
| PSME/VACA | LAOC | 10 | 53 | 10 | 84 | 32 | 110 |
| | PICO | 15 | 47 | 15 | 149 | 53 | 84 |
| | PSME | 10 | 53 | 10 | 131 | 49 | 107 |
| PSME/VAMY | LAOC | 4 | 52 | 4 | 81 | 30 | 158 |
| | PICO | 5 | 46 | 5 | 81 | 26 | 91 |
| | PSME | 2 | 46 | 2 | 117 | 37 | 136 |
| PSME/VAMY/CARU | LAOC | 14 | 47 | 19 | 99 | 34 | 170 |
| | PICO | 15 | 37 | 15 | 116 | 31 | 107 |
| | PIPO | 4 | 73 | 6 | 287 | 91 | 116 |
| | PSME | 14 | 40 | 29 | 166 | 50 | 208 |

[2] Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

## APPENDIX C2

# Site index, growth basal area, and GBA volume estimates by species and type[2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| THPL/OPHO | ABGR | 2 | 101 | 20 | 387 | 280 | 127 |
| | PIEN | 5 | 84 | 5 | 201 | 118 | 1043 |
| | PSME | 13 | 83 | 13 | 363 | 227 | 138 |
| | THPL | 17 | 66 | 17 | 354 | 161 | 129 |
| TSHE/ACCI/ACTR | LAOC | 5 | 79 | 5 | 351 | 195 | 73 |
| | PSME | 5 | 87 | 5 | 328 | 200 | 67 |
| | TSHE | 1 | 55 | 5 | 183 | 70 | 160 |
| TSHE/ACCI/ASCA3 | ABGR | 8 | 100 | 8 | 611 | 431 | 75 |
| | PSME | 14 | 84 | 15 | 315 | 188 | 109 |
| | TSHE | 3 | 68 | 5 | 388 | 185 | 115 |
| TSHE/ACCI/CLUN | ABGR | 16 | 73 | 30 | 249 | 129 | 111 |
| | LAOC | 6 | 77 | 9 | 189 | 103 | 136 |
| | PIMO | 2 | 71 | 3 | 260 | 130 | 145 |
| | PSME | 6 | 76 | 6 | 336 | 184 | 113 |
| | THPL | 8 | 62 | 8 | 230 | 98 | 128 |
| TSHE/ACTR | ABGR | 11 | 81 | 19 | 313 | 200 | 92 |
| | LAOC | 23 | 71 | 23 | 244 | 119 | 101 |
| | PIEN | 4 | 94 | 4 | 559 | 370 | 81 |
| | PSME | 44 | 68 | 44 | 271 | 136 | 99 |
| | THPL | 5 | 47 | 5 | 223 | 73 | 117 |
| | TSHE | 6 | 56 | 8 | 227 | 89 | 95 |
| TSHE/ARNE | PICO | 10 | 40 | 10 | 88 | 25 | 94 |
| | PIMO | 1 | 33 | 3 | 137 | 31 | 154 |
| | PSME | 6 | 45 | 11 | 147 | 28 | 185 |
| TSHE/ASCA3 | ABGR | 12 | 104 | 23 | 566 | 487 | 108 |
| | PIEN | 3 | 88 | 3 | 512 | 314 | 69 |
| | PSME | 13 | 82 | 13 | 454 | 265 | 97 |
| | THPL | 10 | 65 | 10 | 447 | 210 | 125 |
| | TSHE | 5 | 82 | 5 | 313 | 180 | 102 |
| TSHE/BENE | ABGR | 15 | 79 | 16 | 257 | 141 | 83 |
| | PICO | 3 | 59 | 3 | 106 | 43 | 118 |
| | PIMO | 7 | 59 | 7 | 393 | 164 | 112 |
| | PSME | 20 | 73 | 23 | 214 | 103 | 150 |
| | TSHE | 9 | 67 | 26 | 253 | 125 | 183 |
| TSHE/PAMY/CLUN | PSME | 10 | 70 | 10 | 230 | 114 | 109 |

[2] Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

# Site index, growth basal area, and GBA volume estimates by species and type[2]

| TYPE | SPECIES | #SI TREES | SI | #GBA TREES | GBA | VOL | AGE |
|---|---|---|---|---|---|---|---|
| TSME/LUHI | ABLA2 | 8 | 37 | 8 | 171 | 45 | 153 |
| | TSME | 3 | 50 | 3 | 197 | 43 | 143 |
| TSME/MEFE-VAAL | ABAM | 10 | 81 | 20 | 269 | 95 | 226 |
| | TSME | 1 | 67 | 5 | 280 | 82 | 381 |
| TSME/MEFE-VAME | ABAM | 8 | 87 | 10 | 302 | 116 | 223 |
| TSME/PHEM-VADE | ABLA2 | 8 | 32 | 8 | 161 | 32 | 106 |
| | TSME | 1 | 45 | 3 | 230 | 46 | 281 |
| TSME/RHAL-VAAL | ABAM | 9 | 65 | 14 | 201 | 56 | 245 |
| | TSME | 6 | 52 | 11 | 196 | 46 | 259 |
| TSME/RHAL-VAME | ABAM | 30 | 72 | 32 | 284 | 92 | 170 |
| | ABLA2 | 3 | 56 | 3 | 212 | 83 | 58 |
| | CHNO | 3 | 46 | 4 | 205 | 66 | 224 |
| | LAOC | 4 | 50 | 9 | 373 | 55 | 188 |
| | PICO | 4 | 51 | 4 | 141 | 50 | 75 |
| | PIEN | 11 | 63 | 12 | 263 | 115 | 181 |
| | PIMO | 3 | 46 | 6 | 206 | 68 | 123 |
| | PSME | 16 | 59 | 22 | 272 | 123 | 150 |
| | TSME | 14 | 41 | 32 | 242 | 42 | 295 |
| TSME/RULA | ABAM | 7 | 69 | 10 | 257 | 79 | 240 |
| | PICO | 5 | 46 | 5 | 128 | 41 | 80 |
| TSME/VAAL | ABAM | 13 | 84 | 15 | 444 | 175 | 180 |
| | TSME | 3 | 59 | 3 | 410 | 106 | 144 |
| TSME/VAME | ABAM | 6 | 56 | 13 | 267 | 66 | 251 |
| | TSME | 2 | 43 | 10 | 226 | 38 | 337 |
| TSME/VASC/LUHI | ABLA2 | 15 | 38 | 15 | 210 | 61 | 103 |
| | PICO | 14 | 54 | 14 | 357 | 143 | 70 |
| | TSME | 6 | 48 | 7 | 530 | 112 | 204 |
| TSME/XETE-VAMY | ABAM | 4 | 67 | 4 | 347 | 101 | 152 |
| | LAOC | 4 | 52 | 5 | 142 | 52 | 129 |
| | PICO | 14 | 56 | 15 | 134 | 53 | 108 |
| | PSME | 1 | 51 | 3 | 289 | 103 | 189 |
| | TSME | 5 | 48 | 5 | 245 | 52 | 208 |

2 Type = Plant association or community type (in alphabetical order); Species = tree species for which the estimates are made; GBA is Growth Basal Area (Hall 1983); VOL = an estimate of wood production in cubic feet/acre/year from an empirical formula based on site index and GBA (Hall 1983, personal communication); and Sl is the average site index (all trees base 50 except ABAM, ABPR, PIPO and TSME which are base 100- See Introduction for Site index curve sources. #GBA trees is the number of trees used to make the GBA estimates; #SI trees is the number of trees used to determine the Site Index values.

# APPENDIX D

## SERAL CHARACTERISTICS OF SELECTED SPECIES AFTER FIRE

| SPECIES | LIFE FORM | SERAL ORIGIN | FIRE SURVIVAL ADAPTATION |
|---|---|---|---|
| *Acer circinatum* | T-Shrub | Survivor | Root crown |
| *Acer glabrum* | T-Shrub | Survivor | Root crown |
| *Alnus sinuata* | T-Shrub | Survivor | Root crown |
| *Amelanchier alnifolia* | T-Shrub | Survivor | Root crown |
| *Aralia nudicaulis* | Herb | Survivor | Rhizome |
| *Arnica cordifolia* | Herb | Survivor | Rhizome |
| *Asarum caudatum* | Herb | R-colonizer | GSS-1 |
| *Calamagrostis rubescens* | Herb | Survivor | Rhizome |
| *Carex rossii* | Herb | R-colonizer | Rhizome GSS-2 |
| *Ceanothus velutinus* | Shrub | Survivor R-colonizer | Root crown GSS-2 |
| *Clintonia uniflora* | Herb | Survivor | Rhizome |
| *Epilobium angustifolium* | Herb | IO-S colonizer Survivor | Rhizome-like root |
| *Gymnocarpium dryopteris* | Herb | Survivor | Accidental |
| *Holodiscus discolor* | Shrub | Survivor | Root crown |
| *Lonicera utahensis* | Shrub | Survivor | Root crown |
| *Oplopanax horridum* | Shrub | Survivor | Root crown |
| *Pachistima myrsinites* | Shrub | Survivor R-colonizer | Root crown GSS-2 |
| *Populus tremuloides* | Tree | Survivor IO-S colonizer | Root crown |
| *Populus trichocarpa* | Tree | Survivor IO-S colonizer | Root crown |
| *Prunus emarginata* | T-Shrub | Survivor | Root crown |
| *Pteridium aquilinum* | Herb | Survivor | Rhizome |
| *Ribes lacustre* | Shrub | R-colonizer | GSS-2 |
| *Ribes viscosissimum* | Shrub | R-colonizer | GSS-2 |
| *Rosa gymnocarpa* | Shrub | Survivor | Root crown |
| *Rubus parviflorus* | Shrub | Survivor R-colonizer | Rhizome GSS-2 |
| *Salix scouleriana* | T-Shrub | Survivor IO-S colonizer | Root crown |
| *Sambucus racemosa* | Shrub | Survivor R-colonizer | Root crown GSS-2 |
| *Smilacina stellata* | Herb | Survivor | Rhizome |
| *Sorbus scopulina* | T-Shrub | Survivor | Root crown |
| *Spiraea betulifolia* | Shrub | Survivor | Rhizome |
| *Symphoricarpos albus* | Shrub | Survivor | Rhizome |
| *Tiarella trifoliata* | Herb | Survivor | Caudex |
| *Trautvetteria caroliniensis* | Herb | Survivor | Rhizome |
| *Vaccinium membranaceum* | Shrub | Survivor | Rhizome |
| *Viola orbiculata* | Herb | Survivor R-colonizer | Rhizome GSS-1 |
| *Xerophyllum tenax* | Shrub (Herb) | Survivor | Rhizome |

Seral origin:
Introduced denotes planted or seeded by man.
R-colonizer denotes residual colonizer.
I O-S colonizer denotes initial offsite colonizer (immigration in succession year 1).

Fire survival adaptation:
CSS = Tree crown source seed (onsite); -1 short-term viability, -2 long-term viability.
GSS = Ground source seed (onsite); -1 short-term viability, -2 long-term viability.

Adapted from Stickney, Peter F. 1986. First decade plant succession following the Sundance forest fire, northern Idaho. Intermountain Research Station. Ogden, Ut. General Technical Report INT-197. 26 pp.

# FIELD FORM

Use the field form provided as a master to make copies as needed for stand identification. When completing a field form, follow the steps below:

1. Select a vegetatively uniform area representative of the community in question to record data on the field form. Plot size for vegetation data should be either 375 square meters or 1/10 acre. The radius of a 375-square-meter plot is approximately 11 meters, or 36 feet; a 1/10 acre plot has a radius of approximately 11.3 meters, or 37 feet.

2. Complete the field form before trying to key the stand. Record all location and physical attributes listed on the form. Stand age is also helpful and can be approximated by using the age of the oldest tree in the stand. Use stand age to determine if the community is mature enough to fit the keys or whether the community composition will need to be projected to a later stage of succession (and suggest the use of the optional keys).

Identify and list tree, shrub, and indicator herb species and estimate the cover of each. Although cover is typically estimated to the nearest percent up to 10 percent and to the nearest 5 percent thereafter, the field form displays cover classes. Cover classes are normally adequate, although more precise data may be helpful and can be recorded on the form if desired.