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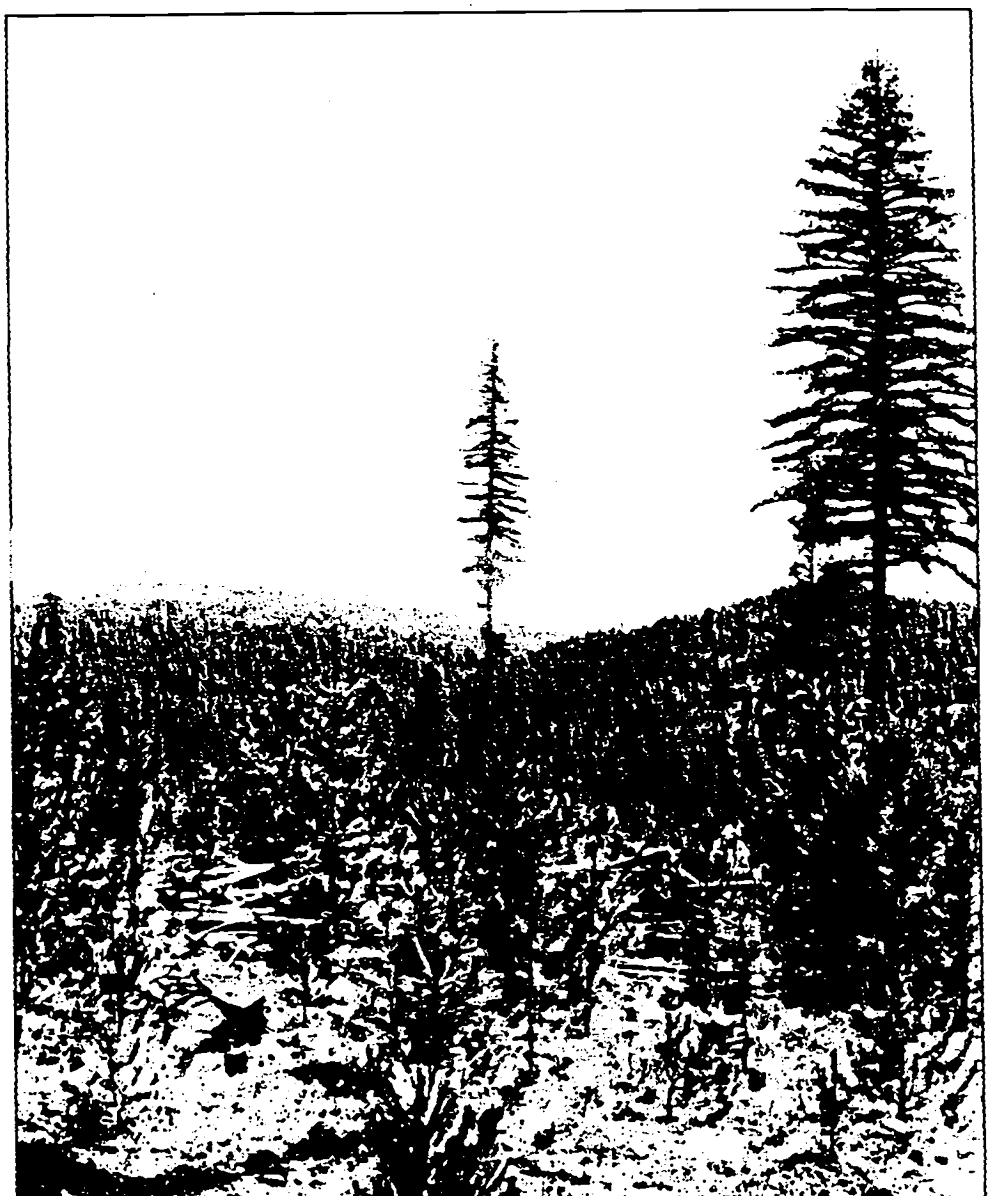
The Grand Fir Series of Northeastern Oregon and Southeastern Washington: Successional Stages and Management Guide

by Rodrick R. Clausnitzer



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PREFACE

This guide is the culmination of four years of field study, analyses, and report preparation. It could not have been accomplished without the support from: Charles Johnson, Area Ecologist-Area 3; Area 3 Forest Supervisors (Bob Richmond, Mark Boche, and Jeff Blackwood); and Area 3 National Forest District personnel. Wallowa-Whitman employees Paula McBroom, Kathy Hottle, and Alice DeVries were particularly helpful in the culmination and production of the written text.

This guide is dedicated to my family whose support was appreciated.

Rod Clausnitzer

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INTRODUCTION

Objectives

This guide is a summary of successional vegetation of the grand fir series in southeastern Washington and northeastern Oregon. The classification serves as an effective tool in the management of forest lands administered by the USDA Forest Service and will aid in the practice of more intensive, site-specific management. Knowledge of plant succession is the foundation of sound vegetation management where the primary goal is to retard, arrest, or accelerate the natural forces of vegetation change. The early-, mid-, and late-successional stages described will aid the assignment of highly disturbed sites to the appropriate plant association. In addition, the classification provides a framework for compositional and structural elements of plant biodiversity at the species, community, and landscape levels. Finally, the classification provides knowledge of ecological processes that apply to restoration and rehabilitation of forest lands in the area. Detailed knowledge of desired plant communities, their probable developmental pathways, and site-specific habitat factors (i.e., soils, slope, aspect, elevation, geology) can assist in identifying alternatives for program-wide management objectives and vegetation units.

Descriptions of layer groups and layer types for major grand fir plant associations and keys for their identification are presented. Successional classification diagrams of the tree, shrub, and herb layers depict the conceptional framework for the keys and association tables presented within each plant association. Successional dynamics and management implications for the vegetation layers are described within the plant association framework.

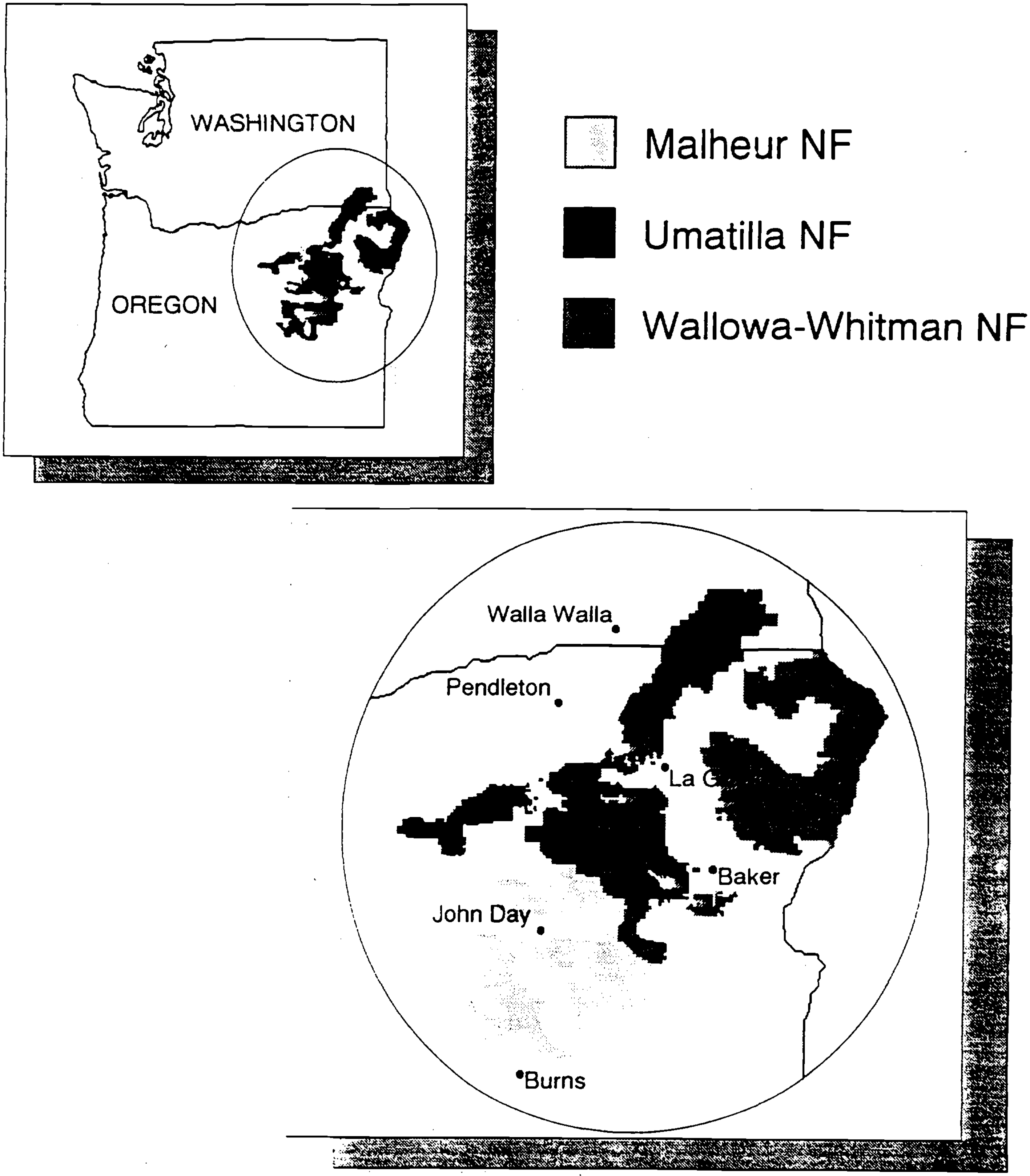
The plant associations are fully described for the Wallowa-Snake Province (Johnson and Simon 1987) and for the Blue and Ochoco Mountains (Johnson and Clausnitzer 1992 and Hall 1973) in ecological publications for Region 6. This management guide provides the first approximation of the seral stages and successional dynamics for grand fir plant associations in the Blue Mountain Region. It is our intent to study, classify, and provide similar management guides for the successional stages of the other principal forest series of this area (i.e., ponderosa pine, Douglas-fir, and subalpine fir) following the format and descriptions of this publication in the forthcoming years.

Succession

Vegetation succession is the unidirectional change in species proportions of a stand or the complete replacement of one community by another (Daubenmire 1968). It is the process of species establishment, development, and replacement within a community. Primary succession is the change that occurs on a surface recently bared by physiographic processes such as lava flows, glacial retreat, and erosion (Daubenmire 1968). After colonization and vegetational development of such sites, subsequent disturbance initiates a sequence of vegetation change defined as secondary succession. In secondary successional seres, change is initiated by disturbance agents (such as fire, insects, wind, flooding, and logging) that affect existing vegetation.

Patterns of succession have been proposed relative to the temporal and spatial discreteness of stages as well as the initiation and development of important floristic components within the sere (Egler 1954, Drury and Nesbet 1973, Halpern 1989, Smith 1982). These patterns have been termed relay floristics and initial floristics, respectively. Smith (1982), Franklin (1982), and Farrell (1991) have suggested that succession is a complex process with a multitude of mechanisms and patterns yet to be analyzed and described. A view of succession has emerged that is driven by life histories of individual species, autecological attributes, and by chance elements (Franklin 1982, West and others 1982). A strictly deterministic model of the natural process has evolved to a model in which stochastic elements drive both biotic and abiotic interactions (Christensen 1988).

Connell and Slatyer (1977) described three successional models dependent on species interactions during establishment and development of post-disturbance populations: the tolerance model--early successional species interaction with mid- and late-successional species is minimal with no effect on the establishment of the later colonists; the facilitation models--early successional species interact with later successional species and hasten their establishment; the inhibition models--early successional species



Malheur, Umatilla and Wallowa-Whitman National Forests in the Blue Mountains of N.E. Oregon and S.E. Washington interact with later successional species and slow their establishment (Farrell 1991). Along this interaction gradient, specific mechanisms of successional change should be identified and described to promote understanding of ecosystem dynamics in the inland Northwest.

Successional pathways depict the probable course of community development within a framework of defined community types for a disturbance regime. If the natural disturbance regime is altered in type, frequency, duration, intensity, scale, or reliability (Rykiel 1979) or management effects on ecosystem components are modified through technological evolution, the successional sere may also change. Altered abiotic and biotic interactions may lead to different expressions of individual plant species responses and the identification of different successional pathways. Predictability of ecosystem responses may suffer unless new interaction data are incorporated into a more complete model of successional change.

Steele (1984) and Arno and others (1985) proposed approaches to classifying successional vegetation of: intermountain and northern Rocky Mountain forest vegetation, respectively. These efforts describe the temporal variation in plant association structure and composition and promote the understanding of western forest ecosystem dynamics. The classification concepts presented by Steele (1984) and subsequently by Steele and Geier-Hayes (1987a, 1987b, 1988, 1989a, 1989b, 1990, 1992a, and 1992b) have been applied in the development of the successional classification for grand fir plant associations in this study.

Study Area

The grand fir successional study was conducted on lands administered by the USDA Forest Service in the Blue Mountain Region of northeastern Oregon and southeastern Washington. Plots were established on the Malheur, Umatilla, and Wallowa-Whitman National Forests (Table 1).

FOREST	DISTRICT	NO. PLOTS
Malheur	Bear Valley	33
	Burns	38
	Long Creek	48
	Prairie City	27
	TOTAL	146 (23%)
Umatilla	Heppner	65
	Pomeroy	33
	North Fork John Day	62
	Walla Walla	81
	TOTAL	241 (37%)
Wallowa-Whitman	Baker	59
	Wallowa Valley	48
	Hells Canyon NRA	4
	Eagle Cap	0
	La Grande	69
	Pine	45
	Unity	36
	TOTAL	261 (40%)

Table 1. Successional plot distribution in northeastern Oregon and southeastern Washington.

The Blue Mountain Region includes the Blue Mountains and Wallowa-Snake Physiographic Provinces (Johnson and Simon 1987). These provinces consist of glacially sculpted mountains, rolling dissected basalt plateaus as well as the river valleys and rugged canyonlands carved by major rivers and tributaries. The rivers include the Snake, Malheur, John Day, Umatilla, Walla Walla, Touche, Tucannon, and Grande Ronde river systems. Elevations range from 9,845 feet in the Wallowa Mountains to 870 feet in the Snake River Canyon. The elevational range for the Blue Mountains is less--from 9,000 feet in the Strawberry Mountains to 2,300 feet in canyon bottoms of the northern Blue Mountains.

The geology of the province is diverse with igneous rock dominant and sedimentary and metamorphic rocks locally important. During the Paleozoic Era (250 million years ago) marine sandstone, shale, chert, and limestone were formed. Metavolcanics of the Snake River and surrounding mountains were formed in late Paleozoic or early Mesozoic Eras. The Mesozoic Era (225-65 million years ago) produced major intrusive igneous masses, such as the granitics of the Snake River Canyon, the granodiorites of the Elkhorn, Greenhorn, and Strawberry Mountains, and the granitic batholith of the Wallowa Mountains. During this period, too, the ultramafic rocks of the Strawberry range and the sedimentary and metamorphic rocks of the Wallowa Mountains were formed.

The Cenozoic Era (65 million years ago) was dominated by periods of active volcanism in the region. Vast areas were covered by extrusive flows and tephra. The Columbia River basalts, Strawberry volcanics, John Day formation, and Clarno formation cover much of the province and were formed during this era. These flows were subsequently uplifted with folding and faulting of the ranges to form the axis of the Blue Mountains. Alpine glaciation during the Pleistocene (2 to 3 million years ago) created glacial landforms in the mountains and alluvial deposits in the valleys. Lake sediments of the central basin in Washington were the source of loessial deposits in the northern Blue Mountain Province. More recently, volcanic ash has been deposited on the landscape by eruptions of Glacier Peak (12,000 years ago) and Mt. Mazama (6,000 years ago).

The climate of the Blue Mountain Region is an expression of both the temperate oceanic and temperate continental (cool summer phase) climates of Trewartha (1968). The northern portion of the region is influenced by marine climatic conditions which results in a climate significantly different than the southern portions. Differences in precipitation, cloud cover, humidities, and temperature fluctuations with respect to the temperate continental climate influence the occurrence and distribution of plant communities in the region. More precipitation, percentage of greater cloud days, higher relative humidities, and less fluctuation in winter temperatures characterize the temperate oceanic climate in contrast to the temperate continental climate. Lower precipitation, fewer cloud days, low relative humidities, rapid evapo-transpiration, and wide temperature and precipitation fluctuations are characteristic of the latter climatic regime.

Soils of the Blue Mountain Region are quite variable and range from those on thin, rocky, low-productivity ridgetop scablands to those in deep ash accumulations on very productive grand fir sites. Soil differences result from variations in climate, topography, parent material, vegetation, and time. The greatest influence to soils in this area has come from ash deposited primarily from Mt. Mazama and Glacier Peak approximately 6,600 and 12,000 years ago respectively (Fryxell 1965). Perhaps of equal impact, especially in the northern dissected basalt plateau, has been the deposition of loess from the central Washington channeled scablands region prior to and following glaciation during the Pleistocene (1 million years ago); over time much of the material has been eroded away by wind and water (USDA 1985). Continued weathering of the basalts and other rock types has resulted in a mixing of wind-borne ash and loess with rocky colluvium in many areas. Consequently, soils fall under one of the following broad categories:

1. Residual- derived in place from predominately bedrock or colluvial rock materials

2. Ash-Loess- derived from deposited and accumulated ash and/or loess over older buried soil material.

3. Mixed- derived from colluvium, ash and/or loess mixed well in surface layers over older buried soil material (Johnson and Simon 1987).

Of the varied geologic material available for soil formation, basalt and andesite are the most common in the province. Residual soils formed from these materials differ from the volcanic ash and loessial soils in several respects: 1) finer textured in the upper profile, 2) increased structure, 3) higher coarse fragments, 4) lower water-holding capacity, and 5) higher bulk densities. Other materials provide locally important substrates that impart characteristic attributes to soils, as, the occurrence of rhyolitic rock and subsequent low soil nutrient status.

Productivity of forested and non-forested plant communities is closely related to ash and loess content in soils. Unique characteristics of ash soils include: 1) high water holding capacity, 2) high water infiltration rates, 3) moderate compactability, 4) high detachability, and 5) disproportionately high amounts of nutrients in upper surface layers. Under undisturbed conditions these soils support good vegetation cover which protects the ash from erosion (USDA 1985).

Loess may also provide important qualities to many soils. Loessial deposits are normally: 1) high in base saturation (can hold a large amount of nutrients), 2) have high content of weathered minerals and are thus high in nutrient reserve, and 3) generally have excellent physical properties (Johnson and Simon 1987).

Soil characteristics related to parent material interact with other environmental factors to define the distributional limits of plant communities and their individual species.

METHODS

Data Collection

Ten grand fir plant associations commonly encountered in the Blue Mountain Region were sampled. Plots were established to depict differences in grand fir vegetation due to successional status of sampled stands. Data were gathered in successional stages representing very early to late or climax conditions. Data collection sites disturbed by fire or harvest activities were primarily sampled although insect, disease, animal, and wind damage were evident in some stands. Paired plots were established to describe very early seral stands--one in the recently disturbed area, the other in adjacent, older stands with similar site factors. This permitted plant association identification of the disturbed site in addition to data collection of later seral stages.

A circular reconnaissance plot of 375 square meters (10.9 meters or 35.9 feet in radius) was installed. Ocular estimates were made of crown canopy coverage for trees, shrubs, and herbs in the plot. Tree canopy coverage was estimated for overstory and understory components. The overstory component includes two categories: dominant-codominant crown classes and intermediate-suppressed crown classes. These classes are identified as "D" and "I" respectively in the tree layer coverage/constancy tables. The tree understory component includes two categories: poles (4-12" DBH) and seedlings-saplings (0-4" DBH). These classes are identified as "P" and "S" respectively in the tree layer coverage/constancy tables. In addition to vegetation attributes, soil surface characteristics and site variables were measured. Color slides and black and white photographs were taken and are intended to visually document vegetation change in future site monitoring activities.

Data Analyses

The plant association data were first separated into component layers of trees, shrubs, and herbs in recognition of the developmental independence displayed by these layers. This independence is related to differential susceptibility to disturbance and differential rates of recovery in the tree overstory and shrub-herb understories. Within this successional framework, data analyses and summaries were completed with computer programs developed or adapted for use in Region 6 (Wheeler 1987).

A series of subjective group orderings were created with consideration given to dominant species of the successional sere. Additionally, previous successional classification efforts in adjacent national forest lands were considered (Steele 1984, Steele and Geier-Hays 1987b, Steele and Geier-Hays 1988, Steele and Geier-Hays 1992b). Ordination and classification programs were used to develop concepts of classification group membership and species successional amplitudes.

Results from these analyses were used to adjust classification units and plot order. A series of association tables and summaries were produced, examined, and adjusted to reflect concepts of successional amplitude of indicator species. Successional amplitude reflects species life history characteristics (such as, shade-tolerance, regeneration strategies, age of senescence, seedbed requirements, and reaction to competition). The classification incorporates current knowledge of these attributes as well as observations of plant responses to ecological conditions. This grand fir successional classification is a first approximation reflecting the status of investigative efforts in the area.

USE OF THE GUIDE

The successional classification presented in this guide is a framework for the delineation and description of plant communities on disturbed sites supporting ten common grand fir plant associations of the Blue Mountain and Wallowa Mountain Provinces. The plant community is separated into tree, shrub, and herbaceous components for classification purposes. Keys to layer groups (LG) and layer types (LT) are presented for each lifeform layer within the plant associations. Plant species used as seral indicators had at least 5% canopy coverage and dominated the lifeform layer at a point in vegetation succession. Often, groups of similar species were used as seral indicators. Those groups are identified by footnotes in the individual keys.

A layer group is a level of layer organization in which a diagnostic seral indicator species occurs at 5 percent or greater level of abundance. For example, in the tree layer of the ABGR/TABR/CLUN plant association, there are five layer groups defined. Each layer group is named for a seral indicator: LAOC, western larch; PIPO, ponderosa pine; PSME, Douglas-fir; PIEN, Engelmann spruce; or ABGR, grand fir. The species near the base of the classification diagram (fig. 1) have less successional amplitude than those near the top; that is, these species are found during the early stages of vegetation development only, while the climax species may be found during all stages. The LAOC Layer Group is the earliest successional tree layer and includes stands with western larch at 5 percent or greater canopy coverage.

The layer type is a level of layer organization, a classification unit in which a particular plant species dominates a portion of the layer group. Fig. 1 illustrates five layer types within the LAOC Layer Group. These separate layer types depict stands dominated by LAOC, PIPO, PSME, PIEN, or ABGR; they represent structural and compositional development along the successional gradient within a layer group. The nomenclature for this unit is: seral indicator species - dominant species; i.e. LAOC-LAOC, LAOC-PIPO, LAOC-PSME, LAOC-PIEN, and LAOC-ABGR. For example, LAOC-ABGR would include all stands within this plant association in which western larch occurs at 5 percent or greater canopy coverage and grand fir dominates the tree layer.

The designation for a plant community is the summation of the tree, shrub, and herb layers as: TREE LT/SHRUB LT/HERB LT. For example, in the ABGR/TABR/CLUN plant association a stand could be keyed to the PIEN-ABGR/ALSI-LIBO2/ARCO-CLUN plant community.

This coding for plant community may be further modified by including descriptors of stand structure for the tree and shrub indicator species and dominant species; as:

PIEN(P)-ABGR(S)/ALSI(T)-LIBO2(L)/ARCO-CLUN plant community.

Where:

P = pole-sized trees
S = sapling-sized trees
T = tall shrub (5+ feet)
L = low shrub (less than 2 feet).

The association tables display the canopy coverage and constancy of major plant species within layer types for each of the ten plant associations. Canopy coverage is displayed on the left of the slash and constancy on the right, as: cover/constancy = 10/90. Not all layer types were sampled during the study; some layer types may be rare due to the ephemeral nature of the plant community or because of limited distribution in Area 3 while others have not yet been encountered in the field.

Grand fir/Pacific yew/queen's cup beadlily plant association

Abies grandis/Taxus brevifolia/Clintonia uniflora

ABGR/TABR/CLUN (CWC8 11 AND CWF4 22)

Mature ABGR/TABR/CLUN in Big Hole Canyon (Pomeroy RD, Umatilla NF)

This plant association, representing the more mesic portion of the grand fir series, was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Johnson and Clausnitzer 1992; Johnson and Simon 1987). Its best development occurs on moist, deep ash soils of upland sites in the northern Blue Mountains and east flank of the Wallowa Mountains, but it can occasionally be found on protected toe slopes and steam bottoms through the central Blue Mountain and Wallowa-Snake Provinces. Stands representing this plant association can be found between 3,600 feet and 5,300 feet elevation on all aspects.

In climax and late successional stands, Pacific yew (TABR) dominates a dense tall-shrub layer occurring with an overstory of grand fir (ABGR) and occasional Engelmann spruce (PIEN) and Douglas-fir (PSME). Rocky mountain maple may be found as a minor tall-shrub component in some stands. Where the mid-shrub and low-shrub layers are well developed, big huckleberry (VAME), baldhip rose (ROGY), Utah honeysuckle (LOUT2), twinflower (LIBO2), and prince's pine (CHUM) are prominent components of the understory. The herb layer is usually dominated by queen's cup beadlily (CLUN); round-leaved violet (VIOR2), meadowrue (THOC), Columbia brome (BRVU), sidebells pyrola (PYSE), starry false Solomon's seal (SMST), rattlesnake plantain (GOOB), fragrant bedstraw (GATR), mitella (MIST2), sweet cicely (OSCH), foamflower (TITRU), trail plant (ADBI), heartleaf arnica (ARCO), and strawberry (FRAGA) are common associates.

Table 2. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/TABR/CLUN p.a.

1. LAOC ≥ 5% canopy coverage[2]	LAOC LG
1a. LAOC dominant[3]	LAOC-LAOC LT
1b. PIPO dominant or codominant	LAOC-PIPO LT
1c. PSME dominant or codominant	LAOC-PSME LT
1d. PIEN dominant or codominant	LAOC-PIEN LT
1e. ABGR dominant or codominant	LAOC-ABGR LT
1. LAOC < 5% canopy coverage	2
2. PIPO ≥ 5% canopy coverage	PIPO LG
2a. PIPO dominant	PIPO-PIPO LT
2b. PSME dominant or codominant	PIPO-PSME LT
2c. PIEN dominant or codominant	PIPO-PIEN LT
2d. ABGR dominant or codominant	PIPO-ABGR LT
2. PIPO < 5% canopy coverage	3
3. PSME ≥ 5% canopy coverage	PSME LG
3a. PSME dominant	PSME-PSME LT
3b. PIEN dominant or codominant	PSME-PIEN LT
3c. ABGR dominant or codominant	PSME-ABGR LT
3. PSME < 5% canopy coverage	4
4. PIEN ≥ 5% canopy coverage	PIEN LG
4a. PIEN dominant	PIEN-PIEN LT
4b. ABGR dominant or codominant	PIEN-ABGR LT
4. PIEN < 5% canopy coverage	5
5. ABGR ≥ 5% canopy coverage	ABGR LG
5a. ABGR dominant	ABGR-ABGR LT
5. ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/TABR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.

[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.

[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

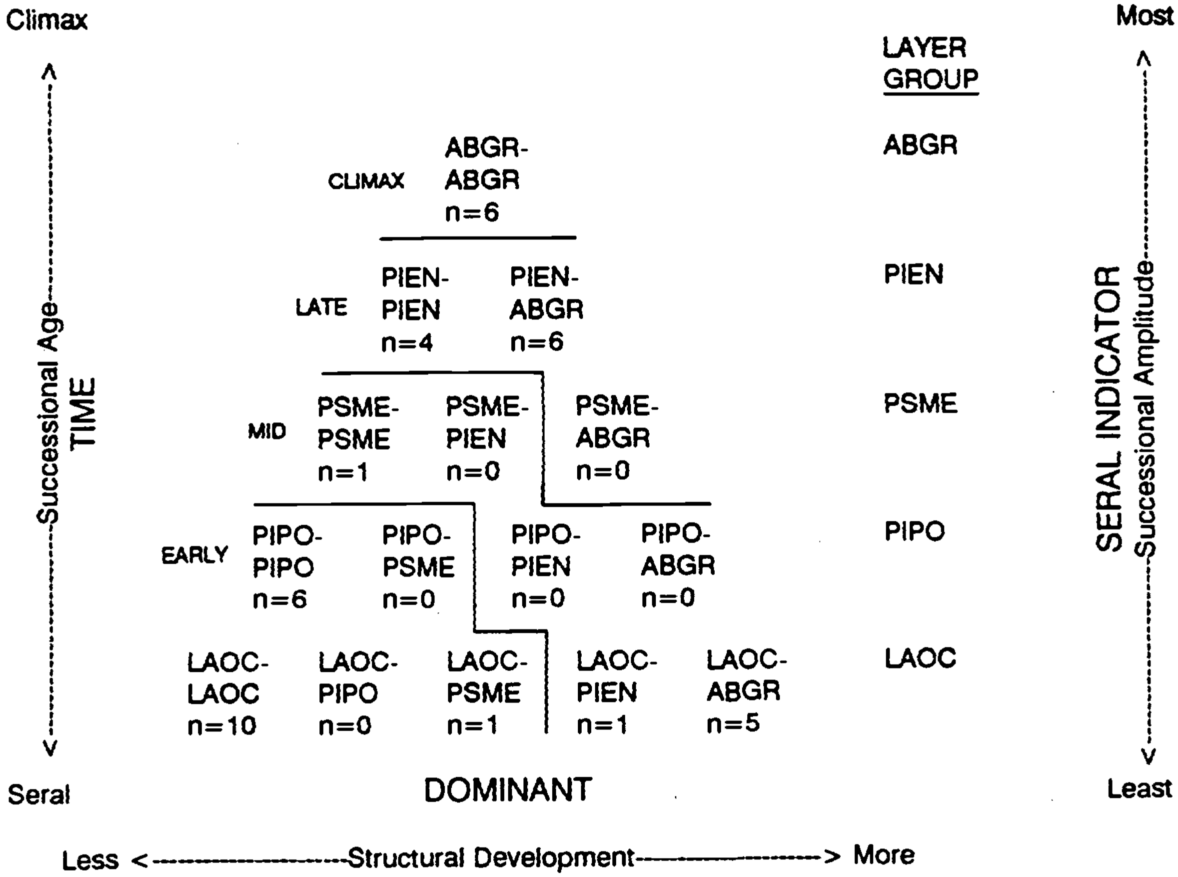


Figure 1. Succession classification diagram of the tree layer in the ABGR/TABR/CLUN p.a.

TREE LAYER

Description

Trees prevalent during succession include western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 1) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, LAOC, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g. fire). This seral tree species can compete for growing space because of its rapid early height growth but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of wildfires and may be developed through silvicultural activity (e.g. seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group; layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified using the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association; its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/TABR/CLUN plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the four seral tree species (LAOC, PIPO, PSME, and PIEN) 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/TABR/CLUN plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/TABR/CLUN plant association.

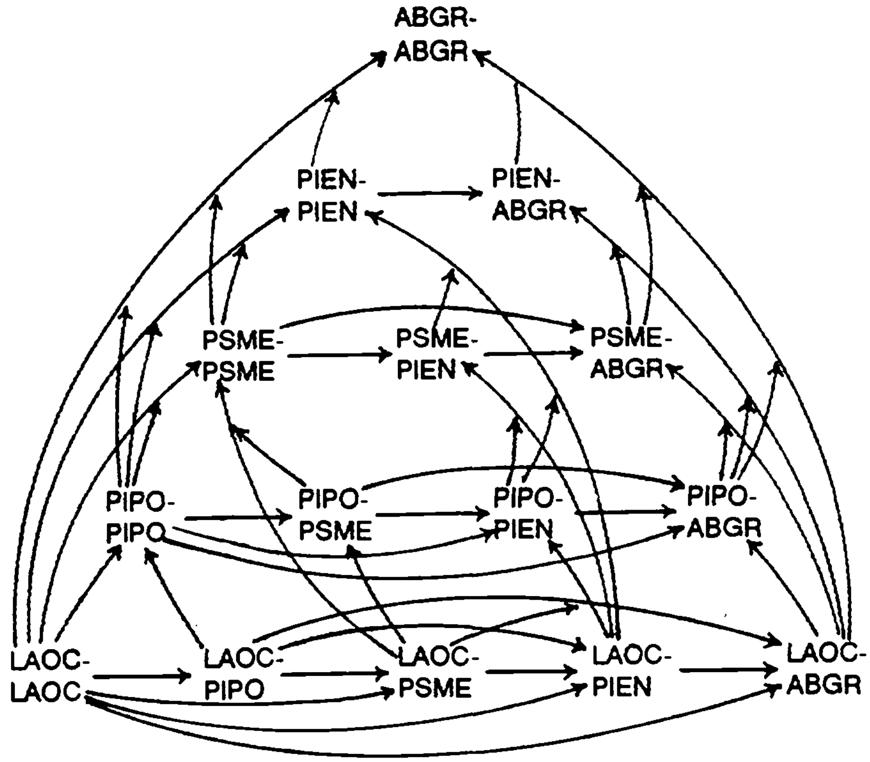


Figure 2. Successional pathways for the tree layer in the ABGR/TABR/CLUN p.a.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

For example, a moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 1) depicts the distribution of major tree species in the ABGR/TABR/CLUN plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in late and mid-seral stands as well as early seral stands. The successional status (i.e. late, mid-, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is relatively lower in the LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

LAOC-LAOC LT with the tall shrub SASC on Hoodoo Ridge (Walla Walla RD, Umatilla NF)

Table 3. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/TABR/CLUN p.a.

1. CEVE[2] $\geq$ 5% canopy coverage	CEVE LG
1a. CEVE dominant[3]	CEVE-CEVE LT
1b. RIVI[4] dominant or codominant	CEVE-RIVI LT
1c. SASC dominant or codominant	CEVE-SASC LT
1d. ALSI dominant or codominant	CEVE-ALSI LT
1e. LIBO2[5] dominant or codominant	CEVE-LIBO2 LT
1f. TABR dominant or codominant	CEVE-TABR LT
1. CEVE $<$ 5% canopy coverage	2
2. RIVI $\geq$ 5% canopy coverage	RIVI LG
2a. RIVI dominant	RIVI-RIVI LT
2b. SASC dominant or codominant	RIVI-SASC LT
2c. ALSI dominant or codominant	RIVI-ALSI LT
2d. LIBO2 dominant or codominant	RIVI-LIBO2 LT
2e. TABR dominant or codominant	RIVI-TABR LT
2. RIVI $<$ 5% canopy coverage	3
3. SASC $\geq$ 5% canopy coverage	SASC LG
3a. SASC dominant	SASC-SASC LT
3b. ALSI dominant or codominant	SASC-ALSI LT
3c. LIBO2 dominant or codominant	SASC-LIBO2 LT
3d. TABR dominant or codominant	SASC-TABR LT
3. SASC $<$ 5% canopy coverage	4
4. ALSI $\geq$ 5% canopy coverage	ALSI LG
4a. ALSI dominant	ALSI-ALSI LT
4b. LIBO2 dominant or codominant	ALSI-LIBO2 LT
4c. TABR dominant or codominant	ALSI-TABR LT
4. ALSI $<$ 5% canopy coverage	5
5. LIBO2 $\geq$ 5% canopy coverage	LIBO2 LG
5a. LIBO2 dominant	LIBO2-LIBO2 LT
5b. TABR dominant or codominant	LIBO2-TABR LT
5. LIBO2 $<$ 5% canopy coverage	6
6. TABR $\geq$ 5% canopy coverage	TABR LG
6a. TABR dominant	TABR-TABR LT
6. TABR $<$ 5% canopy coverage	depauperate or undefined layer or not ABGR/TABR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CEVE refers to the following group of species: CEVE and CESA.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] RIVI refers to the following group of species: RIVI, RILA, and PAMY.
[5] LIBO2 refers to the following group of species: LIBO2, VAME, and RUPA.

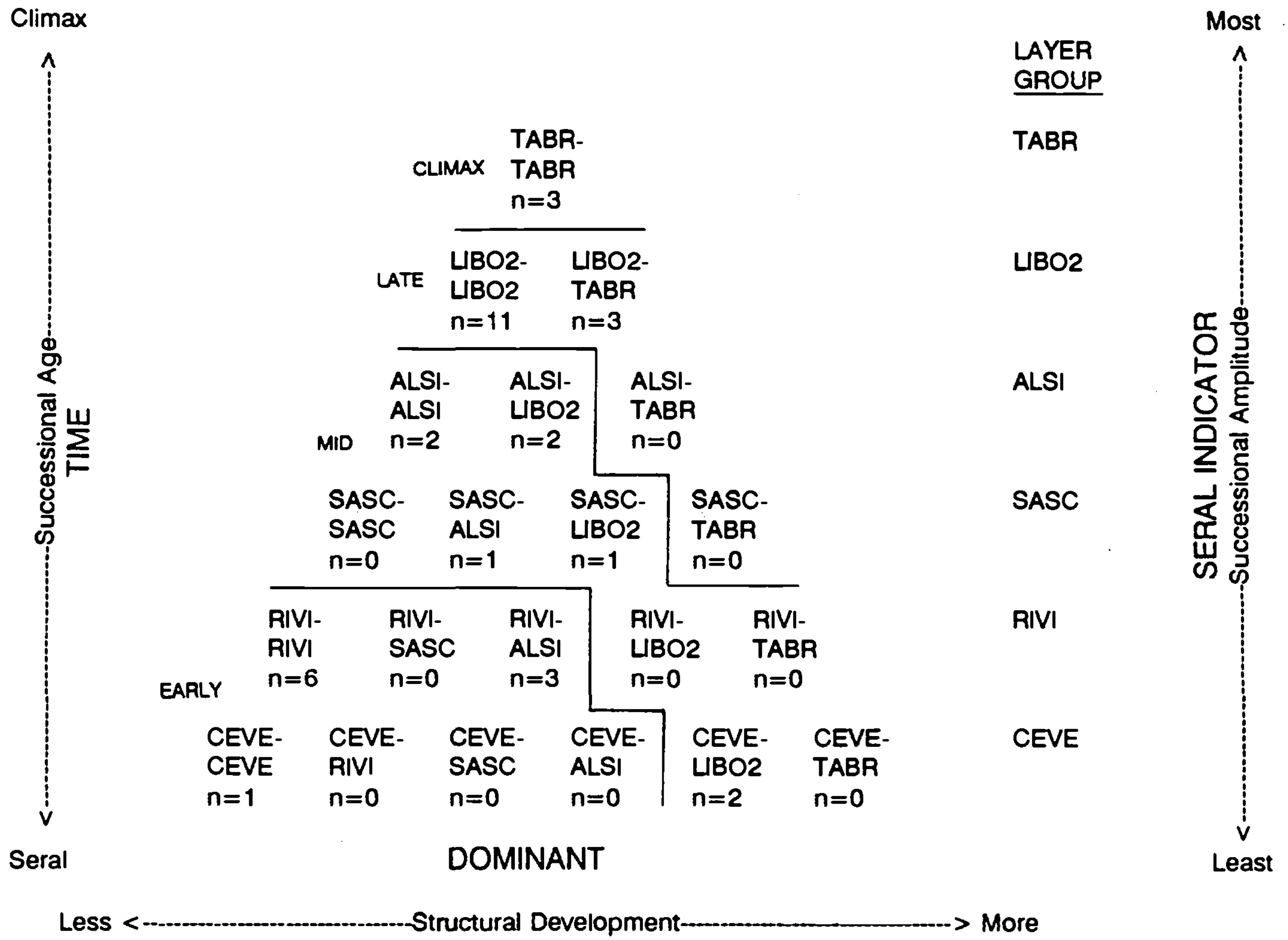


Figure 3. Succession classification diagram of the shrub layer in the ABGR/TABR/CLUN p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), sticky currant (RIVI), Scouler willow (SASC), Sitka alder (ALSI), big huckleberry (VAME), twinflower (LIBO2), and Pacific yew (TABR). The classification diagram (Fig. 3) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, TABR, appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while Pacific yew can be found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/TABR/CLUN plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has six layer types defined: CEVE-CEVE LT, CEVE-RIVI LT, CEVE-SASC LT, CEVE-ALSI LT, CEVE-LIBO2 LT, and CEVE-TABR. Redstem ceanothus (CESA) is not as common as snowbrush ceanothus in the ABGR/TABR/CLUN plant association, but where it occurs it should be included in the CEVE LG.

The RIVI LG includes the shrub species swamp gooseberry (RILA) and Oregon boxwood (PAMY) in addition to sticky currant (RIVI). These three species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. Oregon boxwood, although more shade-tolerant, generally declines after an increase in cover following fire or logging disturbance. The layer types defined are: RIVI-RIVI LT, RIVI-SASC LT, RIVI-ALSI LT, RIVI-LIBO2 LT, and RIVI-TABR LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has four defined layer types: SASC-SASC LT, SASC-ALSI LT, SASC-LIBO2 LT, and SASC-TABR LT.

Sitka alder is a mid-seral shrub that dominated some disturbed sites in the ABGR/TABR/CLUN plant association. It has light, windblown seed that is dispersed from scattered seeps and stream banks. It establishes on moist mineral soil exposed by fire or logging. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of Sitka alder as increased light levels encourage vigor in the multi-stemmed shrub. Three layer types represent community development towards the climax state: ALSI-ALSI LT, ALSI-LIBO2 LT, and ALSI-TABR LT.

The LIBO2 LG includes three late seral to climax species: twinflower (LIBO2), big huckleberry (VAME), and thimbleberry (RUPA). These low-to mid-shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/TABR/CLUN plant association. Thimbleberry regenerates quickly from rhizomes or stored seed in the soil and duff layers following fire or logging disturbance. Big huckleberry revegetates sites through sprouting rhizomes; seedling regeneration appears to be rare and unimportant. The relatively shallow rhizomes of big huckleberry are susceptible to moderate and high intensity fires. The shrub species is sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. Twinflower revegetates from shallow rhizomes principally in the upper soil and duff layers. Fire or logging that remove or disturb these layers lead to the decline in twinflower cover. Plants in favorable microsites that escape the disturbance become centers of recolonization; this centrifugal expansion would appear a slow process. Two layer types are defined in this group: LIBO2-LIBO2 LT and LIBO2-TABR LT.

The TABR LT represents climax conditions where Pacific yew dominates the tall shrub layer beneath grand fir. Allelopathic properties of the shrub's foliage may enable its sole dominance. Yew is a fire sensitive species and will decline in a fire disturbance regime. It sprouts readily from epicormic buds near the stem base and layers profusely when branches contact the ground as overstory trees fall on mature shrubs. Seedlings establish in logged areas adjacent to undisturbed stands after 15-20 years. Avian distribution of seed may be related to stand structure at this time or, alternatively, environmental conditions for establishment may be reached. Yew reacts to complete overstory removal and subsequent temperature extremes; the foliage color often changes to brown with dieback of twigs and branches. Pacific yew cover declines as individual shrubs react and mortality is encountered. Winter desiccation may have an important role in this effect as exposure to sun with cold soil temperatures causes stress to the Pacific yew. Snow lines are evident in the impacted foliage of some shrubs following clearcutting. Partial overstory removals allow the shrub to acclimate to changing environmental conditions in the stand.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. Differential responses of snowbrush ceanothus, sticky currant, big huckleberry, and Pacific yew are related to many of these factors. For example, a low intensity spring burn of a recently logged site may result in a decline in Pacific yew, no change in big huckleberry, a large increase in sticky currant, and no ceanothus germinants. Yet the same fire in the fall, with a moderate intensity burn, may result in the disappearance of Pacific yew, a decline in big huckleberry, a small increase in sticky currant, and abundant ceanothus germinants. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. The former case could result in the identification of the RIVI-LIBO2 LT while the latter case could be the CEVE-CEVE LT.

Management Implications

The potential shrub layer types in the ABGR/TABR/CLUN plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession processes. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus and Sitka alder also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Sticky currant, swamp gooseberry, and Oregon boxwood provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants and gooseberries also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds, nesting sites for birds, and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings, may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

Sitka alder provides food for grouse and other non-game birds but is not a preferred browse by deer or elk. Shrubfields can provide hiding and thermal cover for these big game species, however.

Big huckleberry and thimbleberry provide fruit used by bear, grouse, non-game birds, and small mammals. In addition, VAME provides browse for wild ungulates and domestic livestock. The recreational use of big huckleberry shrubfields for berry-picking attracts forest visitors in late summer.

Pacific yew is an important source of browse for deer, elk, and small mammals. The fruit (aril) is used by birds and the fleshy pulp of the aril is eaten by the red squirrel. Dense stands of this tall shrub provide hiding and thermal cover for big game. Taxol, a compound used to treat ovarian cancer, comes from the bark and foliage of Pacific yew. Management guidelines that ensure the conservation of this valuable resource have been developed for Region Six.

ALSI dominates shrub layer of harvest unit near Palmer Corral (Walla Walla RD, Umatilla NF)

Table 4. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/TABR/CLUN p.a.

	Condition	Result
1.	CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a.	CIVU dominant[3]	CIVU-CIVU LT
1b.	RUOC dominant or codominant	CIVU-RUOC LT
1c.	THMO dominant or codominant	CIVU-THMO LT
1d.	PTAQ dominant or codominant	CIVU-PTAQ LT
1e.	FRVE[4] dominant or codominant	CIVU-FRVE LT
1f.	ARCO[5] dominant or codominant	CIVU-ARCO LT
1g.	THOC[6] dominant or codominant	CIVU-THOC LT
1h.	CLUN dominant or codominant	CIVU-CLUN LT
1.	CIVU < 5% canopy coverage	2
2.	RUOC ≥ 5% canopy coverage	RUOC LG
2a.	RUOC dominant	RUOC-RUOC LT
2b.	THMO dominant or codominant	RUOC-THMO LT
2c.	PTAQ dominant or codominant	RUOC-PTAQ LT
2d.	FRVE dominant or codominant	RUOC-FRVE LT
2e.	ARCO dominant or codominant	RUOC-ARCO LT
2f.	THOC dominant or codominant	RUOC-THOC LT
2g.	CLUN dominant or codominant	RUOC-CLUN LT
2.	RUOC < 5% canopy coverage	3
3.	THMO ≥ 5% canopy coverage	THMO LG
3a.	THMO dominant	THMO-THMO LT
3b.	PTAQ dominant or codominant	THMO-PTAQ LT
3c.	FRVE dominant or codominant	THMO-FRVE LT
3d.	ARCO dominant or codominant	THMO-ARCO LT
3e.	THOC dominant or codominant	THMO-THOC LT
3f.	CLUN dominant or codominant	THMO-CLUN LT
3.	THMO < 5% canopy coverage	4
4.	PTAQ ≥ 5% canopy coverage	PTAQ LG
4a.	PTAQ dominant	PTAQ-PTAQ LT
4b.	FRVE dominant or codominant	PTAQ-FRVE LT
4c.	ARCO dominant or codominant	PTAQ-ARCO LT
4d.	THOC dominant or codominant	PTAQ-THOC LT
4e.	CLUN dominant or codominant	PTAQ-CLUN LT
4.	PTAQ < 5% canopy coverage	5
5.	FRVE ≥ 5% canopy coverage	FRVE LG
5a.	FRVE dominant	FRVE-FRVE LT
5b.	ARCO dominant or codominant	FRVE-ARCO LT
5c.	THOC dominant or codominant	FRVE-THOC LT
5d.	CLUN dominant or codominant	FRVE-CLUN LT
5.	FRVE < 5% canopy coverage	6
6.	ARCO ≥ 5% canopy coverage	ARCO LG
6a.	ARCO dominant	ARCO-ARCO LT
6b.	THOC dominant or codominant	ARCO-THOC LT
6c.	CLUN dominant or codominant	ARCO-CLUN LT
6.	ARCO < 5% canopy coverage	7
7.	THOC ≥ 5% canopy coverage	THOC LG
7a.	THOC dominant	THOC-THOC LT
7b.	CLUN dominant or codominant	THOC-CLUN LT
7.	THOC < 5% canopy coverage	8
8.	CLUN ≥ 5% canopy coverage	CLUN LG
8a.	CLUN dominant	CLUN-CLUN LT
8.	CLUN < 5% canopy coverage	depauperate or undefined layer or not ABGR/TABR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU, ANMA, and VETH.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] FRVE refers to FRAGARIA SPP.
[5] ARCO refers to the following group of species: ARCO and ADBI.
[6] THOC refers to the following group of species: THOC, MIST2, VIOR2, and BRVU.

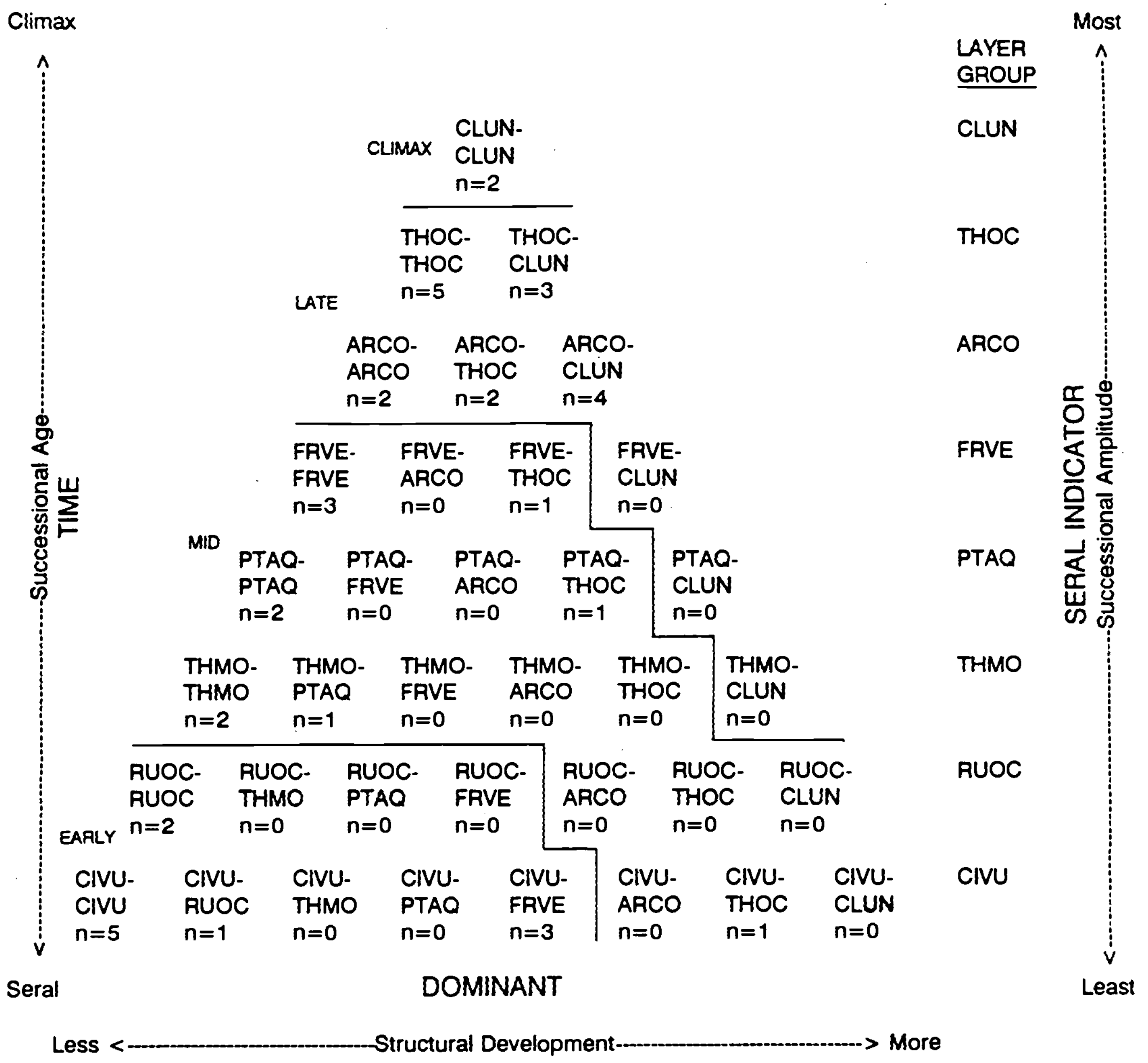


Figure 4. Succession classification diagram of the herb layer in the ABGR/TABR/CLUN p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pearly-everlasting (ANMA), flannel mullein (VETH), western coneflower (RUOC), golden-pea (THMO), braken-fern (PTAQ), woods strawberry (FRVE), broadpetal strawberry (FRVI), heartleaf arnica (ARCO), trail plant (ADBI), western meadowrue (THOC), mitella (MIST2), round-leaved violet (VIOR2), Columbia brome (BRVU), and queen's cup beadlily (CLUN). The classification diagram (Fig. 4) depicts the herb layer groups and herb layer types. CIVU, ANMA, and VETH are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. CLUN, a climax herbaceous species, appears at the top of the figure.

Bull thistle and flannel mullein are tap-rooted, alien biennials that establish on recently disturbed sites of this plant association. Pearly-everlasting is a native perennial. CIVU and ANMA are composites with windblown seed; VETH is a tall plant dispersed via dihescent capsules. VETH can be locally abundant in a disturbed patch but seldom has the coverage of the wind-dispersed CIVU or ANMA. The CIVU LG includes these species and has eight layer types defined: the CIVU-CIVU LT, CIVU-RUOC LT, CIVU-THMO LT, CIVU-PTAQ LT, CIVU-FRVE LT, CIVU-ARCO LT, CIVU-THOC LT, and CIVU-CLUN LT.

The western coneflower layer group has seven layer types defined: RUOC-RUOC LT, RUOC-THMO LT, RUOC-PTAQ LT, RUOC-FRVE LT, RUOC-ARCO LT, RUOC-THOC LT, and RUOC-CLUN LT. RUOC is an early seral, perennial forb of the sunflower family. Unlike bull thistle, it has no mechanism for wind dispersal. Gravity, small mammals, and birds act as dispersal agents.

There are six layer types within the THMO LG: THMO-THMO LT, THMO-PTAQ LT, THMO-FRVE LT, THMO-ARCO LT, THMO-THOC LT, THMO-CLUN LT. Golden-pea is a perennial, rhizomatous legume that increases in post-fire plant communities of this plant association.

Braken-fern, PTAQ, is a mid-seral, perennial herb that reproduces vegetatively by rhizomes or through wind-dispersed spores. It is moderately shade-tolerant and can persist beneath partial tree canopies and in stand openings and edges. Five layer types are defined: PTAQ-PTAQ LT, PTAQ-FRVE LT, PTAQ-ARCO LT, PTAQ-THOC LT, and PTAQ-CLUN LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has four layer types: FRVE-FRVE LT, FRVE-ARCO LT, FRVE-THOC LT, and FRVE-CLUN LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. Trail plant (ADBI) is grouped with heartleaf arnica in the ARCO LG. Layer types are: ARCO-ARCO LT, ARCO-THOC LT, and ARCO-CLUN LT. Both ARCO and ADBI, members of the sunflower family, produce achenes dispersed by wind. In addition, ARCO can reproduce by rhizomes.

Western meadowrue, mitella, round-leaved violet, and Columbia brome compose a group of shade-tolerant, perennial herbs of late seral and climax stands used to define the THOC LG. All occasionally dominate the herbaceous layer although THOC is the most constant and abundant member of the layer group. Defined layer types are: THOC-THOC LT and THOC-CLUN LT.

Queen's cup beadlily is a shade-tolerant, perennial forb of the climax herb layer in the ABGR/TABR/CLUN plant association. It regenerates readily from rhizomes following light disturbances, but is slow to recover following ground scarification or high intensity burns that impact the shallow rhizomes. The layer type defined for the CLUN LG is the CLUN-CLUN LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer. Factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The early seral species RUOC is favored by conditions created during mechanical scarification while THMO is favored by burning.

The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. The ARCO-ARCO LT following a light intensity fire would recycle to an ARCO-ARCO LT because of this species ability to regenerate quickly from rhizomes and to flower and set seed. Both of these regeneration strategies allow ARCO to quickly increase in abundance following such disturbances.

Management Implications

The species of the herb layer within the ABGR/TABR/CLUN plant association react differentially to disturbance events and impact management of the forest ecosystems. One such impact is through allelopathy, the effect a plant has on another by producing inhibitory or stimulatory biochemical compounds. Two species, braken-fern and western coneflower, have demonstrated inhibitory characteristics on other vegetation through the production of volatile or water-soluble compounds. The sources of these compounds lie in the senescent leaf litter of PTAQ and RUOC or the root caudex of RUOC (Ferguson and Boyd, 1988 and Ferguson, 1991). Conifer regeneration may be delayed in layer types where these two species dominate the understory.

The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. The FRVE-FRVE LT was found in 20 to 25 year old harvest units that had been burned. Golden-pea is favored by burning and is beneficial in its role as a nitrogen-fixer. In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU. However, this species was successfully established on litter in this moist plant association. Apparently, conditions are moist enough in the ABGR/TABR/CLUN p.a. that CIVU seedlings can reach stable soil moisture before desiccation leads to mortality.

The practice of planting exotic grasses in harvest units of this plant association appears to have had little impact on subsequent vegetation development, with one exception. Areas planted with red fescue (FERU) following broadcast burning have resulted in scattered and inadequate tree regeneration. Associated with the fescue is western braken-fern (PTAQ). PTAQ establishment is encouraged by burning and this allelopathic species inhibits tree regeneration. The seeding of FERU coupled with a natural response of PTAQ is detrimental to subsequent tree regeneration. Other grass seedings of timothy (PHPR), orchard grass (DAGL), and wheatgrasses (AGROP) appear short-lived with little impact on vegetation development.

TABLE 5. Mean canopy coverage and constancy of tree species by layer type in the ABGR/TABR/CLUN p.a.

TREE LAYER GROUP	LAOC																PIPO			
TREE LAYER TYPE	LAOC-LAOC				LAOC-PSME				LAOC-PIEN				LAOC-ABGR				PIPO-PIPO			
NUMBER OF STANDS	10				1				1				5				6			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR		10/10		9/100				2/100		2/100		2/100	15/40	9/40	8/100	13/100				4/100
ABLA2																				
LAOC	25/10		9/90	15/90			4/100	1/100				5/100	20/40	2/40	8/60	2/60			1/83	1/83
PIEN			1/80	9/80				5/100	5/100			5/100	10/60	3/60	3/80	5/80			3/50	5/50
PICO																				
PIMO																				
PIPO			4/40	2/40				1/100				1/100			10/20	10/20			36/100	1/100
POTR																				
PSME			1/70	3/70			4/100	6/100					30/20		3/40	2/40				1/33
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	PSME				PIEN								ABGR			
TREE LAYER TYPE	PSME-PSME				PIEN-PIEN				PIEN-ABGR				ABGR-ABGR			
NUMBER OF STANDS	1				4				6				6			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR				2/100	8/50	10/50		3/100	23/83	7/83	2/100	5/100	34/100	13/100	2/83	3/83
ABLA2																
LAOC							1/50	1/50	3/16			2/16				
PIEN				1/100	21/50	3/50	3/100	7/100	6/83	5/83	3/66	6/66	2/33	2/33		1/33
PICO																
PIMO																
PIPO								1/25								
POTR																
PSME				35/100				1/25				2/33				
BASAL AREA (FT²/AC)																

TABLE 6. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/TABR/CLUN p.a.

SHRUB LAYER GROUP	CEVE		RIVI		SASC		ALSI		LIBO2		TABR
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-LIBO2	RIVI-RIVI	RIVI-ALSI	SASC-ALSI	SASC-LIBO2	ALSI-ALSI	ALSI-LIBO2	LIBO2-LIBO2	LIBO2-TABR	TABR-TABR
NUMBER OF STANDS	1	2	6	3	1	1	2	2	11	3	3
Species											
ACGL	1/100	1/50	1/33	2/33				1/50	1/45	1/33	2/33
ALSI	1/100	18/100	1/50	32/100	15/100	5/100	35/100	14/100	3/9	1/33	1/33
AMAL		1/50	1/50						1/9		
ARNE											
ARUV											
BENE											
CESA		5/100									
CEVE	40/100	12/50		1/33					2/9		
CELE											
CHUM	1/100	5/50	1/33	1/66		5/100	1/50	3/100	3/90	3/100	2/66
HODI											
LIBO2		20/100	4/66	4/66		55/100	1/50	5/100	24/90	5/100	1/66
LOUT2		5/100	3/100	8/66	1/100	3/100	4/50	3/100	2/100	4/100	1/66
PAMY	2/100	8/50	11/66	6/100			2/50	1/50	1/54	1/33	1/66
PHMA											
RICE						1/100					
RILA	1/100		4/83	1/100	1/100		2/100	2/100	1/63	1/33	2/66
RIVI		3/50	13/100	7/66	3/100	3/100	2/50	1/50	1/27	1/66	
ROGY			1/66	1/33			5/50	1/100	3/54	1/100	1/33
RUPA	1/100	2/100	4/83	3/100	10/100	3/100	3/50	1/50	9/45	1/33	1/33
SASC	2/100	10/50	7/100	6/100	10/100	5/100	3/100	1/50	1/9		1/33
SHCA											
SPBE									2/18		
SYAL		8/50	1/16						1/18		1/33
SYOR											
TABR	1/100	2/100	2/50	1/66	2/100	3/100	5/50	11/100	9/100	57/100	21/100
VACA											
VAME		25/100	4/83	18/100		20/100	28/100	38/100	24/100	8/100	2/66
VAMY											
VASC											

TABLE 7. Mean canopy coverage and constancy of herb species by layer type in the ABGR/TABR/CLUN p.a.

HERB LAYER GROUP	CIVU				RUOC	THMO		PTAQ	
HERB LAYER TYPE	CIVU-CIVU	CIVU-RUOC	CIVU-FRVE	CIVU-THOC	RUOC-RUOC	THMO-THMO	THMO-PTAQ	PTAQ-PTAQ	PTAQ-THOC
NUMBER OF STANDS	5	1	3	1	2	2	1	2	1
Species									
ACMI	2/80		1/100		1/50	1/50		1/50	
ADBI	2/20		1/33						
AGUR	1/20								
ANMA	32/40	5/100	11/100	5/100	2/100	2/100	1/100	2/100	
ANTEN	3/20								
APAN									
ARCO	5/80		2/66			1/50		3/50	
ASCA7	1/40		1/66		1/50	1/50	1/100		
BRVU	5/20			20/100				2/50	30/100
CARU	1/20							1/50	
CACO	2/20		1/33			1/100			
CAGE	1/20					1/50			
CARO	3/60	1/100	1/100		2/100		1/100		
CAMI2									
CIVU	20/80		1/33		1/50	1/50		2/50	
CLUN	1/60		1/66	3/100		2/50	1/100	20/50	15/100
ELGL	2/20								
FEOC	1/20		1/66	3/100	2/50	1/50			
FRVE	4/100	15/100	17/100		20/100	5/100	25/100	3/50	5/100
FRVI									
GOOB									
HIAL	1/40		2/33	1/100		1/100	3/100		
LUPIN									
MIST2	1/60	1/100	2/66	10/100		1/50			15/100
PONE									
PTAQ	1/20		2/33	5/100	23/100		75/100	25/100	5/100
PYAS						1/50			2/100
PYSE	1/20			5/100		1/50			8/100
RUOC	1/20	50/100	20/33		63/100				3/100
SMST	2/60		1/100	1/100	1/50	1/50	2/100	3/50	
THOC	1/80	1/100	1/66	5/100	2/100	2/100		1/50	
THMO	1/20	25/100	8/33		2/50	7/100	10/100		
VETH	3/60		1/66		1/50		1/100	1/50	
VIOR2	1/100		4/100	3/100	8/50	1/50	2/100	2/50	

TABLE 7 (cont.). **Mean canopy coverage and constancy of herb species by layer type in the ABGR/TABR/CLUN p.a.**

HERB LAYER GROUP	FRVE		ARCO			THOC		CLUN
HERB LAYER TYPE	FRVE-FRVE	FRVE-THOC	ARCO-ARCO	ARCO-THOC	ARCO-CLUN	THOC-THOC	THOC-CLUN	CLUN-CLUN
NUMBER OF STANDS	3	1	2	2	4	5	3	2
Species								
ACMI	1/100					1/40		
ADBI			4/100	9/100	9/100	2/60	2/100	1/100
AGUR								
ANMA	2/100	1/100				1/60	2/33	
ANTEN								
APAN								
ARCO	1/33		12/100	10/50	1/100	1/80	1/33	2/50
ASCO								
ASCA7					1/25	1/20		
BRVU	1/100		1/50	3/50	1/75	1/100	2/100	1/50
CARU						1/20		
CACO						2/40		
CAGE	3/33					4/40		
CARO	2/66	1/100			2/25	2/60		
CAMI2								
CIVU	1/33				1/25			
CLUN	7/66		4/100	12/100	12/100	3/100	19/100	5/100
ELGL								
FEOC	1/33				1/25	1/40	1/33	
FRVE	8/100	5/100	1/50	1/50	1/75	2/60	2/33	
FRVI	1/33							
GOOB			1/100	1/50	1/100	1/60	1/33	1/100
HIAL	1/33	1/100	1/50		1/100	1/60	1/100	1/50
LUPIN								
MIST2	1/33	1/100			1/25	7/80	2/33	
MONTI								
PONE								
PTAQ	1/33							
PYAS					1/25	1/40		1/50
PYSE	1/33	1/100	1/100	2/50	2/100	1/80	3/66	1/100
RUOC							1/33	
SMST	5/100	2/100	2/100	5/100	1/75	1/80	2/66	1/100
THOC		1/100	4/100	18/100	2/100	3/100	2/100	1/100
THMO					1/50			
VETH	1/33					1/40		
VIOR2	1/66	6/100	1/100	1/50	1/100	1/80	1/100	1/50

Grand fir/Rocky Mountain maple plant association

Abies grandis/Acer glabrum

ABGR/ACGL (CWS9 12 and CWS5 41)

ABGR/ACGL in Lick Creek drainage (Pomeroy RD, Umatilla NF)

This plant association, representing moist and warm conditions in the grand fir series, was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Johnson and Clausnitzer 1992; Johnson and Simon 1987). This community occurs on lower slope and stream bottom positions or near moist seeps in the northern and central Blue Mountains and on the southern flank of the Wallowa Mountains. It is found in a wide elevational belt between 3,300 and 6,100 feet.

In climax and late successional stands, Rocky Mountain maple (ACGL) dominates the shrub layer beneath a multi-storied canopy of grand fir (ABGR), Engelmann spruce (PIEN), and Douglas-fir (PSME). Big huckleberry (VAME), prince's pine (CHUM), baldhip rose (ROGY), Oregon boxwood (PAMY), thimbleberry (RUPA), and twinflower (LIBO2) are common associates. The herb layer is often composed of round-leaved violet (VIOR2), meadowrue (THOC), starry false Solomon's seal (SMST), sweet cicely (OSCH), bedstraw (GATR), heartleaf arnica (ARCO), queen's cup beadlily (CLUN), mitella (MIST2), trail plant (ADBI), fairybells (DITR and DIHO), and Piper's anemone (ANPI).

Table 8. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/ACGL p.a.

1. LAOC ≥ 5% canopy coverage[2]	LAOC LG
1a. LAOC dominant[3]	LAOC-LAOC LT
1b. PIPO dominant or codominant	LAOC-PIPO LT
1c. PSME dominant or codominant	LAOC-PSME LT
1d. PIEN dominant or codominant	LAOC-PIEN LT
1e. ABGR dominant or codominant	LAOC-ABGR LT
1. LAOC < 5% canopy coverage	2
2. PIPO ≥ 5% canopy coverage	PIPO LG
2a. PIPO dominant	PIPO-PIPO LT
2b. PSME dominant or codominant	PIPO-PSME LT
2c. PIEN dominant or codominant	PIPO-PIEN LT
2d. ABGR dominant or codominant	PIPO-ABGR LT
2. PIPO < 5% canopy coverage	3
3. PSME ≥ 5% canopy coverage	PSME LG
3a. PSME dominant	PSME-PSME LT
3b. PIEN dominant or codominant	PSME-PIEN LT
3c. ABGR dominant or codominant	PSME-ABGR LT
3. PSME < 5% canopy coverage	4
4. PIEN ≥ 5% canopy coverage	PIEN LG
4a. PIEN dominant	PIEN-PIEN LT
4b. ABGR dominant or codominant	PIEN-ABGR LT
4. PIEN < 5% canopy coverage	5
5. ABGR ≥ 5% canopy coverage	ABGR LG
5a. ABGR dominant	ABGR-ABGR LT
5. ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/ACGL p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

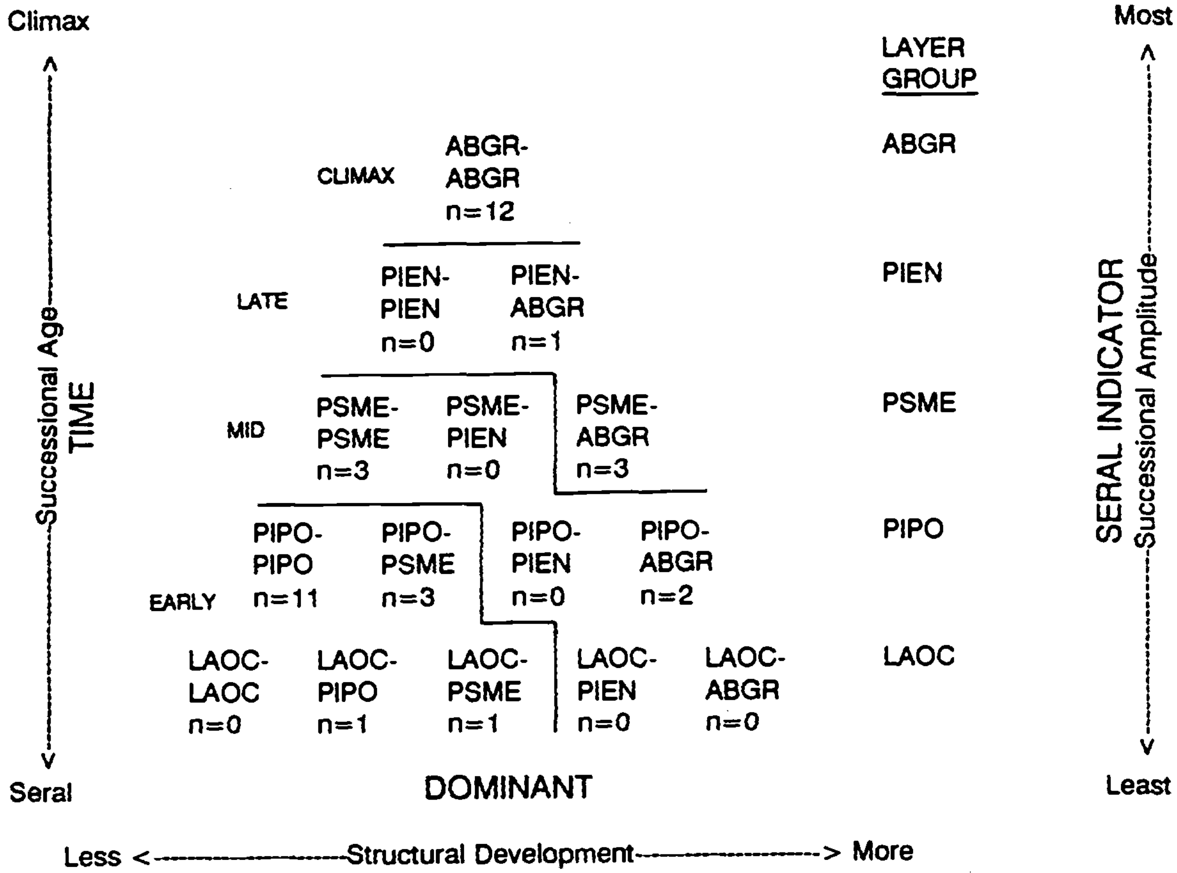


Figure 5. Succession classification diagram of the tree layer in the ABGR/ACGL p.a.

TREE LAYER

Description

Trees prevalent during succession include western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 5) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, LAOC, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group; layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified using the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association; its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/ACGL plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the four seral tree species (LAOC, PIPO, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/ACGL plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/ACGL plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/ACGL plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

For example, a moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the affected community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 5) depicts the distribution of major tree species in the ABGR/ACGL plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PIPO, PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is relatively lower in the LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 9. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/ACGL p.a.

1. CEVE[2] ≥ 5% canopy coverage .... CEVE LG
   1a. CEVE dominant[3] .... CEVE-CEVE LT
   1b. RIVI[4] dominant or codominant .... CEVE-RIVI LT
   1c. SASC dominant or codominant .... CEVE-SASC LT
   1d. ALSI dominant or codominant .... CEVE-ALSI LT
   1e. SYAL[5] dominant or codominant .... CEVE-SYAL LT
   1f. VAME[6] dominant or codominant .... CEVE-VAME LT
   1g. ACGL[7] dominant or codominant .... CEVE-ACGL LT

1. CEVE < 5% canopy coverage 2

   2. RIVI ≥ 5% canopy coverage .... RIVI LG
      2a. RIVI dominant .... RIVI-RIVI LT
      2b. SASC dominant or codominant .... RIVI-SASC LT
      2c. ALSI dominant or codominant .... RIVI-ALSI LT
      2d. SYAL dominant or codominant .... RIVI-SYAL LT
      2e. VAME dominant or codominant .... RIVI-VAME LT
      2f. ACGL dominant or codominant .... RIVI-ACGL LT

   2. RIVI < 5% canopy coverage 3

3. SASC ≥ 5% canopy coverage .... SASC LG
   3a. SASC dominant .... SASC-SASC LT
   3b. ALSI dominant or codominant .... SASC-ALSI LT
   3c. SYAL dominant or codominant .... SASC-SYAL LT
   3d. VAME dominant or codominant .... SASC-VAME LT
   3e. ACGL dominant or codominant .... SASC-ACGL LT

3. SASC < 5% canopy coverage 4

   4. ALSI ≥ 5% canopy coverage .... ALSI LG
      4a. ALSI dominant .... ALSI-ALSI LT
      4b. SYAL dominant or codominant .... ALSI-SYAL LT
      4c. VAME dominant or codominant .... ALSI-VAME LT
      4d. ACGL dominant or codominant .... ALSI-ACGL LT

   4. ALSI < 5% canopy coverage 5

5. SYAL ≥ 5% canopy coverage .... SYAL LG
   5a. SYAL dominant .... SYAL-SYAL LT
   5b. VAME dominant or codominant .... SYAL-VAME LT
   5c. ACGL dominant or codominant .... SYAL-ACGL LT

5. SYAL < 5% canopy coverage 6

   6. VAME ≥ 5% canopy coverage .... VAME LG
      6a. VAME dominant .... VAME-VAME LT
      6b. ACGL dominant or codominant .... VAME-ACGL LT

   6. VAME < 5% canopy coverage 7

7. ACGL ≥ 5% canopy coverage .... ACGL LG
   7a. ACGL dominant .... ACGL-ACGL LT

7. ACGL < 5% canopy coverage .... depauperate or undefined layer or not ABGR/ACGL p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CEVE refers to the following group of species: CEVE and CESA.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] RIVI refers to the following group of species: RIVI and RILA.
[5] SYAL refers to the following group of species: SYAL and SPBE.
[6] VAME refers to the following group of species: VAME and RUPA.
[7] ACGL refers to the following group of species: ACGL and PHMA.

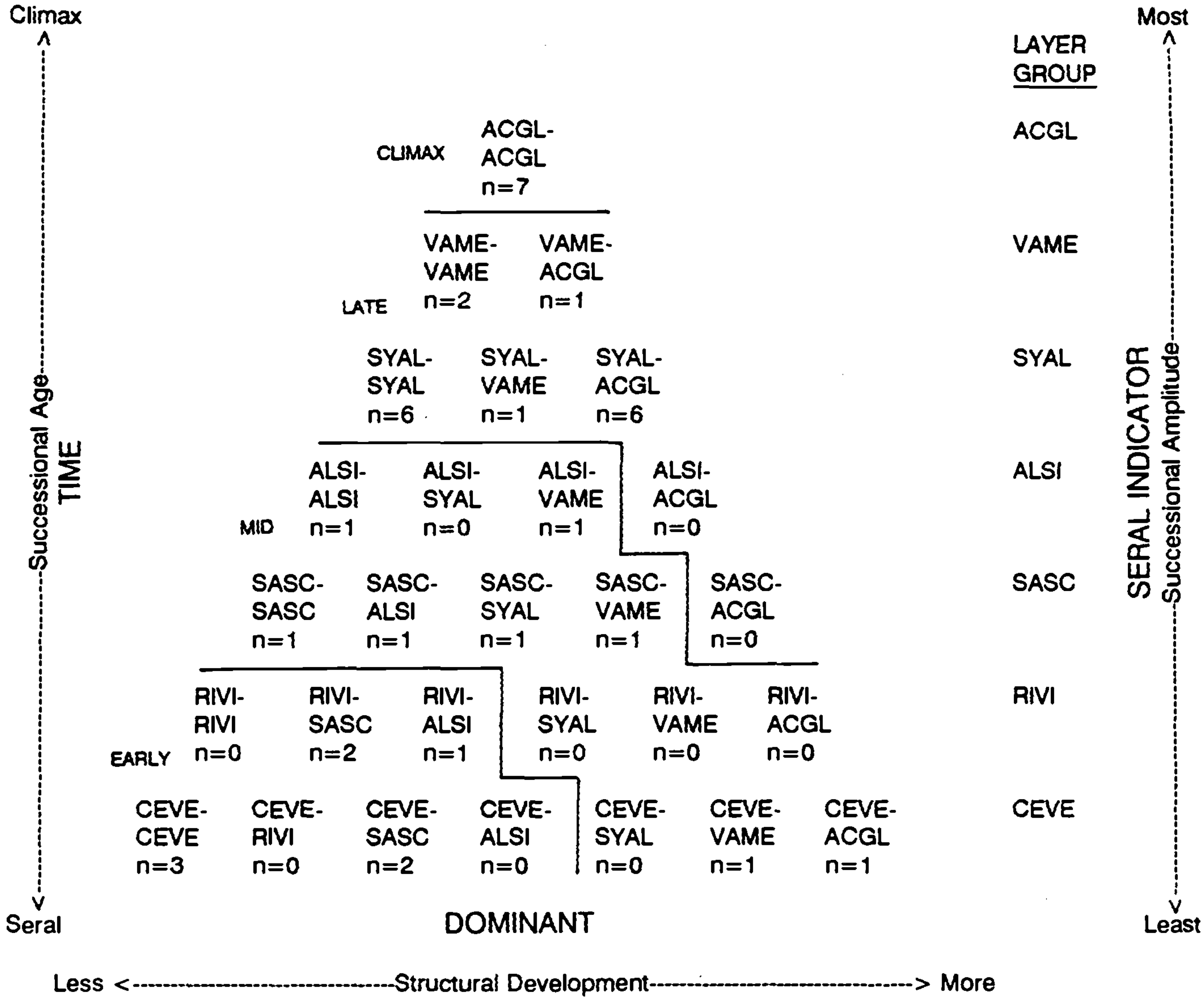


Figure 6. Succession classification diagram of the shrub layer in the ABGR/ACGL p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), redstem ceanothus (CESA), sticky currant (RIVI), swamp gooseberry (RILA), Scouler willow (SASC), Sitka alder (ALSI), common snowberry (SYAL), birchleaf spirea (SPBE), big huckleberry (VAME), thimbleberry (RUPA), mallow ninebark (PHMA), and Rocky mountain maple (ACGL). The classification diagram (Fig. 6) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, ACGL, appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while Rocky mountain maple can be found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/ACGL plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following light intensity fires. The CEVE layer group has seven layer types defined: CEVE-CEVE LT, CEVE-RIVI LT, CEVE-SASC LT, CEVE-ALSI LT, CEVE-SYAL LT, CEVE-VAME LT, and CEVE-ACGL. Redstem ceanothus (CESA) is not as common as snowbrush ceanothus in the ABGR/ACGL plant association, but where it occurs it should be included in the CEVE LG.

The RIVI LG includes the shrub species swamp gooseberry (RILA). These species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. The layer types defined are: RIVI-RIVI LT, RIVI-SASC LT, RIVI-ALSI LT, RIVI-SYAL LT, RIVI-VAME LT, and RIVI-ACGL LT.

Scouler willow is a mid-seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has five defined layer types: SASC-SASC LT, SASC-ALSI LT, SASC-SYAL LT, SASC-VAME LT, and SASC-ACGL LT.

Sitka alder is a mid-seral shrub that dominated some disturbed sites in the ABGR/ACGL plant association. It has light, windblown seed that is dispersed from scattered seeps and stream banks. It establishes on moist mineral soil exposed by fire or logging. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of Sitka alder as increased light levels encourage vigor in the multi-stemmed shrub. Four layer types represent community development towards the climax state: ALSI-ALSI LT, ALSI-SYAL LT, ALSI-VAME LT, and ALSI-ACGL LT.

Common snowberry and spirea are late-seral shrub species of this plant association and form the SYAL LG. SPBE is a low shrub reproducing vegetatively by rhizomes in post-disturbance communities. Seedlings were rarely found. It is moderately shade-tolerant and persists under overstory canopies. Common snowberry is a medium shrub that sprouts readily from rhizomes or rootcrowns following fire. Birds and small mammals disperse seed and aid SYAL regeneration (small groups of seedlings had the appearance of rodent caches). These shrubs withstand soil scarification and ripping; recovery may be rapid. The SYAL LG has three layer types: the SYAL-SYAL LT, SYAL-VAME LT, and SYAL-ACGL LT.

The mid-shrubs, VAME and RUPA, are rhizomatous and shade-tolerant; these species persist in climax forests of the ABGR/ACGL plant association. Big huckleberry revegetates sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of big huckleberry are susceptible to moderate and high intensity fires. The shrub species is sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. Thimbleberry regenerates quickly from rhizomes or stored seed in the soil and duff layers following fire or logging disturbance. Two layer types are defined in this layer group: VAME-VAME LT and VAME-ACGL LT.

The ACGL LG includes mallow ninebark (PHMA) in addition to Rocky Mountain maple (ACGL). These tall shrub species are shade-tolerant members of the climax shrub layer in the ABGR/ACGL plant association. ACGL is non-rhizomatous but sprouts vigorously from a rootcrown following fire or scarification. Maple seedlings establish infrequently in mature stands. Mallow ninebark is a rhizomatous shrub that responds quickly by virorous sprouting in post-disturbance stands. PHMA is a component of the ABGR/ACGL in the eastern portion of the range of this plant association only.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state of stand initiation and stochastic factors. Differential responses of snowbrush ceanothus, sticky currant, and big huckleberry are related to many of these factors. For example, a low intensity spring burn of a recently logged site may result in no change in big huckleberry, a large increase in sticky currant, and no ceanothus germinants. Yet the same fire in the fall, with a moderate intensity burn, may result in a decline in big huckleberry, a small increase in sticky currant, and abundant ceanothus germinants. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. The former case could result in the identification of the RIVI-VAME LT while the latter case could be the CEVE-CEVE LT.

Management Implications

The potential shrub layer types in the ABGR/ACGL plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus and Sitka alder also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Sticky currant and swamp gooseberry provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants and gooseberries also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds, nesting sites for birds, and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings, may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes 1992).

Sitka alder provides food for grouse and other non-game birds but is not a preferred browse by deer or elk. Shrubfields can provide hiding and thermal cover for these big game species, however.

Common snowberry provides food for grouse and other non-game birds but is not preferred browse by deer and elk. Spirea provides browse for ungulates but is not a preferred species of big game either.

Big huckleberry and thimbleberry provide fruit used by bear, grouse, non-game birds, and small mammals. In addition, VAME provides browse for wild ungulates and domestic livestock. The recreational use of big huckleberry shrubfields for berry-picking attracts forest visitors in late summer.

Rocky Mountain maple provides food for small mammals, browse for ungulates, cover for big game, and nesting and feeding habitat for birds. Mallow ninebark provides cover for wildlife and browse for ungulates but is not a preferred species of deer and elk.

SASC dominates shrub layer with PTAQ abundant in understory of plantation (Ruckel Ridge, Walla Walla RD, Umatilla NF)

Table 10. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/ACGL p.a.

1. CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a. CIVU dominant[3]	CIVU-CIVU LT
1b. AGUR[4] dominant or codominant	CIVU-AGUR LT
1c. ASCA7[5] dominant or codominant	CIVU-ASCA7 LT
1d. PTAQ dominant or codominant	CIVU-PTAQ LT
1e. FRVE[6] dominant or codominant	CIVU-FRVE LT
1f. ARCO[7] dominant or codominant	CIVU-ARCO LT
1g. VIOR2[8] dominant or codominant	CIVU-VIOR2 LT
1. CIVU < 5% canopy coverage	2
2. AGUR ≥ 5% canopy coverage	AGUR LG
2a. AGUR dominant	AGUR-AGUR LT
2b. ASCA7 dominant or codominant	AGUR-ASCA7 LT
2c. PTAQ dominant or codominant	AGUR-PTAQ LT
2d. FRVE dominant or codominant	AGUR-FRVE LT
2e. ARCO dominant or codominant	AGUR-ARCO LT
2f. VIOR2 dominant or codominant	AGUR-VIOR2 LT
2. AGUR < 5% canopy coverage	3
3. ASCA7 ≥ 5% canopy coverage	ASCA7 LG
3a. ASCA7 dominant	ASCA7-ASCA7 LT
3b. PTAQ dominant or codominant	ASCA7-PTAQ LT
3c. FRVE dominant or codominant	ASCA7-FRVE LT
3d. ARCO dominant or codominant	ASCA7-ARCO LT
3e. VIOR2 dominant or codominant	ASCA7-VIOR2 LT
3. ASCA7 < 5% canopy coverage	4
4. PTAQ ≥ 5% canopy coverage	PTAQ LG
4a. PTAQ dominant	PTAQ-PTAQ LT
4b. FRVE dominant or codominant	PTAQ-FRVE LT
4c. ARCO dominant or codominant	PTAQ-ARCO LT
4d. VIOR2 dominant or codominant	PTAQ-VIOR2 LT
4. PTAQ < 5% canopy coverage	5
5. FRVE ≥ 5% canopy coverage	FRVE LG
5a. FRVE dominant	FRVE-FRVE LT
5b. ARCO dominant or codominant	FRVE-ARCO LT
5c. VIOR2 dominant or codominant	FRVE-VIOR2 LT
5. FRVE < 5% canopy coverage	6
6. ARCO ≥ 5% canopy coverage	ARCO LG
6a. ARCO dominant	ARCO-ARCO LT
6b. VIOR2 dominant or codominant	ARCO-VIOR2 LT
6. ARCO < 5% canopy coverage	7
7. VIOR2 ≥ 5% canopy coverage	VIOR2 LG
7a. VIOR2 dominant	VIOR2-VIOR2 LT
7. VIOR2 < 5% canopy coverage	depauperate or undefined layer or not ABGR/ACGL p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU, ANMA, and VETH.
[3] Dominant refers to species with greatest canopy coverage: codominant refers to species with canopy coverages equal or nearly so.
[4] AGUR refers to the following group of species: AGUR and URDI.
[5] ASCA7 refers to the following group of species: ASCA7, THMO, and LUPIN.
[6] FRVE refers to the following group of species: FRVE and FRVI.
[7] ARCO refers to the following group of species: ARCO, CARU, CAGE, and ASCO.
[8] VIOR2 refers to the following group of species: VIOR2, MIST2, BRVU, DITR, CLUN, LANEC, and THOC.

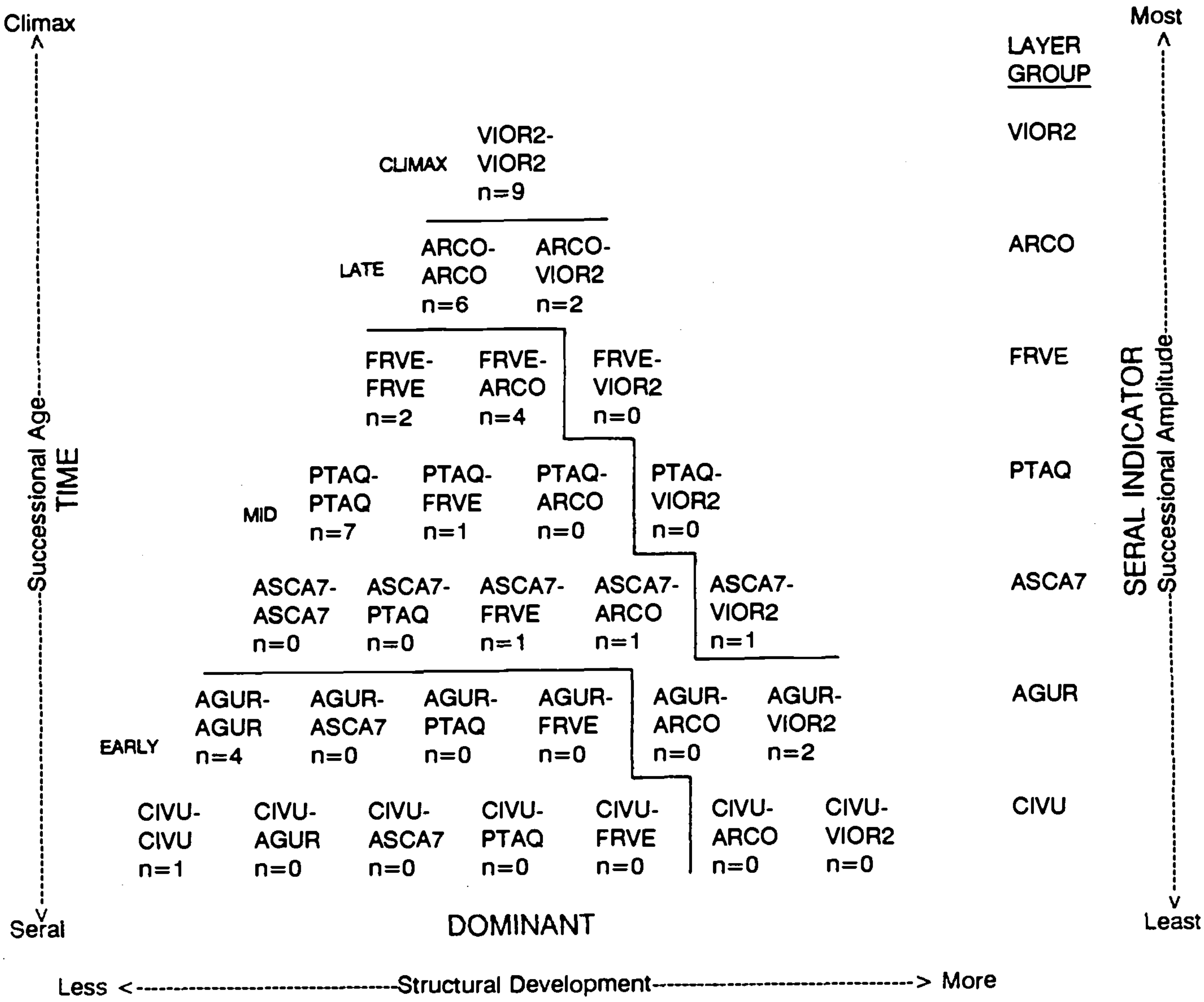


Figure 7. Succession classification diagram of the herb layer in the ABGR/ACGL p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pearly-everlasting (ANMA), flannel mullein (VETH), nettleleaf horsemint (AGUR), stinging nettle (URDI), Canada milkvetch (ASCA7), lupine (LUPIN), golden-pea (THMO), braken-fern (PTAQ), woods strawberry (FRVE), broadpetal strawberry (FRVI), heartleaf arnica (ARCO), pinegrass (CARU), elk sedge (CAGE), showy aster (ASCO), western meadowrue (THOC), mitella (MIST2), round-leaved violet (VIOR2), Columbia brome (BRVU), queen's cup beadlily (CLUN), fairybells (DITR), and Sierran peavine (LANEC). The classification diagram (Fig. 7) depicts the herb layer groups and herb layer types. CIVU, ANMA, and VETH are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. VIOR2, a climax herbaceous species, appears at the top of the figure.

Bull thistle and flannel mullein are tap-rooted, alien biennials that establish on recently disturbed sites of this plant association. Pearly-everlasting is a native perennial. CIVU and ANMA are composites with windblown seed; VETH is a tall plant dispersed via dihescent capsules. VETH can be locally abundant in a disturbed patch but seldom has the coverage of the wind-dispersed CIVU or ANMA. The CIVU LG includes these species and has seven layer types defined: the CIVU-CIVU LT, CIVU-AGUR LT, CIVU-ASCA7 LT, CIVU-PTAQ LT, CIVU-FRVE LT, CIVU-ARCO LT, and CIVU-VIOR2 LT.

Nettleleaf horsemint and stinging nettle, early successional species in this plant association, are rhizomatous forbs that increase in post-disturbance communities. Fire and scarification create conditions favorable to establishment of these shade-intolerant species. The increase in abundance can be a result of off-site colonization (from seed), germination of seed stored in the soil, or rapid vegetative reproduction from on-site rhizomes. The factors directly responsible are not known at this time. Six layer types are described: AGUR-AGUR LT, AGUR-ASCA7 LT, AGUR-PTAQ LT, AGUR-FRVE LT, AGUR-ARCO LT, and AGUR-VIOR2 LT.

The ASCA7 layer group has three mid-seral species: Canada milkvetch, golden-pea, and lupine. ASCA7 was the most constant and abundant member of this group; the remaining members were occasionally abundant. These rhizomatous species increase in post-disturbance communities of the AGBR/ACGL plant association. The legumes are nitrogen-fixers. Five layer types are defined for the ASCA7 layer group: ASCA7-ASCA7 LT, ASCA7-PTAQ LT, ASCA7-FRVE LT, ASCA7-ARCO LT, and ASCA7-VIOR2 LT.

Braken-fern, PTAQ, is a mid-seral, perennial herb that reproduces vegetatively by rhizomes or through wind-dispersed spores. It is moderately shade-tolerant and can persist beneath partial tree canopies and in stand openings and edges. Four layer types are defined: PTAQ-PTAQ LT, PTAQ-FRVE LT, PTAQ-ARCO LT, and PTAQ-VIOR2 LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-ARCO LT, and FRVE-VIOR2 LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. ARCO, a member of the sunflower family, produces achenes dispersed by wind. In addition, it reproduces by rhizomes. Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/ACGL plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. Pinegrass is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from rhizomes. Showy aster is a rhizomatous forb that occasionally dominates late seral understories. Layer types are: ARCO-ARCO LT and ARCO-VIOR2 LT.

Western meadowrue, mitella, round-leaved violet, Columbia brome, queen's cup beadlily (CLUN), Sierran peavine (LANEC), and fairybells (DITR) compose a group of shade-tolerant, perennial herbs of climax stands used to define the VIOR2 LG. All occasionally dominate the herbaceous layer although VIOR2 is the most constant and abundant member of the layer group. Queen's cup beadlily regenerates readily from rhizomes following light disturbances, but is slow to recover following ground scarification or high intensity burns that impact the shallow rhizomes. VIOR2 regenerates from rhizomes and seed stored in the soil and litter layers. BRVU is a non-rhizomatous grass that infrequently dominates the understory. The sole layer type of the VIOR2 LG is the VIOR2-VIOR2 LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. The ARCO-ARCO LT following a light intensity fire would recycle to an ARCO-ARCO LT because of this species ability to regenerate quickly from rhizomes and to flower and set seed. Both of these regeneration strategies allow ARCO to quickly increase in abundance following such disturbances.

Management Implications

The species of the herb layer within the ABGR/ACGL plant association react differentially to disturbance events and impact management of the forest ecosystems. One such impact is through allelopathy, the effect a plant has on another by producing inhibitory or stimulatory biochemical compounds. Braken-fern has demonstrated inhibitory characteristics on other vegetation through the production of volatile or water-soluble compounds. The sources of these compounds lie in the senescent leaf litter of PTAQ (Ferguson and Boyd 1988). Conifer regeneration may be delayed in layer types where this species dominates the understory.

In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU; however, this species was successfully established an litter in this moist plant association. Apparently, conditions are moist enough in the ABGR/ACGL p.a. that CIVU seedlings can reach stable soil moisture before desiccation leads to mortality. Lupine, golden-pea, and milkvetch are favored by burning and are beneficial as nitrogen-fixers. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. The FRVE-FRVE LT was found in 20 to 25 year old harvest units that had been burned. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries.

TABLE 11. Mean canopy coverage and constancy of tree species by layer type in the ABGR/ACGL p.a.

TREE LAYER GROUP	LAOC								PIPO											
TREE LAYER TYPE	LAOC-PIPO				LAOC-PSME				PIPO-PIPO				PIPO-PSME				PIPO-ABGR			
NUMBER OF STANDS	1				1				11				3				2			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR				15/100				3/100	4/9	2/9	1/81	1/81		6/33	2/100	8/100	4/50	1/50	2/100	7/100
ABLA2																				
LAOC				5/100		5/100			1/9		1/27	1/27	3/33							
PIEN											1/36	1/36								1/50
PICO						1/100														
PIMO																				
PIPO			35/100	15/100					13/18	3/18	39/90	2/90	9/100		1/33		5/50	1/50	5/50	1/50
POTR																				
PSME				8/100		20/100	25/100	5/100	7/18	3/18	1/45	1/45	14/100	6/100	4/66	1/66	2/50	2/50		
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	PSME								PIEN				ABGR			
TREE LAYER TYPE	PSME-PSME				PSME-ABGR				PIEN-ABGR				ABGR-ABGR			
NUMBER OF STANDS	3				3				1				12			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR			3/66	1/33	17/100	4/100		3/100	40/100	5/100	4/100	2/100	16/91	1/91	1/100	2/100
ABLA2																
LAOC																1/16
PIEN				1/33					3/100	2/100						1/8
PICO			1/33													
PIMO																
PIPO					2/66	1/66									1/25	1/25
POTR																
PSME	15/100	3/100	12/100	4/100	3/100	6/100		1/33	1/100		1/100			3/8		1/50
BASAL AREA (FT²/AC)																

TABLE 12. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/ACGL p.a.

SHRUB LAYER GROUP	CEVE				RIVI		SASC		
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-SASC	CEVE-VAME	CEVE-ACGL	RIVI-SASC	RIVI-ALSI	SASC-SASC	SASC-ALSI	SASC-SYAL
NUMBER OF STANDS	3	2	1	1	2	1	1	1	1
Species									
ACGL	2/66		2/100	26/100	4/100	20/100	12/100	1/100	2/100
ALSI						60/100		37/100	
AMAL	2/66	5/50	3/100	1/100	1/50		2/100		3/100
ARNE									
ARUV									
BENE									
CESA		15/50							
CEVE	72/100	5/50	30/100	10/100	3/50		1/100		
CELE									
CHUM	1/33	1/50		1/100				1/100	
HODI	2/100	3/100		1/100	1/50	3/100		1/100	
LIBO2			3/100		5/50				
LOUT2	2/66	2/50	3/100	4/100	1/50		4/100	2/100	
PAMY	33/66		25/100	20/100	10/50	3/100			
PHMA		1/50							2/100
RICE									
RILA	1/66	1/50	1/100		6/100	15/100		2/100	
RIVI	4/100	2/100	1/100	2/100	3/50	10/100	1/100	1/100	
ROGY	2/66	4/100	1/100	5/100	1/50				1/100
RUPA	2/100	2/50	40/100	1/100	3/100	25/100		4/100	
SASC	9/66	43/100	20/100	10/100	18/100	5/100	20/100	33/100	7/100
SHCA									
SPBE	4/66	3/50		23/100			2/100		6/100
SYAL	2/33	5/100	2/100	2/100	5/100	15/100	2/100		75/100
SYOR					4/50				
TABR									
VACA									
VAME	5/100	2/50	2/100	20/100	20/50			3/100	
VAMY									
VASC									

TABLE 12 (cont.). **Mean canopy coverage and constancy of shrub species by layer type in the ABGR/ACGL p.a.**

SHRUB LAYER GROUP	SASC	ALSI		SYAL			VAME		ACGL
SHRUB LAYER TYPE	SASC-VAME	ALSI-ALSI	ALSI-VAME	SYAL-SYAL	SYAL-VAME	SYAL-ACGL	VAME-VAME	VAME-ACGL	ACGL-ACGL
NUMBER OF STANDS	1	1	1	6	1	6	2	1	7
Species									
ACGL	1/100	1/100	1/100	7/83	8/100	7/66	6/100	3/100	24/71
ALSI		85/100	10/100						
AMAL	1/100		2/100	6/83	3/100	2/66	3/50		1/57
ARNE									1/14
ARUV									
BENE			1/100				1/50		
CESA									
CEVE	1/100		1/100	1/16					
CELE									
CHUM	1/100			6/33		1/16	1/100		1/14
HODI	2/100		2/100			10/16			
LIBO2							2/100		
LOUT2	1/100		4/100	3/16	4/100		4/100	1/100	1/14
PAMY			3/100				2/50		
PHMA				5/16		47/100		30/100	40/28
RICE									
RILA				1/16	1/100	2/16			1/28
RIVI	1/100			1/33	2/100	1/16	1/50		2/28
ROGY	3/100		2/100	2/83	2/100	2/50	3/100	1/100	2/28
RUPA	2/100		4/100		1/100	2/33	3/100		1/14
SASC	12/100		1/100	2/16					1/28
SHCA									
SPBE			3/100	5/50	1/100	4/100		1/100	1/42
SYAL	3/100		5/100	20/83	10/100	6/100	4/50		2/57
SYOR				3/33					2/28
TABR							1/100		
VACA									
VAME	10/100		8/100	1/50	27/100		15/100	15/100	
VAMY									
VASC									

TABLE 13. Mean canopy coverage and constancy of herb species by layer type in the ABGR/ACGL p.a.

HERB LAYER GROUP	CIVU	AGUR		ASCA7			PTAQ		FRVE
HERB LAYER TYPE	CIVU-CIVU	AGUR-AGUR	AGUR-VIOR2	ASCA7-FRVE	ASCA7-ARCO	ASCA7-VIOR2	PTAQ-PTAQ	PTAQ-FRVE	FRVE-FRVE
NUMBER OF STANDS	1	4	2	1	1	1	7	1	2
Species									
ACMI	1/100	2/100		1/100	1/100		2/57	1/100	1/100
ADBI	1/100			1/100	1/100		1/42	2/100	2/50
AGUR		15/100			1/100		1/14		
ANMA	1/100						1/28		
ANTEN									
APAN	1/100	2/50						1/100	
ARCO	3/100	1/50		20/100	65/100	1/100	2/57		1/100
ASCO		1/100					1/42	1/100	
ASCA7		1/50				5/100	1/14	1/100	
BRVU		1/25	3/50			3/100	1/71		1/50
CARU	2/100	2/50			5/100		2/42	2/100	3/100
CACO									
CAGE	3/100			1/100	1/100	1/100	2/57		2/50
CARO		2/25					2/57	2/100	2/100
CIVU	3/100						1/42	1/100	1/50
CLUN							2/57		
ELGL	3/100	3/75					2/42	3/100	2/50
FEOC					1/100		1/57		1/100
FRVE	1/100	3/25		40/100	1/100		3/100	9/100	10/100
FRVI									
GOOB									
HIAL	1/100	1/25				1/100	1/42		1/50
LANEC									
LUPIN					1/100				
MIST2		1/25	10/50			1/100	2/42		
MONTI									
PONE									
PTAQ		1/50	10/50	3/100			30/100	8/100	2/50
PYAS							1/28		
PYSE							2/28		1/50
RUOC		1/50	1/50	2/100					
SMST		1/50	3/50			2/100	2/57	1/100	1/50
THOC		6/100	3/50		1/100	4/100	1/71	1/100	1/100
THMO				20/100			2/28		
URDI	1/100	2/50	10/100				1/28		
VETH	1/100			1/100			1/14	1/100	
VIOR2			60/50	5/100			1/42		

TABLE 13 (cont.). **Mean canopy coverage and constancy of herb species by layer type in the ABGR/ACGL p.a.**

HERB LAYER GROUP	FRVE	ARCO		VIOR2
HERB LAYER TYPE	FRVE-ARCO	ARCO-ARCO	ARCO-VIOR2	VIOR2-VIOR2
NUMBER OF STANDS	4	6	2	9
Species				
ACMI	1/75	1/16		1/33
ADBI	1/25	2/50		2/88
AGUR				1/11
ANMA				1/11
ANTEN				
APAN	2/50			1/11
ARCO	14/50	3/50	11/100	1/55
ASCO	6/50	2/83	3/50	2/44
ASCA7	1/25	1/33	1/50	2/44
BRVU		1/50		3/66
CARU	16/100	7/66	1/50	1/11
CACO				
CAGE	1/25	9/83	5/50	1/11
CARO	1/25	1/16		1/44
CIVU	1/25			1/11
CLUN		1/16		6/66
ELGL	3/50	2/16		1/33
FEOC	1/25	1/50	1/50	2/33
FRVE	7/75	2/100	1/50	3/66
FRVI	5/25			
GOOB		1/83	1/50	3/44
HIAL	1/50	1/16		1/66
LANEC			40/50	
LUPIN	1/25			
MIST2		2/83	3/100	4/77
MONTI				
PONE				
PTAQ	1/25	1/16		1/44
PYAS		1/16		2/11
PYSE		1/33		2/55
RUOC				1/11
SMST		1/33		1/55
THOC	3/25	2/83	2/100	2/100
THMO				
URDI				1/22
VETH		1/16		1/22
VIOR2		1/33		1/44

Grand fir/queen's cup beadlily plant association

Abies grandis/Clintonia uniflora

ABGR/CLUN (CWF4 21)

ABGR/CLUN plant association with ARCO-ARCO LT in the herb layer (Birch Creek drainage, Long Creek RD, Malheur NF)

The ABGR/CLUN plant association was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Johnson and Clausnitzer 1992, Johnson and Simon 1987).

This plant association represents a forb-rich type indicative of the mesic portion of the grand fir series. ABGR/CLUN is found at mid and upper elevations (2,600 to 6,000 feet) in the area. The lowest occurrences are in the northern Blue Mountains on lower slope positions in moist, sheltered drainages. The highest occurrences are represented by upper elevation sites on favorable, northerly aspects or in moist drainage headlands of the Blue and Wallowa Mountains.

In climax and late successional stands, queen's cup beadlily (CLUN) dominates an asemblage of mesic-site herbs mixed with a low shrub and mid-shrub layer under a multi-storied canopy of grand fir (ABGR), Engelmann spruce (PIEN), and Douglas-fir (PSME). Twinflower (LIBO2) or big huckleberry (VAME) are often abundant; prince's pine (CHUM), baldhip rose (ROGY), Oregon boxwood (PAMY), and Utah honeysuckle (LOUT2) are also prominent members of the shrub layer. In addition to CLUN, the herb layer contains Columbia brome (BRVU), sidebells pyrola (PYSE), rattlesnake plantain (GOOB), mitella (MIST2), round-leaved violet (VIOR2), meadowrue (THOC), fairy bells (DITR), starry false Solomon's seal (SMST), bedstraw (GATR), sweet cicely (OSCH), foamflower (TITRU), heartleaf arnica (ARCO), trail plant (ADBI), and woods strawberry (FRVE).

Table 14. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/CLUN plant association.

1. PICO $\geq$ 5% canopy coverage[2]	PICO LG
1a. PICO dominant[3]	PICO-PICO LT
1b. LAOC dominant or codominant	PICO-LAOC LT
1c. PIPO dominant or codominant	PICO-PIPO LT
1d. PSME dominant or codominant	PICO-PSME LT
1e. PIEN dominant or codominant	PICO-PIEN LT
1f. ABGR dominant or codominant	PICO-ABGR LT
1. PICO < 5% canopy coverage	2
2. LAOC $\geq$ 5% canopy coverage	LAOC LG
2a. LAOC dominant	LAOC-LAOC LT
2b. PIPO dominant or codominant	LAOC-PIPO LT
2c. PSME dominant or codominant	LAOC-PSME LT
2d. PIEN dominant or codominant	LAOC-PIEN LT
2e. ABGR dominant or codominant	LAOC-ABGR LT
2. LAOC < 5% canopy coverage	3
3. PIPO $\geq$ 5% canopy coverage	PIPO LG
3a. PIPO dominant	PIPO-PIPO LT
3b. PSME dominant or codominant	PIPO-PSME LT
3c. PIEN dominant or codominant	PIPO-PIEN LT
3d. ABGR dominant or codominant	PIPO-ABGR LT
3. PIPO < 5% canopy coverage	4
4. PSME $\geq$ 5% canopy coverage	PSME LG
4a. PSME dominant	PSME-PSME LT
4b. PIEN dominant or codominant	PSME-PIEN LT
4c. ABGR dominant or codominant	PSME-ABGR LT
4. PSME < 5% canopy coverage	5
5. PIEN $\geq$ 5% canopy coverage	PIEN LG
5a. PIEN dominant	PIEN-PIEN LT
5b. ABGR dominant or codominant	PIEN-ABGR LT
5. PIEN < 5% canopy coverage	6
6. ABGR $\geq$ 5% canopy coverage	ABGR LG
6a. ABGR dominant	ABGR-ABGR LT
6. ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.

[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.

[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

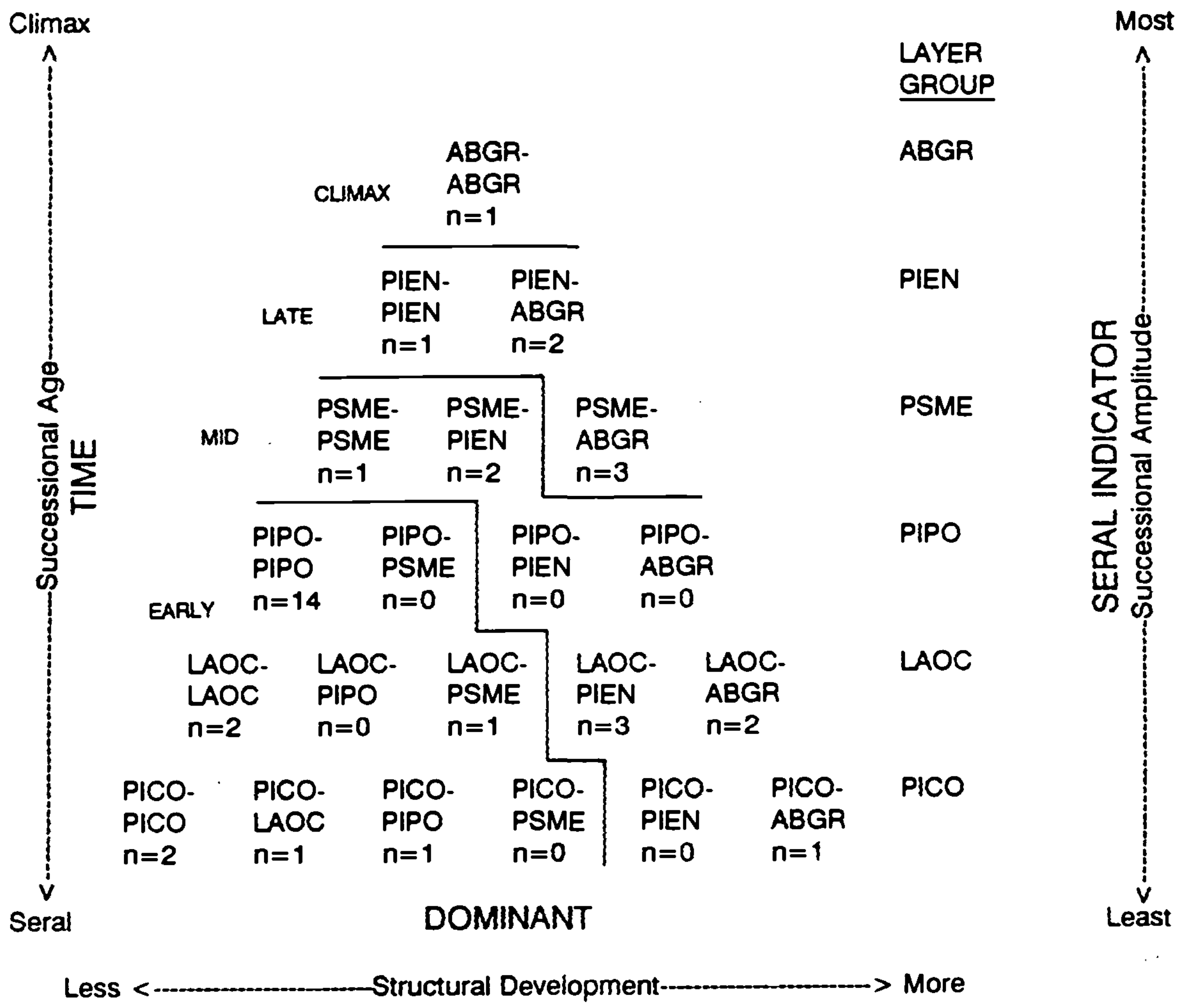


Figure 8. Succession classification diagram of the tree layer in the ABGR/CLUN plant association.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 8) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of wildfires and may also be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates the PIPO LG, at 5% canopy coverage or greater. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified using the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association. Its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/CLUN plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the five seral tree species (PICO, LAOC, PIPO, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/CLUN plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/CLUN plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/CLUN plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 8) depicts the distribution of major tree species in the ABGR/CLUN plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 15. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/CLUN p.a.

1.	CEVE ≥ 5% canopy coverage	CEVE LG
1a.	CEVE dominant[2]	CEVE-CEVE LT
1b.	RIVI[3] dominant or codominant	CEVE-RIVI LT
1c.	SASC dominant or codominant	CEVE-SASC LT
1d.	ALSI dominant or codominant	CEVE-ALSI LT
1e.	VAME[4] dominant or codominant	CEVE-VAME LT
1f.	LIBO2 dominant or codominant	CEVE-LIBO2 LT
1.	CEVE < 5% canopy coverage	2
2.	RIVI ≥ 5% canopy coverage	RIVI LG
2a.	RIVI dominant	RIVI-RIVI LT
2b.	SASC dominant or codominant	RIVI-SASC LT
2c.	ALSI dominant or codominant	RIVI-ALSI LT
2d.	VAME dominant or codominant	RIVI-VAME LT
2e.	LIBO2 dominant or codominant	RIVI-LIBO2 LT
2.	RIVI < 5% canopy coverage	3
3.	SASC ≥ 5% canopy coverage	SASC LG
3a.	SASC dominant	SASC-SASC LT
3b.	ALSI dominant or codominant	SASC-ALSI LT
3c.	VAME dominant or codominant	SASC-VAME LT
3d.	LIBO2 dominant or codominant	SASC-LIBO2 LT
3.	SASC < 5% canopy coverage	4
4.	ALSI ≥ 5% canopy coverage	ALSI LG
4a.	ALSI dominant	ALSI-ALSI LT
4b.	VAME dominant or codominant	ALSI-VAME LT
4c.	LIBO2 dominant or codominant	ALSI-LIBO2 LT
4.	ALSI < 5% canopy coverage	5
5.	VAME ≥ 5% canopy coverage	VAME LG
5a.	VAME dominant	VAME-VAME LT
5b.	LIBO2 dominant or codominant	VAME-LIBO2 LT
5.	VAME < 5% canopy coverage	6
6.	LIBO2 ≥ 5% canopy coverage	LIBO2 LG
6a.	LIBO2 dominant	LIBO2-LIBO2 LT
6.	LIBO2 < 5% canopy coverage	depauperate or undefined layer or not ABGR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[3] RIVI refers to the following group of species: RIVI, RILA, and RICE.
[4] VAME refers to the following group of species: VAME, SYAL, and ROGY.

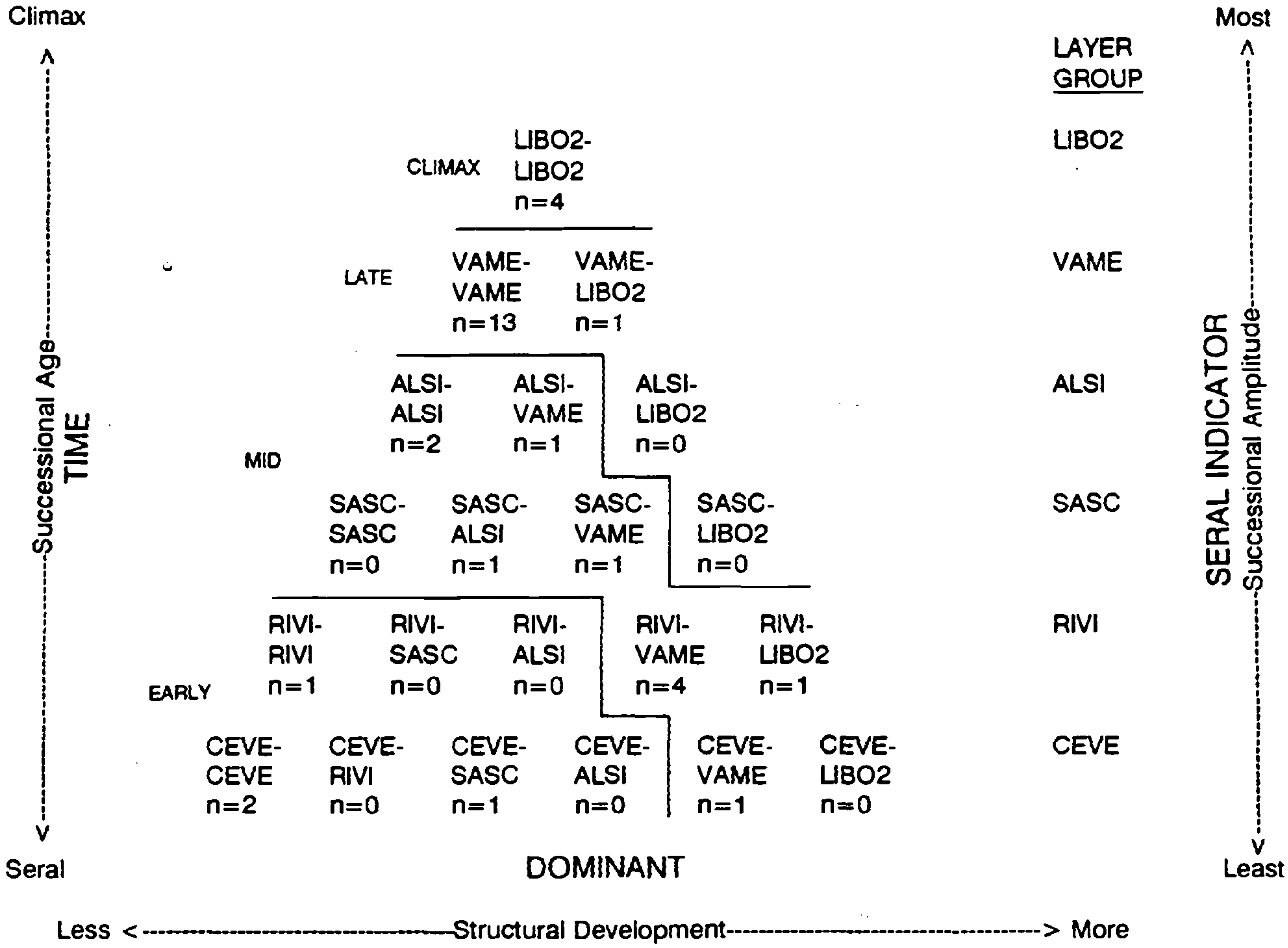


Figure 9. Succession classification diagram of the shrub layer in the ABGR/CLUN p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), sticky currant (RIVI), swamp gooseberry (RILA), squaw currant (RICE), Scouler willow (SASC), Sitka alder (ALSI), big huckleberry (VAME), common snowberry (SYAL), baldhip rose (ROGY), and twinflower (LIBO2). The classification diagram (Fig. 9) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, LIBO2, appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while twinflower is found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of the ABGR/CLUN plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has six layer types defined: CEVE-CEVE LT, CEVE-RIVI LT, CEVE-SASC LT, CEVE-ALSI LT, CEVE-VAME LT, and CEVE-LIBO2. Redstem ceanothus (CESA) is not common in the ABGR/CLUN plant association, but where it occurs it should be included in the CEVE LG.

The RIVI LG includes swamp gooseberry (RILA) and squaw currant (RICE) in addition to sticky currant (RIVI). These three species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. The layer types defined are: RIVI-RIVI LT, RIVI-SASC LT, RIVI-ALSI LT, RIVI-VAME LT, and RIVI-LIBO2 LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has four defined layer types: SASC-SASC LT, SASC-ALSI LT, SASC-VAME LT, and SASC-LIBO2 LT.

Sitka alder is a mid-seral shrub that dominated some disturbed sites in the ABGR/CLUN plant association. It has light, windblown seed that is dispersed from scattered seeps and stream banks. It establishes on moist mineral soil exposed by fire or logging. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of Sitka alder as increased light levels encourage vigor in the multi-stemmed shrub. Three layer types represent community development towards the climax state: ALSI-ALSI LT, ALSI-VAME LT, and ALSI-LIBO2 LT.

The VAME LG includes three late seral to climax species: big huckleberry (VAME), common snowberry (SYAL), and baldhip rose (ROGY). These mid-shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/CLUN plant association. Snowberry regenerates quickly from rhizomes or rodent-cached seed in the soil and duff layers following fire or logging disturbance. Big huckleberry revegetates sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of big huckleberry are susceptible to moderate and high intensity fires. The shrub species is sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. Two layer types are defined in this group: VAME-VAME LT and VAME-LIBO2 LT.

Twinflower revegetates from shallow rhizomes principally in the upper soil and duff layers. Fire or logging that remove or disturb these layers lead to the decline in twinflower cover. Plants in favorable microsites that escape the disturbance become centers of recolonization; this centrifugal expansion is a slow process. The LIBO2 LT represents climax conditions in the shrub layer of the ABGR/CLUN plant association.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. Differential responses of snowbrush ceanothus, sticky currant, big huckleberry, and twinflower are related to many of these factors. For example, a low intensity spring burn of a recently logged site may result in a decline in twinflower, no change in big huckleberry, a large increase in sticky currant, and no ceanothus germinants. Yet the same fire in the fall, with a moderate intensity burn, may result in the disappearance of twinflower, a decline in big huckleberry, a small increase in sticky currant, and abundant ceanothus germinants. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. The former case could result in the identification of the RIVI-RIVI LT while the latter case could be the CEVE-CEVE LT.

Management Implications

The potential shrub layer types in the ABGR/CLUN plant association include those which function as important habitat for wildlife species in addition to those which function as essential to the ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus and Sitka alder also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Sticky currant, swamp gooseberry, and squaw currant provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants and gooseberries also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes 1992).

Sitka alder provides food for grouse and other non-game birds but is not a preferred browse by deer or elk. Shrubfields can provide hiding and thermal cover for these big game species, however.

Big huckleberry, snowberry, and baldhip rose provide fruit used by bear, grouse, non-game birds, and small mammals. In addition, these shrubs provides browse for wild ungulates and domestic livestock. The recreational use of big huckleberry shrubfields for berry-picking attracts forest visitors in late summer.

Logging impacts to forested plant communities are related to the season of disturbance as well as the perturbating activity (machine scarification, broadcast burning, pile and burn, etc.). A truncated disturbance regime relative to a time factor is found in the Intermountain West as logging has not been a historical disturbance factor in the same timescale as fire. Nonetheless, the impacts of machine scarification differentially affect species establishment, survival, and growth. In grand fir plant associations, for example, huckleberry species are susceptible to this type of disturbance. More information is needed concerning community and species responses to these types of disturbance regimes.

Early seral stand of CEVE layer group in ABGR/CLUN p.a. (Walla Walla RD, Umatilla NF)

Table 16. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/CLUN p.a.

1. CIVU[2] ≥ 5% canopy coverage .... CIVU LG
    - 1a. CIVU dominant[3] .... CIVU-CIVU LT
    - 1b. CARO[4] dominant or codominant .... CIVU-CARO LT
    - 1c. RUOC dominant or codominant .... CIVU-RUOC LT
    - 1d. PTAQ dominant or codominant .... CIVU-PTAQ LT
    - 1e. FRVE[5] dominant or codominant .... CIVU-FRVE LT
    - 1f. ARCO[6] dominant or codominant .... CIVU-ARCO LT
    - 1g. VIOR2[7] dominant or codominant .... CIVU-VIOR2 LT
    - 1h. CLUN dominant or codominant .... CIVU-CLUN LT

1. CIVU < 5% canopy coverage 2

    2. CARO ≥ 5% canopy coverage .... CARO LG
        - 2a. CARO dominant .... CARO-CARO LT
        - 2b. RUOC dominant or codominant .... CARO-RUOC LT
        - 2c. PTAQ dominant or codominant .... CARO-PTAQ LT
        - 2d. FRVE dominant or codominant .... CARO-FRVE LT
        - 2e. ARCO dominant or codominant .... CARO-ARCO LT
        - 2f. VIOR2 dominant or codominant .... CARO-VIOR2 LT
        - 2g. CLUN dominant or codominant .... CARO-CLUN LT

    2. CARO < 5% canopy coverage 3

3. RUOC ≥ 5% canopy coverage .... RUOC LG
    - 3a. RUOC dominant .... RUOC-RUOC LT
    - 3b. PTAQ dominant or codominant .... RUOC-PTAQ LT
    - 3c. FRVE dominant or codominant .... RUOC-FRVE LT
    - 3d. ARCO dominant or codominant .... RUOC-ARCO LT
    - 3e. VIOR2 dominant or codominant .... RUOC-VIOR2 LT
    - 3f. CLUN dominant or codominant .... RUOC-CLUN LT

3. RUOC < 5% canopy coverage 4

    4. PTAQ ≥ 5% canopy coverage .... PTAQ LG
        - 4a. PTAQ dominant .... PTAQ-PTAQ LT
        - 4b. FRVE dominant or codominant .... PTAQ-FRVE LT
        - 4c. ARCO dominant or codominant .... PTAQ-ARCO LT
        - 4d. VIOR2 dominant or codominant .... PTAQ-VIOR2 LT
        - 4e. CLUN dominant or codominant .... PTAQ-CLUN LT

    4. PTAQ < 5% canopy coverage 5

5. FRVE ≥ 5% canopy coverage .... FRVE LG
    - 5a. FRVE dominant .... FRVE-FRVE LT
    - 5b. ARCO dominant or codominant .... FRVE-ARCO LT
    - 5c. VIOR2 dominant or codominant .... FRVE-VIOR2 LT
    - 5d. CLUN dominant or codominant .... FRVE-CLUN LT

5. FRVE < 5% canopy coverage 6

    6. ARCO ≥ 5% canopy coverage .... ARCO LG
        - 6a. ARCO dominant .... ARCO-ARCO LT
        - 6b. VIOR2 dominant or codominant .... ARCO-VIOR2 LT
        - 6c. CLUN dominant or codominant .... ARCO-CLUN LT

    6. ARCO < 5% canopy coverage 7

7. VIOR2 ≥ 5% canopy coverage .... VIOR2 LG
    - 7a. VIOR2 dominant .... VIOR2-VIOR2 LT
    - 7b. CLUN dominant or codominant .... VIOR2-CLUN LT

7. VIOR2 < 5% canopy coverage 8

    8. CLUN ≥ 5% canopy coverage .... CLUN LG
        - 8a. CLUN dominant .... CLUN-CLUN LT

    8. CLUN < 5% canopy coverage .... depauperate or undefined layer or not ABGR/CLUN p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIRSIUM SPP., ANMA, and VETH.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO, CACO, and FEOC.
[5] FRVE refers to the following group of species: FRVE, FRVI, and ACMI.
[6] ARCO refers to the following group of species: ARCO, ADBI, CARU, and CAGE.
[7] VIOR2 refers to the following group of species: VIOR2, THOC, PYSE, GOOB, and MIST2.

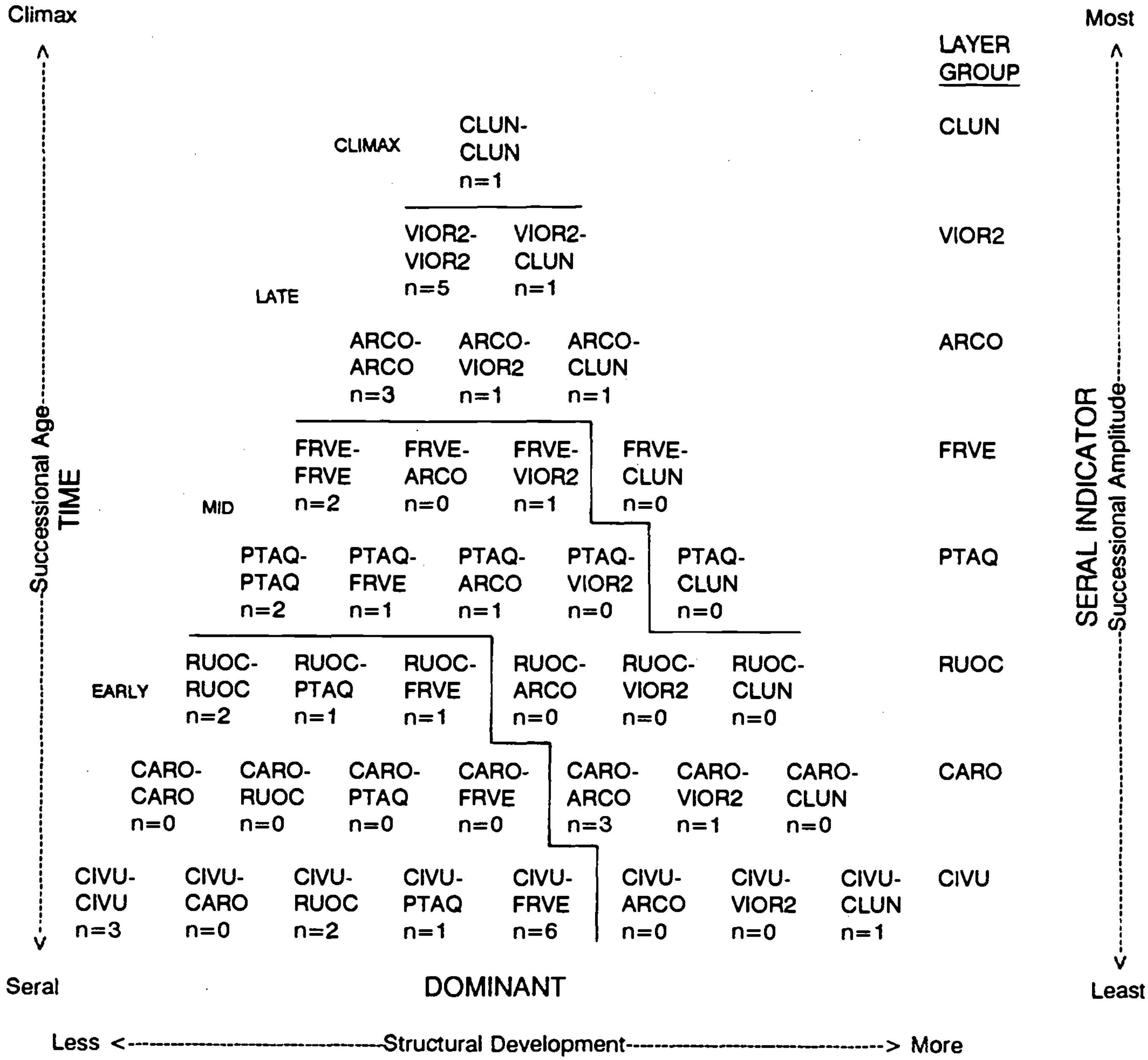


Figure 10. Succession classification diagram of the herb layer in the ABGR/CLUN p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), Canada thistle (CIAR), pearly-everlasting (ANMA), flannel mullein (VETH), Ross sedge (CARO), northwestern sedge (CACO), western fescue (FEOC), western coneflower (RUOC), braken-fern (PTAQ), woods strawberry (FRVE), broadpetal strawberry (FRVI), yarrow (ACMI), heartleaf arnica (ARCO), trail plant (ADBI), elk sedge (CAGE), pinegrass (CARU), western meadowrue (THOC), mitella (MIST2), round-leaved violet (VIOR2), sidebells pyrola (PYSE), rattlesnake plantain (GOOB), and queen's cup beadlily (CLUN). The classification diagram (Fig. 10) depicts the herb layer groups and herb layer types. CIVU, ANMA, and VETH are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. CLUN, a climax herbaceous species, appears at the top of the figure.

Bull thistle and flannel mullein are tap-rooted, alien biennials that establish on recently disturbed sites of this plant association. Pearly-everlasting is a native perennial. CIVU and ANMA are composites with windblown seed; VETH is a tall plant dispersed via dihescent capsules. VETH can be locally abundant in a disturbed patch but seldom has the coverage of the wind-dispersed CIVU or ANMA. CIAR is a rhizomatous perennial occasionally abundant on disturbed sites in the ABGR/CLUN plant association. The CIVU LG includes these species and has eight layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-RUOC LT, CIVU-PTAQ LT, CIVU-FRVE LT, CIVU-ARCO LT, CIVU-VIOR2 LT, and CIVU-CLUN LT.

The CARO LG includes the sedges CARO and CACO and the graminoid, FEOC. Ross sedge and northwestern sedge increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). Western fescue was abundant in some early successional stages but will decline in coverage over time. The CARO LG has seven layer types: the CARO-CARO LT, CARO-RUOC LT, CARO-PTAQ LT, CARO-FRVE LT, CARO-ARCO LT, CARO-VIOR2, and CARO-CLUN LT.

The western coneflower layer group has six layer types defined: RUOC-RUOC LT, RUOC-PTAQ LT, RUOC-FRVE LT, RUOC-ARCO LT, RUOC-VIOR2 LT, and RUOC-CLUN LT. RUOC is an early seral, perennial forb of the sunflower family. Unlike bull thistle, it has no mechanism for wind dispersal. Gravity, small mammals, and birds act as dispersal agents.

Braken-fern, PTAQ, is a mid-seral, perennial herb that reproduces vegetatively by rhizomes or through wind-dispersed spores. It is moderately shade-tolerant and can persist beneath partial tree canopies and in stand openings and edges. Five layer types are defined: PTAQ-PTAQ LT, PTAQ-FRVE LT, PTAQ-ARCO LT, PTAQ-VIOR2 LT, and PTAQ-CLUN LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has four layer types: FRVE-FRVE LT, FRVE-ARCO LT, FRVE-VIOR2 LT, and FRVE-CLUN LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. Trail plant (ADBI) is grouped with heartleaf arnica in the ARCO LG. Both ARCO and ADBI, members of the sunflower family, produce achenes dispersed by wind. ARCO, in addition, can reproduce by rhizomes. Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/CLUN plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. Pinegrass is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from rhizomes. Layer types are: ARCO-ARCO LT, ARCO-VIOR2 LT, and ARCO-CLUN LT.

Western meadowrue, mitella, round-leaved violet, sidebells pyrola, and rattlesnake plantain compose a group of shade-tolerant, perennial forbs of late seral and climax stands used to define the THOC LG. All occasionally dominate the herbaceous layer although VIOR2 is the most constant and abundant member of the layer group. Defined layer types are: VIOR2-VIOR2 LT and VIOR2-CLUN LT.

Queenscup beadlily is a shade-tolerant, perennial forb of the climax herb layer in the ABGR/CLUN plant association. It regenerates readily from rhizomes following light disturbances, but is slow to recover following ground scarification or high intensity burns that impact the shallow rhizomes. The layer type defined for the CLUN LG is the CLUN-CLUN LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The early seral species RUOC is favored by conditions created during mechanical scarification while PTAQ is favored by burning.

The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. The ARCO-ARCO LT following a light intensity fire would recycle to an ARCO-ARCO LT because of this species ability to regenerate quickly from rhizomes and to flower and set seed. Both of these regeneration strategies allow ARCO to quickly increase in abundance following such disturbances.

Management Implications

The species of the herb layer within the ABGR/CLUN plant association react differentially to disturbance events and impact management of the forest ecosystems. One such impact is through allelopathy, the effect a plant has on another by producing inhibitory or stimulatory biochemical compounds. Two species, braken-fern and western coneflower, have demonstrated inhibitory characteristics on other vegetation through the production of volatile or water-soluble compounds. The sources of these compounds lie in the senescent leaf litter of PTAQ and RUOC or the root caudex of RUOC (Ferguson and Boyd 1988 and Ferguson 1991). Conifer regeneration may be delayed in layer types where these two species dominate the understory.

In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU; however, this species was successfully established an litter in this moist plant association. Apparently, conditions are moist enough in the ABGR/CLUN p.a. that CIVU seedlings can reach stable soil moisture before desiccation leads to mortality. The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. The FRVE-FRVE LT was found in 20 to 25 year old harvest units that had been burned. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries.

TABLE 17. Mean canopy coverage and constancy of tree species by layer type in the ABGR/CLUN p.a.

TREE LAYER GROUP	PICO																LAOC			
TREE LAYER TYPE	PICO-PICO				PICO-LAOC				PICO-PIPO				PICO-ABGR				LAOC-LAOC			
NUMBER OF STANDS	2				1				1				1				2			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR		18/50				1/100		7/100				3/100	18/100		35/100	40/100	8/100	2/100		6/100
ABLA2																				
LAOC		1/50			15/100			2/100	3/100		1/100		5/100		3/100		20/50			13/100
PIEN		6/50										1/100					10/50	5/50		2/100
PICO	40/100	5/100				2/100		3/100	4/100		5/100	2/100	15/100	10/100						
PIMO																				
PIPO									20/100	8/100										
POTR																				
PSME		5/50			9/100			2/100								10/100				
BASAL AREA (FT^2/AC)																				

TREE LAYER GROUP	LAOC												PIPO			
TREE LAYER TYPE	LAOC-PSME				LAOC-PIEN				LAOC-ABGR				PIPO-PIPO			
NUMBER OF STANDS	1				3				2				14			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR							2/66	11/66	8/100	20/100	10/100	16/100			1/92	6/92
ABLA2								3/33								1/7
LAOC	25/100	15/100			17/100				5/100	3/100					1/35	1/35
PIEN				25/100	12/100	15/100	7/66	4/100	6/50	2/50	5/50		3/7		1/57	4/57
PICO				1/100											1/14	1/14
PIMO																2/7
PIPO															23/100	9/100
POTR																
PSME	30/100		15/100	1/100					17/100						2/50	2/50
BASAL AREA (FT^2/AC)																

TABLE 17 (cont.). Mean canopy coverage and constancy of tree species by layer type in the ABGR/CLUN p.a.

TREE LAYER GROUP	PSME												PIEN			
TREE LAYER TYPE	PSME-PSME				PSME-PIEN				PSME-ABGR				PIEN-PIEN			
NUMBER OF STANDS	1				2				3				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR				8/100			5/50	5/100	30/66	5/66	6/100	9/100	8/100	7/100	3/100	
ABLA2																
LAOC				3/100	1/50											
PIEN				5/100	13/100	8/100		1/50	6/33	1/33		1/33	30/100			
PICO									1/33			1/33				
PIMO																
PIPO																
POTR																
PSME				15/100	13/100		5/50	10/50	8/66		3/33	3/33				
BASAL AREA (FT^2/AC)																

TREE LAYER GROUP	PIEN				ABGR			
TREE LAYER TYPE	PIEN-ABGR				ABGR-ABGR			
NUMBER OF STANDS	2				1			
SIZE CLASSES	D	I	P	S	D	I	P	S
Species								
ABGR	30/50	5/50		12/100	15/100	15/100	15/100	4/100
ABLA2								
LAOC					3/100			
PIEN	6/50	14/50	2/100	4/100				
PICO				3/50				
PIMO								
PIPO								
POTR								
PSME								
BASAL AREA (FT^2/AC)								

TABLE 18. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/CLUN p.a.

SHRUB LAYER GROUP	CEVE			RIVI			SASC		ALSI
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-SASC	CEVE-VAME	RIVI-RIVI	RIVI-VAME	RIVI-LIBO2	SASC-ALSI	SASC-VAME	ALSI-ALSI
NUMBER OF STANDS	2	1	1	1	4	1	1	1	2
Species									
ACGL		2/100			3/25			1/100	
ALSI							60/100	2/100	28/100
AMAL	1/50				1/25	1/100			
ARNE									
ARUV									
BENE									
CESA									
CEVE	58/100	5/100	20/100		3/25			1/100	1/50
CELE									
CHUM		3/100			5/25		7/100		3/100
HODI			1/100		1/25			1/100	
LIBO2			20/100	25/100	1/25	70/100			7/100
LOUT2		5/100	1/100	1/100	4/50				
PAMY	13/100	3/100	5/100		2/75		7/100	1/100	1/100
PHMA									
RICE				8/100					
RILA			3/100	1/100	1/50	25/100		1/100	1/50
RIVI	11/100	5/100	10/100	25/100	6/100			1/100	2/50
ROGY					1/25	1/100			4/50
RUPA	2/50	10/100			1/75			1/100	1/50
SASC	8/50	35/100	3/100	1/100	3/100	1/100	7/100	8/100	2/50
SHCA									
SPBE		5/100				5/100			1/50
SYAL	2/100	5/100			2/25			5/100	1/50
SYOR									
TABR								1/100	
VACA									
VAME	5/50	15/100	55/100	10/100	29/100	20/100	20/100	20/100	23/100
VAMY									
VASC							3/100		1/50

TABLE 18 (cont.). Mean canopy coverage and constancy of shrub species by layer type in the ABGR/CLUN p.a.

SHRUB LAYER GROUP	ALSI	VAME		LIBO2
SHRUB LAYER TYPE	ALSI-VAME	VAME-VAME	VAME-LIBO2	LIBO2-LIBO2
NUMBER OF STANDS	1	13	1	4
Species				
ACGL				
ALSI	60/100	1/23		
AMAL		1/15	1/100	
ARNE		3/7		3/25
ARUV				
BENE		45/7		1/25
CESA				
CEVE		1/7		
CELE				
CHUM	8/100	8/38	10/100	2/75
HODI				
LIBO2	15/100	11/53	45/100	8/100
LOUT2		2/23	1/100	3/25
PAMY		3/69		2/100
PHMA				
RICE				
RILA		1/30		
RIVI		1/38		2/50
ROGY		4/53	5/100	1/25
RUPA		2/46		1/25
SASC		1/38		
SHCA		60/7		
SPBE		1/23	10/100	1/25
SYAL		3/38		
SYOR				
TABR				2/50
VACA				
VAME	70/100	37/100	30/100	1/100
VAMY		5/7		
VASC		5/7		5/25

TABLE 19. Mean canopy coverage and constancy of herb species by layer type in the ABGR/CLUN p.a.

HERB LAYER GROUP	CIVU					CARO		RUOC		
HERB LAYER TYPE	CIVU-CIVU	CIVU-RUOC	CIVU-PTAQ	CIVU-FRVE	CIVU-CLUN	CARO-ARCO	CARO-VIOR2	RUOC-RUOC	RUOC-PTAQ	RUOC-FRVE
NUMBER OF STANDS	3	2	1	6	1	3	1	2	1	1
Species										
ACMI	1/33			8/100		1/66		4/100	1/100	10/100
ADBI					1/100	3/33				
AGUR								2/50		
ANMA	3/33	4/100	15/100	5/100	3/100			2/100	1/100	
ANTEN										
APAN										
ARCO	1/33		5/100	5/50		25/66		2/50		
ASCO						1/66				
ASCA7	5/33	3/50	1/100	10/66				1/50		
BRVU	5/33	4/100	2/100	8/16	3/100		1/100	2/50		
CARU						20/100				
CACO	8/66			3/16		2/66	4/100			
CAGE		2/100		11/33		4/66		3/100		1/100
CARO		1/50	2/100	9/50	2/100	8/66				
CAMI2										
CIVU	26/100	1/100		3/66	7/100	1/100		1/50		
CLUN			1/100	3/33	12/100	2/66	2/100	2/50		1/100
ELGL		3/50		2/33				1/100		3/50
FEOC	1/33				1/100	5/66	1/100			1/100
FRVE	2/66	9/100	50/100	34/100	5/100	7/100		15/100	20/100	15/100
FRVI	1/66		8/100	5/16		1/33				
GOOB							1/100			
HIAL	1/100	1/50		2/66	2/100	2/100	1/100			
LUPIN	1/66					1/33				
MIST2				10/33		1/33				
MONTI										
PONE										
PTAQ		15/50	70/100	2/16		15/33			60/100	3/100
PYAS					1/100					
PYSE					2/100	2/100	1/100			
RUOC		23/100	10/100	2/66				45/100	35/100	20/100
SMST	1/33		1/100	1/33	1/100	1/33		1/100	1/100	1/100
THOC	2/33		15/100	2/66	1/100	25/33		2/100	3/100	2/100
THMO			2/100	3/16				19/100	3/100	
VETH	10/33	3/100		2/83				1/50		1/100
VIOR2	1/100	5/50	1/100	2/50	2/100	1/66	10/100	5/100	1/100	1/100

TABLE 19 (cont.). **Mean canopy coverage and constancy of herb species by layer type in the ABGR/CLUN p.a.**

HERB LAYER GROUP	PTAQ			FRVE		ARCO			VIOR2		CLUN
HERB LAYER TYPE	PTAQ-PTAQ	PTAQ-FRVE	PTAQ-ARCO	FRVE-FRVE	FRVE-VIOR2	ARCO-ARCO	ARCO-VIOR2	ARCO-CLUN	VIOR2-VIOR2	VIOR2-CLUN	CLUN-CLUN
NUMBER OF STANDS	2	1	1	2	1	3	1	1	5	1	1
Species											
ACMI		2/100		4/100							
ADBI	6/50		8/100			33/66	5/100		1/20	1/100	
AGUR											
ANMA				2/100							
ANTEN											
APAN											
ARCO	1/50	3/100	1/100	3/50		30/100		5/100	1/60		1/100
ASCO	2/50								1/20		
ASCA7				2/100		1/33	1/100	1/100			
BRVU	5/50					3/66	1/100	1/100	1/20	1/100	
CARU			1/100		5/100			1/100	1/40		
CACO	1/50		1/100			1/33			3/20		1/100
CAGE		3/100		1/50	1/100	2/33			3/20		2/100
CARO				2/50	1/100	2/66	1/100			1/100	1/100
CAMI2											
CIVU				1/100			1/100				1/100
CLUN	8/100	1/100	5/100	3/100	5/100	9/66	3/100	20/100	2/60	25/100	4/100
ELGL		5/100		3/50							
FEOC			1/100			2/33			1/20		1/100
FRVE	10/50	25/100	1/100	23/100	5/100	2/100	4/100		1/60	1/100	2/100
FRVI								4/100			
GOOB			1/100		1/100	3/33		1/100	2/60	1/100	1/100
HIAL	2/50		1/100	1/50	1/100	1/66	1/100	1/100	2/40		2/100
LUPIN						4/33					1/100
MIST2	1/50			1/50		2/66			3/20		
MONTI											
PONE											
PTAQ	53/100	25/100	5/100				3/100				
PYAS						1/33			3/60		
PYSE	1/50		1/100	2/50		2/66	2/100	1/100	3/100	5/100	1/100
RUOC		2/100		3/50							
SMST	1/50	1/100	1/100	6/100		2/33				1/100	2/100
THOC	3/50	1/100		2/50		4/100	3/100	15/100	3/20	5/100	
THMO		10/100									
VETH				1/50							
VIOR2	1/50	5/100		5/50	15/100	3/66	3/100	3/100	3/80	10/100	2/100

Grand fir/twinflower plant association

Abies grandis/Linnaea borealis

ABGR/LIBO2 (CWF3 11 and CWF3 12)

Two years after harvest and burn: early seral stand on ABGR/LIBO2 site with CIVU-CIVU LT in the herb layer (Billy Meadows, Wallowa Valley RD, Wallowa-Whitman NF)

This plant association, representing intermediate moisture and temperature conditions in the grand fir series, was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Hall 1973, Johnson and Clausnitzer 1992, Johnson and Simon 1987). ABGR/LIBO2 occurs on mid and upper elevation slopes (2,500 to 5,800 feet) with moderate ash depths. In the xeric portions of the provinces, its distribution is limited to moist stream bottoms and coves or northerly aspects. It is, perhaps, the most abundant and widely distributed forested plant association of the Blue and Wallowa Mountains.

In climax and late successional stands, twinflower (LIBO2) frequently dominates the shrub and herb layers beneath a multi-storied canopy of grand fir (ABGR), Engelmann spruce (PIEN), and Douglas-fir (PSME). Big huckleberry (VAME) is occasionally dominant with prince's pine (CHUM), baldhip rose (ROGY), Oregon boxwood (PAMY), Utah honeysuckle (LOUT2), and Oregon grape (BERE or BENE) as common associates. The herb layer is often composed of round-leaved violet (VIOR2), meadowrue (THOC), Columbia brome (BRVU), sidebells pyrola (PYSE), pink wintergreen (PYAS), starry false Solomon's seal (SMST), sweet cicely (OSCH), bedstraw (GATR), rattlesnake plantain (GOOB), and heartleaf arnica (ARCO).

Table 20. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/LIBO2 p.a.

- -

1. PICO ≥ 5% canopy coverage[2] .... PICO LG
   1a. PICO dominant[3] .... PICO-PICO LT
   1b. LAOC dominant or codominant .... PICO-LAOC LT
   1c. PIPO dominant or codominant .... PICO-PIPO LT
   1d. PSME dominant or codominant .... PICO-PSME LT
   1e. PIEN dominant or codominant .... PICO-PIEN LT
   1f. ABGR dominant or codominant .... PICO-ABGR LT

1. PICO < 5% canopy coverage 2

   2. LAOC ≥ 5% canopy coverage .... LAOC LG
      2a. LAOC dominant .... LAOC-LAOC LT
      2b. PIPO dominant or codominant .... LAOC-PIPO LT
      2c. PSME dominant or codominant .... LAOC-PSME LT
      2d. PIEN dominant or codominant .... LAOC-PIEN LT
      2e. ABGR dominant or codominant .... LAOC-ABGR LT

   2. LAOC < 5% canopy coverage 3

3. PIPO ≥ 5% canopy coverage .... PIPO LG
   3a. PIPO dominant .... PIPO-PIPO LT
   3b. PSME dominant or codominant .... PIPO-PSME LT
   3c. PIEN dominant or codominant .... PIPO-PIEN LT
   3d. ABGR dominant or codominant .... PIPO-ABGR LT

3. PIPO < 5% canopy coverage 4

   4. PSME ≥ 5% canopy coverage .... PSME LG
      4a. PSME dominant .... PSME-PSME LT
      4b. PIEN dominant or codominant .... PSME-PIEN LT
      4c. ABGR dominant or codominant .... PSME-ABGR LT

   4. PSME < 5% canopy coverage 5

5. PIEN ≥ 5% canopy coverage .... PIEN LG
   5a. PIEN dominant .... PIEN-PIEN LT
   5b. ABGR dominant or codominant .... PIEN-ABGR LT

5. PIEN < 5% canopy coverage 6

   6. ABGR ≥ 5% canopy coverage .... ABGR LG
      6a. ABGR dominant .... ABGR-ABGR LT

   6. ABGR < 5% canopy coverage .... depauperate or undefined layer or not ABGR/LIBO2 p.a.

- -

[1] When determination of LT is made, stop at the first applicable condition.
[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

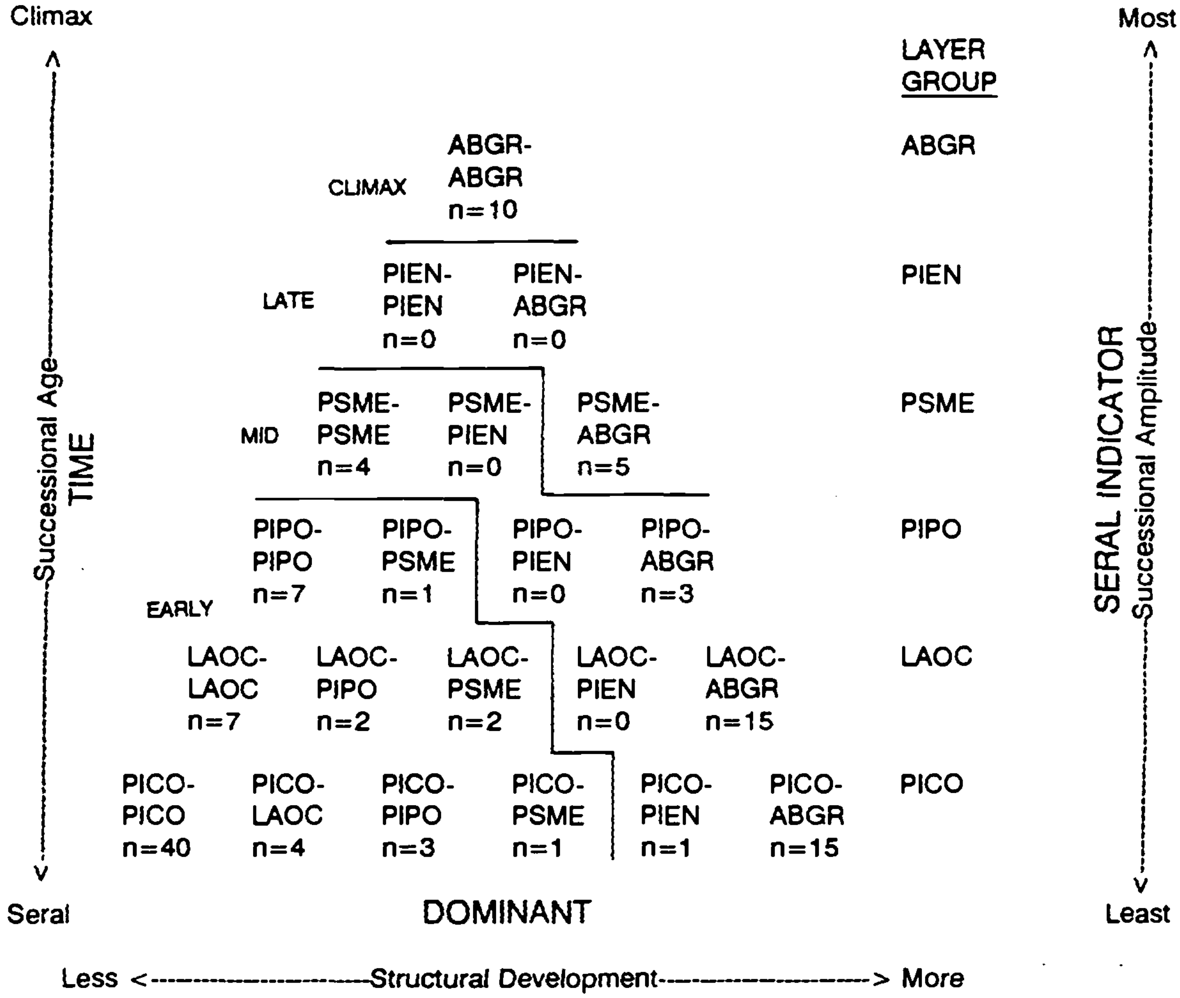


Figure 11. Succession classification diagram of the tree layer in the ABGR/LIBO2 p.a.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 11) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other tree species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Engelmann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

Engelmann spruce is a late seral tree in the ABGR/LIBO2 plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the five seral tree species (PICO, LAOC, PIPO, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/LIBO2 plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/LIBO2 plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/LIBO2 plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 11) depicts the distribution of major tree species in the ABGR/LIBO2 plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 21. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/LIBO2 p.a.

Condition	Result
1. CEVE[2] ≥ 5% canopy coverage	CEVE LG
1a. CEVE dominant[3]	CEVE-CEVE LT
1b. ARNE[4] dominant or codominant	CEVE-ARNE LT
1c. RIVI[5] dominant or codominant	CEVE-RIVI LT
1d. SASC dominant or codominant	CEVE-SASC LT
1e. ALSI dominant or codominant	CEVE-ALSI LT
1f. VASC[6] dominant or codominant	CEVE-VASC LT
1g. VAME dominant or codominant	CEVE-VAME LT
1h. LIBO2[7] dominant or codominant	CEVE-LIBO2 LT
1. CEVE < 5% canopy coverage	2
2. ARNE ≥ 5% canopy coverage	ARNE LG
2a. ARNE dominant	ARNE-ARNE LT
2b. RIVI dominant or codominant	ARNE-RIVI LT
2c. SASC dominant or codominant	ARNE-SASC LT
2d. ALSI dominant or codominant	ARNE-ALSI LT
2e. VASC dominant or codominant	ARNE-VASC LT
2f. VAME dominant or codominant	ARNE-VAME LT
2g. LIBO2 dominant or codominant	ARNE-LIBO2 LT
2. ALSI < 5% canopy coverage	3
3. RIVI ≥ 5% canopy coverage	RIVI LG
3a. RIVI dominant	RIVI-RIVI LT
3b. SASC dominant or codominant	RIVI-SASC LT
3c. ALSI dominant or codominant	RIVI-ALSI LT
3d. VASC dominant or codominant	RIVI-VASC LT
3e. VAME dominant or codominant	RIVI-VAME LT
3f. LIBO2 dominant or codominant	RIVI-LIBO2 LT
3. RIVI < 5% canopy coverage	4
4. SASC ≥ 5% canopy coverage	SASC LG
4a. SASC dominant	SASC-SASC LT
4b. ALSI dominant or codominant	SASC-ALSI LT
4c. VASC dominant or codominant	SASC-VASC LT
4d. VAME dominant or codominant	SASC-VAME LT
4e. LIBO2 dominant or codominant	SASC-LIBO2 LT
4. SASC < 5% canopy coverage	5
5. ALSI ≥ 5% canopy coverage	ALSI LG
5a. ALSI dominant	ALSI-ALSI LT
5b. VASC dominant or codominant	ALSI-VASC LT
5c. VAME dominant or codominant	ALSI-VAME LT
5d. LIBO2 dominant or codominant	ALSI-LIBO2 LT
5. ALSI < 5% canopy coverage	6
6. VASC ≥ 5% canopy coverage	VASC LG
6a. VASC dominant	VASC-VASC LT
6b. VAME dominant or codominant	VASC-VAME LT
6c. LIBO2 dominant or codominant	VASC-LIBO2 LT
6. VASC < 5% canopy coverage	7
7. VAME ≥ 5% canopy coverage	VAME LG
7a. VAME dominant	VAME-VAME LT
7b. LIBO2 dominant or codominant	VAME-LIBO2 LT
7. VAME < 5% canopy coverage	8
8. LIBO2 ≥ 5% canopy coverage	LIBO2 LG
8a. LIBO2 dominant	LIBO2-LIBO2 LT
8. LIBO2 < 5% canopy coverage	depauperate or undefined layer or not ABGR/LIBO2 p.a.

1 When determination of LT is made, stop at the first applicable condition.
2 CEVE refers to the following group of species: CEVE and CESA.
3 Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
4 ARNE refers to the following group of species: ARNE and ARUV.
5 RIVI refers to the following group of species: RIVI, RILA, and RICE.
6 VASC refers to the following group of species: VASC, VAMY, and VACA.
7 LIBO2 refers to the following group of species: LIBO2, CHUM, and BENE.

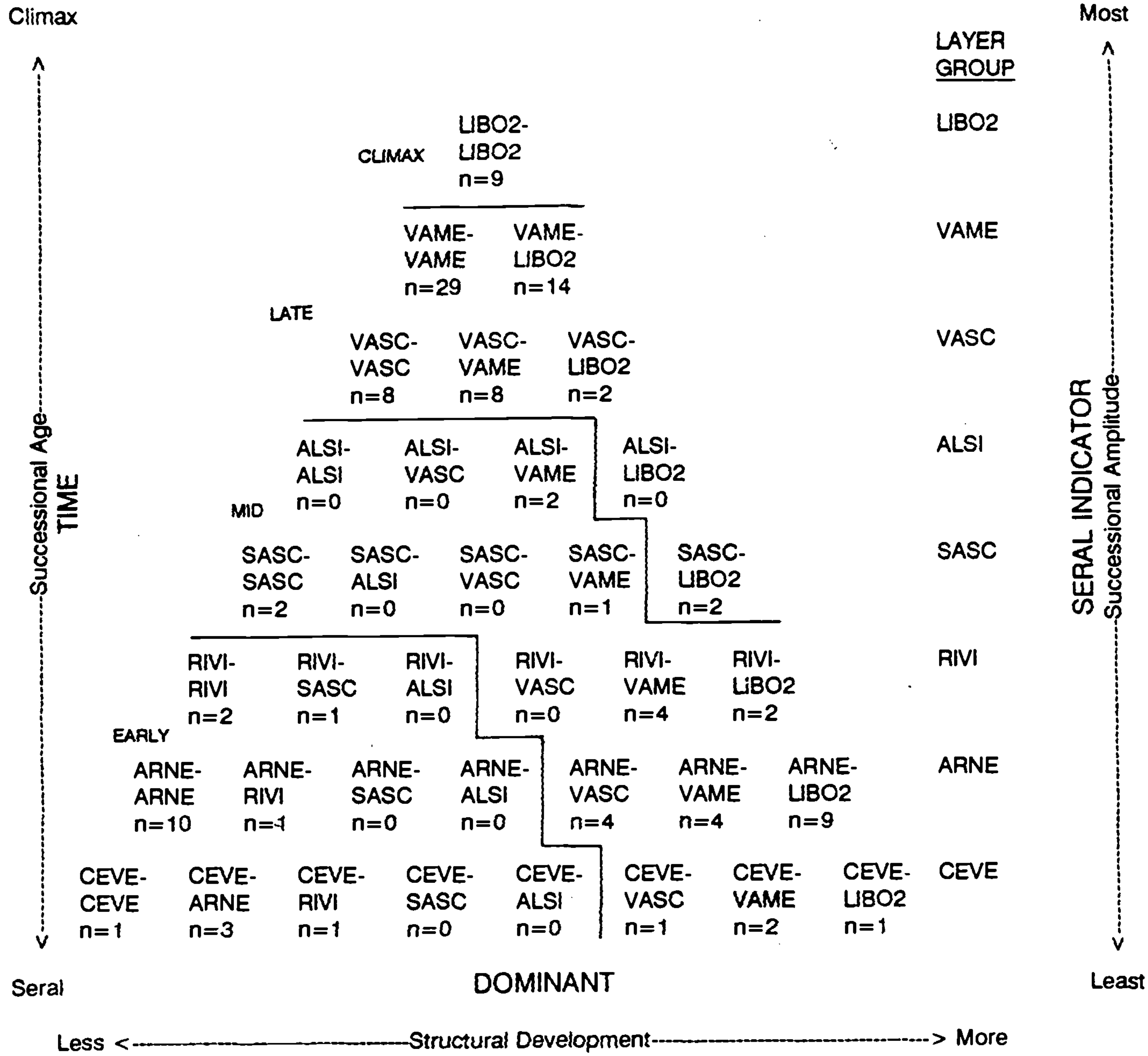


Figure 12. Succession classification diagram of the shrub layer in the ABGR/LIBO2 p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), redstem ceanothus (CESA), pinemat manzanita (ARNE), bearberry (ARUV), sticky currant (RIVI), swamp gooseberry (RILA), squaw currant (RICE), Scouler willow (SASC), Sitka alder (ALSI), grouse huckleberry (VASC), dwarf huckleberry (VACA), low huckleberry (VAMY), big huckleberry (VAME), and twinflower (LIBO2). The classification diagram (Fig. 12) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, LIBO2 appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while twinflower can be found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/LIBO2 plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following light intensity fires. The CEVE layer group has eight layer types defined: CEVE-CEVE LT, CEVE-ARNE LT, CEVE-RIVI LT, CEVE-SASC LT, CEVE-ALSI LT, CEVE-VASC LT, CEVE-VAME LT, and CEVE-LIBO2. Redstem ceanothus (CESA) is not as common as snowbrush ceanothus in the ABGR/LIBO2 plant association, but where it occurs it should be included in the CEVE LG.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

The RIVI LG includes swamp gooseberry (RILA) and squaw currant (RICE) in addition to sticky currant (RIVI). These three species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. The layer types defined are: RIVI-RIVI LT, RIVI-SASC LT, RIVI-ALSI LT, RIVI-VASC LT, RIVI-VAME LT, and RIVI-LIBO2 LT.

Scouler willow is an mid-seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has five defined layer types: SASC-SASC LT, SASC-ALSI LT, SASC-VASC LT, SASC-VAME LT, and SASC-LIBO2 LT.

Sitka alder is a mid-seral shrub that dominated some disturbed sites in the ABGR/LIBO2 plant association. It has light, windblown seed that is dispersed from scattered seeps and stream banks. It establishes on moist mineral soil exposed by fire or logging. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of Sitka alder as increased light levels encourage vigor in the multi-stemmed shrub. Four layer types represent community development towards the climax state: ALSI-ALSI LT, ALSI-VASC LT, ALSI-VAME LT, and ALSI-LIBO2 LT.

The VASC LG includes three late seral species: grouse huckleberry (VASC), low huckleberry (VAMY), and dwarf huckleberry (VACA). These low shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/LIBO2 plant association. The huckleberries revegetate sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of these shrubs are susceptible to moderate and high intensity fires in addition to mechanical scarification of the top six inches of soil and duff. Three layer types are defined in this layer group: VASC-VASC LT, VASC-VAME LT, and VASC-LIBO2 LT.

The VAME LG has 5% or greater coverage of big huckleberry in the absence of earlier successional indicator species. This mid-shrub is rhizomatous and shade-tolerant; it will persist in climax forests of the ABGR/LIBO2 plant association. Big huckleberry revegetates sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of big huckleberry are susceptible to moderate and high intensity fires. The shrub species is sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. Two layer types are defined in this group: VAME-VAME LT and VAME-LIBO2 LT.

The LIBO2 LG includes three late seral to climax species: twinflower (LIBO2), prince's pine (CHUM), and Oregon grape (BENE). These low shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/LIBO2 plant association. Twinflower revegetates from shallow rhizomes principally in the upper soil and duff layers. Fire or logging that remove or disturb these layers lead to the decline in twinflower cover. Plants in favorable microsites that escape the disturbance become centers of recolonization; this centrifugal expansion would appear a slow process. CHUM and BENE become abundant in shaded undestories because of their ability to compete in low light levels beneath a dense overstory canopy.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. Differential responses of snowbrush ceanothus, sticky currant, big huckleberry, and twinflower are related to many of these factors. For example, a low intensity spring burn of a recently logged site may result in a decline in twinflower, no change in big huckleberry, a large increase in sticky currant, and no ceanothus germinants. Yet the same fire in the fall, with a moderate intensity burn, may result in the disappearance of twinflower, a decline in big huckleberry, a small increase in sticky currant, and abundant ceanothus germinants. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. The former case could result in the identification of the RIVI-RIVI LT while the latter case could be the CEVE-CEVE LT.

Management Implications

The potential shrub layer types in the ABGR/LIBO2 plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus and Sitka alder also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Sticky currant, swamp gooseberry, and squaw currant provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants and gooseberries also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes 1992).

Sitka alder provides food for grouse and other non-game birds but is not a preferred browse by deer or elk. Shrubfields can provide hiding and thermal cover for these big game species, however.

The huckleberries provide fruit used by bear, grouse, non-game birds, and small mammals. In addition, they provide browse for wild ungulates and domestic livestock. The recreational use of big huckleberry shrubfields for berry-picking attracts forest visitors in late summer.

Logging impacts to forested plant communities are related to the season of disturbance as well as the perturbating activity (machine scarification, broadcast burning, pile and burn, etc.). A truncated disturbance regime relative to a time factor is found in the Intermountain West as logging has not been a historical disturbance factor in the same timescale as fire. Nonetheless, the impacts of machine scarification differentially affect species establishment, survival, and growth. In grand fir plant associations, for example, huckleberry species are susceptible to this type of disturbance. More information is needed concerning community and species responses to these types of disturbance regimes.

Table 22. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/LIBO2 p.a.

1.	CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a.	CIVU dominant[3]	CIVU-CIVU LT
1b.	CARO[4] dominant or codominant	CIVU-CARO LT
1c.	ASCA7[5] dominant or codominant	CIVU-ASCA7 LT
1d.	FRVE[6] dominant or codominant	CIVU-FRVE LT
1e.	ARCO[7] dominant or codominant	CIVU-ARCO LT
1f.	VIOR2[8] dominant or codominant	CIVU-VIOR2 LT
1.	CIVU < 5% canopy coverage	2
2.	CARO ≥ 5% canopy coverage	CARO LG
2a.	CARO dominant	CARO-CARO LT
2b.	ASCA7 dominant or codominant	CARO-ASCA7 LT
2c.	FRVE dominant or codominant	CARO-FRVE LT
2d.	ARCO dominant or codominant	CARO-ARCO LT
2e.	VIOR2 dominant or codominant	CARO-VIOR2 LT
2.	CARO < 5% canopy coverage	3
3.	ASCA7 ≥ 5% canopy coverage	ASCA7 LG
3a.	ASCA7 dominant	ASCA7-ASCA7 LT
3b.	FRVE dominant or codominant	ASCA7-FRVE LT
3c.	ARCO dominant or codominant	ASCA7-ARCO LT
3d.	VIOR2 dominant or codominant	ASCA7-VIOR2 LT
3.	ASCA7 < 5% canopy coverage	4
4.	FRVE ≥ 5% canopy coverage	FRVE LG
4a.	FRVE dominant	FRVE-FRVE LT
4b.	ARCO dominant or codominant	FRVE-ARCO LT
4c.	VIOR2 dominant or codominant	FRVE-VIOR2 LT
4.	FRVE < 5% canopy coverage	5
5.	ARCO ≥ 5% canopy coverage	ARCO LG
5a.	ARCO dominant	ARCO-ARCO LT
5b.	VIOR2 dominant or codominant	ARCO-VIOR2 LT
5.	ARCO < 5% canopy coverage	6
6.	VIOR2 ≥ 5% canopy coverage	VIOR2 LG
6a.	VIOR2 dominant	VIOR2-VIOR2 LT
6.	VIOR2 < 5% canopy coverage	depauperate or undefined layer or not ABGR/LIBO2 p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU and ANTEN.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO, CACO, FEOC, and HIAL.
[5] ASCA7 refers to the following group of species: ASCA7, CAMI2, ELGL, THMO, and LUPIN.
[6] FRVE refers to FRAGARIA SPP.
[7] ARCO refers to the following group of species: ARCO, ADBI, CARU, and CAGE.
[8] VIOR2 refers to the following group of species: VIOR2, THOC, BRVU, PYAS, and SMST.

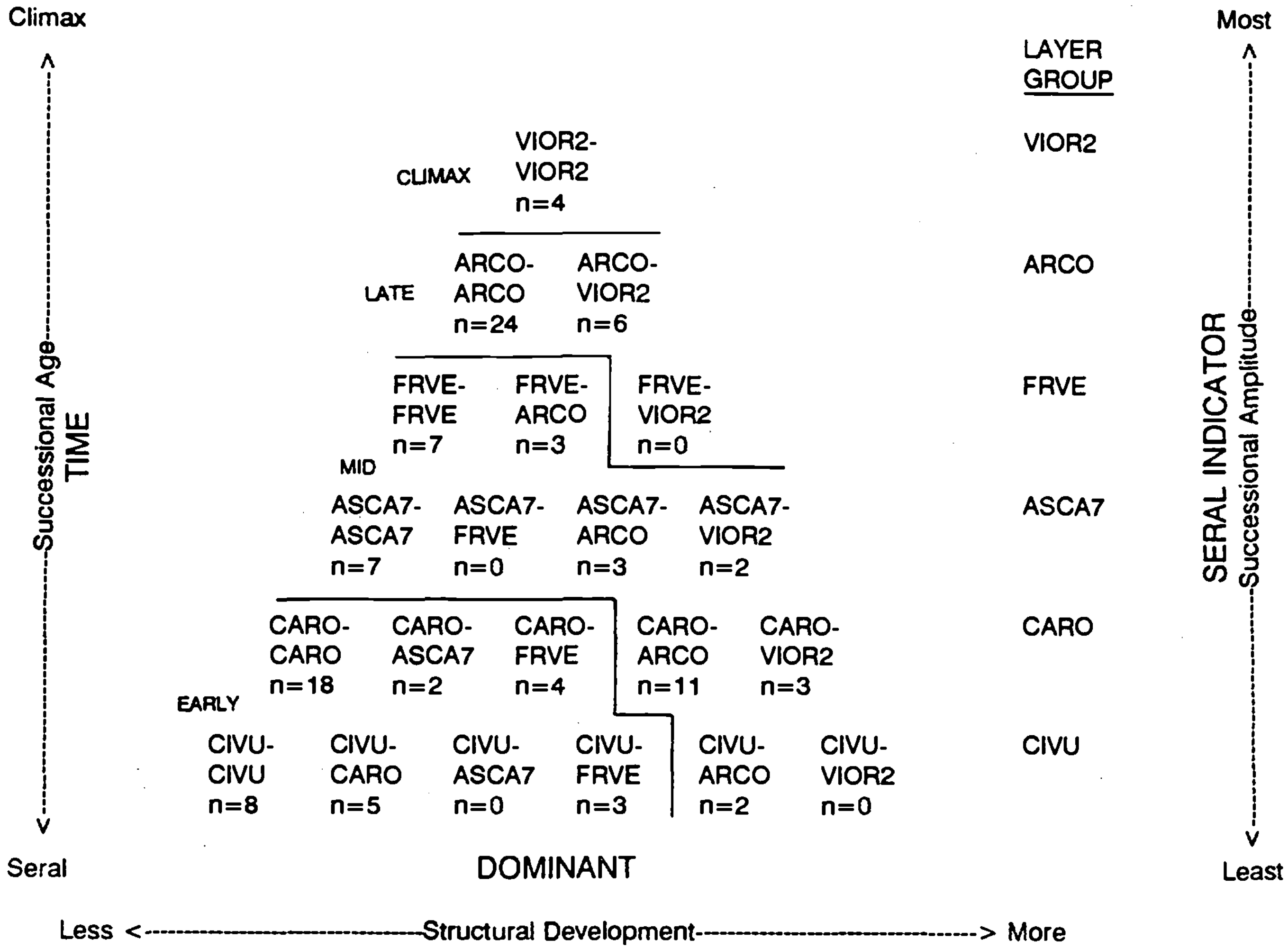


Figure 13. Succession classification diagram of the herb layer in the ABGR/LIBO2 p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pussytoes (ANTEN), Ross sedge (CARO), northwestern sedge (CACO), western fescue (FEOC), white hawkweed (HIAL), Canada milkvetch (ASCA7), scarlet paintbrush (CAMI2), blue wildrye (ELGL), lupine (LUPIN), golden-pea (THMO), woods strawberry (FRVE), broadpetal strawberry (FRVI), heartleaf arnica (ARCO), trail plant (ADBI), elk sedge (CAGE), pinegrass (CARU), western meadowrue (THOC), round-leaved violet (VIOR2), Columbia brome (BRVU), pink wintergreen (PYAS), and starry false Solomon's seal (SMST). The classification diagram (Fig. 13) depicts the herb layer groups and herb layer types. CIVU and ANTEN are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. VIOR2 (and others), climax herbaceous species, appears at the top of the figure.

Bull thistle is a tap-rooted, alien biennial that establishes on recently disturbed sites of this plant association. Pussytoes are native perennials. CIVU and ANTEN are composites with windblown seed. ANTEN can be locally abundant in a disturbed patch but seldom has the coverage of CIVU. The CIVU LG includes these species and has six layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-ASCA7 LT, CIVU-FRVE LT, CIVU-ARCO LT, and CIVU-VIOR2 LT.

The CARO LG includes Ross sedge, northwestern sedge, western fescue, and white hawkweed. CARO and CACO are perennial sedges that increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). Western fescue is a perennial bunchgrass that increases following disturbances of the climax understory. White hawkweed was abundant in some early successional stages. This perennial forb is a member of the sunflower family and increases through windblown seeds. There are five defined layer types in the CARO LG: CARO-CARO LT, CARO-ASCA7 LT, CARO-FRVE LT, CARO-ARCO LT, and CARO-VIOR2 LT.

The ASCA7 layer group has five mid-seral species: Canada milkvetch, scarlet paintbrush, blue wildrye, golden-pea, and lupine. ASCA7 was the most constant and abundant member of this group; the remaining members were occasionally abundant. These rhizomatous species increase in post-disturbance communities of the ABGR/LIBO2 plant association. The legumes are nitrogen-fixers. Four layer types are defined for the ASCA7 layer group.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-ARCO LT, and FRVE-VIOR2 LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. Trail plant (ADBI) is grouped with heartleaf arnica in the ARCO LG. Both ARCO and ADBI, members of the sunflower family, produce achenes dispersed by wind. ARCO, in addition, can reproduce by rhizomes. Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/LIBO2 plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. Pinegrass is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from rhizomes. Layer types are: ARCO-ARCO LT and ARCO-VIOR2 LT.

Western meadowrue, round-leaved violet, pink wintergreen, starry false Solomon's seal, and Columbia brome compose a group of shade-tolerant, perennial herbs of climax stands used to define the VIOR2 LG. All occasionally dominate the herbaceous layer although VIOR2 is the most constant and abundant member of the layer group. The sole layer type of the climax herb layer is the VIOR2-VIOR2 LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The early seral species CARO is favored by conditions created during mechanical scarification while THMO is favored by burning.

The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. The ARCO-ARCO LT following a light intensity fire would recycle to an ARCO-ARCO LT because of this species ability to regenerate quickly from rhizomes and to flower and set seed. Both of these regeneration strategies allow ARCO to quickly increase in abundance following such disturbances.

Management Implications

The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine, golden-pea, and milkvetch are favored by burning and are beneficial as nitrogen-fixers. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries.

The practice of planting exotic grasses in harvest units of this plant association appears to have had little impact on subsequent vegetation development. Grass seedings of timothy (PHPR), orchard grass (DAGL), and wheatgrasses (AGROP) appear short-lived with little impact on vegetation development.

TABLE 23. Mean canopy coverage and constancy of tree species by layer type in the ABGR/LIBO2 p.a.

TREE LAYER GROUP	PICO																			
TREE LAYER TYPE	PICO-PICO				PICO-LAOC				PICO-PIPO				PICO-PSME				PICO-PIEN			
NUMBER OF STANDS	40				4				3				1				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR	6/14	1/14	1/70	7/72	4/25			6/75				8/100								8/100
ABLA2			1/17	3/14				1/25												
LAOC	7/30	1/27	1/52	2/55	13/50			30/50				2/33	20/100	20/100						1/100
PIEN	1/2			3/32	7/25			2/75				3/66								70/100
PICO	31/47	8/47	5/77	20/80	13/25			9/75			2/100	5/100	45/100			5/100				5/100
PIMO																				
PIPO	15/2		2/14	4/14				3/25			20/100	21/100	15/100			1/100				
POTR																				
PSME	4/5		1/62	7/70				1/25				15/33	30/100		10/100	15/100				
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	PICO				LAOC															
TREE LAYER TYPE	PICO-ABGR				LAOC-LAOC				LAOC-PIPO				LAOC-PSME				LAOC-ABGR			
NUMBER OF STANDS	15				7				2				2				15			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR	19/46	3/26	8/93	34/100	2/14			4/85				25/50	3/50	12/50	1/100	6/100	13/80	14/80	6/86	18/86
ABLA2			2/13	2/13													2/6	1/6		1/13
LAOC	10/66	3/46	1/46	1/40	22/57	4/57		21/85			3/100	9/100	6/50			10/50	13/80	2/80	1/33	11/33
PIEN	8/13			5/33				10/14				8/50				5/50	3/20	1/20		3/33
PICO	11/86	9/86	1/53	8/46			1/71	2/71				2/50					1/13	1/13		1/53
PIMO																				
PIPO				1/6				3/28			13/100	13/100				1/50	1/6			5/33
POTR																				
PSME	5/26	4/33	5/53	7/53		2/14	1/71	2/71				5/100	28/50			20/50	2/20	6/20		2/66
BASAL AREA (FT²/AC)																				

TABLE 23 (cont.). **Mean canopy coverage and constancy of tree species by layer type in the ABGR/LIBO2 p.a.**

TREE LAYER GROUP	PIPO												PSME							
TREE LAYER TYPE	PIPO-PIPO				PIPO-PSME				PIPO-ABGR				PSME-PSME				PSME-ABGR			
NUMBER OF STANDS	7				1				3				4				5			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR			1/85	9/85							3/100	9/100	3/75	9/75		6/75	37/100	16/100	7/100	24/100
ABLA2																			5/20	
LAOC			2/42	3/42								3/33	3/50	1/50		1/25				
PIEN				3/71							1/100	1/100					4/60	7/60		
PICO				2/28									2/25			1/75	2/20			
PIMO																				
PIPO			29/100	9/100	30/100				5/33		3/100	5/100				1/25				
POTR																				
PSME			1/100	3/100	35/100		10/100	40/100				5/33	22/100	2/75		2/75	16/100	1/100		
BASAL AREA (FT^2/AC)																				

TREE LAYER GROUP	ABGR			
TREE LAYER TYPE	ABGR-ABGR			
NUMBER OF STANDS	10			
SIZE CLASSES	D	I	P	S
Species				
ABGR	23/100	8/100	5/90	15/90
ABLA2				
LAOC	2/10			2/10
PIEN				
PICO	1/10			1/10
PIMO				
PIPO				1/10
POTR				
PSME	4/20			2/30
BASAL AREA (FT^2/AC)				

TABLE 24. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/LIBO2 p.a.

SHRUB LAYER GROUP	CEVE						ARNE			
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-ARNE	CEVE-RIVI	CEVE-VASC	CEVE-VAME	CEVE-LIBO2	ARNE-ARNE	ARNE-RIVI	ARNE-VASC	ARNE-VAME
NUMBER OF STANDS	1	3	1	1	2	1	10	1	4	4
Species										
ACGL					2/50					
ALSI					10/50					
AMAL					2/50		1/30		1/25	
ARNE		38/66		15/100			24/70		9/75	
ARUV		5/33	8/100				36/40	5/100	20/25	10/100
BENE									1/25	
CESA								3/100		
CEVE	80/100	8/100	8/100	8/100	18/100	30/100	2/40			
CELE										
CHUM		1/33		2/100	2/50	10/100	2/30		2/75	12/75
HODI	2/100				1/50		1/10			1/25
LIBO2	1/100	2/100	15/100		9/100	55/100	6/80		8/100	19/100
LOUT2						8/100	1/10			5/25
PAMY	30/100	2/100		1/100	15/50	10/100	3/70		2/75	
PHMA										
RICE										
RILA					2/50		1/20	10/100		
RIVI	10/100	2/33	35/100		15/100	1/100	8/20	3/100	2/25	1/25
ROGY							1/20			5/75
RUPA	1/100				2/50					
SASC	10/100	2/66	5/100	1/100	17/100		1/60	3/100	1/75	
SHCA				1/100			3/20		5/75	
SPBE		2/66	2/100	1/100		1/100	2/40		3/75	8/75
SYAL	5/100									8/50
SYOR							1/20			
TABR										
VACA							2/10		50/25	
VAME	3/100	5/100	5/100	5/100	55/100	5/100	6/60	3/100	6/75	40/100
VAMY										
VASC		3/66		40/100			9/50		42/75	

TABLE 24 (cont.). Mean canopy coverage and constancy of shrub species by layer type in the ABGR/LIBO2 p.a.

SHRUB LAYER GROUP	ARNE	RIVI				SASC			ALSI	VASC
SHRUB LAYER TYPE	ARNE-LIBO2	RIVI-RIVI	RIVI-SASC	RIVI-VAME	RIVI-LIBO2	SASC-SASC	SASC-VAME	SASC-LIBO2	ALSI-VAME	VASC-VASC
NUMBER OF STANDS	9	2	1	4	2	2	1	2	2	8
Species										
ACGL										
ALSI		1/50		3/25		30/50			7/100	
AMAL	1/22			3/50			1/100	3/50		1/50
ARNE	19/22					1/50	2/100		1/50	2/50
ARUV	12/77				2/50					1/12
BENE										
CESA		1/50								
CEVE	1/22			1/75				1/50		
CELE										
CHUM	15/55			15/25	2/50	1/50	3/100		4/100	4/100
HODI			1/100		1/50					
LIBO2	29/100	5/100	1/100	8/100	38/100	10/100	1/100	23/100	20/100	9/100
LOUT2	5/44			1/25	1/50				1/50	
PAMY	1/22	5/50		5/25		1/50	5/100	3/50	1/50	2/100
PHMA								3/50		
RICE	2/33		1/100	3/25	3/50	1/50				
RILA		10/50	1/100	10/25						
RIVI	1/33	15/50	3/100	12/100	10/100					
ROGY	2/44								10/50	2/12
RUPA	1/11									
SASC	2/55		5/100	2/75		43/100	17/100	10/100	1/50	1/62
SHCA	2/22						1/100			8/25
SPBE	3/55			1/25			3/100		6/100	2/37
SYAL	3/11					1/50		5/50		
SYOR										1/12
TABR										
VACA										
VAME	6/77	2/100		54/100	14/100	1/50	25/100	10/100	35/100	17/100
VAMY	3/11									
VASC	2/11						5/100			44/100

TABLE 24 (cont.). **Mean canopy coverage and constancy of shrub species by layer type in the ABGR/LIBO2 p.a.**

SHRUB LAYER GROUP	VASC		VAME		LIBO2
SHRUB LAYER TYPE	VASC-VAME	VASC-LIBO2	VAME-VAME	VAME-LIBO2	LIBO2-LIBO2
NUMBER OF STANDS	8	2	29	14	9
Species					
ACGL			1/3		
ALSI			2/6	1/7	
AMAL	1/37	1/100	1/27	1/14	
ARNE	2/87	1/50	2/20	3/7	2/22
ARUV			1/13		
BENE				4/7	3/22
CESA					
CEVE	1/12		1/10		
CELE					
CHUM	5/87	2/100	4/68	4/85	5/77
HODI			6/6	1/7	
LIBO2	10/100	40/100	12/96	22/100	17/100
LOUT2			3/20	2/35	2/22
PAMY	2/87	1/100	2/58	1/50	1/33
PHMA			6/6		1/11
RICE			3/3		
RILA	2/25		1/6	2/14	
RIVI	1/12		2/20	3/7	1/22
ROGY	2/37	2/100	2/34	3/42	1/44
RUPA					
SASC	1/75		1/41	1/7	2/11
SHCA	2/37	10/50	6/17		1/11
SPBE	5/50	1/100	4/51	3/50	1/33
SYAL			2/6	1/14	1/22
SYOR				1/7	
TABR					
VACA					
VAME	60/100	14/100	39/100	16/100	1/77
VAMY	5/12	20/50			
VASC	22/87	5/50	2/24	2/28	2/22

TABLE 25. Mean canopy coverage and constancy of herb species by layer type in the ABGR/LIBO2 p.a.

HERB LAYER GROUP	CIVU				CARO				
HERB LAYER TYPE	CIVU-CIVU	CIVU-CARO	CIVU-FRVE	CIVU-ARCO	CARO-CARO	CARO-ASCA7	CARO-FRVE	CARO-ARCO	CARO-VIOR2
NUMBER OF STANDS	8	5	3	2	18	2	4	11	3
Species									
ACMI	1/50	1/20	2/100		2/44	5/50	2/100	1/45	
ADBI	1/12	1/20			14/16			1/18	1/33
AGUR									
ANMA	21/25		9/66		2/11	1/50	1/25		
ANTEN	6/87	4/100	9/100	15/50	2/27		2/25	2/27	
APAN									
ARCO	4/37	1/40	2/66		4/11	5/50	25/25	2/36	13/66
ASCO		1/20		5/50	1/5				
ASCA7	13/25		3/66		2/22	2/50	2/50	3/9	
BRVU	2/12				2/27		10/25		5/33
CARU	1/12	1/60	2/33	18/100	5/61	5/50	1/25	36/100	10/100
CACO	3/75	12/100		5/50	7/66			6/63	6/66
CAGE	2/25	2/100	2/33		2/11		1/25	18/27	15/33
CARO	3/62	6/60	8/66		7/77	1/50	9/100	5/54	8/66
CAMI2			4/66			15/50	1/25		
CIVU	24/87	9/80		5/50	1/38		2/75	1/18	
CLUN									
ELGL	1/12							2/9	
FEOC	1/37	8/80		1/50	8/66	5/50		2/72	1/33
FRVE	8/62	1/80	40/100	11/100	6/83	5/100	24/100	10/63	5/33
FRVI	1/25	2/20			1/27			8/54	10/33
GOOB		1/20		1/50	1/38			1/18	1/66
HIAL	1/50	1/60	2/66	1/50	2/66	4/100	3/25	2/81	2/100
LUPIN	1/12					1/50		3/45	1/33
MIST2	2/37	1/20	3/66		1/16	1/50	2/50		
MONTI	1/37								
PONE									
PTAQ									
PYAS					1/5		1/50		
PYSE		1/20			2/38	1/50	2/25	1/54	1/33
RUOC					1/11		1/25		
SMST							3/25		
THOC	2/25	1/20	2/66	1/50	6/11		10/25	15/36	22/100
THMO					7/5				
VETH	2/75	1/60			1/22		1/25		
VIOR2	1/37	1/40	12/100		3/61	9/100	8/50	3/63	25/100

TABLE 25 (cont.). Mean canopy coverage and constancy of herb species by layer type in the ABGR/LIBO2 p.a.

HERB LAYER GROUP	ASCA7			FRVE		ARCO		VIOR2
HERB LAYER TYPE	ASCA7-ASCA7	ASCA7-ARCO	ASCA7-VIOR2	FRVE-FRVE	FRVE-ARCO	ARCO-ARCO	ARCO-VIOR2	VIOR2-VIOR2
NUMBER OF STANDS	7	3	2	7	3	24	6	4
Species								
ACMI	2/28	2/66	3/50	4/57		1/12		
ADBI							1/16	
AGUR								
ANMA		1/33	2/50	2/57	1/33			
ANTEN				2/14		1/16		
APAN								
ARCO	1/14	30/33		4/57	6/66	8/62	4/50	
ASCO						1/4	1/16	3/25
ASCA7	4/57	7/66		2/57	4/33		1/16	
BRVU	4/28		15/50		15/33	1/8	4/50	1/75
CARU	3/28	45/66			15/66	25/91	6/83	1/25
CACO	2/28			3/14		2/75	1/50	1/75
CAGE	13/28	5/100	1/50	5/14	1/33	3/37	1/33	2/25
CARO	2/14			3/28	1/33	1/4	1/33	1/25
CAMI2		2/33		2/14				
CIVU	1/42			1/57		1/16		
CLUN	1/14		1/50	1/14		1/4		
ELGL	9/28	3/33	10/50					
FEOC	1/14			1/42		1/45	1/50	1/25
FRVE	12/85	9/100	10/50	33/100	7/66	1/54	3/16	2/100
FRVI	1/14				3/66	1/33	1/16	1/25
GOOB	1/14				8/66	1/45	1/66	1/75
HIAL	1/42	1/33		1/42	1/100	1/75	1/50	
LUPIN	8/14	1/33			1/66	2/33	1/16	
MIST2	3/28	3/33	8/50	6/71		1/4	2/16	3/25
MONTI								
PONE								
PTAQ								
PYAS	1/14					1/25	4/33	2/25
PYSE	1/14	2/33			2/66	1/66	2/50	5/25
RUOC	2/28		3/100	5/14				
SMST	1/14		10/50	3/28	1/33	1/8		
THOC	2/28	2/66	2/50	2/28		4/12	2/66	4/50
THMO	45/28	8/33	5/50			1/4		
VETH	1/28		1/50	1/42				
VIOR2	4/28	5/33	5/50	13/42	9/66	2/50	9/83	7/75

Grand fir/big huckleberry plant association

Abies grandis/Vaccinium membranaceum

ABGR/VAME (CWS2 11 and CWS2 12)

Post-fire shrub layer type of CEVE-CEVE LT in ABGR/VAME plant association (Spring Ridge, Baker RD, Wallowa-Whitman NF)

This plant association was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Hall 1973; Johnson and Clausnitzer 1992; Johnson and Simon 1987). It is widely distributed on moderately steep to steep slopes at elevations between 4,000 feet and 6,400 feet on ash and mixed ash-residual soils. The ABGR/VAME p.a. is one of the most common plant associations of the area.

In climax and late successional stands, big huckleberry (VAME) dominates an understory of shrubs and herbs beneath an overstory canopy of grand fir (ABGR) and scattered Douglas-fir (PSME) and Engelmann spruce (PIEN). Frequently associated with VAME in the shrub layer are prince's pine (CHUM), Oregon boxwood (PAMY), baldhip rose (ROGY), and Utah honeysuckle (LOUT2). Principal species of the herb layer include pinegrass (CARU), elk sedge (CAGE), Columbia brome (BRVU), heartleaf arnica (ARCO), mitella (MIST2), sidebells pyrola (PYSE), rattlesnake plantain (GOOB), round-leaved violet (VIOR2), meadowrue (THOC), sweet cicely (OSCH), bigleaf sandwort (ARMA3), trail plant (ADBI), showy aster (ASCO), and hawkweeds (HIAL and HIAL2).

Table 26. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/VAME plant association.

1.	PICO ≥ 5% canopy coverage[2]	PICO LG
1a.	PICO dominant	PICO-PICO LT
1b.	LAOC dominant or codominant[3]	PICO-LAOC LT
1c.	PIPO dominant or codominant	PICO-PIPO LT
1d.	PSME dominant or codominant	PICO-PSME LT
1e.	PIEN dominant or codominant	PICO-PIEN LT
1f.	ABGR dominant or codominant	PICO-ABGR LT
1.	PICO < 5% canopy coverage	2
2.	LAOC ≥ 5% canopy coverage	LAOC LG
2a.	LAOC dominant	LAOC-LAOC LT
2b.	PIPO dominant or codominant	LAOC-PIPO LT
2c.	PSME dominant or codominant	LAOC-PSME LT
2d.	PIEN dominant or codominant	LAOC-PIEN LT
2e.	ABGR dominant or codominant	LAOC-ABGR LT
2.	LAOC < 5% canopy coverage	3
3.	PIPO ≥ 5% canopy coverage	PIPO LG
3a.	PIPO dominant	PIPO-PIPO LT
3b.	PSME dominant or codominant	PIPO-PSME LT
3c.	PIEN dominant or codominant	PIPO-PIEN LT
3d.	ABGR dominant or codominant	PIPO-ABGR LT
3.	PIPO < 5% canopy coverage	4
4.	PSME ≥ 5% canopy coverage	PSME LG
4a.	PSME dominant	PSME-PSME LT
4b.	PIEN dominant or codominant	PSME-PIEN LT
4c.	ABGR dominant or codominant	PSME-ABGR LT
4.	PSME < 5% canopy coverage	5
5.	PIEN ≥ 5% canopy coverage	PIEN LG
5a.	PIEN dominant	PIEN-PIEN LT
5b.	ABGR dominant or codominant	PIEN-ABGR LT
5.	PIEN < 5% canopy coverage	6
6.	ABGR ≥ 5% canopy coverage	ABGR LG
6a.	ABGR dominant	ABGR-ABGR LT
6.	ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/VAME p.a.

[1] When determination of LT is made, stop at the first applicable condition.

[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.

[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

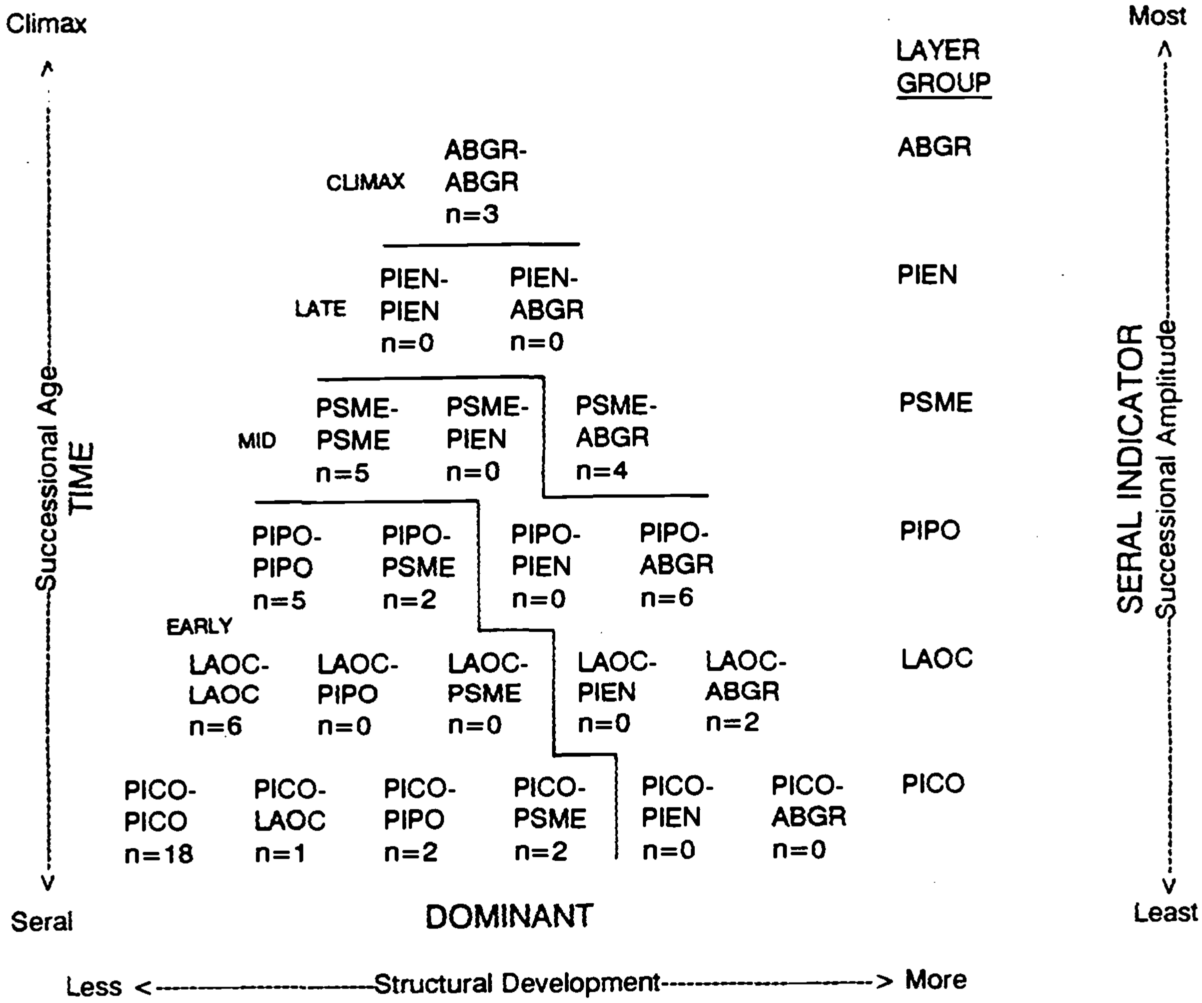


Figure 14. Succession classification diagram of the tree layer in the ABGR/VAME plant association.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 14) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/VAME plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the five seral tree species (PICO, LAOC, PIPO, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/VAME plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/VAME plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/VAME plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 14) depicts the distribution of major tree species in the ABGR/VAME plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 27 Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/VAME p.a.

1. CEVE ≥ 5% canopy coverage	CEVE LG
1a. CEVE dominant[2]	CEVE-CEVE LT
1b. ARNE[3] dominant or codominant	CEVE-ARNE LT
1c. RIVI[4] dominant or codominant	CEVE-RIVI LT
1d. SASC dominant or codominant	CEVE-SASC LT
1e. AMAL dominant or codominant	CEVE-AMAL LT
1f. SPBE[5] dominant or codominant	CEVE-SPBE LT
1g. VASC[6] dominant or codominant	CEVE-VASC LT
1h. VAME dominant or codominant	CEVE-VAME LT
1. CEVE < 5% canopy coverage	2
2. ARNE ≥ 5% canopy coverage	ARNE LG
2a. ARNE dominant	ARNE-ARNE LT
2b. RIVI dominant or codominant	ARNE-RIVI LT
2c. SASC dominant or codominant	ARNE-SASC LT
2d. AMAL dominant or codominant	ARNE-AMAL LT
2e. SPBE dominant or codominant	ARNE-SPBE LT
2f. VASC dominant or codominant	ARNE-VASC LT
2g. VAME dominant or codominant	ARNE-VAME LT
2. ARNE < 5% canopy coverage	3
3. RIVI ≥ 5% canopy coverage	RIVI LG
3a. RIVI dominant	RIVI-RIVI LT
3b. SASC dominant or codominant	RIVI-SASC LT
3c. AMAL dominant or codominant	RIVI-AMAL LT
3d. SPBE dominant or codominant	RIVI-SPBE LT
3e. VASC dominant or codominant	RIVI-VASC LT
3f. VAME dominant or codominant	RIVI-VAME LT
3. RIVI < 5% canopy coverage	4
4. SASC ≥ 5% canopy coverage	SASC LG
4a. SASC dominant	SASC-SASC LT
4b. AMAL dominant or codominant	SASC-AMAL LT
4c. SPBE dominant or codominant	SASC-SPBE LT
4d. VASC dominant or codominant	SASC-VASC LT
4e. VAME dominant or codominant	SASC-VAME LT
4. SASC < 5% canopy coverage	5
5. AMAL ≥ 5% canopy coverage	AMAL LG
5a. AMAL dominant	AMAL-AMAL LT
5b. SPBE dominant or codominant	AMAL-SPBE LT
5c. VASC dominant or codominant	AMAL-VASC LT
5d. VAME dominant or codominant	AMAL-VAME LT
5. AMAL < 5% canopy coverage	6
6. SPBE ≥ 5% canopy coverage	SPBE LG
6a. SPBE dominant	SPBE-SPBE LT
6b. VASC dominant or codominant	SPBE-VASC LT
6c. VAME dominant or codominant	SPBE-VAME LT
6. SPBE < 5% canopy coverage	7
7. VASC ≥ 5% canopy coverage	VASC LG
7a. VASC dominant	VASC-VASC LT
7b. VAME dominant or codominant	VASC-VAME LT
7. VASC < 5% canopy coverage	8
8. VAME ≥ 5% canopy coverage	VAME LG
8a. VAME dominant	VAME-VAME LT
8. VAME < 5% canopy coverage	depauperate or undefined layer or not ABGR/VAME p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[3] ARNE refers to the following group of species: ARNE and ARUV.
[4] RIVI refers to the following group of species: RIVI, RILA, RICE, and PAMY.
[5] SPBE refers to the following group of species: SPBE and SYAL.
[6] VASC refers to the following group of species: VASC, VAMY, VACA, and LOUT2.

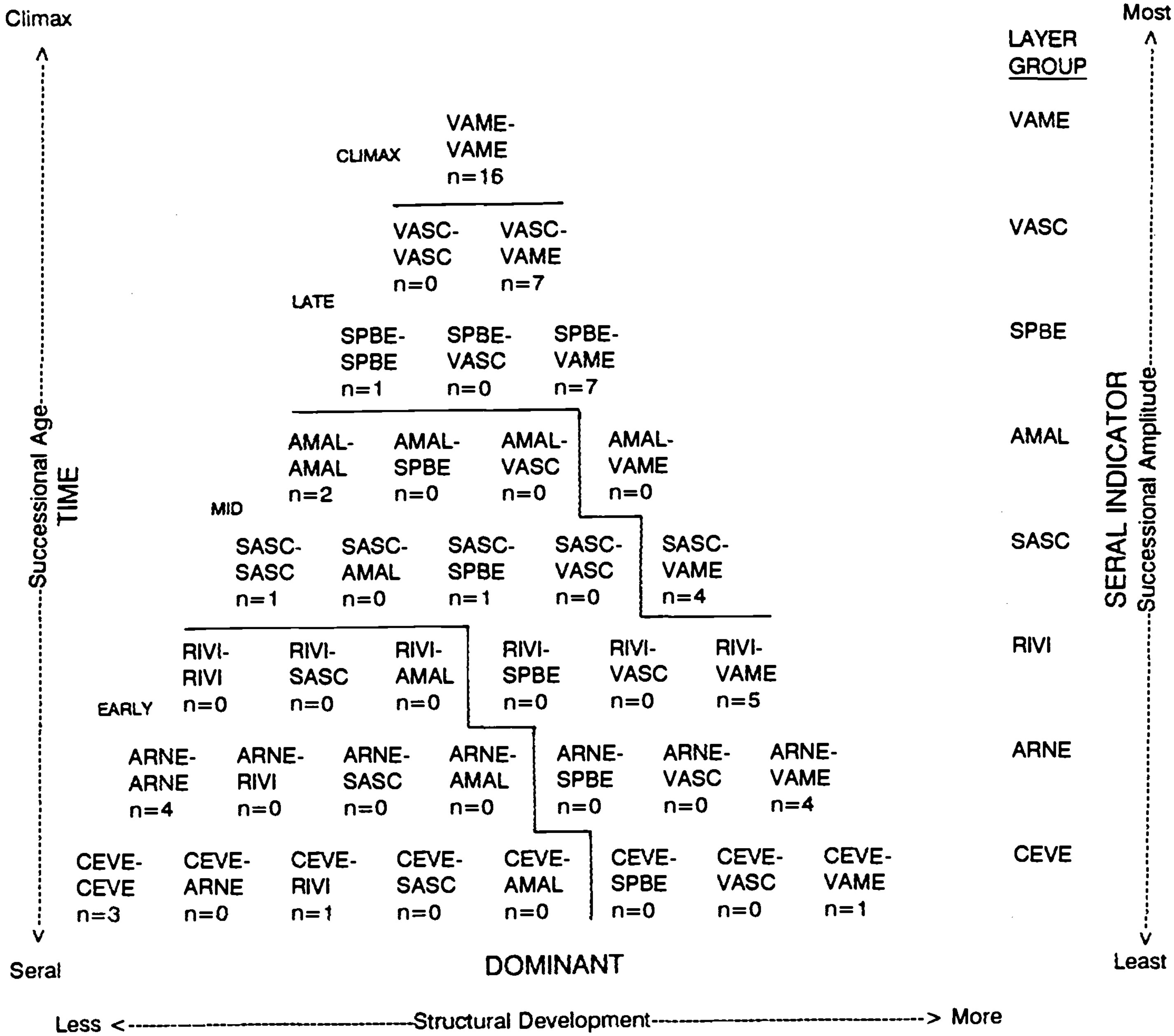


Figure 15. Succession classification diagram of the shrub layer in the ABGR/VAME p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), pinemat manzanita (ARNE), bearberry (ARUV), sticky currant (RIVI), swamp gooseberry (RILA), squaw currant (RICE), Oregon boxwood (PAMY), Scouler willow (SASC), serviceberry (AMAL), common snowberry (SYAL), birchleaf spirea (SPBE), grouse huckleberry (VASC), dwarf kuckleberry (VACA), low huckleberry (VAMY), Utah honeysuckle (LOUT2), and big huckleberry (VAME). The classification diagram (Fig. 15) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, VAME, appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while big huckleberry can be found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/VAME plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has eight layer types defined: CEVE-CEVE LT, CEVE-ARNE LT, CEVE-RIVI LT, CEVE-SASC LT, CEVE-AMAL LT, CEVE-SPBE LT, CEVE-VASC LT, and CEVE-VAME.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

The RIVI LG includes the shrub species swamp gooseberry (RILA), squaw currant (RICE), and Oregon boxwood (PAMY) in addition to sticky currant (RIVI). These species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. Oregon boxwood, although more shade-tolerant, generally declines after an increase in cover following fire or logging disturbance. The layer types defined are: RIVI-RIVI LT, RIVI-SASC LT, RIVI-AMAL LT, RIVI-SPBE LT, RIVI-VASC LT, and RIVI-VAME LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has five defined layer types: SASC-SASC LT, SASC-AMAL LT, SASC-SPBE LT, SASC-VASC LT, and SASC-VAME LT.

Serviceberry is a mid-seral shrub that dominated some disturbed sites in the ABGR/VAME plant association. It has a fleshy fruit with seed that are dispersed by animals and birds. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of serviceberry as increased light levels encourage vigor in the multi-stemmed shrub. Four layer types represent community development towards the climax state: AMAL-AMAL LT, AMAL-SPBE LT, AMAL-VASC LT, and AMAL-VAME LT.

Spirea and common snowberry are late-seral shrub species of this plant association and form the SPBE LG. SPBE is a low shrub reproducing vegetatively by rhizomes in post-disturbance communities. Seedlings were rarely found. It is moderately shade-tolerant and persists under overstory canopies. Common snowberry is a late-seral, medium shrub that sprouts readily from rhizomes or rootcrowns following fire. Birds and small mammals disperse seed and aid SYAL regeneration (small groups of seedlings had the appearance of rodent caches). These shrubs withstand soil scarification and ripping; recovery may be rapid.

The VASC LG includes four late-seral species: grouse huckleberry (VASC), low huckleberry (VAMY), dwarf huckleberry (VACA), and Utah honeysuckle (LOUT2). These shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/VASC plant association. Utah honeysuckle regenerates quickly from rhizomes following fire or logging disturbance. The huckleberries revegetate sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of these shrubs are susceptible to moderate and high intensity fires in addition to mechanical scarification of the top six inches of soil and duff. Two layer types are defined in this group: VASC-VASC LT and VASC-VAME LT.

The VAME LG includes the mid-shrub, big huckleberry (VAME), a rhizomatous and shade-tolerant species that persists in climax forests of the ABGR/VAME plant association. Big huckleberry revegetates sites through sprouting rhizomes; seedling regeneration appears to be rare and unimportant. The relatively shallow rhizomes of big huckleberry are susceptible to moderate and high intensity fires. The shrub species is sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. One layer types is defined in this group: VAME-VAME LT.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. Differential responses of snowbrush ceanothus, sticky currant, and big huckleberry are related to many of these factors. For example, a low intensity spring burn of a recently logged site may result in no change in big huckleberry, a large increase in sticky currant, and no ceanothus germinants. Yet the same fire in the fall, with a moderate intensity burn, may result in a decline in big huckleberry, a small increase in sticky currant, and abundant ceanothus germinants. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. The former case could result in the identification of the RIVI-VAME LT while the latter case could be the CEVE-CEVE LT.

Management Implications

The potential shrub layer types in the ABGR/VAME plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus provides ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Sticky currant, swamp gooseberry, squaw currant, and Oregon boxwood provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants and gooseberries also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

Serviceberry and common snowberry provide food for grouse and other non-game birds but are not preferred browse by deer or elk. Bear eat serviceberry fruit as it ripens in late summer. Shrubfields can provide hiding and thermal cover for these big game species. Spirea provides browse for ungulates but is not a preferred species.

The huckleberries provide fruit used by bear, grouse, non-game birds, and small mammals. In addition, they provide browse for wild ungulates and domestic livestock. The recreational use of big huckleberry shrubfields for berry-picking attracts forest visitors in late summer.

Logging impacts to forested plant communities are related to the season of disturbance as well as the perturbating activity (machine scarification, broadcast burning, pile and burn, etc.). A truncated disturbance regime relative to a time factor is found in the Intermountain West as logging has not been a historical disturbance factor in the same timescale as fire. Nonetheless, the impacts of machine scarification differentially affect species establishment, survival, and growth. In grand fir plant associations, for example, huckleberry species are susceptible to this type of disturbance. More information is needed concerning community and species responses to these types of disturbance regimes.

Table 28. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/VAME p.a.

Key	Result
1. CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a. CIVU dominant[3]	CIVU-CIVU LT
1b. CARO[4] dominant or codominant	CIVU-CARO LT
1c. LUPIN[5] dominant or codominant	CIVU-LUPIN LT
1d. PTAQ dominant or codominant	CIVU-PTAQ LT
1e. FRVE[6] dominant or codominant	CIVU-FRVE LT
1f. CAGE[7] dominant or codominant	CIVU-CAGE LT
1g. CARU[8] dominant or codominant	CIVU-CARU LT
1h. THOC[9] dominant or codominant	CIVU-THOC LT
1. CIVU < 5% canopy coverage	2
2. CARO ≥ 5% canopy coverage	CARO LG
2a. CARO dominant	CARO-CARO LT
2b. LUPIN dominant or codominant	CARO-LUPIN LT
2c. PTAQ dominant or codominant	CARO-PTAQ LT
2d. FRVE dominant or codominant	CARO-FRVE LT
2e. CAGE dominant or codominant	CARO-CAGE LT
2f. CARU dominant or codominant	CARO-CARU LT
2g. THOC dominant or codominant	CARO-THOC LT
2. CARO < 5% canopy coverage	3
3. LUPIN ≥ 5% canopy coverage	LUPIN LG
3a. LUPIN dominant	LUPIN-LUPIN LT
3b. PTAQ dominant or codominant	LUPIN-PTAQ LT
3c. FRVE dominant or codominant	LUPIN-FRVE LT
3d. CAGE dominant or codominant	LUPIN-CAGE LT
3e. CARU dominant or codominant	LUPIN-CARU LT
3f. THOC dominant or codominant	LUPIN-THOC LT
3. LUPIN < 5% canopy coverage	4
4. PTAQ ≥ 5% canopy coverage	PTAQ LG
4a. PTAQ dominant	PTAQ-PTAQ LT
4b. FRVE dominant or codominant	PTAQ-FRVE LT
4c. CAGE dominant or codominant	PTAQ-CAGE LT
4d. CARU dominant or codominant	PTAQ-CARU LT
4e. THOC dominant or codominant	PTAQ-THOC LT
4. PTAQ < 5% canopy coverage	5
5. FRVE ≥ 5% canopy coverage	FRVE LG
5a. FRVE dominant	FRVE-FRVE LT
5b. CAGE dominant or codominant	FRVE-CAGE LT
5c. CARU dominant or codominant	FRVE-CARU LT
5d. THOC dominant or codominant	FRVE-THOC LT
5. FRVE < 5% canopy coverage	6
6. CAGE ≥ 5% canopy coverage	CAGE LG
6a. CAGE dominant	CAGE-CAGE LT
6b. CARU dominant or codominant	CAGE-CARU LT
6c. THOC dominant or codominant	CAGE-THOC LT
6. CAGE < 5% canopy coverage	7
7. CARU ≥ 5% canopy coverage	CARU LG
7a. CARU dominant	CARU-CARU LT
7b. THOC dominant or codominant	CARU-THOC LT
7. CARU < 5% canopy coverage	8
8. THOC ≥ 5% canopy coverage	THOC LG
8a. THOC dominant	THOC-THOC LT
8. THOC < 5% canopy coverage	depauperate or undefined layer or not ABGR/VAME p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU, VETH, and MONTI.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO and CACO.
[5] LUPIN refers to the following group of species: LUPIN and THMO.
[6] FRVE refers to the following group of species: FRVE and FRVI.
[7] CAGE refers to the following group of species: CAGE and ASCO.
[8] CARU refers to the following group of species: CARU, ARCO, and ADBI.
[9] THOC refers to the following group of species: THOC, PYSE, and MIST2.

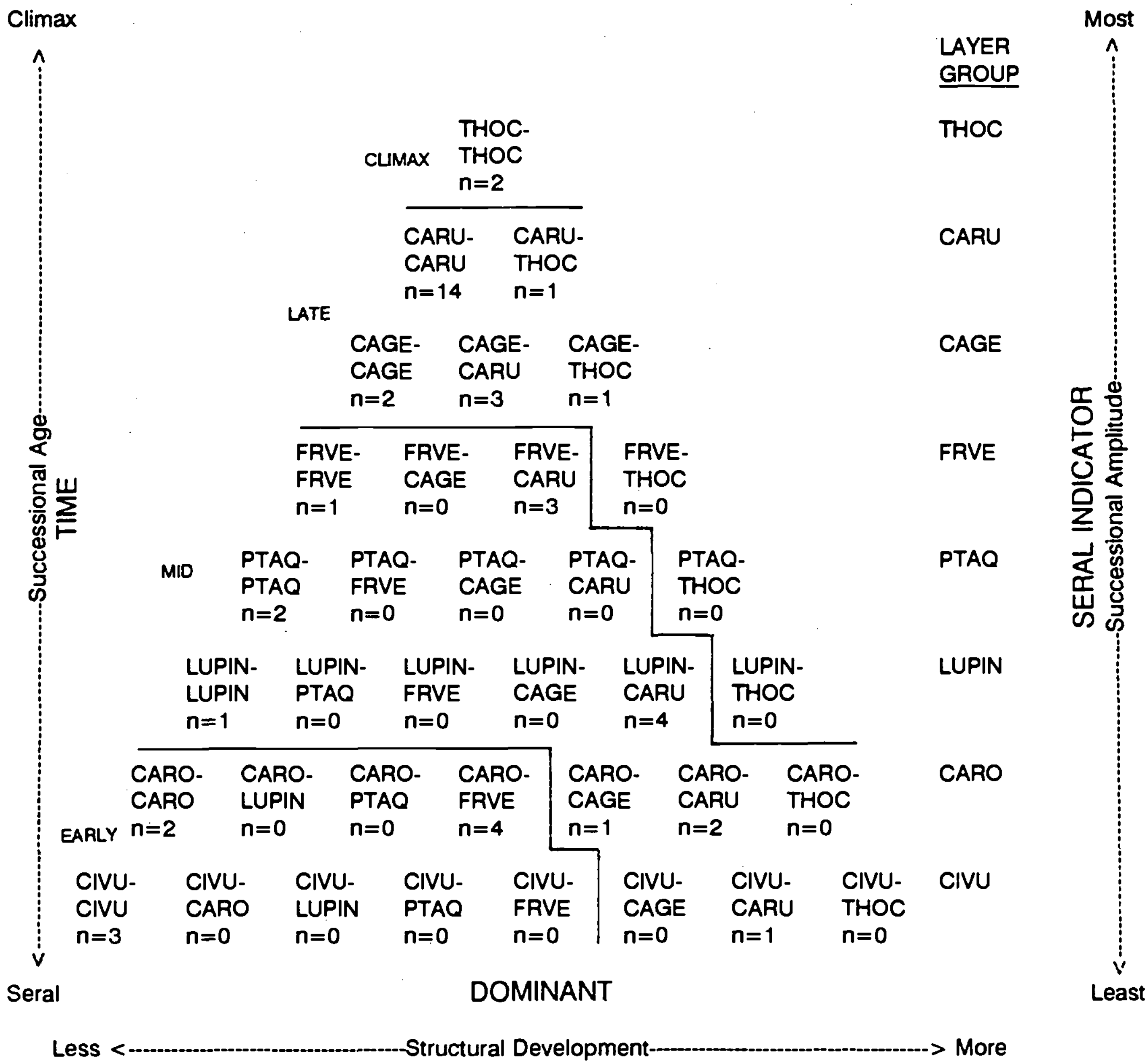


Figure 16. Succession classification diagram of the herb layer in the ABGR/VAME p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), flannel mullein (VETH), montia (MONTI), Ross sedge (CARO), northwestern sedge (CACO), lupine (LUPIN), golden-pea (THMO), braken-fern (PTAQ), woods strawberry (FRVE), broadpetal strawberry (FRVI), elk sedge (CAGE), showy aster (ASCO), heartleaf arnica (ARCO), trail plant (ADBI), pinegrass (CARU), western meadowrue (THOC), mitella (MIST2), and sidebells pyrola (PYSE). The classification diagram (Fig. 16) depicts the herb layer groups and herb layer types. CIVU, MONTI, and VETH are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. THOC, a climax herbaceous species, appears at the top of the figure.

Bull thistle and flannel mullein are tap-rooted, alien biennials that establish on recently disturbed sites of this plant association. Montia are native perennial and annual plants. CIVU is a composite with windblown seed; VETH is a tall plant dispersed via dihescent capsules. VETH and MONTI can be locally abundant in a disturbed patch but seldom have the coverage of the wind-dispersed CIVU. The CIVU LG includes these species and has eight layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-LUPIN LT, CIVU-PTAQ LT, CIVU-FRVE LT, CIVU-CAGE LT, CIVU-CARU LT, and CIVU-THOC LT.

The CARO LG includes the sedges CARO and CACO. Ross sedge and northwestern sedge increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). The CARO LG has seven layer types defined: the CARO-CARO LT, CARO-LUPIN LT, CARO-PTAQ LT, CARO-FRVE LT, CARO-CAGE LT, CARO-CARU LT, and CARO-THOC LT.

Lupines and golden-pea are perennial herbs abundant in early- and mid-seral stands. Like other members of the pea family, these species fix nitrogen and are important members of post-fire communities in the ABGR/VAME plant association. The LUPIN LG has six layer types defined: the LUPIN-LUPIN LT, LUPIN-PTAQ LT, LUPIN-FRVE LT, LUPIN-CAGE LT, LUPIN-CARU LT, and LUPIN-THOC LT.

Braken-fern, PTAQ, is a mid-seral, perennial herb that reproduces vegetatively by rhizomes or through wind-dispersed spores. It is moderately shade-tolerant and can persist beneath partial tree canopies and in stand openings and edges. Five layer types are defined: PTAQ-PTAQ LT, PTAQ-FRVE LT, PTAQ-CAGE LT, PTAQ-CARU LT, and PTAQ-THOC LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has four layer types: FRVE-FRVE LT, FRVE-CAGE LT, FRVE-CARU LT, and FRVE-THOC LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the AGBR/VAME plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. Showy aster is a perennial, rhizomatous forb that is occasionally well represented in the ABGR/VAME understory. ASCO is moderately shade-tolerant. This species group forms three layer types within the CAGE LG: the CAGE-CAGE LT, CAGE-CARU LT, and CAGE-THOC LT.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. Trail plant (ADBI) is grouped with heartleaf arnica in the CARU LG. Both ARCO and ADBI, members of the sunflower family, produce achenes dispersed by wind. ARCO, in addition, can reproduce by rhizomes. The herbaceous species, pinegrass, is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in additoin to sprouting from underground rhizomes. The two layer types in the CARU LG are the CARU-CARU LT and the CARU-THOC LT.

Western meadowrue, mitella, and sidebells pyrola compose a group of shade-tolerant, perennial forbs of climax stands used to define the THOC LG. All occasionally dominate the herbaceous layer although THOC is the most constant and abundant member of the layer group. The sole layer type defined is the THOC-THOC LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The early seral species CARO is favored by conditions created during mechanical scarification while PTAQ is favored by burning.

The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. The CARU-CARU LT following a light intensity fire would recycle to an CARU-CARU LT because of this species ability to regenerate quickly from rhizomes and to flower and set seed. Both of these regeneration strategies allow CARU to quickly increase in abundance following such disturbances.

Management Implications

The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine is favored by burning and is beneficial in its role as a nitrogen fixer.

The species of the herb layer within the ABGR/VAME plant association react differentially to disturbance events and impact management of the forest ecosystems. One such impact is through allelopathy, the effect a plant has on another by producing inhibitory or stimulatory biochemical compounds. Braken-fern demonstrated inhibitory characteristics on other vegetation through the production of volatile or water-soluble compounds. The sources of these compounds lie in the senescent leaf litter of PTAQ (Ferguson and Boyd 1988). Conifer regeneration may be delayed in layer types where this species dominates the understory.

The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. The FRVE-FRVE LT was found in 20 to 25 year old harvest units that had been burned. Golden-pea is favored by burning and is beneficial in its role as a nitrogen fixer.

Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries. CARU and CAGE competition in plantations is a management concern in the ABGR/VAME plant association.

TABLE 29. Mean canopy coverage and constancy of tree species by layer type in the ABGR/VAME p.a.

TREE LAYER GROUP	PICO																LAOC			
TREE LAYER TYPE	PICO-PICO				PICO-LAOC				PICO-PIPO				PICO-PSME				LAOC-LAOC			
NUMBER OF STANDS	18				1				2				2				6			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR	9/38		1/22	4/33				3/100				3/100			5/50	5/50		5/17		4/66
ABLA2	3/5			1/5																
LAOC	5/5			5/5	12/100	10/100		1/100			3/100	5/100	3/50				13/83	1/66		7/83
PIEN	1/5			5/5								2/100								1/17
PICO	20/33	14/33	8/33	11/33	10/100			10/100		5/50		8/50	5/50	5/100		1/50	2/17			2/50
PIMO																				5/17
PIPO	2/11			5/5				1/100	25/50		20/50	30/50	10/50				6/33	1/17		1/66
POTR												1/50								
PSME	10/5			2/16								1/50	25/100		20/50	15/100	8/33			4/50
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	LAOC				PIPO												PSME			
TREE LAYER TYPE	LAOC-ABGR				PIPO-PIPO				PIPO-PSME				PIPO-ABGR				PSME-PSME			
NUMBER OF STANDS	2				5				2				6				5			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR	10/50	20/50	5/50	13/100			3/80	5/80				3/50	7/83	9/83	9/100	9/100			3/60	10/80
ABLA2			1/50																	5/20
LAOC	8/100			3/50	1/20			2/20									2/60		1/20	
PIEN				1/50															3/40	3/20
PICO		3/50		1/50									2/16	1/16		1/16	1/20		1/20	
PIMO																				
PIPO	5/50				30/60	3/40	20/60	12/80	13/100	1/100	1/50	5/50	13/100	2/100		1/50	1/20			
POTR																				
PSME				5/50	5/20		3/40	1/40	27/100	15/50		6/100	4/50	3/50		1/50	26/80	8/80	5/60	4/80
BASAL AREA (FT²/AC)																				

TABLE 29 (cont.). Mean canopy coverage and constancy of tree species by layer type in the ABGR/VAME p.a.

TREE LAYER GROUP	PSME				ABGR			
TREE LAYER TYPE	PSME-ABGR				ABGR-ABGR			
NUMBER OF STANDS	4				3			
SIZE CLASSES	D	I	P	S	D	I	P	S
Species								
ABGR	22/25	5/25	3/100	26/100	9/66	17/66	7/100	17/100
ABLA2				2/50				
LAOC				2/25				
PIEN		2/25	2/75	1/75				
PICO	1/25							
PIMO	13/25	4/25		1/25				
PIPO				1/25				
POTR								
PSME	40/50		3/50	3/50	3/33			
BASAL AREA (FT²/AC)								

TABLE 30. **Mean canopy coverage and constancy of shrub species by layer type in the ABGR/VAME p.a.**

SHRUB LAYER GROUP	CEVE			ARNE		RIVI	SASC		
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-RIVI	CEVE-VAME	ARNE-ARNE	ARNE-VAME	RIVI-VAME	SASC-SASC	SASC-SPBE	SASC-VAME
NUMBER OF STANDS	3	1	1	4	4	5	1	1	4
Species									
ACGL						1/20			
ALSI									
AMAL			5/100					3/100	20/25
ARNE	2/33			14/50	11/100	1/20			
ARUV				33/50					
BENE									
CESA									
CEVE	52/100	50/100	13/100	1/25		2/20			1/25
CELE									
CHUM			1/100	1/50	2/100	4/60	1/100		2/75
HODI	5/33					1/20			
LIBO2									
LOUT2		5/100	3/100			5/20	1/100	1/100	1/75
PAMY	2/33	65/100			2/100	8/80	1/100		
PHMA								1/100	
RICE				1/25		3/40			
RILA									
RIVI	5/33	10/100	1/100			11/40			1/25
ROGY	1/33		2/100		3/50	1/20			1/50
RUPA						1/20			
SASC	6/66	25/100	20/100	1/25	1/25	3/20	15/100	5/100	11/100
SHCA				1/25	1/50				
SPBE	18/66		6/100	13/25	5/75	4/40		20/100	20/50
SYAL	3/33			4/25	2/25	4/40			
SYOR			1/100						
TABR									
VACA									
VAME	13/100	10/100	65/100	9/100	29/100	47/100		20/100	58/100
VAMY									
VASC				6/75	12/75	7/20			

TABLE 30 (cont.). Mean canopy coverage and constancy of shrub species by layer type in the ABGR/VAME p.a.

SHRUB LAYER GROUP	AMAL	SPBE		VASC	VAME
SHRUB LAYER TYPE	AMAL-AMAL	SPBE-SPBE	SPBE-VAME	VASC-VAME	VAME-VAME
NUMBER OF STANDS	2	1	7	7	16
Species					
ACGL	1/50		1/14		1/6
ALSI			1/14		
AMAL	45/100	1/100	1/42	3/14	1/6
ARNE			2/28	2/14	2/12
ARUV				1/14	1/18
BENE					
CESA					
CEVE					1/18
CELE					
CHUM	1/50	1/100	3/71	2/71	4/75
HODI					1/6
LIBO2					
LOUT2	1/50		1/14	13/42	1/12
PAMY			2/42	2/42	1/56
PHMA			3/28		
RICE					
RILA					1/25
RIVI		1/100		1/14	2/37
ROGY	1/50	1/100	3/28	1/28	3/6
RUPA					
SASC		3/100	2/28	2/42	1/43
SHCA			1/14	1/14	1/12
SPBE	3/100	15/100	9/100	2/28	2/25
SYAL	20/50			1/14	
SYOR				1/14	
TABR					
VACA					
VAME	17/100	10/100	42/100	30/100	32/100
VAMY					
VASC			2/14	17/57	1/25

TABLE 31. Mean canopy coverage and constancy of herb species by layer type in the ABGR/VAME p.a.

HERB LAYER GROUP	CIVU		CARO				LUPIN	
HERB LAYER TYPE	CIVU-CIVU	CIVU-CARU	CARO-CARO	CARO-FRVE	CARO-CAGE	CARO-CARU	LUPIN-LUPIN	LUPIN-CARU
NUMBER OF STANDS	3	1	2	4	1	2	1	4
Species								
ACMI	1/33		1/50	3/100		1/50	1/100	1/33
ADBI	1/33					1/50		
AGUR								
ANMA								1/25
ANTEN				10/25		2/100		1/25
APAN								
ARCO	7/33	20/100				1/50		27/50
ASCO					10/100			
ASCA7				2/75				1/25
BRVU				2/50				1/25
CARU			2/100	9/50	5/100	13/100		52/75
CACO	3/100		12/100	18/50		5/50		
CAGE	3/33	10/100	4/50	7/50	5/100	3/50	2/100	3/25
CARO	6/66	5/100	2/50	9/100	10/100	5/100		1/50
CAMI2								
CIVU	30/100	5/100	1/50				1/100	1/25
CLUN								
ELGL								
FEOC		3/100	2/50	10/50		2/100		1/50
FRVE	3/66		1/100	25/100	5/100	1/50	8/100	2/50
FRVI			4/100		1/100	5/50		5/50
GOOB		1/100				1/50		1/25
HIAL	1/33	20/100	1/100	1/25		2/50	1/100	2/100
LUPIN	3/33		2/50					24/75
MIST2	1/33		1/50	10/25			1/100	1/25
MONTI	15/33							
PONE								
PTAQ								
PYAS								
PYSE		1/100	2/100	5/25		1/50		1/25
RUOC							1/100	
SMST								
THOC	1/33							3/25
THMO							35/100	30/25
VETH	1/33	10/100				1/50		
VIOR2	5/66			3/25				1/25

TABLE 31 (cont.). Mean canopy coverage and constancy of herb species by layer type in the ABGR/VAME p.a.

HERB LAYER GROUP	PTAQ	FRVE		CAGE			CARU		THOC
HERB LAYER TYPE	PTAQ-PTAQ	FRVE-FRVE	FRVE-CARU	CAGE-CAGE	CAGE-CARU	CAGE-THOC	CARU-CARU	CARU-THOC	THOC-THOC
NUMBER OF STANDS	2	1	3	2	3	1	14	1	2
Species									
ACMI		2/100							
ADBI				1/50					
AGUR									
ANMA							1/36		
ANTEN	2/50	3/100			10/33			1/100	1/50
APAN									
ARCO	3/50		3/33	2/50	22/100		12/50	10/100	1/50
ASCO				1/50	12/100		2/14		1/50
ASCA7			1/33						
BRVU	10/50	1/100	1/33			3/100	1/7	3/100	1/100
CARU			28/100	5/50	42/100	1/100	15/85		
CACO							2/57	1/100	1/50
CAGE	5/50	3/100		10/100	3/33	5/100	1/35		1/50
CARO		2/100	1/33				1/50		1/50
CAMI2					3/33				
CIVU							1/7		
CLUN									
ELGL			1/33	1/50			1/7		
FEOC			1/33		1/33	1/100	1/35		
FRVE	6/100	5/100	13/100	3/50	2/66		2/50	1/100	2/100
FRVI	1/50		10/33				1/7		
GOOB			1/33	1/50	2/100	10/100	1/28	5/100	5/50
HIAL	1/50		8/66	1/50	1/33	1/100	2/71		
LUPIN					1/33		2/14		
MIST2	3/50		10/33				1/7	10/100	1/50
MONTI							1/7		
PONE									
PTAQ	40/100								
PYAS						1/100			
PYSE		2/100		1/50	5/33	20/100	2/7	5/100	3/100
RUOC									
SMST			1/33				1/21	1/100	
THOC			8/66	2/100	2/100		1/42	20/100	18/100
THMO									
VETH									
VIOR2			1/33	1/50			1/28	5/100	4/100

Grand fir/grouse huckleberry-twinflower plant association

Abies grandis/Vaccinium scoparium-Linnaea borealis

ABGR/VASC-LIBO2 (CWS8 12)

PICO overstory with ABGR saplings; PICO-PICO LT with potential for PICO-ABGR LT (Lick Creek area, North Fork John Day RD, Umatilla NF)

The ABGR/VASC-LIBO2 plant association was described for the Blue Mountain Province by Johnson and Clausnitzer (1992). It occurs on gentle to moderately steep slopes between 4,200 and 6,000 feet in the central and southern Blue Mountains. This plant community is often found in cold-air drainages or on exposed ridges.

In climax and late successional stands, grouse huckleberry (VASC) and, occasionally, dwarf huckleberry (VAMY) or twinflower (LIBO2) dominate a low shrub layer occurring under grand fir (ABGR), Engelmann spruce (PIEN), and Douglas-fir (PSME). Other shrubs include prince's pine (CHUM), and Oregon boxwood (PAMY). Common herbaceous associates are elk sedge (CAGE), northwestern sedge (CACO), pinegrass (CARU), heartleaf arnica (ARCO), white hawkweed (HIAL), sidebells pyrola (PYSE), rattlesnake plantain (GOOB), violets (VIOLA), and strawberries (FRVE and FRVI).

Table 32. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/VASC-LIBO2 p.a.

1. PICO ≥ 5% canopy coverage[2]	PICO LG
1a. PICO dominant[3]	PICO-PICO LT
1b. LAOC dominant or codominant	PICO-LAOC LT
1c. PSME dominant or codominant	PICO-PSME LT
1d. PIEN dominant or codominant	PICO-PIEN LT
1e. ABGR dominant or codominant	PICO-ABGR LT
1. PICO < 5% canopy coverage	2
2. LAOC ≥ 5% canopy coverage	LAOC LG
2a. LAOC dominant	LAOC-LAOC LT
2b. PSME dominant or codominant	LAOC-PSME LT
2c. PIEN dominant or codominant	LAOC-PIEN LT
2d. ABGR dominant or codominant	LAOC-ABGR LT
2. LAOC < 5% canopy coverage	3
3. PSME ≥ 5% canopy coverage	PSME LG
3a. PSME dominant	PSME-PSME LT
3b. PIEN dominant or codominant	PSME-PIEN LT
3c. ABGR dominant or codominant	PSME-ABGR LT
3. PSME < 5% canopy coverage	4
4. PIEN ≥ 5% canopy coverage	PIEN LG
4a. PIEN dominant	PIEN-PIEN LT
4b. ABGR dominant or codominant	PIEN-ABGR LT
4. PIEN < 5% canopy coverage	5
5. ABGR ≥ 5% canopy coverage	ABGR LG
5a. ABGR dominant	ABGR-ABGR LT
5. ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/VASC-LIBO2 p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

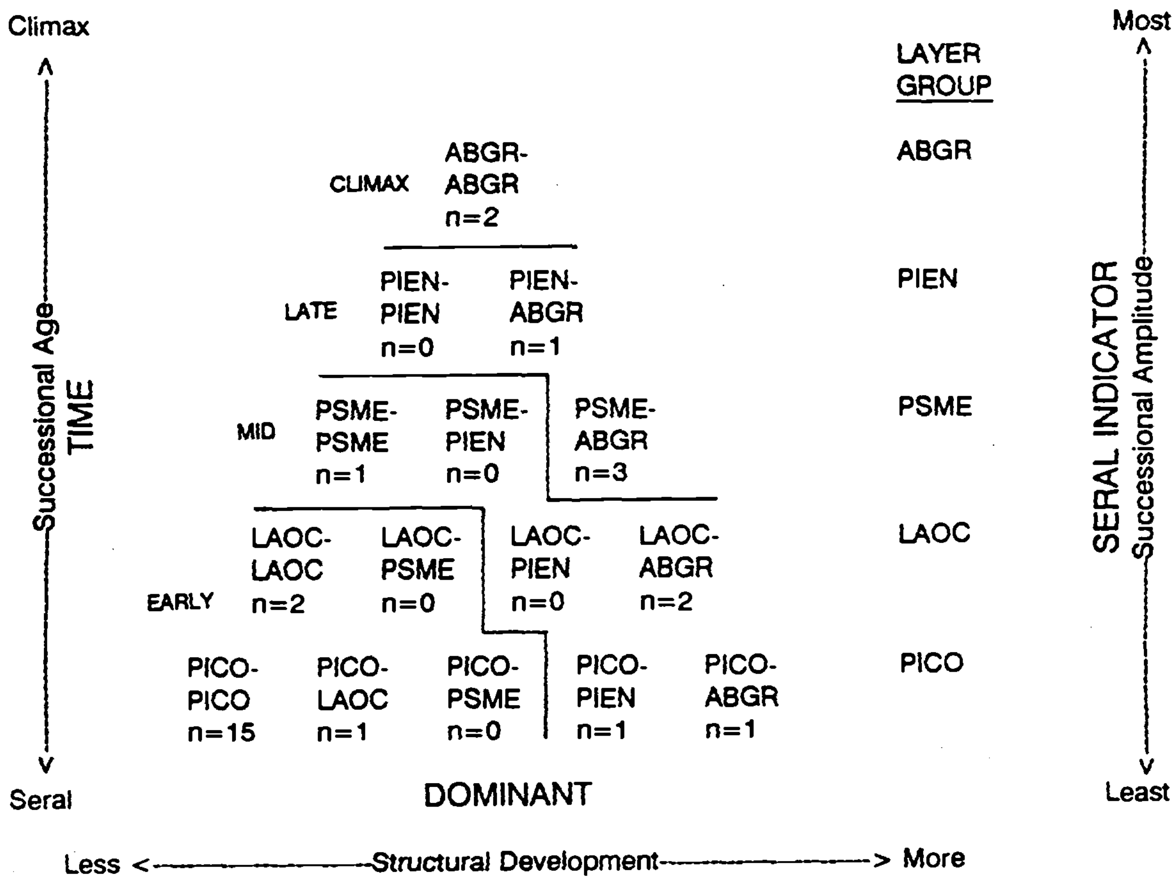


Figure 17. Succession classification diagram of the tree layer in the ABGR/VASC-LIBO2 p.a.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 17) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/VASC-LIBO2 plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the four seral tree species (PICO, LAOC, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/VASC-LIBO2 plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/VASC-LIBO2 plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/VASC-LIBO2 plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, a moderate-intensity burn in the PICO-LAOC LT may lead to no change in layer type designation. Fire-sensitive lodgepole pine could produce seedlings from residual trees or from trees on the unburned perimeter while fire-resistent larch could maintain or increase populations following the disturbance. Tree diameter distributions and silvical characteristics interact to determine whether species are differentially impacted by a single or recurrent events.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 17) depicts the distribution of major tree species in the ABGR/VASC-LIBO2 plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, mid-seral, and early seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, and LAOC-LAOC LT.

Table 33. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/VASC-LIBO2 p.a.

---

1. ARNE[2] ≥ 5% canopy coverage ....ARNE LG
   - 1a. ARNE dominant[3] .... ARNE-ARNE LT
   - 1b. SHCA dominant or codominant .... ARNE-SHCA LT
   - 1c. SASC dominant or codominant .... ARNE-SASC LT
   - 1d. ALSI dominant or codominant .... ARNE-ALSI LT
   - 1e. LIBO2[4] dominant or codominant .... ARNE-LIBO2 LT

1. ARNE < 5% canopy coverage 2

   2. SHCA ≥ 5% canopy coverage ....SHCA LG
      - 2a. SHCA dominant .... SHCA-SHCA LT
      - 2b. SASC dominant or codominant .... SHCA-SASC LT
      - 2c. ALSI dominant or codominant .... SHCA-ALSI LT
      - 2d. LIBO2 dominant or codominant .... SHCA-LIBO2 LT

   2. SHCA < 5% canopy coverage 3

3. SASC ≥ 5% canopy coverage ....SASC LG
   - 3a. SASC dominant .... SASC-SASC LT
   - 3b. ALSI dominant or codominant .... SASC-ALSI LT
   - 3c. LIBO2 dominant or codominant .... SASC-LIBO2 LT

3. SASC < 5% canopy coverage 4

   4. ALSI ≥ 5% canopy coverage ....ALSI LG
      - 4a. ALSI dominant .... ALSI-ALSI LT
      - 4b. LIBO2 dominant or codominant .... ALSI-LIBO2 LT

   4. ALSI < 5% canopy coverage 5

5. LIBO2 ≥ 5% canopy coverage ....LIBO2 LG
   - 5a. LIBO2 dominant .... LIBO2-LIBO2 LT

5. LIBO2 < 5% canopy coverage ....depauperate or undefined layer or not ABGR/VASC-LIBO2 p.a.

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[1] When determination of LT is made, stop at the first applicable condition.
[2] ARNE refers to the following group of species: ARNE and ARUV.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] LIBO2 refers to the following group of species: VASC, VACA, VAMY, and LIBO2.

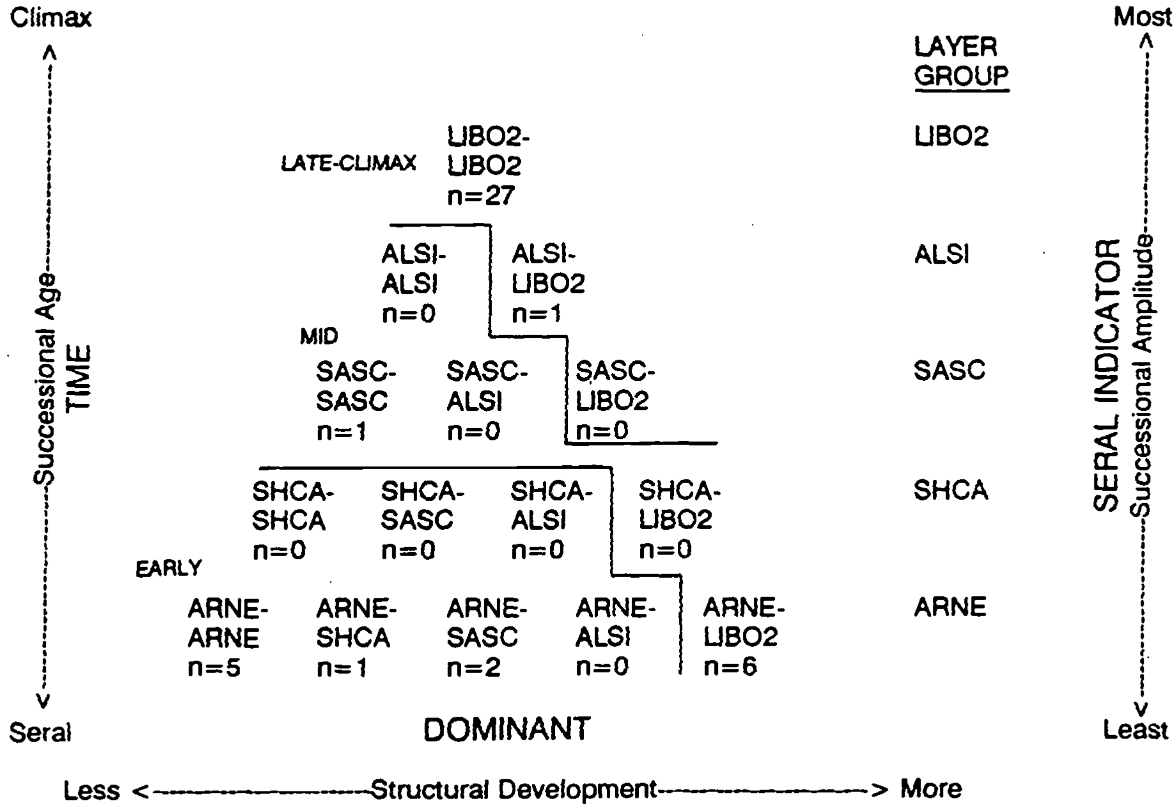


Figure 18. Succession classification diagram of the shrub layer in the ABGR/VASC-LIBO2 p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include pinemat manzanita (ARNE), bearberry (ARUV), buffaloberry (SHCA), Scouler willow (SASC), Sitka alder (ALSI), twinflower (LIBO2), grouse huckleberry (VASC), dwarf huckleberry (VACA), and low huckleberry. The classification diagram (Fig. 18) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, ARNE, forms the base while the species with the most successional amplitude, LIBO2 and VASC, appears at the top of the figure. This implies that pinemat manzanita is restricted to early successional stages while twinflower and grouse huckleberry are found in all stages.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has three defined layer types: SASC-SASC LT, SASC-ALSI LT, and SASC-LIBO2 LT.

Sitka alder is a mid-seral shrub that dominated some disturbed sites in the ABGR/VASC-LIBO2 plant association. It has light, windblown seed that is dispersed from scattered seeps and stream banks. It establishes on moist mineral soil exposed by fire or logging. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of Sitka alder as increased light levels encourage vigor in the multi-stemmed shrub. Two layer types represent community development towards the climax state: ALSI-ALSI LT and ALSI-LIBO2 LT.

The LIBO2 LG includes four late seral to climax species: twinflower (LIBO2), grouse huckleberry (VASC), dwarf huckleberry (VACA), and low huckleberry (VAMY). These low shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/VASC-LIBO2 plant association. The huckleberries revegetate sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of huckleberries are susceptible to moderate and high intensity fires. The shrub species are sensitive to mechanical scarification of the top six inches of soil and duff because of shallow rhizomes. Twinflower revegetates from shallow rhizomes principally in the upper soil and duff layers. Fire or logging that remove or disturb these layers lead to the decline in twinflower cover. Plants in favorable microsites that escape the disturbance become centers of recolonization; this centrifugal expansion is a slow process. A single layer type is defined for this climax group: LIBO2-LIBO2 LT.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study. Many of the shrubs within the ABGR/VASC-LIBO2 are fire-resistant, individual shrubs resprout from underground rhizomes or root crowns. Twinflower is the most fire-susceptible.

Management Implications

The potential shrub layer types in the ABGR/VASC-LIBO2 plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Buffaloberry and Sitka alder also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

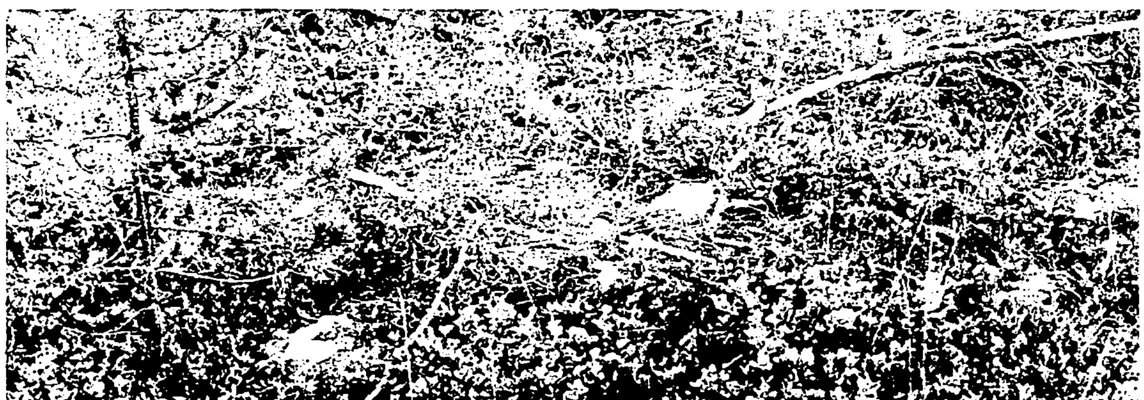
Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Buffaloberry is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

Sitka alder provides food for grouse and other non-game birds but is not a preferred browse by deer or elk. Shrubfields can provide hiding and thermal cover for these big game species, however.

The huckleberries have fruit used by bear, grouse, non-game birds, and small mammals. In addition, they provide browse for wild ungulates and domestic livestock.



Post-disturbance shrub layer type is ARNE-ARNE LT on ABGR/VASC-LIBO2 site that was machine scarified (Dry Creek, La Grande RD, Wallowa-Whitman NF)

Table 34. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/VASC-LIBO2 p.a.

1.	CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a.	CIVU dominant[3]	CIVU-CIVU LT
1b.	CARO[4] dominant or codominant	CIVU-CARO LT
1c.	LUPIN dominant or codominant	CIVU-LUPIN LT
1d.	FRVE[5] dominant or codominant	CIVU-FRVE LT
1e.	CAGE dominant or codominant	CIVU-CAGE LT
1f.	CARU[6] dominant or codominant	CIVU-CARU LT
1.	CIVU < 5% canopy coverage	2
2.	CARO ≥ 5% canopy coverage	CARO LG
2a.	CARO dominant	CARO-CARO LT
2b.	LUPIN dominant or codominant	CARO-LUPIN LT
2c.	FRVE dominant or codominant	CARO-FRVE LT
2d.	CAGE dominant or codominant	CARO-CAGE LT
2e.	CARU dominant or codominant	CARO-CARU LT
2.	CARO < 5% canopy coverage	3
3.	LUPIN ≥ 5% canopy coverage	LUPIN LG
3a.	LUPIN dominant	LUPIN-LUPIN LT
3b.	FRVE dominant or codominant	LUPIN-FRVE LT
3c.	CAGE dominant or codominant	LUPIN-CAGE LT
3d.	CARU dominant or codominant	LUPIN-CARU LT
3.	LUPIN < 5% canopy coverage	4
4.	FRVE ≥ 5% canopy coverage	FRVE LG
4a.	FRVE dominant	FRVE-FRVE LT
4b.	CAGE dominant or codominant	FRVE-CAGE LT
4c.	CARU dominant or codominant	FRVE-CARU LT
4.	FRVE < 5% canopy coverage	5
5.	CAGE ≥ 5% canopy coverage	CAGE LG
5a.	CAGE dominant	CAGE-CAGE LT
5b.	CARU dominant or codominant	CAGE-CARU LT
5.	CAGE < 5% canopy coverage	6
6.	CARU ≥ 5% canopy coverage	CARU LG
6a.	CARU dominant	CARU-CARU LT
6.	CARU < 5% canopy coverage	depauperate or undefined layer or not ABGR/VASC-LIBO2 p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU, ANTEN, and ANMA.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO, CACO, and FEOC.
[5] FRVE refers to FRAGARIA SPP.
[6] CARU refers to the following group of species: CARU and ARCO.

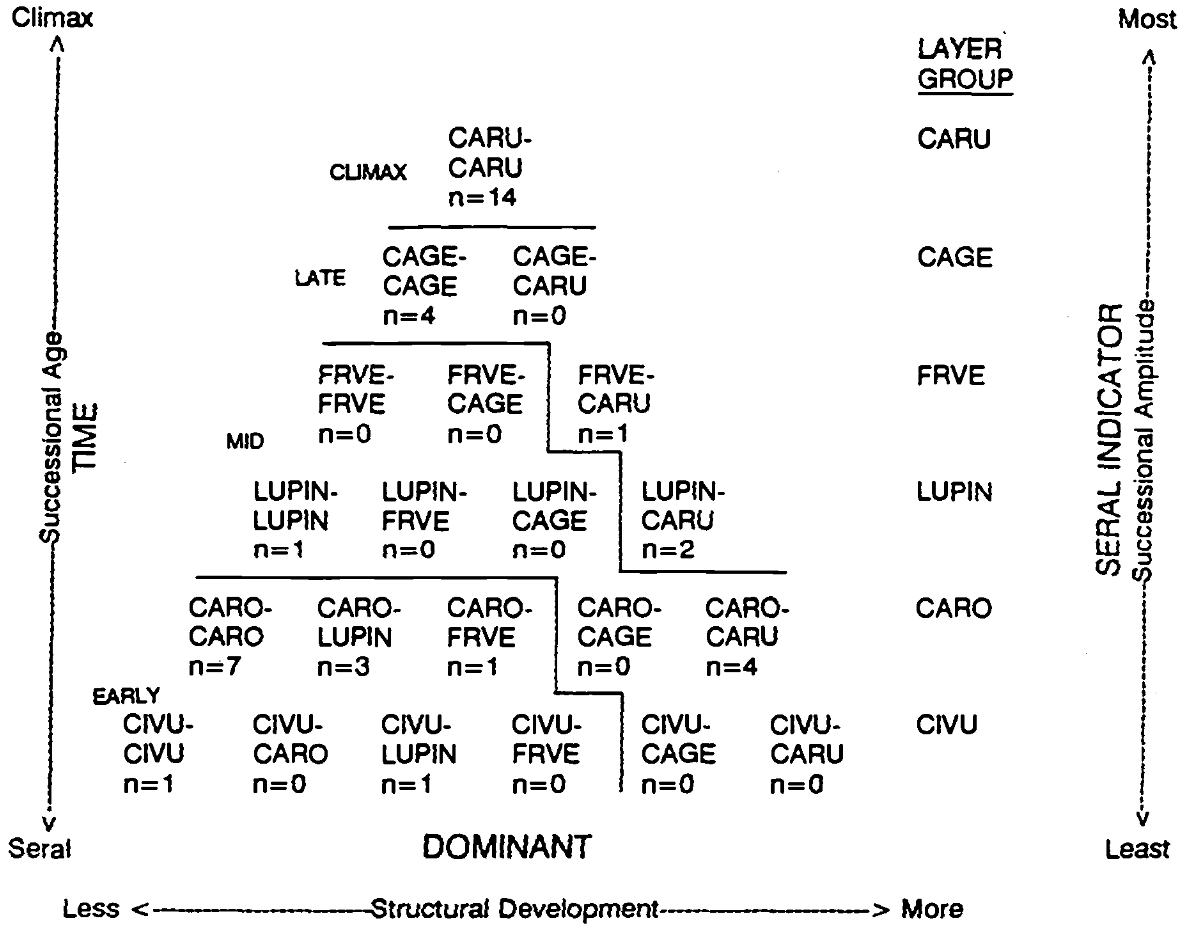


Figure 19. Succession classification diagram of the herb layer in the ABGR/VASC-LIBO2 p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pearly-everlasting (ANMA), pussy-toes (ANTEN), Ross sedge (CARO), northwestern sedge (CACO), western fescue (FEOC), lupine (LUPIN), woods strawberry (FRVE), broadpetal strawberry (FRVI), elk sedge (CAGE), heartleaf arnica (ARCO), and pinegrass (CARU). The classification diagram (Fig. 19) depicts the herb layer groups and herb layer types. CIVU, ANMA, and ANTEN are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. CARU, a climax herbaceous species, appears at the top of the figure.

Bull thistle is a tap-rooted, alien biennial that establishes on recently disturbed sites of this plant association. Pearly-everlasting and pussytoes are native perennials. CIVU, ANMA, and ANTEN are composites with windblown seed. ANMA and ANTEN can be locally abundant in a disturbed patch but seldom has the coverage of the wind-dispersed CIVU. The CIVU LG includes these species and has six layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-LUPIN LT, CIVU-FRVE LT, CIVU-CAGE LT, and CIVU-CARO LT.

The CARO LG includes the sedges, CARO and CACO, and the graminoid, FEOC. Ross sedge and northwestern sedge increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge reponse may be inhibited by burning (Steele and Geier-Hayes 1987b). Western fescue was abundant in some early successional stages but will decline in coverage over time. The CARO LG has five layer types.

Lupines are perennial herbs abundant in early- and mid-seral stands. Like other members of the pea family, lupines fix nitrogen and are important members of post-fire communities in the ABGR/VASC-LIBO2 plant association. The LUPIN LG has four layer types defined: the LUPIN-LUPIN LT, LUPIN-FRVE LT, LUPIN-CAGE LT, and LUPIN-CARU LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-CAGE LT, and FRVE-CARU LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/VASC-LIBO2 plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. It forms two layer types within the CAGE LG: the CAGE-CAGE LT and CAGE-CARU LT.

The climax herbaceous species, pinegrass, is a rhizomatous grass of moderate shade-tolerance. Heartleaf arnica is a rhizomatous forb that persists in the shade of an overstory canopy. These herbs regenerate quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from underground rhizomes. The sole layer type in the CARU LG is the CARU-CARU LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands

and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. Following a low intensity burn, the CIVU-CARO LT could develop as a CIVU-CAGE LT or even a CAGE-CAGE LT depending on the associated species in the CIVU-CARO LT and the severity and timing of the burn.

Management Implications

The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine is favored by burning and is beneficial in its role as a nitrogen fixer. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries. CARU and CAGE competition in plantations is a management concern in the ABGR/VASC-LIBO2 plant association.

Pinegrass dominates herb layer with western fescue cover of 10%; the CARO-CARU LT of the ABGR/VASC-LIBO2 p.a. (Ditch Creek, Heppner RD, Umatilla NF)

TABLE 35. Mean canopy coverage and constancy of tree species by layer type in the ABGR/VASC-LIBO2 p.a.

TREE LAYER GROUP	PICO															
TREE LAYER TYPE	PICO-PICO				PICO-LAOC				PICO-PIEN				PICO-ABGR			
NUMBER OF STANDS	15				1				1				2			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR	28/6	2/6	1/80	5/80		2/100	6/100	3/100		2/100		5/100	21/100	7/100		7/100
ABLA2				2/13												
LAOC	4/40	1/40		1/60	25/100	2/100			4/100				4/100	3/100		
PIEN			1/26	3/26							5/100	25/100				
PICO	17/53	3/53	1/100	22/100	5/100	2/100			18/100	2/100		1/100		4/50		16/100
PIMO				1/13												
PIPO				1/13				1/100								
POTR																
PSME	2/13	2/13	1/66	2/66				7/100					6/50			1/100
BASAL AREA (FT²/AC)																

TREE LAYER GROUP	LAOC								PSME								PIEN			
TREE LAYER TYPE	LAOC-LAOC				LAOC-ABGR				PSME-PSME				PSME-ABGR				PIEN-ABGR			
NUMBER OF STANDS	2				2				1				3				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR		2/100		2/100	15/100	3/100	1/100	3/100		2/100		2/100	17/100	13/100		6/66	35/100	30/100	10/100	3/100
ABLA2		2/50		1/50		1/50		1/50											1/100	1/100
LAOC	19/100	5/100			6/100	1/100			3/100	1/100										
PIEN					5/50	2/50	5/50	1/50									22/100	2/100	1/100	
PICO				1/100	1/50			2/50				1/100			2/33				1/100	
PIMO																				
PIPO								1/50												
POTR																				
PSME		2/50		1/100	5/50			1/50	15/100			1/100	10/100	3/100		1/33				
BASAL AREA (FT²/AC)																				

TABLE 35 (cont.). **Mean canopy coverage and constancy of tree species by layer type in the ABGR/VASC-LIBO2 p.a.**

TREE LAYER GROUP	ABGR			
TREE LAYER TYPE	ABGR-ABGR			
NUMBER OF STANDS	2			
SIZE CLASSES	D	I	P	S
Species				
ABGR	32/100	5/100	6/100	13/100
ABLA2				
LAOC	2/50			1/50
PIEN				1/50
PICO				1/100
PIMO				
PIPO				
POTR				
PSME				1/50
BASAL AREA (FT^2/AC)				

TABLE 36. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/VASC-LIBO2 p.a.

SHRUB LAYER GROUP	ARNE				SASC	ALSI	LIBO2
SHRUB LAYER TYPE	ARNE-ARNE	ARNE-SHCA	ARNE-SASC	ARNE-LIBO2	SASC-SASC	ALSI-LIBO2	LIBO2-LIBO2
NUMBER OF STANDS	5	1	2	6	1	1	27
Species							
ACGL					1/100		
ALSI			5/100		1/100	8/100	3/3
AMAL	1/20						1/25
ARNE	29/100	25/100	8/100	20/83	3/100	1/100	2/66
ARUV				8/16			1/3
BENE							
CESA							
CEVE			3/50				1/7
CELE							
CHUM	2/20	1/100	1/100	1/66	1/100	4/100	2/77
HODI							
LIBO2	3/100	3/100		6/83	1/100	54/100	11/96
LOUT2							
PAMY	1/80	1/100	3/50	3/66		1/100	2/70
PHMA							
RICE	1/20						
RILA							1/7
RIVI		1/50					
ROGY	2/40			1/16			1/25
RUPA							
SASC		3/100	28/100	2/50	15/100		1/18
SHCA	8/20	30/100	3/50	3/33	1/100	1/100	1/14
SPBE	6/40			5/50			2/55
SYAL	1/20			1/33			1/18
SYOR	1/40						
TABR							
VACA							3/3
VAME	3/20	2/100	1/50	3/33			2/29
VAMY							25/3
VASC	5/80	15/100	8/100	26/100	1/100	8/66	32/96

TABLE 37. **Mean canopy coverage and constancy of herb species by layer type in the ABGR/VASC-LIBO2 p.a.**

HERB LAYER GROUP	CIVU		CARO				LUPIN	
HERB LAYER TYPE	CIVU-CIVU	CIVU-LUPIN	CARO-CARO	CARO-LUPIN	CARO-FRVE	CARO-CARU	LUPIN-LUPIN	LUPIN-CARU
NUMBER OF STANDS	1	1	7	3	1	4	1	2
Species								
ACMI	1/100	1/100	1/42	1/33		1/75		2/50
ADBI								
AGUR								
ANMA	3/100		1/42		1/100			
ANTEN	1/100	6/100	1/56			1/25		1/100
APAN								
ARCO	1/100	1/100	1/28	1/33		1/25		2/50
ASCO			1/14			3/25		
ASCA7								
BRVU		1/100						
CARU		15/100	5/71	16/100		26/100	10/100	33/100
CACO			3/57	2/100		5/75	1/100	1/50
CAGE	1/100	1/100	6/42			2/50		2/100
CARO			17/42		10/100	10/25		
CAMI2								
CIVU	1/100		1/85			1/75		1/100
CLUN								
ELGL								
FEOC			5/57	3/100		4/75	1/100	1/50
FRVE			9/42	2/66	10/100			1/50
FRVI	1/100	15/100	2/42	1/66		2/75	1/100	3/50
GOOB			1/42					
HIAL	1/100	1/100	1/100	2/100	1/100	1/100		1/100
LUPIN		20/100	7/56	43/100		1/75	16/100	5/100
MIST2								
MONTI		1/100						
PONE								
PTAQ					1/100			
PYAS								
PYSE			2/28	i/33	1/100	1/50		
RUOC								
SMST								
THOC								
THMO								
VETH						1/25		
VIOR2	1/100		2/28	1/66	1/100	1/50		1/50

TABLE 37 (cont.). Mean canopy coverage and constancy of herb species by layer type in the ABGR/VASC-LIBO2 p.a.

HERB LAYER GROUP	FRVE	CAGE	CARU
HERB LAYER TYPE	FRVE-CARU	CAGE-CAGE	CARU-CARU
NUMBER OF STANDS	1	4	14
Species			
ACMI	1/100	2/50	1/21
ADBI			
AGUR			
ANMA			
ANTEN	1/100		1/14
APAN			
ARCO		1/50	2/21
ASCO			1/14
ASCA7			
BRVU			1/7
CARU	30/100	5/50	11/92
CACO			2/85
CAGE	12/100	25/100	1/35
CARO		2/50	
CAMI2			
CIVU		1/50	1/21
CLUN			1/7
ELGL			
FEOC			1/64
FRVE			1/57
FRVI	20/100		1/64
GOOB			1/42
HIAL		1/75	2/85
LUPIN	1/100		1/35
MIST2		1/25	1/7
MONTI			
PONE			
PTAQ			
PYAS			
PYSE			1/14
RUOC			
SMST			1/7
THOC		1/25	1/7
THMO			
VETH			
VIOR2		1/25	1/21

Grand fir/Grouse huckleberry plant association

Abies grandis/Vaccinium scoparium

ABGR/VASC (CWS8 11)

ABGR/VASC site dominated by lodgepole pine (Pole Spring, Burns RD, Malheur NF)

The ABGR/VASC plant association was described for the Blue Mountain Province by Hall (1973) and Johnson and Clausnitzer (1992). It occurs in the central and southern portion of the province at elevations from 4,200 feet to 6,400 feet. The community is found principally on northerly exposures in a mosaic of relatively xeric vegetation or in cold basins and exposed ridgetops.

In climax and late successional stands, grouse huckleberry (VASC) or dwarf huckleberry (VAMY) dominate a low shrub layer beneath a canopy of grand fir (ABGR); Douglas-fir (PSME) and Engelmann spruce occur as overstory associates. Common shrub species include prince's pine (CHUM), Oregon boxwood (PAMY), and spirea (SPBE). Pinemat manzanita (ARNE) and buffaloberry (SHCA) represent earlier seral communities. The dominant herb is pinegrass (CARU) with elk sedge (CAGE), northwestern sedge (CACO), white hawkweed (HIAL), heartleaf arnica (ARCO), and strawberries (FRVE and FRVI) associated.

Table 38. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/VASC p.a.

1. PICO ≥ 5% canopy coverage[2] .... PICO LG
   - 1a. PICO dominant[3] .... PICO-PICO LT
   - 1b. LAOC dominant or codominant .... PICO-LAOC LT
   - 1c. PIPO dominant or codominant .... PICO-PIPO LT
   - 1d. PSME dominant or codominant .... PICO-PSME LT
   - 1e. PIEN dominant or codominant .... PICO-PIEN LT
   - 1f. ABGR dominant or codominant .... PICO-ABGR LT

1. PICO < 5% canopy coverage 2

   2. LAOC ≥ 5% canopy coverage .... LAOC LG
      - 2a. LAOC dominant .... LAOC-LAOC LT
      - 2b. PIPO dominant or codominant .... LAOC-PIPO LT
      - 2c. PSME dominant or codominant .... LAOC-PSME LT
      - 2d. PIEN dominant or codominant .... LAOC-PIEN LT
      - 2e. ABGR dominant or codominant .... LAOC-ABGR LT

   2. LAOC < 5% canopy coverage 3

3. PIPO ≥ 5% canopy coverage .... PIPO LG
   - 3a. PIPO dominant .... PIPO-PIPO LT
   - 3b. PSME dominant or codominant .... PIPO-PSME LT
   - 3c. PIEN dominant or codominant .... PIPO-PIEN LT
   - 3d. ABGR dominant or codominant .... PIPO-ABGR LT

3. PIPO < 5% canopy coverage 4

   4. PSME ≥ 5% canopy coverage .... PSME LG
      - 4a. PSME dominant .... PSME-PSME LT
      - 4b. PIEN dominant or codominant .... PSME-PIEN LT
      - 4c. ABGR dominant or codominant .... PSME-ABGR LT

   4. PSME < 5% canopy coverage 5

5. PIEN ≥ 5% canopy coverage .... PIEN LG
   - 5a. PIEN dominant .... PIEN-PIEN LT
   - 5b. ABGR dominant or codominant .... PIEN-ABGR LT

5. PIEN < 5% canopy coverage 6

   6. ABGR ≥ 5% canopy coverage .... ABGR LG
      - 6a. ABGR dominant .... ABGR-ABGR LT

   6. ABGR < 5% canopy coverage .... depauperate or undefined layer or not ABGR/VASC p.a.

[1] When determination of LT is made, stop at the first applicable condition.

[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.

[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

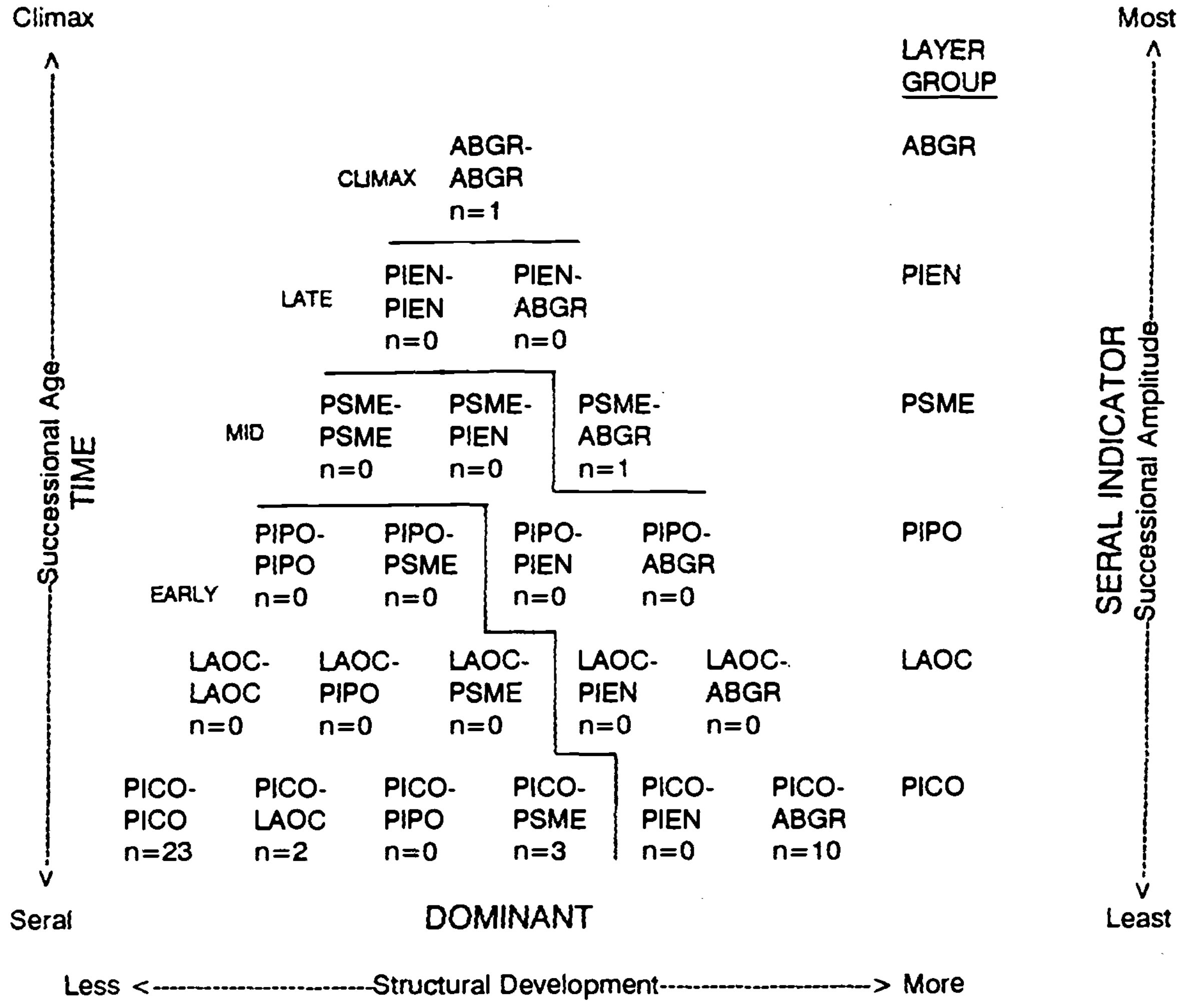


Figure 20. Succession classification diagram of the tree layer in the ABGR/VASC p.a.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), Engelmann spruce (PIEN), and grand fir (ABGR). The classification diagram (Fig. 20) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, Engelmann spruce, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, late seral Engelmann spruce, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir, Englemann spruce, and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT, PSME-PIEN LT, and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

Englemann spruce is a late seral tree in the ABGR/VASC plant association. This long-lived, shade-tolerant species can become established early in the sere where it establishes best on mineral soil seedbeds. It can also develop under canopies where shade and humidity lead to moist environmental conditions on organic seedbeds. Two layer types are defined for the PIEN LG: PIEN-PIEN LT and PIEN-ABGR LT.

In the absence of the five seral tree species (PICO, LAOC, PIPO, PSME, and PIEN), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/VASC plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/VASC plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/VASC plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 20) depicts the distribution of major tree species in the ABGR/VASC plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PIPO, PSME, PIEN, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir, Engelmann spruce, and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 39. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/VASC p.a.

---

1. ARNE[2] ≥ 5% canopy coverage ....ARNE LG
   - 1a. ARNE dominant[3] .... ARNE-ARNE LT
   - 1b. SHCA dominant or codominant .... ARNE-SHCA LT
   - 1c. SASC dominant or codominant .... ARNE-SASC LT
   - 1d. VASC[4] dominant or codominant .... ARNE-VASC LT

1. ARNE < 5% canopy coverage..2

   2. SHCA ≥ 5% canopy coverage ....SHCA LG
      - 2a. SHCA dominant .... SHCA-SHCA LT
      - 2b. SASC dominant or codominant .... SHCA-SASC LT
      - 2c. VASC dominant or codominant .... SHCA-VASC LT

   2. SHCA < 5% canopy coverage 3

3. SASC ≥ 5% canopy coverage...SASC LG
   - 3a. SASC dominant... SASC-SASC LT
   - 3b. VASC dominant or codominant .... SASC-VASC LT

3. SASC < 5% canopy coverage...4

   4. VASC ≥ 5% canopy coverage ....VASC LG
      - 4a. VASC dominant .... VASC-VASC LT

   4. VASC < 5% canopy coverage ....depauperate or undefined layer or not ABGR/VASC p.a.

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[1] When determination of LT is made, stop at the first applicable condition.
[2] ARNE refers to the following group of species: ARNE and ARUV.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] VASC refers to the following group of species: VASC, VAMY, and CHUM.

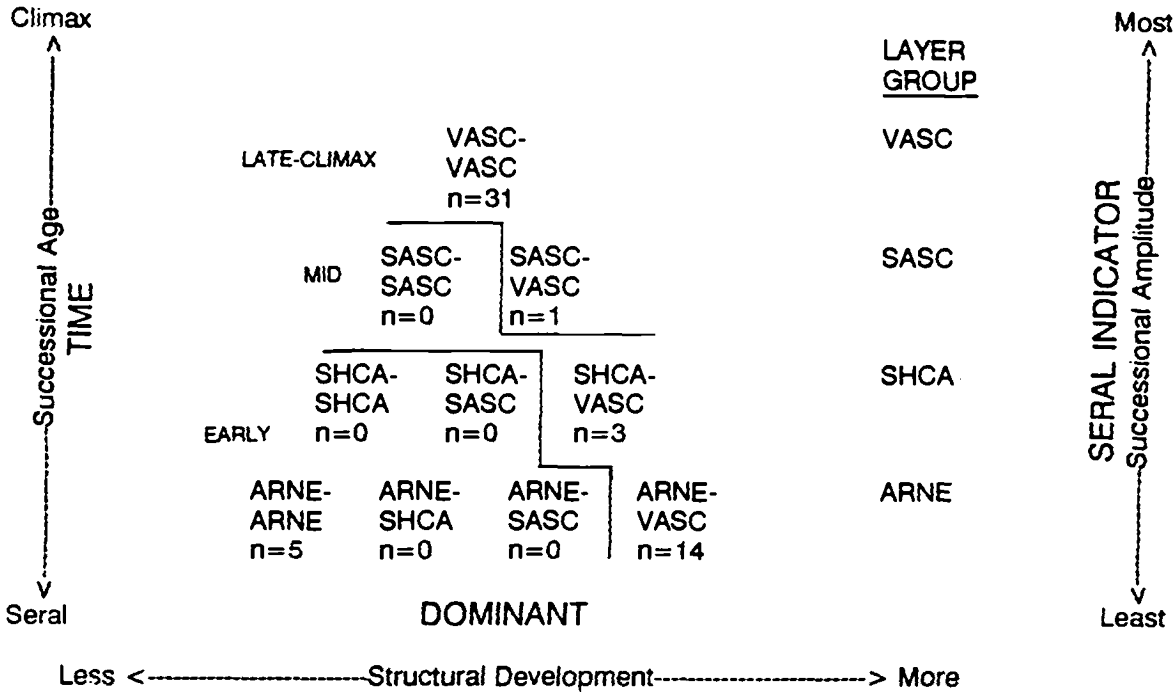


Figure 21. Succession classification diagram of the shrub layer in the ABGR/VASC p.a.

Shrub understory representative of ARNE-ARNE LT in shelterwood regeneration unit of ABGR/VASC p.a. (Pole Spring, Burns RD, Malheur NF)

SHRUB LAYER

Description

Shrubs dominant during different successional stages include pinemat manzanita (ARNE), bearberry (ARUV), buffaloberry (SHCA), Scouler willow (SASC), grouse huckleberry (VASC), low huckleberry (VAMY), and prince's pine (CHUM). The classification diagram (Fig. 21) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, ARNE, forms the base while the species with the most successional amplitude, VASC, appears at the top of the figure. This implies that pinemat manzanita is restricted to early successional stages while grouse huckleberry is found in all stages.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

Buffaloberry is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/VASC plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. SHCA sprouts from the rootcrown following disturbance; seed dispersed by animals is also a source of regeneration on these sites. The SHCA LG has three layer types: the SHCA-SHCA LT, SHCA-SASC LT, and SHCA-VASC LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has two defined layer types: SASC-SASC LT and SASC-VASC LT.

The VASC LG includes three late seral to climax species: grouse huckleberry (VASC), low huckleberry (VAMY), and prince's pine (CHUM). These low shrubs are rhizomatous and shade-tolerant; they persist in climax forests of the ABGR/VASC plant association. Prince's pine regenerates quickly from rhizomes in the soil and duff layers following fire or logging disturbance. The huckleberries revegetate sites through sprouting rhizomes; seedling regeneration appears to be rare. The relatively shallow rhizomes of these shrubs are susceptible to moderate and high intensity fires in addition to mechanical scarification of the top six inches of soil and duff. One layer types is defined in this climax group: VASC-VASC LT.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study.

Management Implications

The potential shrub layer types in the ABGR/VASC plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Buffaloberry provides ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery.

The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Russet buffaloberry's role in forest succession is limited to the coldest plant associations of the grand fir series. In the ABGR/VASC plant association, where CEVE is rare or absent, SHCA is an early successional shrub that fixes nitrogen. SHCA provides fruit for grouse, songbirds, and bear. It also provides valuable browse for ungulates in the central and southern Blue Mountains where browse species are low in abundance.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

The huckleberries have fruit used by bear, grouse, non-game birds, and small mammals. In addition, they provide browse for wild ungulates and domestic livestock.

Heavily browsed SHCA in understory of ABGR/VASC p.a. (Pole Spring, Burns RD, Malheur NF)

Table 40. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/VASC p.a.

1.	CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a.	CIVU dominant[3]	CIVU-CIVU LT
1b.	CARO[4] dominant or codominant	CIVU-CARO LT
1c.	LUPIN[5] dominant or codominant	CIVU-LUPIN LT
1d.	FRVE[6] dominant or codominant	CIVU-FRVE LT
1e.	CAGE dominant or codominant	CIVU-CAGE LT
1f.	CARU dominant or codominant	CIVU-CARU LT
1.	CIVU < 5% canopy coverage	2
2.	CARO ≥ 5% canopy coverage	CARO LG
2a.	CARO dominant	CARO-CARO LT
2b.	LUPIN dominant or codominant	CARO-LUPIN LT
2c.	FRVE dominant or codominant	CARO-FRVE LT
2d.	CAGE dominant or codominant	CARO-CAGE LT
2e.	CARU dominant or codominant	CARO-CARU LT
2.	CARO < 5% canopy coverage	3
3.	LUPIN ≥ 5% canopy coverage	LUPIN LG
3a.	LUPIN dominant	LUPIN-LUPIN LT
3b.	FRVE dominant or codominant	LUPIN-FRVE LT
3c.	CAGE dominant or codominant	LUPIN-CAGE LT
3d.	CARU dominant or codominant	LUPIN-CARU LT
3.	LUPIN < 5% canopy coverage	4
4.	FRVE ≥ 5% canopy coverage	FRVE LG
4a.	FRVE dominant	FRVE-FRVE LT
4b.	CAGE dominant or codominant	FRVE-CAGE LT
4c.	CARU dominant or codominant	FRVE-CARU LT
4.	FRVE < 5% canopy coverage	5
5.	CAGE ≥ 5% canopy coverage	CAGE LG
5a.	CAGE dominant	CAGE-CAGE LT
5b.	CARU dominant or codominant	CAGE-CARU LT
5.	CAGE < 5% canopy coverage	6
6.	CARU ≥ 5% canopy coverage	CARU LG
6a.	CARU dominant	CARU-CARU LT
6.	CARU < 5% canopy coverage	depauperate or undefined layer or not ABGR/VASC p.a.

1 When determination of LT is made, stop at the first applicable condition.
2 CIVU refers to the following group of species: CIVU and ANTEN.
3 Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
4 CARO refers to the following group of species: CARO, CACO, and FEOC.
5 LUPIN refers to LUPINUS SPP.
6 FRVE refers to FRAGARIA SPP.

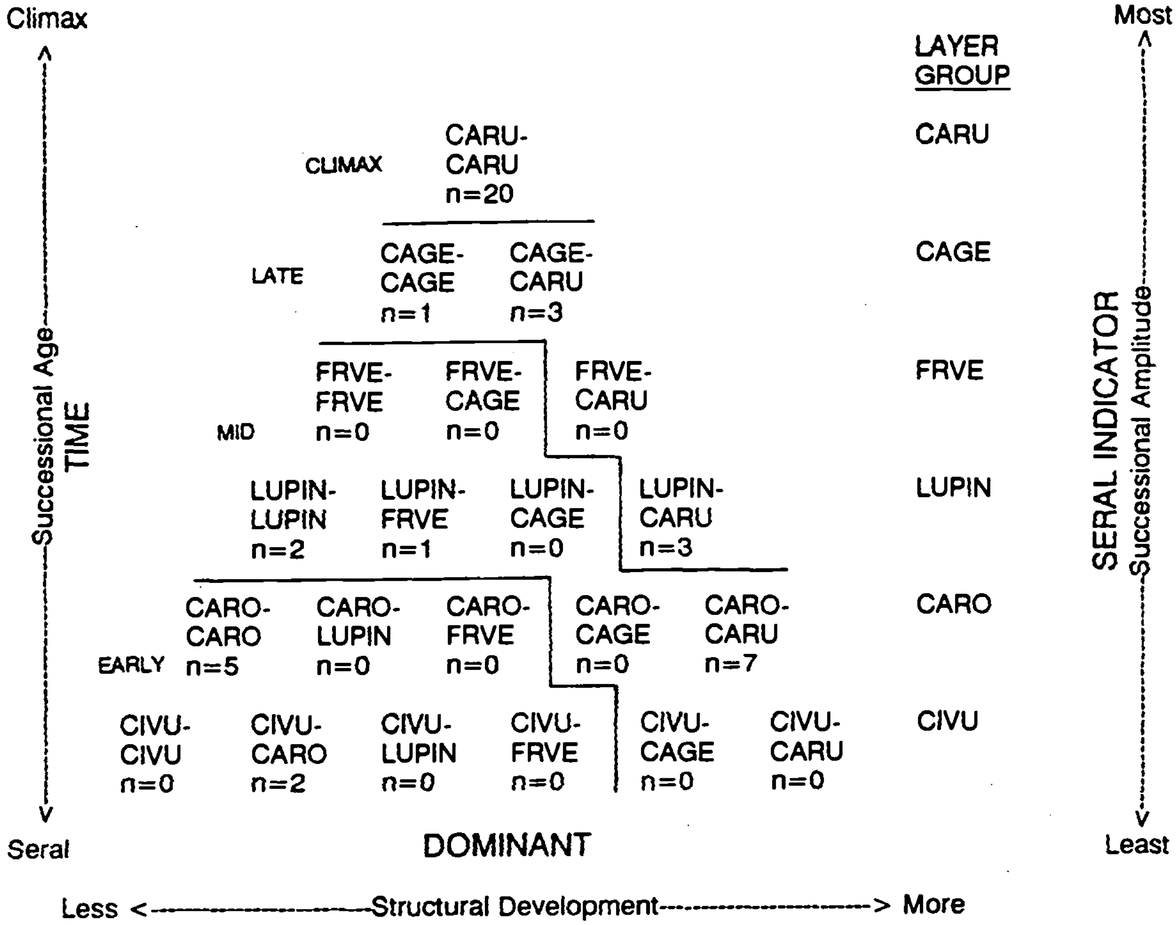


Figure 22. Succession classification diagram of the herb layer in the ABGR/VASC p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pussytoes (ANTEN), Ross sedge (CARO), northwestern sedge (CACO), western fescue (FEOC), lupine (LUPIN), woods strawberry (FRVE), broadpetal strawberry (FRVI), elk sedge (CAGE), and pinegrass (CARU). The classification diagram (Fig. 22) depicts the herb layer groups and herb layer types. CIVU is a herb species with the least successional amplitude and forms the base of the diagram. CARU, a climax herbaceous species, appears at the top of the figure.

Bull thistle (CIVU) is a tap-rooted, alien biennial that establishes on recently disturbed sites of this plant association. CIVU, a member of the sunflower family with windblown seed, germinates and developes on soil bared by fire or logging. Litter is not an effective seedbed in this xeric plant association. Pussytoes (ANTEN) are native perennials that increase in early successional stages through the establishment of wind dispersed seed. Pussytoes can be locally abundant but are not as widely distributed as bull thistle. The CIVU LG includes these species and has six layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-LUPIN LT, CIVU-FRVE LT, CIVU-CAGE LT, and CIVU-CARU LT.

The CARO LG includes the sedges, CARO and CACO, and the graminoid, FEOC. Ross sedge and northwestern sedge increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). Western fescue was abundant in some early successional stages but will decline in coverage over time. The CARO LG has five layer types defined.

Lupines are perennial herbs abundant in early- and mid-seral stands. Like other members of the pea family, lupines fix nitrogen and are important members of post-fire communities in the ABGR/VASC plant association. The LUPIN LG has four layer types defined: the LUPIN-LUPIN LT, LUPIN-FRVE LT, LUPIN-CAGE LT, and LUPIN-CARU LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-CAGE LT, and FRVE-CARU LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/VASC plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. It forms two layer types within the CAGE LG: the CAGE-CAGE LT and the CAGE-CARU LT.

The climax herbaceous species, pinegrass, is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from underground rhizomes. The sole layer type in the CARU LG is the CARU-CARU LT.

Successional Dynamics

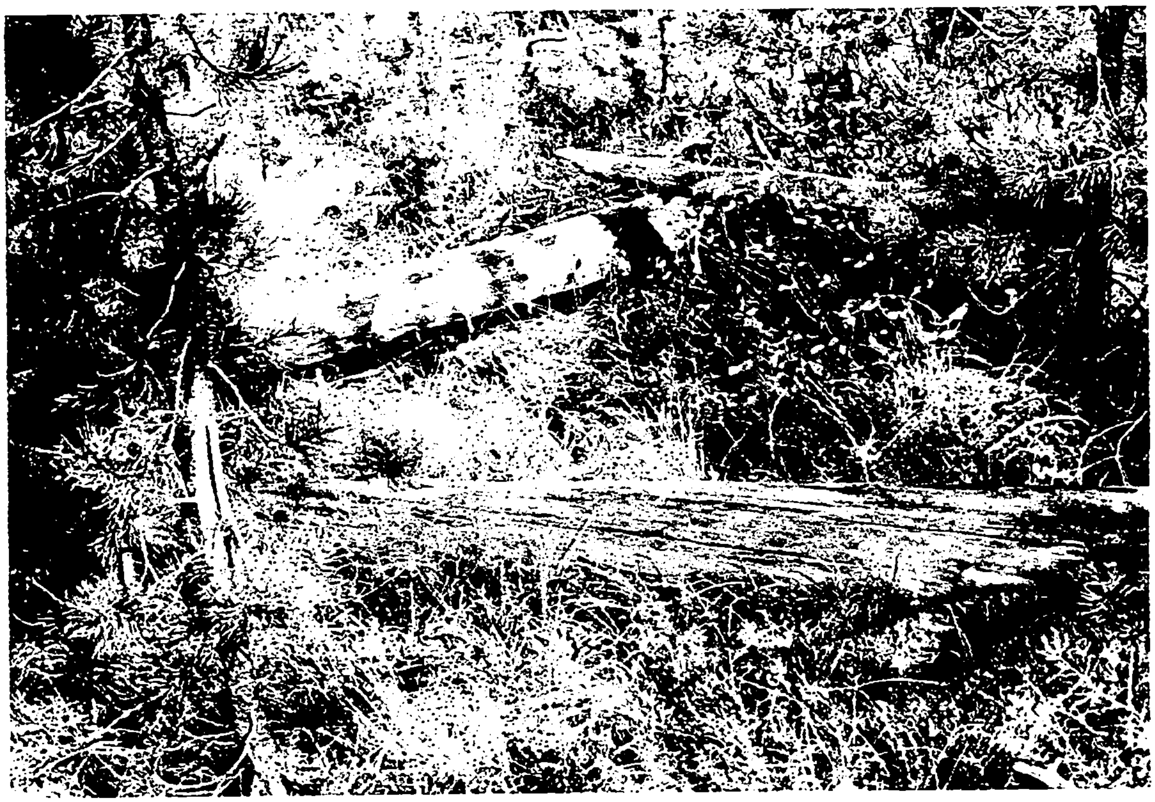
During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands

and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. Following a low intensity burn, the CIVU-CARO LT could develop as a CIVU-CAGE LT or even a CAGE-CAGE LT depending on the associated species in the CIVU-CARO LT and the severity and timing of the burn.

Management Implications

In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU. The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine is favored by burning and is beneficial in its role as a nitrogen fixer. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries. CARU and CAGE competition in plantations is a management concern in the ABGR/VASC plant association.



Herb layer type is climax CARU-CARU LT of ABGR/VASC plant association (Meadowbrook Creek drainage, La Grande RD, Wallowa-Whitman NF)

TABLE 41. Mean canopy coverage and constancy of tree species by layer type in the ABGR/VASC p.a.

TREE LAYER GROUP	PICO															
TREE LAYER TYPE	PICO-PICO				PICO-LAOC				PICO-PSME				PICO-ABGR			
NUMBER OF STANDS	23				2				3				10			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR	2/4			2/34		5/50	1/100	2/100	4/33	6/33		2/100	8/90	10/90	4/100	9/100
ABLA2	1/13															1/10
LAOC	13/4		1/26	3/26	19/100	3/100		2/50	7/66	1/66	4/66	1/66	7/70	1/70	1/30	1/30
PIEN	4/17			1/8									15/10	12/10		1/20
PICO	26/26	2/26	3/47	30/47	3/50	5/50		4/100		4/66	2/100	4/100	6/100	3/100	1/70	1/70
PIMO																
PIPO			2/8	3/8	4/50			1/50	5/33			2/100			1/20	3/20
POTR																
PSME	2/4			1/26				1/50	16/100	3/100	1/100	5/100		3/20	1/70	3/70
BASAL AREA (FT²/AC)																

TREE LAYER GROUP	PSME				ABGR			
TREE LAYER TYPE	PSME-ABGR				ABGR-ABGR			
NUMBER OF STANDS	1				1			
SIZE CLASSES	D	I	P	S	D	I	P	S
Species								
ABGR	8/100	10/100		1/100				10/100
ABLA2								
LAOC								1/100
PIEN								
PICO	2/100			1/100				2/100
PIMO								
PIPO		1/100						
POTR								
PSME	4/100	2/100		1/100				1/100
BASAL AREA (FT²/AC)								

TABLE 42. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/VASC p.a.

SHRUB LAYER GROUP	ARNE		SHCA	SASC	VASC
SHRUB LAYER TYPE	ARNE-ARNE	ARNE-VASC	SHCA-VASC	SASC-VASC	VASC-VASC
NUMBER OF STANDS	5	14	3	1	31
Species					
ACGL					
ALSI					
AMAL		1/7			1/3
ARNE	19/100	9/100	3/66		2/38
ARUV	25/20				
BENE					
CESA					
CEVE	1/20	1/21			1/3
CELE					
CHUM	1/60	3/85	4/100	5/100	3/45
HODI					
LIBO2					
LOUT2					
PAMY	3/40	2/42	2/66		4/48
PHMA					
RICE					
RILA					1/6
RIVI		1/14			1/3
ROGY					1/9
RUPA					
SASC		4/50		5/100	1/22
SHCA	1/20	5/35	5/100		1/12
SPBE	1/40	7/42	1/66		1/25
SYAL		1/7			1/3
SYOR					1/6
TABR					
VACA					
VAME	1/20	3/14	2/33		2/12
VAMY		16/21			33/6
VASC	8/100	41/78	35/100	5/100	34/93

TABLE 43. Mean canopy coverage and constancy of herb species by layer type in the ABGR/VASC p.a.

HERB LAYER GROUP	CIVU	CARO		LUPIN			CAGE		CARU
HERB LAYER TYPE	CIVU-CARO	CARO-CARO	CARO-CARU	LUPIN-LUPIN	LUPIN-FRVE	LUPIN-CARU	CAGE-CAGE	CAGE-CARU	CARU-CARU
NUMBER OF STANDS	2	5	7	2	1	3	1	3	20
Species									
ACMI		1/60	1/71	1/100	1/100	1/33		1/33	1/10
ADBI									
AGUR									
ANMA	1/50	1/20	1/14						
ANTEN	3/50	1/60	1/56						1/25
APAN									
ARCO	15/50		1/14	2/50	1/100	1/33	3/100		4/14
ASCO									1/5
ASCA7									
BRVU									
CARU	5/50	5/100	25/100	13/100	10/100	42/100	4/100	27/100	26/100
CACO		7/20	6/42			1/66		2/33	2/65
CAGE	8/100		6/28	2/100		4/66	35/100	7/100	2/20
CARO	15/100	24/80	5/100						1/5
CAMI2									
CIVU	7/100	1/80	1/14						1/10
CLUN									
ELGL									
FEOC		1/40	5/42			3/33	1/100		1/14
FRVE		3/40	8/71	5/50		2/66	1/100		2/30
FRVI		1/40	4/28	4/100	20/100	2/100	1/100	2/100	1/30
GOOB		1/20							1/20
HIAL	4/100	2/80	1/42	1/100		1/66	1/100		1/60
LUPIN	1/50	3/40	7/85	33/100	15/100	11/100		2/66	2/25
MIST2							3/33		
MONTI									
PONE									
PTAQ									
PYAS									1/5
PYSE	5/50	2/20				1/66			1/50
RUOC									
SMST									
THOC				1/50					
THMO									
VETH	1/50	1/20							
VIOR2									1/5

Grand fir/birchleaf spirea plant association

Abies grandis/Spiraea betulifolia

ABGR/SPBE (CWS3 21 and CWS3 22)

CEVE-CEVE LT in shrub layer of ABGR/SPBE; SASC is associated shrub species
(Big Cow Burn, Unity RD, Wallowa-Whitman NF)

This plant association was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington by Johnson and Clausnitzer (1992) and Johnson and Simon (1987). It is common in the northern and central portion of the Blue Mountains where it occurs between 3,000 and 6,300 feet in elevation on all parts of the terrain. In the Wallowa-Snake Province, the type is commonly encountered on the south flank of the Wallowa Mountains between 3,200 and 4,600 feet in elevation on lower slope positions.

In climax and late successional stands, spirea (SPBE) dominates the shrub layer under a canopy of grand fir (ABGR) with Douglas-fir (PSME) associated in the overstory. Shrubs encountered with SPBE include prince's pine (CHUM), baldhip rose (ROGY), common snowberry (SYAL), Oregon boxwood (PAMY), and creeping Oregon-grape (BERE). Pinegrass (CARU) dominates the herb layer; heartleaf arnica (ARCO), elk sedge (CAGE), sweet cicely (OSCH), white hawkweed (HIAL), and strawberries (FRVE and FRVI) are common associates.

Table 44. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/SPBE p.a.

1.	PICO ≥ 5% canopy coverage[2]	PICO LG
1a.	PICO dominant[3]	PICO-PICO LT
1b.	LAOC dominant or codominant	PICO-LAOC LT
1c.	PIPO dominant or codominant	PICO-PIPO LT
1d.	PSME dominant or codominant	PICO-PSME LT
1e.	ABGR dominant or codominant	PICO-ABGR LT
1.	PICO < 5% canopy coverage	2
2.	LAOC ≥ 5% canopy coverage	LAOC LG
2a.	LAOC dominant	LAOC-LAOC LT
2b.	PIPO dominant or codominant	LAOC-PIPO LT
2c.	PSME dominant or codominant	LAOC-PSME LT
2d.	ABGR dominant or codominant	LAOC-ABGR LT
2.	LAOC < 5% canopy coverage	3
3.	PIPO ≥ 5% canopy coverage	PIPO LG
3a.	PIPO dominant	PIPO-PIPO LT
3b.	PSME dominant or codominant	PIPO-PSME LT
3c.	ABGR dominant or codominant	PIPO-ABGR LT
3.	PIPO < 5% canopy coverage	4
4.	PSME ≥ 5% canopy coverage	PSME LG
4a.	PSME dominant	PSME-PSME LT
4b.	ABGR dominant or codominant	PSME-ABGR LT
4.	PSME < 5% canopy coverage	5
5.	ABGR ≥ 5% canopy coverage	ABGR LG
5a.	ABGR dominant	ABGR-ABGR LT
5.	ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/SPBE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

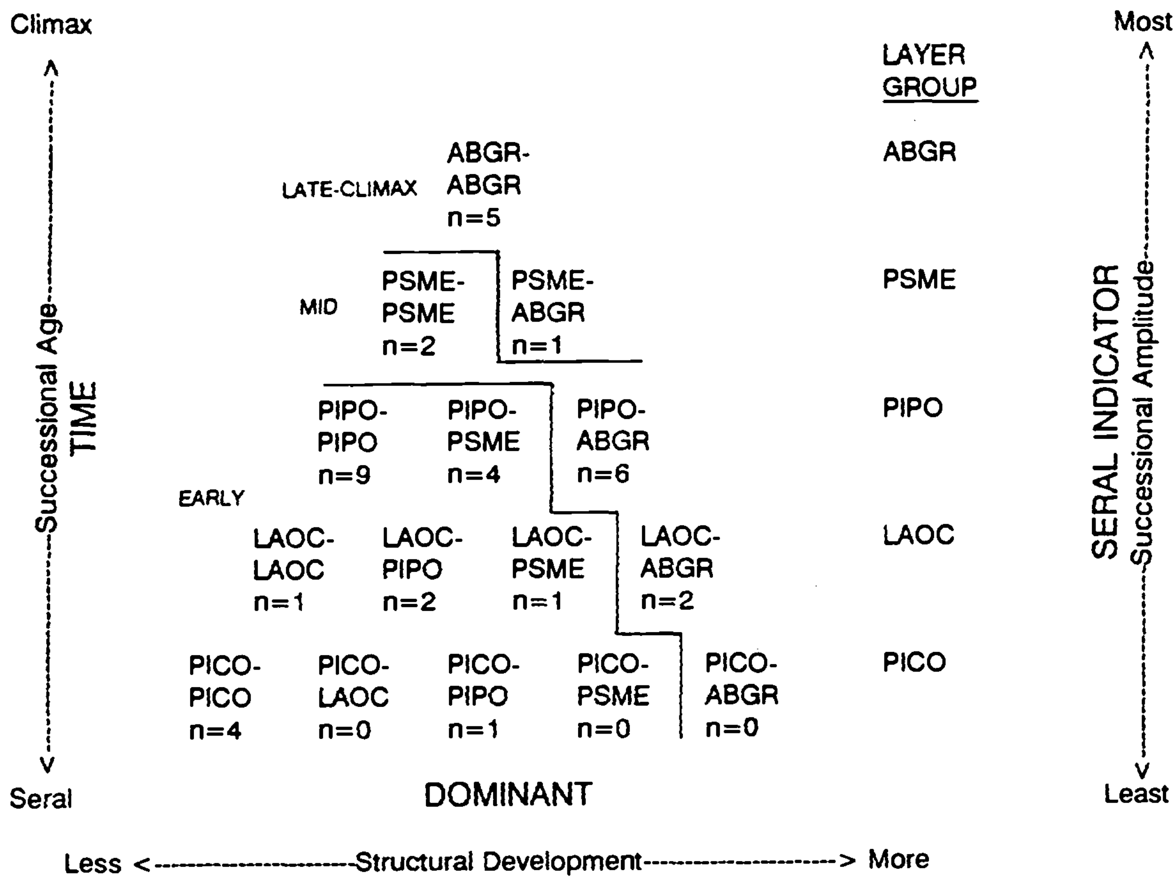


Figure 23. Succession classification diagram of the tree layer in the ABGR/SPBE p.a.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), and grand fir (ABGR). The classification diagram (Fig. 23) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by three layer types in which Douglas-fir and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

In the absence of the four seral tree species (PICO, LAOC, PIPO, and PSME), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/SPBE plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/SPBE plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/SPBE plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 23) depicts the distribution of major tree species in the ABGR/SPBE plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 45. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/SPBE p.a.

1.	CEVE ≥ 5% canopy coverage	CEVE LG
1a.	CEVE dominant[2]	CEVE-CEVE LT
1b.	ARNE[3] dominant or codominant	CEVE-ARNE LT
1c.	SASC dominant or codominant	CEVE-SASC LT
1d.	AMAL[4] dominant or codominant	CEVE-AMAL LT
1e.	SPBE dominant or codominant	CEVE-SPBE LT
1.	CEVE < 5% canopy coverage	2
2.	ARNE ≥ 5% canopy coverage	ARNE LG
2a.	ARNE dominant	ARNE-ARNE LT
2b.	SASC dominant or codominant	ARNE-SASC LT
2c.	AMAL dominant or codominant	ARNE-AMAL LT
2d.	SPBE dominant or codominant	ARNE-SPBE LT
2.	ARNE < 5% canopy coverage	3
3.	SASC ≥ 5% canopy coverage	SASC LG
3a.	SASC dominant	SASC-SASC LT
3b.	AMAL dominant or codominant	SASC-AMAL LT
3c.	SPBE dominant or codominant	SASC-SPBE LT
3.	SASC < 5% canopy coverage	4
4.	AMAL ≥ 5% canopy coverage	AMAL LG
4a.	AMAL dominant	AMAL-AMAL LT
4b.	SPBE dominant or codominant	AMAL-SPBE LT
4.	AMAL < 5% canopy coverage	5
5.	SPBE ≥ 5% canopy coverage	SPBE LG
5a.	SPBE dominant	SPBE-SPBE LT
5.	SPBE < 5% canopy coverage	depauperate or undefined layer or not ABGR/SPBE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[3] ARNE refers to the following group of species: ARNE and ARUV.
[4] AMAL refers to the following group of species: AMAL and SYOR.

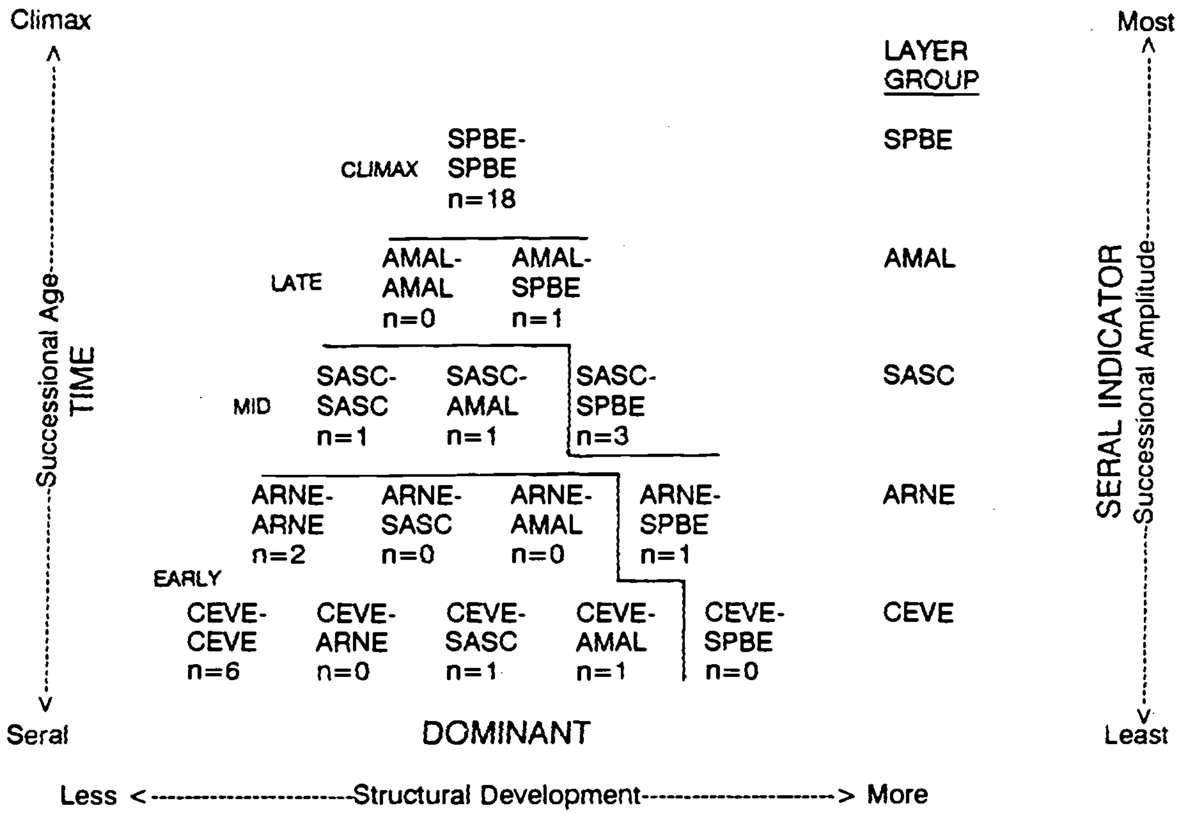


Figure 24. Succession classification diagram of the shrub layer in the ABGR/SPBE p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), pinemat manzanita (ARNE), bearberry (ARUV), Scouler willow (SASC), serviceberry (AMAL), mountain snowberry (SYOR), and birchleaf spirea (SPBE). The classification diagram (Fig. 24) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, SPBE, appears at the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while birchleaf spirea is found in all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/SPBE plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has five layer types defined: CEVE-CEVE LT, CEVE-ARNE LT, CEVE-SASC LT, CEVE-AMAL LT, and CEVE-SPBE LT.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has three defined layer types: SASC-SASC LT, SASC-AMAL LT, and SASC-SPBE LT.

Serviceberry is a mid-seral shrub that dominated some disturbed sites in the ABGR/SPBE plant association. It has fleshy fruit with seed that is dispersed by animals and birds. This species persists in the successional sequence longer than Scouler willow. Partial cutting can maintain a tall-shrub layer of AMAL as increased light levels encourage vigor in the multi-stemmed shrub. Mountain snowberry is a late-seral shrub that sprouts from rhizomes or rootcrowns following fire and mechanical scarification. Birds and small mammals disperse seed and aid regeneration of SYOR. Two layer types represent community development towards the climax state: AMAL-AMAL LT and AMAL-SPBE LT.

Spirea is the climax shrub species of this plant association and forms the SPBE-SPBE LT within the SPBE LG. It is a low shrub reproducing vegetatively by rhizomes in post-disturbance communities. Seedlings were rarely found. It is moderately shade-tolerant and persists under overstory canopies, often as associated species are excluded.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study.

Management Implications

The potential shrub layer types in the ABGR/SPBE plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus provides ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

Serviceberry and mountain snowberry provide food for grouse and other non-game birds but are not preferred browse by deer or elk. Bear eat serviceberry fruit as it ripens in late summer. Shrubfields can provide hiding and thermal cover for these big game species. Spirea provides browse for ungulates but is not a preferred species.

Table 46. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/SPBE p.a.

1.	CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a.	CIVU dominant[3]	CIVU-CIVU LT
1b.	CARO[4] dominant or codominant	CIVU-CARO LT
1c.	LUPIN dominant or codominant	CIVU-LUPIN LT
1d.	PTAQ[5] dominant or codominant	CIVU-PTAQ LT
1e.	FRVE[6] dominant or codominant	CIVU-FRVE LT
1f.	CAGE[7] dominant or codominant	CIVU-CAGE LT
1g.	CARU[8] dominant or codominant	CIVU-CARU LT
1.	CIVU < 5% canopy coverage	2
2.	CARO ≥ 5% canopy coverage	CARO LG
2a.	CARO dominant	CARO-CARO LT
2b.	LUPIN dominant or codominant	CARO-LUPIN LT
2c.	PTAQ dominant or codominant	CARO-PTAQ LT
2d.	FRVE dominant or codominant	CARO-FRVE LT
2e.	CAGE dominant or codominant	CARO-CAGE LT
2f.	CARU dominant or codominant	CARO-CARU LT
2.	CARO < 5% canopy coverage	3
3.	LUPIN ≥ 5% canopy coverage	LUPIN LG
3a.	LUPIN dominant	LUPIN-LUPIN LT
3b.	PTAQ dominant or codominant	LUPIN-PTAQ LT
3c.	FRVE dominant or codominant	LUPIN-FRVE LT
3d.	CAGE dominant or codominant	LUPIN-CAGE LT
3e.	CARU dominant or codominant	LUPIN-CARU LT
3.	LUPIN < 5% canopy coverage	4
4.	PTAQ ≥ 5% canopy coverage	PTAQ LG
4a.	PTAQ dominant	PTAQ-PTAQ LT
4b.	FRVE dominant or codominant	PTAQ-FRVE LT
4c.	CAGE dominant or codominant	PTAQ-CAGE LT
4d.	CARU dominant or codominant	PTAQ-CARU LT
4.	PTAQ < 5% canopy coverage	5
5.	FRVE ≥ 5% canopy coverage	FRVE LG
5a.	FRVE dominant	FRVE-FRVE LT
5b.	CAGE dominant or codominant	FRVE-CAGE LT
5c.	CARU dominant or codominant	FRVE-CARU LT
5.	FRVE < 5% canopy coverage	6
6.	CAGE ≥ 5% canopy coverage	CAGE LG
6a.	CAGE dominant	CAGE-CAGE LT
6b.	CARU dominant or codominant	CAGE-CARU LT
6.	CAGE < 5% canopy coverage	7
7.	CARU ≥ 5% canopy coverage	CARU LG
7a.	CARU dominant	CARU-CARU LT
7.	CARU < 5% canopy coverage	depauperate or undefined layer or not ABGR/SPBE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU and VETH.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO and CACO.
[5] PTAQ refers to the following group of species: PTAQ and APAN.
[6] FRVE refers to the following group of species: FRVE and FRVI.
[7] CAGE refers to the following group of species: CAGE and ASCO.
[8] CARU refers to the following group of species: CARU and ARCO, and ADBI.

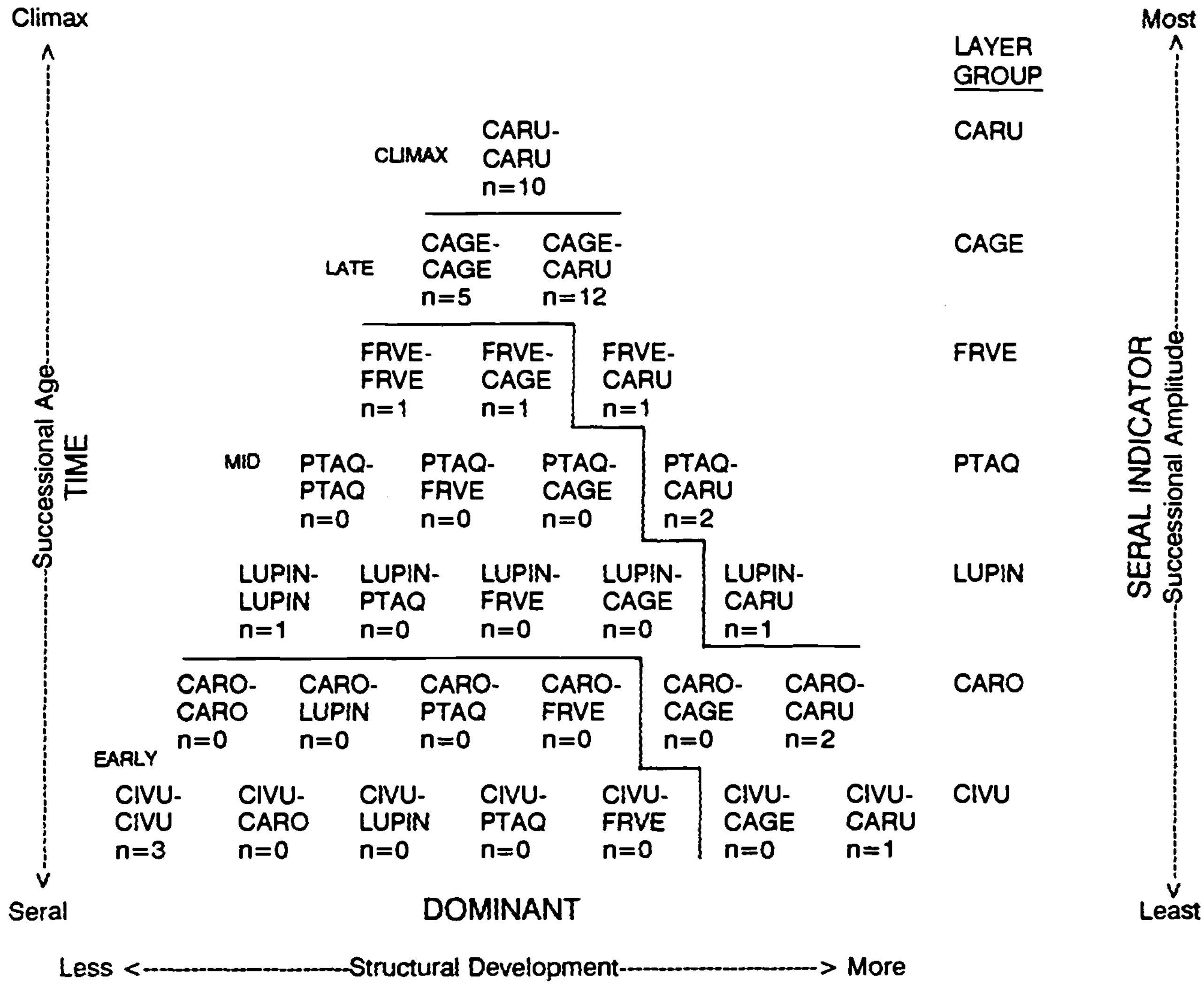


Figure 25. Succession classification diagram of the herb layer in the ABGR/SPBE p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), flannel mullein (VETH), Ross sedge (CARO), northwestern sedge (CACO), lupine (LUPIN), spreading dogbane (APAN), braken-fern (PTAQ), woods strawberry (FRVE), broadpetal strawberry (FRVI), elk sedge (CAGE), showy aster (ASCO), heartleaf arnica (ARCO), trail plant (ADBI), and pinegrass (CARU). The classification diagram (Fig. 25) depicts the herb layer groups and herb layer types. CIVU and VETH are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. CARU, a climax herbaceous species, appears at the top of the figure.

Bull thistle and flannel mullein are tap-rooted, alien biennials that establish on recently disturbed sites of this plant association. CIVU is a composite with windblown seed; VETH is a tall plant dispersed via dihescent capsules. VETH can be locally abundant in a disturbed patch but seldom has the coverage of the wind-dispersed CIVU. The CIVU LG includes these species and has seven layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-LUPIN LT, CIVU-PTAQ LT, CIVU-FRVE LT, CIVU-CAGE LT, and CIVU-CARU LT.

The CARO LG includes Ross sedge and northwestern sedge. CARO and CACO are perennial sedges that increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). There are six defined layer types in the CARO LG.

Lupines are perennial herbs abundant in early- and mid-seral stands. Like other members of the pea family, lupines fix nitrogen and are important members of post-fire communities in the ABGR/SPBE plant association. The LUPIN LG has five layer types defined: The LUPIN-LUPIN LT, LUPIN-PTAQ LT, LUPIN-FRVE LT, LUPIN-CAGE LT, and LUPIN-CARU LT.

Braken-fern, PTAQ, is a mid-seral, perennial herb that reproduces vegetatively by rhizomes or through wind-dispersed spores. It is moderately shade-tolerant and can persist beneath partial tree canopies and in stand openings and edges. Spreading dogbane is a mid-seral, rhizomatous, perennial forb occasionally abundant is this layer group. Four layer types are defined: PTAQ-PTAQ LT, PTAQ-FRVE LT, PTAQ-CAGE LT, and PTAQ-CARU LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-CAGE LT, and FRVE-CARU LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/SPBE plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. Showy aster is a perennial, rhizomatous forb that is occasionally well-represented in the ABGR/SPBE understory. ASCO is moderately shade-tolerant. This species group forms two layer types within the CAGE LG: the CAGE-CAGE and CAGE-CARU LT.

Heartleaf arnica is a shade-tolerant perennial of late seral stands. Trail plant (ADBI) is grouped with heartleaf arnica in the CARU LG. Both ARCO and ADBI, members of the sunflower family, produce achenes dispersed by wind. ARCO, in addition, can reproduce by rhizomes. The climax herbaceous species, pinegrass, is a rhizomatous grass of moderate shade-tolerance. CARU regenerates quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from underground rhizomes. The sole layer type in the CARU LG is the CARU-CARU LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. Following a low intensity burn, the CIVU-CARO LT could develop as a CIVU-CAGE LT or even a CAGE-CAGE LT depending on the associated species in the CIVU-CARO LT and the severity and timing of the burn.

Management Implications

In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU. The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine is favored by burning and is beneficial in its role as a nitrogen fixer. Braken fern has demonstrated inhibitory characteristics on other vegetation through the production of volatile or water-soluble compounds. The sources of these compounds lie in the senescent leaf litter of PTAQ (Ferguson and Boyd 1988). Conifer regeneration may be delayed in layer types where this species dominates the understory. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries. CARU and CAGE competition in plantations is a management concern in the ABGR/SPBE plant association.

Herb layer in ABGR/SPBE, dominated by braken-fern, is the PTAQ-PTAQ LT (Grays Gulch, Baker RD, Wallowa-Whitman NF)

TABLE 47. Mean canopy coverage and constancy of tree species by layer type in the ABGR/SPBE p.a.

TREE LAYER GROUP	PICO								LAOC											
TREE LAYER TYPE	PICO-PICO				PICO-PIPO				LAOC-LAOC				LAOC-PIPO				LAOC-PSME			
NUMBER OF STANDS	4				1				1				2				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR				3/100	2/100		6/100	1/100				1/100				5/50				
ABLA2																				
LAOC				2/25	4/100		2/100		30/100	10/100	3/100		11/100	1/100		2/50	3/100	6/100	5/100	
PIEN																				
PICO	19/50	3/50	1/100	5/100	15/100			1/100	3/100				1/50			1/50				
PIMO																				
PIPO	2/25		2/75	2/75	12/100	6/100							33/100	5/100		5/100	2/100	1/100		
POTR																				
PSME				1/100	4/100			1/100	3/100	1/100		5/100	2/50	2/50		1/50	25/100	5/100	20/100	1/100
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	LAOC				PIPO											
TREE LAYER TYPE	LAOC-ABGR				PIPO-PIPO				PIPO-PSME				PIPO-ABGR			
NUMBER OF STANDS	2				9				4				6			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR		3/50	6/100	20/100	4/22		1/77	1/88				2/75	10/50	22/50	1/100	5/100
ABLA2																
LAOC	14/100	2/100						1/11	1/25			1/25	3/16			
PIEN																
PICO					2/11	2/11										
PIMO																
PIPO		3/50	2/50	1/50	25/88	8/88	7/55	4/66	10/100	4/100	1/75	2/75	8/66	1/66	1/66	5/66
POTR																
PSME	7/100	3/100	1/100	1/100	5/44		2/66	1/66	21/100	8/100		4/100	3/33	1/33	1/66	1/66
BASAL AREA (FT²/AC)																

TABLE 47 (cont.). Mean canopy coverage and constancy of tree species by layer type in the ABGR/SPBE p.a.

TREE LAYER GROUP	PSME								ABGR			
TREE LAYER TYPE	PSME-PSME				PSME-ABGR				ABGR-ABGR			
NUMBER OF STANDS	2				1				5			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S
Species												
ABGR		5/50		3/100	40/100	13/100		1/100	13/100	3/100		5/40
ABLA2												
LAOC												1/20
PIEN												
PICO												
PIMO												
PIPO			3/50	1/100	1/100				2/20			1/60
POTR												
PSME	43/100	5/100	3/100	3/100	8/100				3/40		1/40	
BASAL AREA (FT²/AC)												

TABLE 48. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/SPBE p.a.

SHRUB LAYER GROUP	CEVE			ARNE		SASC			AMAL	SPBE
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-SASC	CEVE-AMAL	ARNE-ARNE	ARNE-SPBE	SASC-SASC	SASC-AMAL	SASC-SPBE	AMAL-SPBE	SPBE-SPBE
NUMBER OF STANDS	6	1	1	2	1	1	1	3	1	18
Species										
ACGL								1/33		
ALSI										
AMAL	1/16			1/50			30/100	2/66	1/100	1/33
ARNE	6/66			23/100	5/100	1/100				2/22
ARUV								3/33		1/5
BENE										
CESA										
CEVE	30/100	18/100	10/100	4/50	3/100			2/66		1/22
CELE										
CHUM						2/100		1/66		2/55
HODI										
LIBO2								1/33		
LOUT2								1/33		
PAMY	1/50	1/100				4/100		3/33		1/27
PHMA										
RICE								1/33		
RILA										
RIVI								2/66		
ROGY		1/100	1/100					1/33		2/27
RUPA										
SASC	7/33	20/100	1/100			10/100	15/100	16/100	1/100	2/22
SHCA								1/33		
SPBE	10/100	6/100	10/100	3/100	5/100	5/100	25/100	33/100	45/100	19/100
SYAL	1/16				3/100		1/100	3/33		2/77
SYOR	1/33	2/100	15/100					5/66	4/100	2/11
TABR										
VACA										
VAME	2/16			1/50		1/100		1/33		
VAMY										
VASC				3/50		3/100				1/5

TABLE 49. **Mean canopy coverage and constancy of herb species by layer type in the ABGR/SPBE p.a.**

HERB LAYER GROUP	CIVU		CARO	LUPIN		PTAQ	FRVE		
HERB LAYER TYPE	CIVU-CIVU	CIVU-CARU	CARO-CARU	LUPIN-LUPIN	LUPIN-CARU	PTAQ-CARU	FRVE-FRVE	FRVE-CAGE	FRVE-CARU
NUMBER OF STANDS	3	1	2	1	1	2	1	1	1
Species									
ACMI	1/100		2/100	5/100		1/50	1/100	1/100	1/100
ADBI	1/100								
AGUR									
ANMA	1/66								
ANTEN									
APAN	1/66					4/100	3/100		
ARCO	1/100	3/100	1/50	1/100	10/100	40/50			
ASCO	1/33				1/100		15/100		1/100
ASCA7	1/33								
BRVU									
CARU	1/100	4/100	13/100	25/100	15/100	41/100	30/100	30/100	35/100
CACO	1/33	3/100	2/50			1/50			1/100
CAGE	1/66	1/100	2/50	5/100	15/100	4/100	10/100	40/100	1/100
CARO	1/66		6/100			1/50			1/100
CAMI2					1/100		1/100		
CIVU	15/100	4/100							
CLUN									
ELGL	1/33						1/100		
FEOC	1/33				1/100				2/100
FRVE	1/100	2/100	2/50		10/100		40/100	5/100	10/100
FRVI			1/50	1/100					2/100
GOOB									
HIAL	1/66		5/50	1/100	5/100	1/50	1/100		1/100
LUPIN				30/100	5/100				
MIST2									
MONTI	1/33								
PONE									
PTAQ	1/33					50/50			
PYAS									
PYSE									
RUOC									
SMST	1/33								
THOC									
THMO									
VETH	5/100	1/100							
VIOR2			1/50						

TABLE 49 (cont.). Mean canopy coverage and constancy of herb species by layer type in the ABGR/SPBE p.a.

HERB LAYER GROUP	CAGE		CARU
HERB LAYER TYPE	CAGE-CAGE	CAGE-CARU	CARU-CARU
NUMBER OF STANDS	5	12	10
Species			
ACMI	1/60	1/50	1/40
ADBI	2/40		2/30
AGUR			
ANMA			
ANTEN			
APAN	1/20	2/41	
ARCO	5/40	10/41	7/20
ASCO	1/20	2/41	1/20
ASCA7			
BRVU			
CARU	4/80	25/100	42/100
CACO	2/40	3/25	2/70
CAGE	27/100	9/100	2/50
CARO	1/40	2/41	1/40
CAMI2			
CIVU	1/60	1/16	1/20
CLUN			
ELGL			
FEOC	2/100	1/8	1/60
FRVE	2/20	2/33	1/90
FRVI	1/40	1/25	2/30
GOOB			1/20
HIAL	2/80	1/25	2/60
LUPIN	2/40	2/25	1/20
MIST2			
MONTI	2/20		
PONE			
PTAQ	1/20		
PYAS			
PYSE			2/20
RUOC			
SMST			1/10
THOC	1/20		
THMO			
VETH			
VIOR2			

Grand fir/pinegrass plant association

Abies grandis/Calamagrostis rubescens

ABGR/CARU (CWG1 12 and CWG1 13)

Harvested ABGR/CARU site: RICE-RICE LT has developed after heavy machine scarification, SYOR associated (Gold Hill, Burns RD, Malheur NF)

This plant association, representing warm and dry conditions in the grand fir series, was described for both the Blue Mountain and Wallowa-Snake Provinces of northeastern Oregon and southeastern Washington (Hall 1973; Johnson and Clausnitzer 1992; Johnson and Simon 1987). ABGR/CARU occurs on mid and upper elevation slopes (4,000 to 6,500 feet) with moderate ash depths. It occurs principally on droughty, southerly exposures in the central and southern Blue Mountains and the southern flank of the Wallowa Mountains.

In climax and late successional ABGR/CARU stands, a continuous sward of pinegrass (CARU) dominates the herb layer beneath a multi-storied canopy of grand fir (ABGR) and occasional Douglas-fir (PSME). As stands approach climax condition, shrub cover declines. In this plant association, mountain snowberry (SYOR), serviceberry (AMAL), common snowberry (SYAL), creeping Oregon grape (BERE), and Scouler willow (SASC) are important mid- and late-seral shrub species. In addition to pinegrass, important herbs include: elk sedge (CAGE), heartleaf arnica (ARCO), white hawkweed (HIAL), western hawkweed (HIAL2), lupine (LUPIN), and strawberries (FRVE and FRVI).

Table 50. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/CARU p.a.

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1. PICO ≥ 5% canopy coverage[2] .... PICO LG
   - 1a. PICO dominant[3] .... PICO-PICO LT
   - 1b. LAOC dominant or codominant .... PICO-LAOC LT
   - 1c. PIPO dominant or codominant .... PICO-PIPO LT
   - 1d. PSME dominant or codominant .... PICO-PSME LT
   - 1e. ABGR dominant or codominant .... PICO-ABGR LT

1. PICO < 5% canopy coverage 2

   2. LAOC ≥ 5% canopy coverage .... LAOC LG
      - 2a. LAOC dominant .... LAOC-LAOC LT
      - 2b. PIPO dominant or codominant .... LAOC-PIPO LT
      - 2c. PSME dominant or codominant .... LAOC-PSME LT
      - 2d. ABGR dominant or codominant .... LAOC-ABGR LT

   2. LAOC < 5% canopy coverage 3

3. PIPO ≥ 5% canopy coverage .... PIPO LG
   - 3a. PIPO dominant .... PIPO-PIPO LT
   - 3b. PSME dominant or codominant .... PIPO-PSME LT
   - 3c. ABGR dominant or codominant .... PIPO-ABGR LT

3. PIPO < 5% canopy coverage 4

   4. PSME ≥ 5% canopy coverage .... PSME LG
      - 4a. PSME dominant .... PSME-PSME LT
      - 4b. ABGR dominant or codominant .... PSME-ABGR LT

   4. PSME < 5% canopy coverage 5

5. ABGR ≥ 5% canopy coverage .... ABGR LG
   - 5a. ABGR dominant .... ABGR-ABGR LT

5. ABGR < 5% canopy coverage .... depauperate or undefined layer or not ABGR/CARU p.a.

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[1] When determination of LT is made, stop at the first applicable condition.

[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.

[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

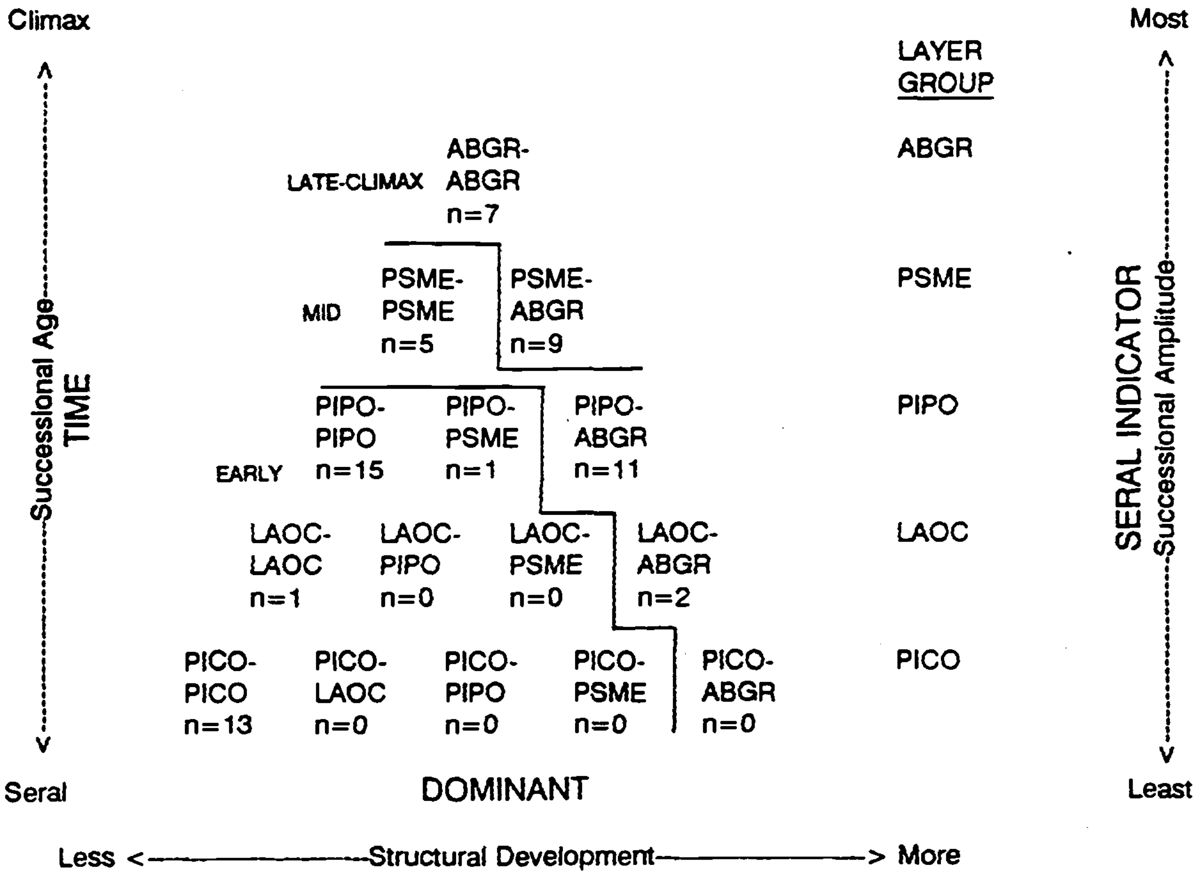


Figure 26. Succession classification diagram of the tree layer in the ABGR/CARU p.a.

TREE LAYER

Description

Trees prevalent during succession include lodgepole pine (PICO), western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), and grand fir (ABGR). The classification diagram (Fig. 26) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, PICO, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

The presence of lodgepole pine (at 5% or greater canopy coverage) indicates the PICO layer group. This early successional tree often forms even-aged stands following stand-replacement fires in the Blue Mountain Region. Lodgepole pine is a shade-intolerant, short-lived tree with rapid juvenile height growth. PICO is a precocious seed producer; trees 8 to 12 years old produce cones in recently established stands. This trait allows rapid colonization of large areas where seed dispersal limits initial tree establishment. Other trees species are important in the PICO LG and form different layer types as they gain dominance in the early successional stands of lodgepole pine.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by two layer types in which Douglas-fir and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

In the absence of the four seral tree species (PICO, LAOC, PIPO, and PSME), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/CARU plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/CARU plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/CARU plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

Grand fir plant communities are uniquely affected by insect pests and pathogens. Individual stands are susceptible to a particular pest dependent on existing stand structure, composition, and environmental stress. Endemic levels of these pests cause the mortality of trees, either singly or in small groups. Epidemics, however, operate at another scale in the landscape and result in tree mortality on large acreages. Historically, the mountain pine beetle, Douglas-fir tussock moth, and western spruce budworm have severely impacted stands of lodgepole pine, grand fir, and Douglas-fir. These disturbance agents interact with forest stand composition and structure to retard, arrest, or accelerate vegetation development. For example, mountain pine beetle could either recycle a mature lodgepole pine community in the absence of other tree species or accelerate succession if a vigorous seedling and sapling understory of grand fir were present in the stand.

A moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 26) depicts the distribution of major tree species in the ABGR/CARU plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PSME or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is relatively lower in the PICO-PICO LT, PICO-LAOC LT, PICO-PIPO LT, LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 51. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/CARU p.a.

- 1. CEVE ≥ 5% canopy coverage .... CEVE LG
  - 1a. CEVE dominant[2] .... CEVE-CEVE LT
  - 1b. ARNE[3] dominant or codominant .... CEVE-ARNE LT
  - 1c. RICE[4] dominant or codominant .... CEVE-RICE LT
  - 1d. SASC dominant or codominant .... CEVE-SASC LT
  - 1e. SYOR[5] dominant or codominant .... CEVE-SYOR LT
  - 1f. CARU dominant or codominant .... CEVE-CARU LT
- 1. CEVE < 5% canopy coverage 2
  - 2. ARNE ≥ 5% canopy coverage .... ARNE LG
    - 2a. ARNE dominant .... ARNE-ARNE LT
    - 2b. RICE dominant or codominant .... ARNE-RICE LT
    - 2c. SASC dominant or codominant .... ARNE-SASC LT
    - 2d. SYOR dominant or codominant .... ARNE-SYOR LT
    - 2e. CARU dominant or codominant .... ARNE-CARU LT
  - 2. ARNE < 5% canopy coverage 3
- 3. RICE ≥ 5% canopy coverage .... RICE LG
  - 3a. RICE dominant .... RICE-RICE LT
  - 3b. SASC dominant or codominant .... RICE-SASC LT
  - 3c. SYOR dominant or codominant .... RICE-SYOR LT
  - 3d. CARU dominant or codominant .... RICE-CARU LT
- 3. RICE < 5% canopy coverage 4
  - 4. SASC ≥ 5% canopy coverage .... SASC LG
    - 4a. SASC dominant .... SASC-SASC LT
    - 4b. SYOR dominant or codominant .... SASC-SYOR LT
    - 4c. CARU dominant or codominant .... SASC-CARU LT
  - 4. SASC < 5% canopy coverage 5
- 5. SYOR ≥ 5% canopy coverage .... SYOR LG
  - 5a. SYOR dominant .... SYOR-SYOR LT
  - 5b. CARU dominant or codominant .... SYOR-CARU LT
- 5. SYOR < 5% canopy coverage .... depauperate or undefined layer or not ABGR/CARU p.a.

[1] When determination of LT is made, stop at the first applicable condition.

[2] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

[3] ARNE refers to the following group of species: ARNE and ARUV.

[4] RICE refers to the following group of species: RICE and RIVI.

[5] SYOR refers to the following group of species: SYOR and AMAL.

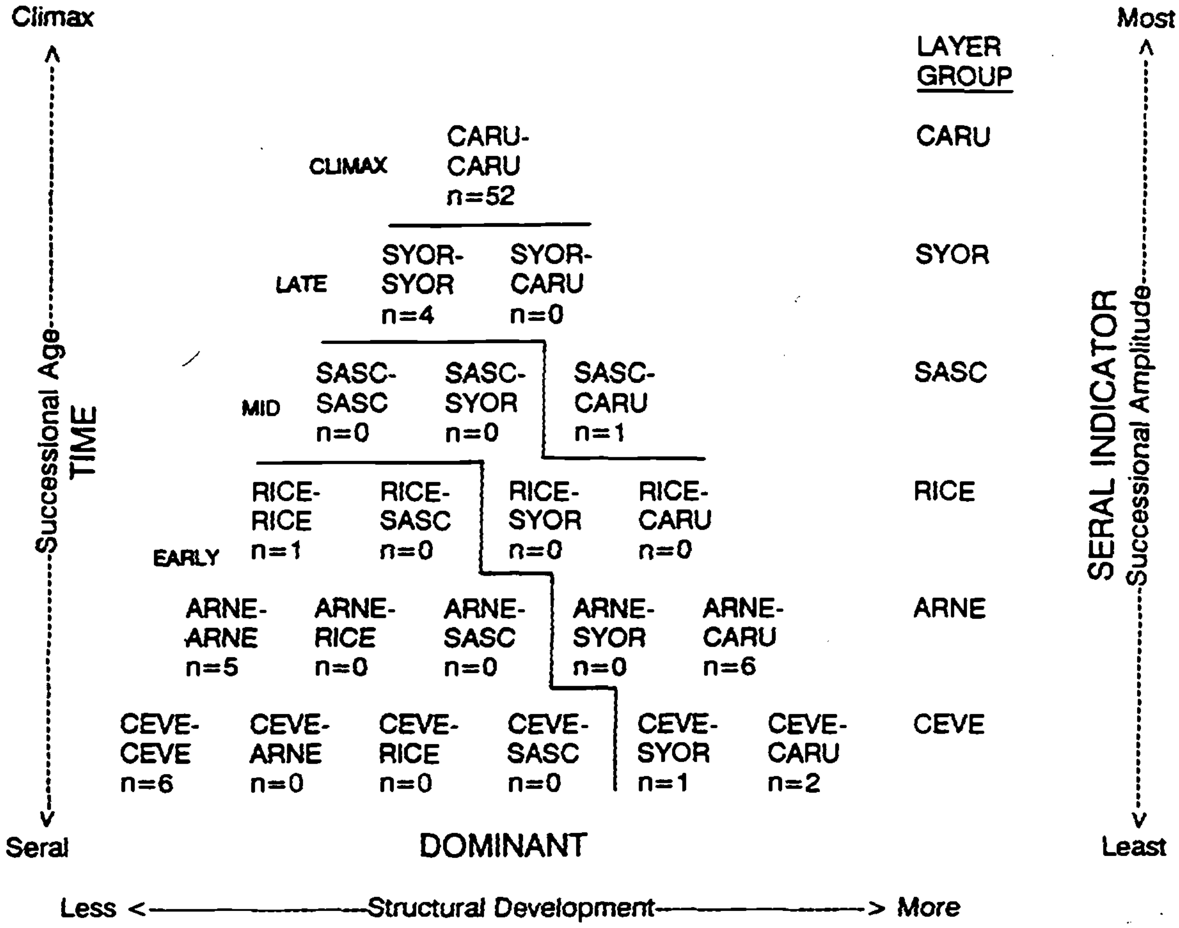


Figure 27. Succession classification diagram of the shrub layer in the ABGR/CARU p.a.

SHRUB LAYER

Description

Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), pinemat manzanita (ARNE), bearberry (ARUV), sticky currant (RIVI), squaw currant (RICE), Scouler willow (SASC), mountain snowberry (SYOR), and serviceberry (AMAL). The classification diagram (Fig. 27) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, SYOR, appears near the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while mountain snowberry is found in most stages. Unlike plant associations described earlier, there is no climax shrub in this community. The climax herb, CARU, is placed in the top position of the figure to depict the truncated nature of shrub succession in this type.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/CARU plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has six layer types defined: CEVE-CEVE LT, CEVE-ARNE LT, CEVE-RICE LT, CEVE-SASC LT, CEVE-SYOR LT, and CEVE-CARU.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

The RICE LG includes the shrub species sticky currant (RIVI) in addition to squaw currant (RICE). These species resprout readily from rootcrowns following light-to moderate intensity fires and recolonize disturbed areas from seed stored in the soil and organic layers. Fire or mechanical scarification lead to germination of stored seed. The Ribes are shade-intolerant and will diminish in stands as overstory shade increases. The layer types defined are: RICE-RICE LT, RICE-SASC LT, RICE-SYOR LT, and RICE-CARU LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has three defined layer types: SASC-SASC LT, SASC-SYOR LT, and SASC-CARU LT.

Mountain snowberry is a late seral shrub that dominated some disturbed sites in the ABGR/CARU plant association. This species persists in the successional sequence longer than Scouler willow. It is a medium shrub that sprouts readily from rhizomes or rootcrowns following fire. The SYOR LG also includes serviceberry (AMAL). This tall shrub is persistent late in the sere; following disturbance it sprouts from rhizomes or increases through seed dispersed by birds and mammals. Two layer types represent community development towards the climax state: SYOR-SYOR LT and SYOR-CARU LT.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. The potential layer types and subsequent developmental pathways are different, yet they fit the successional framework of this study.

Management Implications

The potential shrub layer types in the ABGR/CARU plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus provides ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Sticky currant and squaw currant provide food for grouse, songbirds, small mammals and browse for deer and elk. The currants also serve as the alternate host for white pine blister rust and should be considered where western white pine is a desired stand component.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds, nesting sites for birds, and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes 1992).

Mountain snowberry and serviceberry provide food and cover for songbirds, grouse, and small mammals in addition to browse for wild ungulates and domestic livestock. Bear use the fruit of serviceberry in late summer.

Sites representing late seral and climax conditions in this plant association have low species richness and abundance of shrubs. Where shrubs are important components of the desired vegetation, management activities must be planned to create or maintain the desired stand conditions.

Table 52. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/CARU p.a.

1. CIVU[2] ≥ 5% canopy coverage .... CIVU LG
   1a. CIVU dominant[3] .... CIVU-CIVU LT
   1b. CARO[4] dominant or codominant .... CIVU-CARO LT
   1c. LUPIN[5] dominant or codominant .... CIVU-LUPIN LT
   1d. FRVE[6] dominant or codominant .... CIVU-FRVE LT
   1e. CAGE dominant or codominant .... CIVU-CAGE LT
   1f. CARU[7] dominant or codominant .... CIVU-CARU LT

1. CIVU < 5% canopy coverage 2

   2. CARO ≥ 5% canopy coverage .... CARO LG
      2a. CARO dominant .... CARO-CARO LT
      2b. LUPIN dominant or codominant .... CARO-LUPIN LT
      2c. FRVE dominant or codominant .... CARO-FRVE LT
      2d. CAGE dominant or codominant .... CARO-CAGE LT
      2e. CARU dominant or codominant .... CARO-CARU LT

   2. CARO < 5% canopy coverage 3

3. LUPIN ≥ 5% canopy coverage .... LUPIN LG
   3a. LUPIN dominant .... LUPIN-LUPIN LT
   3b. FRVE dominant or codominant .... LUPIN-FRVE LT
   3c. CAGE dominant or codominant .... LUPIN-CAGE LT
   3d. CARU dominant or codominant .... LUPIN-CARU LT

3. LUPIN < 5% canopy coverage 4

   4. FRVE ≥ 5% canopy coverage .... FRVE LG
      4a. FRVE dominant .... FRVE-FRVE LT
      4b. CAGE dominant or codominant .... FRVE-CAGE LT
      4c. CARU dominant or codominant .... FRVE-CARU LT

   4. FRVE < 5% canopy coverage 5

5. CAGE ≥ 5% canopy coverage .... CAGE LG
   5a. CAGE dominant .... CAGE-CAGE LT
   5b. CARU dominant or codominant .... CAGE-CARU LT

5. CAGE < 5% canopy coverage 6

   6. CARU ≥ 5% canopy coverage .... CARU LG
      6a. CARU dominant .... CARU-CARU LT

   6. CARU < 5% canopy coverage .... depauperate or undefined layer or not ABGR/CARU p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU, CIAR, and CYOF.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO, CACO, and HIAL.
[5] LUPIN refers to the following group of species: LUCA, LUAR3, and LUPIN.
[6] FRVE refers to the following group of species: FRVE and FRVI.
[7] CARU refers to the following group of species: CARU and ARCO.

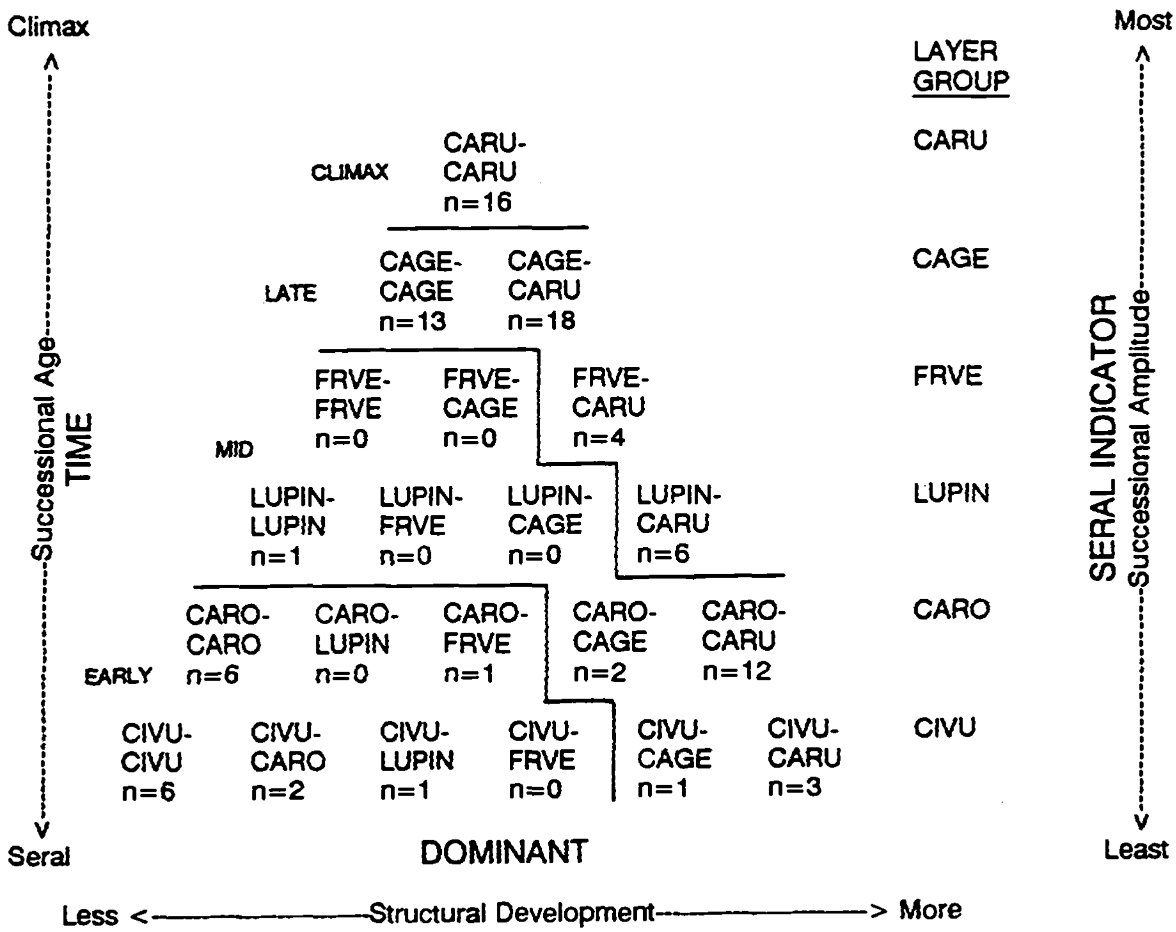


Figure 28. Succession classification diagram of the herb layer in the ABGR/CARU p.a.

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), Canada thistle (CIAR), beggar's lice (CYOR), Ross sedge (CARO), northwestern sedge (CARO), white hawkweed (HIAL), lupine (LUPIN), woods strawberry (FRVE), broadpetal strawberry (FRVI), elk sedge (CAGE), heartleaf arnica (ARCO), and pinegrass (CARU). The classification diagram (Fig. 28) depicts the herb layer groups and herb layer types. CIVU, CIAR, and CYOF are herb species with the least successional amplitude and have been included in a group that forms the base of the diagram. CARU, the climax herbaceous species, appears at the top of the figure.

Bull thistle is a tap-rooted, alien biennial that establishes on recently disturbed sites of this plant association. Canada thistle is a rhizomatous perennial occasionally found in burned or harvested areas. Beggar's lice can be a locally abundant alien annual forb. CIVU and CIAR are composites with windblown seed; CYOF seed is transported by animals. The CIVU LG includes these species and has six layer types defined: the CIVU-CIVU LT, CIVU-CARO LT, CIVU-LUPIN LT, CIVU-FRVE LT, CIVU-CAGE LT, and CIVU-CARU LT.

The CARO LG includes Ross sedge, northwestern sedge, and white hawkweed. CARO and CACO are perennial sedges that increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). White hawkweed was abundant in some early successional stages. This perennial forb is a member of the sunflower family and increases through windblown seeds. There are five defined layer types in the CARO LG.

Lupines are perennial herbs abundant in early- and mid-seral stands. Like other members of the pea family, lupines fix nitrogen and are important members of post-fire communities in the ABGR/CARU plant association. The LUPIN LG has four layer types defined: the LUPIN-LUPIN LT, LUPIN-FRVE LT, LUPIN-CAGE LT, and LUPIN-CARU LT.

The strawberries, FRVE and FRVI, are indicator species of mid-seral stand conditions. The FRVE LG has three layer types: FRVE-FRVE LT, FRVE-CAGE LT, and FRVE-CARU LT. These species are moderately shade-tolerant and reproduce vegetatively by stolons or through seed.

Elk sedge is a rhizomatous sedge of mid- and late-seral stands in the ABGR/CARU plant association. It is moderately shade-tolerant and will persist under open-canopied forest stands. CAGE regenerates from rhizomes following fire and scarification. It forms two layer types within the CAGE LG: the CAGE-CAGE LT and CAGE-CARU LT.

The climax herbaceous species, pinegrass, is a rhizomatous grass of moderate shade-tolerance. Heartleaf arnica is a rhizomatous forb that persists in the shade of an overstory canopy. These herbs regenerate quickly in post-disturbance communities by opportunistic flowering and seeding in addition to sprouting from underground rhizomes. The sole layer type in the CARU LG is the CARU-CARU LT.

Successional Dynamics

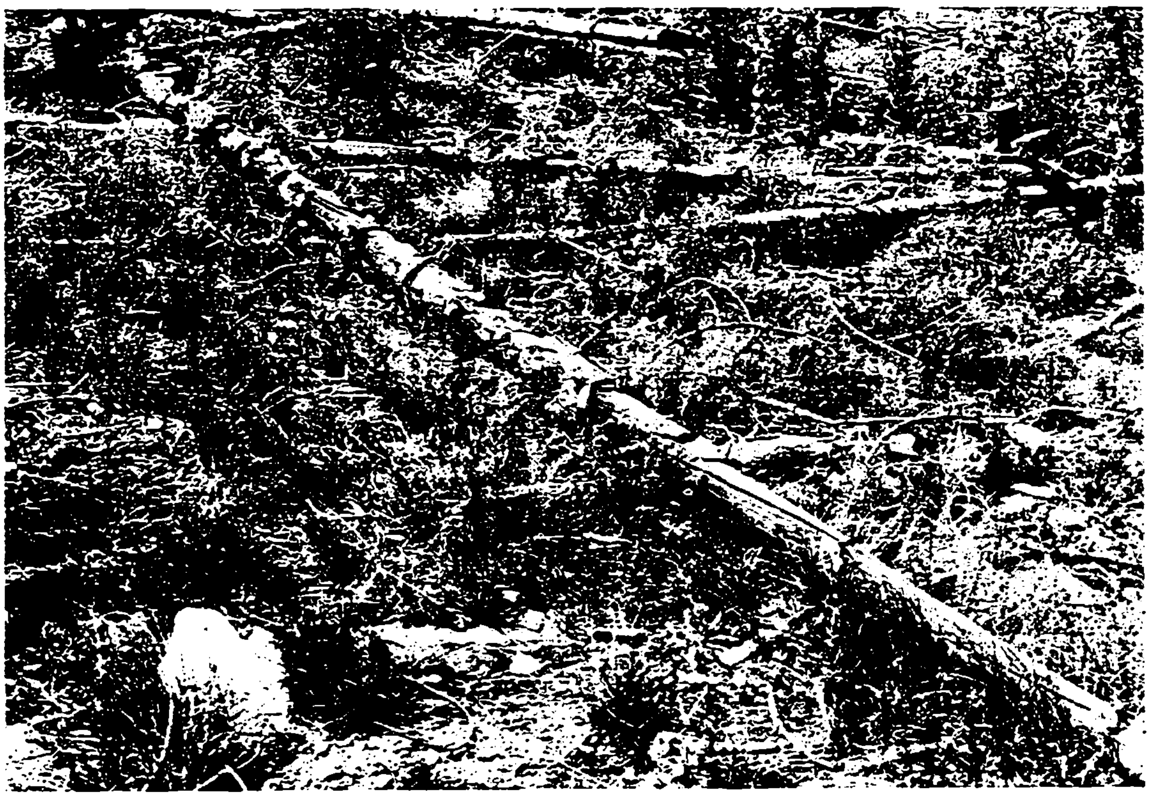
During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands

and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. Following a low intensity burn, the CIVU-CARO LT could develop as a CIVU-CAGE LT or even a CAGE-CAGE LT depending on the associated species in the CIVU-CARO LT and the severity and timing of the burn.

Management Implications

In the xeric grand fir plant associations, bare mineral soil (either from scarification or burning) is required for establishment of CIVU. The CARO LG is promoted by soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Lupine is favored by burning and is beneficial in its role as a nitrogen fixer. The strawberries provide forage for deer and elk, and fruit for grouse, songbirds, small mammals and bear. Elk sedge and pinegrass form a resilient understory resistant to fire and scarification. CAGE is used early in the spring by deer and elk as it is one of the first plants to begin annual growth. CARU is used late by ungulates as associated vegetation dries. CARU and CAGE competition in plantations is a management concern in the ABGR/CARU plant association.



CIVU-CARU LT in herb layer of post-harvest stand; CIVU established on disturbed microsites (Round Mountain, Burns RD, Malheur NF)

TABLE 53. Mean canopy coverage and constancy of tree species by layer type in the ABGR/CARU p.a.

TREE LAYER GROUP	PICO				LAOC								PIPO							
TREE LAYER TYPE	PICO-PICO				LAOC-LAOC				LAOC-ABGR				PIPO-PIPO				PIPO-PSME			
NUMBER OF STANDS	13				1				2				15				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																				
ABGR	7/7		2/53	2/53					19/100	22/100		5/100	1/26	3/26		3/60	8/100			
ABLA2																				
LAOC	20/7			2/7	10/100			1/100	9/100				1/6		3/6					
PIEN																				
PICO	20/46	6/46	3/61	13/61						3/50						1/20				
PIMO																				
PIPO	8/7	6/7		1/38	7/100	1/100				1/50			19/80	6/73	3/80	10/80	9/100			
POTR																				
PSME	7/7		1/30	1/30	3/100			1/100	5/100				4/26	2/26		2/53	43/100			
BASAL AREA (FT²/AC)																				

TREE LAYER GROUP	PIPO				PSME								ABGR			
TREE LAYER TYPE	PIPO-ABGR				PSME-PSME				PSME-ABGR				ABGR-ABGR			
NUMBER OF STANDS	11				5				9				7			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S	D	I	P	S
Species																
ABGR	11/54	8/54	1/63	10/63	5/80	2/80	1/100	2/100	18/66	16/66	6/66	9/66	28/85	12/85	4/100	6/100
ABLA2																
LAOC				1/9	3/20	1/20			1/11							
PIEN							6/20	1/20								
PICO		4/18					1/40	1/40	1/33	1/33	1/33	1/33	2/14		1/42	2/42
PIMO																
PIPO	7/54	2/54	3/45	2/45	2/40	1/40	1/80	1/80	3/22			1/11				1/28
POTR																
PSME	8/45	3/45	3/36	4/36	19/100	10/100	2/80	2/80	5/66	2/66		2/44				2/42
BASAL AREA (FT²/AC)																

TABLE 54. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/CARU p.a.

SHRUB LAYER GROUP	CEVE			ARNE		RICE	SASC	SYOR
SHRUB LAYER TYPE	CEVE-CEVE	CEVE-SYOR	CEVE-CARU	ARNE-ARNE	ARNE-CARU	RICE-RICE	SASC-CARU	SYOR-SYOR
NUMBER OF STANDS	6	1	2	5	6	1	1	4
Species								
ACGL								
ALSI								
AMAL			1/50					12/75
ARNE	25/16		1/50	16/100	10/100			
ARUV								
BENE								
CARU	12/83	15/100	13/100	5/100	32/100	1/100	80/100	9/100
CESA								
CEVE	34/100	6/100	11/100		2/66			
CELE								
CHUM				2/80	1/33			
HODI								
LIBO2								
PAMY					1/33			1/25
PHMA								
RICE		5/100				13/100		
RILA								
RIVI								
ROGY			1/50					1/25
RUPA								
SASC	1/16		8/50	1/20	1/16	1/100	5/100	
SHCA					1/16			
SPBE				1/20	1/83		1/100	1/25
SYAL	1/16			1/20	1/50		1/100	
SYOR	1/16	15/100	1/50			8/100		14/100
TABR								
VACA				1/20				
VAME	1/16				1/16			
VAMY								
VASC					3/33			

TABLE 55. Mean canopy coverage and constancy of herb species by layer type in the ABGR/CARU p.a.

HERB LAYER GROUP	CIVU					CARO				LUPIN
HERB LAYER TYPE	CIVU-CIVU	CIVU-CARO	CIVU-LUPIN	CIVU-CAGE	CIVU-CARU	CARO-CARO	CARO-FRVE	CARO-CAGE	CARO-CARU	LUPIN-LUPIN
NUMBER OF STANDS	6	2	1	1	3	6	1	2	12	1
Species										
ACMI	3/66	3/50	1/100			1/66	1/100		1/41	1/100
ADBI										
AGUR										
ANMA	1/16								1/16	
ANTEN	6/50		1/100			2/66			1/50	1/100
APAN		5/50			1/33			3/50	1/8	
ARCO		2/100		1/100	1/100	2/50			5/75	5/100
ASCO	1/16									
ASCA7										
BRVU									2/8	
CARU	5/66	5/100	25/100	3/100	16/100	9/100	5/100	10/100	25/100	20/100
CACO	1/50		5/100		2/33	8/66	5/100		4/75	1/100
CAGE	3/66	3/100	1/100	5/100	8/66	6/66	4/100	14/100	4/66	10/100
CARO	6/50	17/100	10/100	1/100	5/33	15/50	1/100	12/100	3/58	
CAMI2										
CIAR	2/33	5/50	1/100		1/33	2/16			1/16	
CIVU	14/100	4/100	8/100	5/100	6/100	1/50			1/66	
CLUN										
CYOF	8/33					1/33				
ELGL										
FEOC	2/33		1/100		1/33	1/50	4/100	1/50	2/33	6/100
FRVE	1/33				1/66	1/83	8/100		1/58	2/100
FRVI	1/16		1/100			1/16			2/8	
GOOB						1/16		1/50	1/8	
HIAL	1/50	1/50	1/100	1/100	1/33	3/66	2/100	3/100	2/66	
LUPIN	2/33	1/50	30/100			2/33			2/50	30/100
MIST2										
MONTI		7/50				2/16				
PONE										
PTAQ										
PYAS										
PYSE							2/100		1/16	
RUOC										
SMST										
THOC										
THMO										
VETH	1/66		2/50		1/33	1/16			1/8	
VIOR2			1/100				1/100			

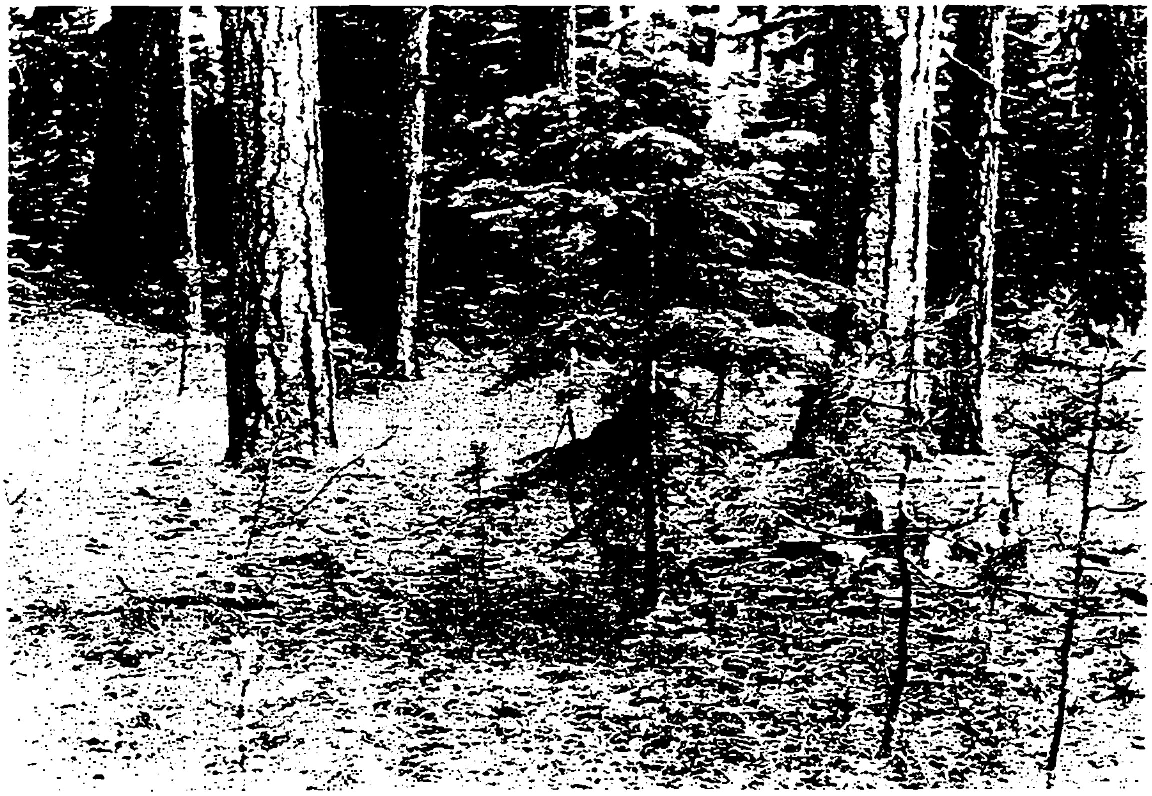
TABLE 55 (cont.). Mean canopy coverage and constancy of herb species by layer type in the ABGR/CARU p.a.

HERB LAYER GROUP	LUPIN	FRVE	CAGE		CARU
HERB LAYER TYPE	LUPIN-CARU	FRVE-CARU	CAGE-CAGE	CAGE-CARU	CARU-CARU
NUMBER OF STANDS	6	4	13	18	16
Species					
ACMI	1/83	5/25	3/53	2/44	1/25
ADBI					1/6
AGUR					
ANMA				1/5	
ANTEN	1/16		1/30	1/44	1/18
APAN			2/15	1/5	2/12
ARCO	14/66	15/75	10/38	16/72	7/68
ASCO		1/25	1/7		
ASCA7					
BRVU	5/16	1/25			1/12
CARU	18/100	32/75	9/92	20/94	24/100
CACO				1/11	1/31
CAGE	8/66	9/75	24/100	11/100	2/50
CARO	2/50	2/25	2/30	2/27	1/31
CAMI2					
CIAR					
CIVU		1/25	1/15	1/22	1/25
CLUN					
CYOF					
ELGL					
FEOC	1/33	3/25	3/15	3/22	1/12
FRVE	4/66	7/50	2/38	2/38	1/50
FRVI	1/33	5/75	2/15	2/33	3/12
GOOB			1/7		
HIAL	1/66	2/25	1/15	1/38	1/56
LUPIN	8/100	1/25	2/45	2/55	1/43
MIST2	1/16	1/25	1/7	1/5	1/12
MONTI					
PONE				1/5	
PTAQ					
PYAS					
PYSE	2/16	3/25		2/5	1/12
RUOC					
SMST					
THOC	1/16	10/25	3/23		
THMO					
VETH		1/25	1/7	1/5	
VIOR2					1/6

Grand fir/elk sedge plant association

Abies grandis/Carex geyeri

ABGR/CAGE (CWG1 11)



PIPO-PIPO LT will become PIPO-ABGR LT if ABGR/CAGE site remains disturbance-free (Myrtle Park, Burns RD, Malheur NF)

This plant association, representing the warmest and driest conditions in the grand fir series, was described for the Blue Mountain Province of northeastern Oregon and southeastern Washington (Johnson and Clausnitzer 1992). ABGR/CAGE occurs on mid and upper elevation slopes and ridges (4,650 to 6,750 feet) principally on residual soils.

In climax and late successional stands, elk sedge (CAGE) frequently dominates the herb layer beneath a multi-storied canopy of grand fir (ABGR) and Douglas-fir (PSME). Common snowberry (SYAL) and mountain snowberry (SYOR) are occasionally well represented with prince's pine (CHUM) and Oregon grape (BERE). The forb layer is often composed of heartleaf arnica (ARCO), white hawkweed (HIAL), and bigleaf sandwort (ARMA3).

Table 56. Key to tree layer groups (LG) and layer types (LT)[1] in the ABGR/CAGE p.a.

1. LAOC ≥ 5% canopy coverage[2]	LAOC LG
1a. LAOC dominant[3]	LAOC-LAOC LT
1b. PIPO dominant or codominant	LAOC-PIPO LT
1c. PSME dominant or codominant	LAOC-PSME LT
1d. ABGR dominant or codominant	LAOC-ABGR LT
1. LAOC < 5% canopy coverage	2
2. PIPO ≥ 5% canopy coverage	PIPO LG
2a. PIPO dominant	PIPO-PIPO LT
2b. PSME dominant or codominant	PIPO-PSME LT
2c. ABGR dominant or codominant	PIPO-ABGR LT
2. PIPO < 5% canopy coverage	3
3. PSME ≥ 5% canopy coverage	PSME LG
3a. PSME dominant	PSME-PSME LT
3b. ABGR dominant or codominant	PSME-ABGR LT
3. PSME < 5% canopy coverage	4
4. ABGR ≥ 5% canopy coverage	ABGR LG
4a. ABGR dominant	ABGR-ABGR LT
4. ABGR < 5% canopy coverage	depauperate or undefined layer or not ABGR/CAGE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Consider canopy coverage as sum of all diameter classes present. Seedlings less than breast height should be included in sapling class for canopy coverage determinations.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.

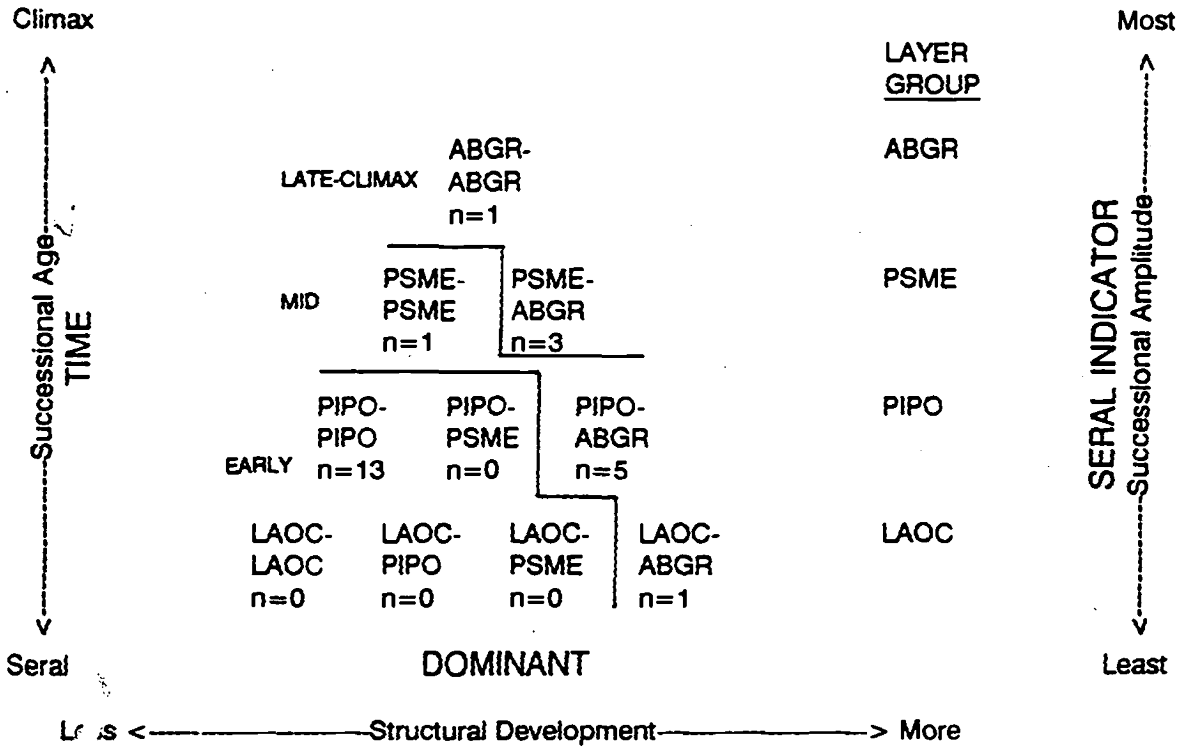


Figure 29. Succession classification diagram of the tree layer in the ABGR/CAGE p.a.

TREE LAYER

Description

Trees prevalent during succession include western larch (LAOC), ponderosa pine (PIPO), Douglas-fir (PSME), and grand fir (ABGR). The classification diagram (Fig. 29) depicts the tree layer groups (LG) and layer types (LT). The species with the least successional amplitude, LAOC, forms the base while the tree species with the most successional amplitude, ABGR, appears at the top of the figure. Successional amplitude refers to the species' relative ability to establish, develop, and persist under changing environmental conditions during succession.

Suitable habitat conditions for western larch establishment occur after major stand disturbance (e.g., fire). This seral tree species can compete for growing space because of its rapid early height growth; but, in the absence of continued disturbance, it will not persist. The accumulations of litter and duff on the mineral soil surface and increases in overstory shade are some of the environmental changes that occur during development of the tree layer. New seedlings of western larch cannot become established with this set of environmental factors and the species will not persist on site. Grand fir can germinate and grow in early seral as well as late seral stages. The successional amplitude of western larch is relatively narrower than that for grand fir. The indicator value of western larch is recognized by delineating a layer group in which this shade-intolerant, early seral species has canopy coverage of 5% or greater. If larch also dominates the tree layer, the layer type (within the LAOC layer group) is classified as LAOC-LAOC. Stands representing this layer type occur as a result of some wildfires and may be developed through silvicultural activity (e.g., seed tree regeneration cut with larch overstory reserved). Other tree species are important in the LAOC layer group and layer types are defined in which ponderosa pine, Douglas-fir, and grand fir are dominants of the tree layer. These layer types represent increased stand structural development (diameter distributions and multi-storied canopies) relative to the LAOC-LAOC LT. For example, the LAOC-ABGR LT could be represented in a stand of scattered overstory larch with a multi-storied grand fir canopy beneath.

In the absence of western larch, the early seral, shade-intolerant ponderosa pine indicates, at 5% canopy coverage, the PIPO LG. While past fires created conditions favorable to the development of ponderosa pine stands, silvicultural treatments or appropriately used prescribed fire lead to the establishment and growth of ponderosa pine stands in the fire suppression era. Layer types within the ponderosa pine layer group are classified with knowledge of the canopy coverage of the early seral ponderosa pine, mid-seral Douglas-fir, and the climax grand fir. When these species are dominant in the tree layer, they form layer types of PIPO-PIPO, PIPO-PSME, and PIPO-ABGR, respectively.

The Douglas-fir LG is represented by two layer types in which Douglas-fir and grand fir dominate the tree layer. Classification units are defined as: PSME-PSME LT and PSME-ABGR LT. Douglas-fir is a mid-seral species of this plant association and its successional amplitude is wider than either western larch or ponderosa pine.

In the absence of the three seral tree species (LAOC, PIPO, and PSME), 5% canopy coverage of AGBR indicates the ABGR layer group. The sole layer type for this group is the ABGR-ABGR LT. Grand fir is the climax dominant and is the most shade-tolerant species that can establish on sites representing the ABGR/CAGE plant association. It can establish on mineral soil and organic seedbeds, although shade improves seedling survival on organic seedbeds. Grand fir has the widest successional amplitude of tree species in the plant association. Coverage-constancy tables display the mean canopy coverage and constancy within tree layer types for the ABGR/CAGE plant association.

Successional Dynamics

Fig. 2 illustrates the possible tree layer successional pathways for the ABGR/TABR/CLUN plant association. The concepts presented in that figure would apply to the ABGR/CAGE plant association. Layer type change is generally to the right and upward in the classification diagram. These pathways depict natural stand development following a single disturbance event. Fire, logging, insects, and other disturbance agents, differentially affecting tree species populations, would alter developmental sequences.

For example, a moderate-intensity surface fire in the LAOC-ABGR LT could lead directly to the development of a LAOC-LAOC LT, LAOC-PIPO LT, or LAOC-PSME LT. The exact layer type is dependent upon site-specific composition and structure of the impacted community. On the other hand, the moderate-intensity burn in the PIPO-PSME LT may lead to no change in layer type designation. Tree diameter distributions would determine whether species are differentially impacted. If the Douglas-fir component contained saplings and poles under large diameter ponderosa pine, the tree layer would change to a PIPO-PIPO LT. If the Douglas-fir component contained larger, fire-resistant trees, the layer type would remain the PIPO-PSME LT.

Probabilities of an individual pathway from any particular layer type are unequal and depend upon the site specific composition and structure of the tree layer. The potential pathways depicted in Fig. 2 exemplify the complexities of overstory succession in this plant association.

Management Implications

The succession classification diagram (Fig. 29) depicts the distribution of major tree species in the ABGR/CAGE plant association. Western larch is absent; or a minor stand component outside the LAOC LG. Should it be desirable to develop a component of western larch in stands of the PIPO, PSME, or ABGR LG, vegetation treatments could be designed that use adjacent seed sources or artificial means to introduce the species. Although western larch is an early seral species, the diagram shows that this tree can be an important component in mid-seral stands as well as early seral stands. The successional status (i.e., late, mid, early) of stands should not be used solely to form management options as composition and structure interact to form the classification.

Some layer types may be more susceptible to pests than others. Douglas-fir tussock moth and western spruce budworm are potential problems in climax, late seral, and mid-seral stands depicted in the classification diagram. Grand fir and Douglas-fir are major stand components in these layer types. While these susceptible species can also occur in the early seral layer types, their coverage (importance) is relatively lower in the LAOC-LAOC LT, LAOC-PIPO LT, and PIPO-PIPO LT.

Table 57. Key to shrub layer groups (LG) and layer types (LT)[1] in the ABGR/CAGE p.a.

1.	CEVE ≥ 5% canopy coverage	CEVE LG
1a.	CEVE dominant[2]	CEVE-CEVE LT
1b.	ARNE dominant or codominant	CEVE-ARNE LT
1c.	CELE dominant or codominant	CEVE-CELE LT
1d.	SASC dominant or codominant	CEVE-SASC LT
1e.	SYOR[3] dominant or codominant	CEVE-SYOR LT
1f.	CAGE dominant or codominant	CEVE-CAGE LT
1.	CEVE < 5% canopy coverage	2
2.	ARNE ≥ 5% canopy coverage	ARNE LG
2a.	ARNE dominant	ARNE-ARNE LT
2b.	CELE dominant or codominant	ARNE-CELE LT
2c.	SASC dominant or codominant	ARNE-SASC LT
2d.	SYOR dominant or codominant	ARNE-SYOR LT
2e.	CAGE dominant or codominant	ARNE-CAGE LT
2.	ARNE < 5% canopy coverage	3
3.	CELE ≥ 5% canopy coverage	CELE LG
3a.	CELE dominant	CELE-CELE LT
3b.	SASC dominant or codominant	CELE-SASC LT
3c.	SYOR dominant or codominant	CELE-SYOR LT
3d.	CAGE dominant or codominant	CELE-CAGE LT
3.	CELE < 5% canopy coverage	4
4.	SASC ≥ 5% canopy coverage	SASC LG
4a.	SASC dominant	SASC-SASC LT
4b.	SYOR dominant or codominant	SASC-SYOR LT
4c.	CAGE dominant or codominant	SASC-CAGE LT
4.	SASC < 5% canopy coverage	5
5.	SYOR ≥ 5% canopy coverage	SYOR LG
5a.	SYOR dominant	SYOR-SYOR LT
5b.	CAGE dominant or codominant	SYOR-CAGE LT
5.	SYOR < 5% canopy coverage	depauperate or undefined layer or not ABGR/CAGE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[3] SYOR refers to the following group of species: SYOR and SYAL.

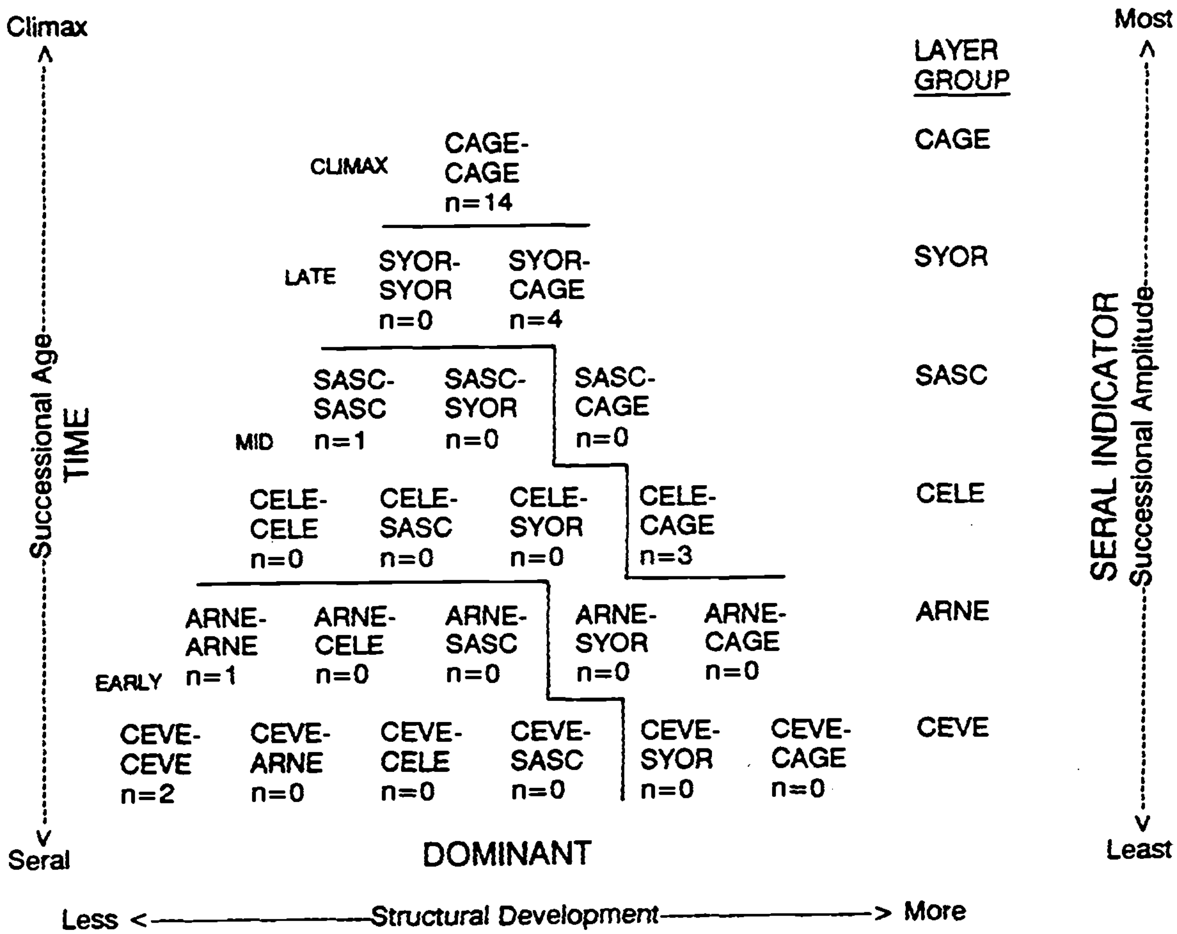


Figure 30. Succession classification diagram of the shrub layer in the ABGR/CAGE p.a.

SHRUB LAYER

Description

The ABGR/CAGE plant association has no shrubs well represented in climax stands. Therefore, the shrub classification diagram (Fig. 30) is truncated and elk sedge is depicted in the climax position. Succession in the shrub layer leads to dominance of the climax sedge, CAGE. Shrubs dominant during different successional stages include snowbrush ceanothus (CEVE), pinemat manzanita (ARNE), curlleaf mountain-mahogany (CELE), Scouler willow (SASC), common snowberry (SYAL), and mountain snowberry (SYOR). The classification diagram (Fig. 30) depicts the shrub layer groups and shrub layer types. The shrub species with the least successional amplitude, CEVE, forms the base while the species with the most successional amplitude, SYOR, appears near the top of the figure. This implies that snowbrush ceanothus is restricted to early successional stages while mountain snowberry can be found in nearly all stages.

Snowbrush ceanothus is a shade-intolerant, early seral shrub species prominent in post-fire stands of ABGR/CAGE plant association. It is found regenerating in post-harvest stands that have been broadcast burned, piled-and-burned, or mechanically scarified. Greatest canopy coverage occurs in broadcast burned stands. Hot fires result in maximum exposure of seed stored in the soil and duff layers (where long-lived seed can remain viable for 300 years). The heat scarified seed imbibes water with most germinating the first year. The deep-rooted, evergreen, perennial shrubs are nitrogen-fixing plants. While the shrub is susceptible to fire, snowbrush ceanothus does resprout from the rootcrown following low intensity fires. The CEVE layer group has six layer types defined: CEVE-CEVE LT, CEVE-ARNE LT, CEVE-CELE LT, CEVE-SASC LT, CEVE-SYOR LT, and CEVE-CAGE.

The ARNE LG includes the shrub species pinemat manzanita and bearberry. These species are prostrate, evergreen, shade-intolerant shrubs found in early successional stages of this plant association. Both ARNE and ARUV are susceptible to fire or scarification because plants are shallow-rooted. They reproduce vegetatively through the rooting of prostrate stems; seedlings establish from seed stored in litter and soil. In addition, ARUV resprouts from a rootcrown in post-fire or post-harvest stands. Layer types defined for the ARNE LG are depicted in the shrub classification diagram.

Curlleaf mountain-mahogany is a mid-seral, tall shrub in forested stands of the ABGR/CAGE plant association. It colonizes sites by windblown seed from the forest-steppe ecotone following fire. It persists in open forested stands but will decline in vigor as tree density increases and the overstory canopy closes. The defined layer types include: CELE-CELE LT, CELE-SASC LT, CELE-SYOR LT, and CELE-CAGE LT.

Scouler willow is an early seral, tall shrub with windblown seed that develop on recently exposed mineral soil following fire or logging. It can persist in stands even after being overtopped by conifers. As vigor wanes, it will disappear unless partial-cutting opens the crown to sunlight. Established shrubs sprout from the rootcrown following fire. The SASC LG has three defined layer types: SASC-SASC LT, SASC-SYOR LT, and SASC-CAGE LT.

The SYOR LG includes mountain snowberry and common snowberry. These late-seral, medium shrubs sprout readily from rhizomes or rootcrowns following fire. Birds and small mammals disperse seed and aid SYOR regeneration (small groups of seedlings had the appearance of rodent caches). These shrubs withstand soil scarification and ripping; recovery may be rapid.

Successional Dynamics

The historic role of fire in controlling the composition of the early seral shrub layer is important as managers interpret factors responsible for stand establishment. Random factors interacting with disturbance regimes and vegetation life history traits have led to the development of vegetation units. Fire intensity and season of application lead to multiple initiations of successional seres dependent upon the vegetation state at stand initiation and stochastic factors. The shrubs prominent during stand development in the ABGR/CAGE plant association are fire-adapted species. Regeneration is accomplished by light, windblown seed, or long-lived seed stored in soil and litter, or from underground buds on root and stem tissue. Disturbance of ABGR/CAGE sites determines subsequent developmental pathways.

Management Implications

The potential shrub layer types in the ABGR/CAGE plant association include those which function as important habitat for wildlife species in addition to those which function as essential to ecological succession process. The shrub indicator species provide food and cover for a variety of big game, small mammal, and avian species of the Blue Mountain and Wallowa-Snake Provinces. Snowbrush ceanothus and curlleaf mountain-mahogany also provide ecosystem nitrogen synchronized to a successional stage where this element may limit ecosystem development and recovery. The shrub layer types may function as nutrient sinks in the recovery process, maintaining accumulated nutrients on site following disturbance.

Snowbrush ceanothus is browsed heavily by deer and elk where browse species are rare and its seeds provide food for small mammals and birds. Shrubfields serve as cover for wild ungulates and nest sites for songbirds. The early seral trees, western larch and ponderosa pine, compete well with ceanothus germinants; efforts to plant these shade-intolerant species in established shrubfields will fail unless competition from overtopping shrubs is reduced. Grand fir regeneration fares better in the shrub canopy shade. During December of 1990 in northeastern Oregon, unseasonably frigid temperatures (-10°F) occurred in the absence of a deep, insulating snowpack. Topkill of this cold-intolerant shrub was prevalent during the 1991 growing season. Although damage was not uniform and topkilled shrubs subsequently resprouted, seemingly random events and varied responses as these affect the rate and direction of vegetation development at different temporal and spatial scales.

Pinemat manzanita and bearberry provide fruit for songbirds, grouse, bear, and small mammals and browse for wild ungulates. These shade-intolerant plants will decline under a closed forest canopy; if they are desired as understory stand components, then open forest stands should be maintained.

Curlleaf mountain-mahogany provides food and cover for birds, cover for big game, and excellent browse for deer and elk. This shrub is fire-sensitive but regenerates quickly from residual seed-producing shrubs.

Scouler willow is browsed by both big game and domestic livestock. It provides food for small mammals and birds as well as nesting sites for birds and cover for deer and elk. Competition with tree regeneration, especially ponderosa pine seedlings may be acute. SASC stump sprouts are more competitive than SASC seedlings (Steele and Geier-Hayes, 1992).

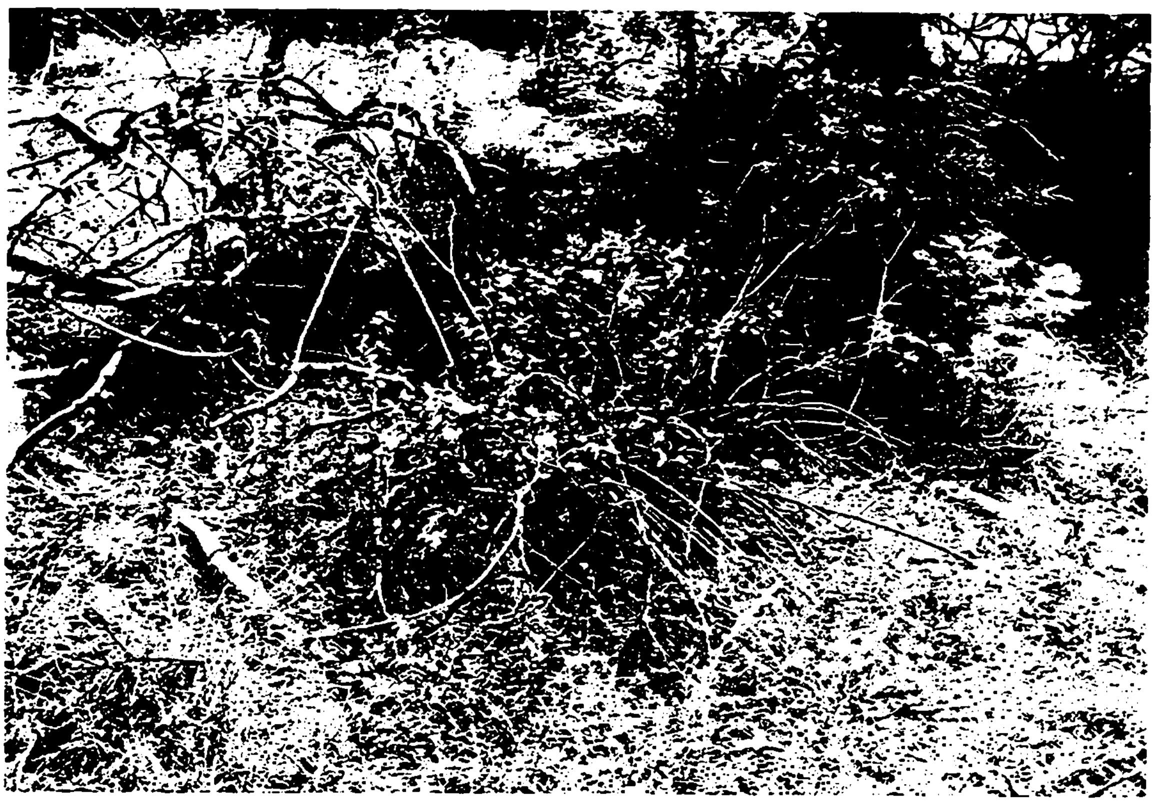
Mountain snowberry and common snowberry provide food and cover for songbirds, grouse, and small mammals in addition to browse for wild ungulates and domestic livestock.

Sites representing late seral and climax conditions in this plant association have low species richness and abundance of shrubs. Where shrubs are important components of the desired vegetation, management activities must be planned to create or maintain the desired stand conditions.

Table 58. Key to herb layer groups (LG) and layer types (LT)[1] in the ABGR/CAGE p.a.

1. CIVU[2] ≥ 5% canopy coverage	CIVU LG
1a. CIVU dominant[3]	CIVU-CIVU LT
1b. CARO[4] dominant or codominant	CIVU-CARO LT
1c. CAGE dominant or codominant	CIVU-CAGE LT
1. CIVU < 5% canopy coverage	2
2. CARO ≥ 5% canopy coverage	CARO LG
2a. CARO dominant	CARO-CARO LT
2b. CAGE dominant or codominant	CARO-CAGE LT
2. CARO < 5% canopy coverage	3
3. CAGE ≥ 5% canopy coverage	CAGE LG
3a. CAGE dominant	CAGE-CAGE LT
3. CAGE < 5% canopy coverage	depauperate or undefined layer or not ABGR/CAGE p.a.

[1] When determination of LT is made, stop at the first applicable condition.
[2] CIVU refers to the following group of species: CIVU and ANTEN.
[3] Dominant refers to species with greatest canopy coverage; codominant refers to species with canopy coverages equal or nearly so.
[4] CARO refers to the following group of species: CARO, CACO, and FEOC.



SYOR-CAGE LT in ABGR/CAGE p.a.; CELE dead in background suggests shrub layer type was previously CELE-CAGE (Fall Mountain, Bear Valley RD, Malheur NF)

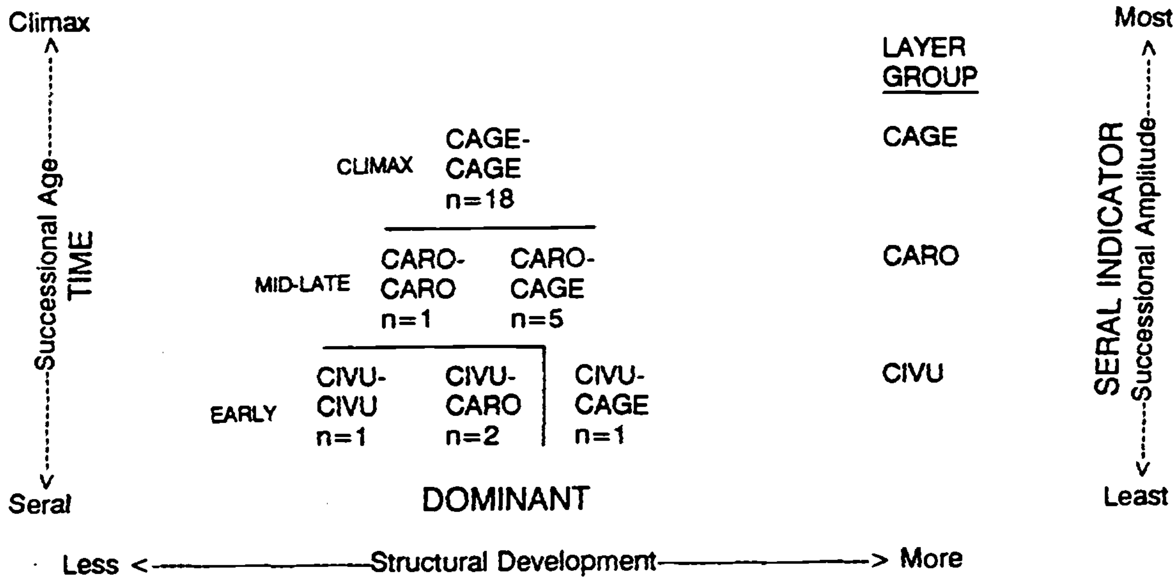


Figure 31. Succession classification diagram of the herb layer in the ABGR/CAGE p.a.

CAGE-CAGE LT, the climax herb layer type, is resilient to fire and scarification
(West Fork of Bridge Creek, Burns RD, Malheur NF)

HERB LAYER

Description

Important herbs in the successional sequence include bull thistle (CIVU), pussytoes (ANTEN), Ross sedge (CARO), northwestern sedge (CACO), western fescue (FEOC), and elk sedge (CAGE). The classification diagram (Fig. 31) depicts the herb layer groups and herb layer types. CIVU is the herb species with the least successional amplitude and forms the base of the diagram. CAGE, a climax herbaceous species, appears at the top of the figure.

Bull thistle (CIVU) is a tap-rooted, alien biennial that establishes on recently disturbed sites of this plant association. CIVU, a member of the sunflower family with windblown seed, germinates and develops on soil bared by fire or logging. Litter is not an effective seedbed in this xeric plant association. Pussytoes (ANTEN) are native perennials that increase in early successional stages through the establishment of wind dispersed seed. Pussytoes can be locally abundant but are not as widely distributed as bull thistle. The CIVU LG includes three layer types: the CIVU-CIVU LT, CIVU-CARO LT, and CIVU-CAGE LT.

The CARO LG includes the sedges CARO and CACO and the graminoid, FEOC. Ross sedge and northwestern sedge increase in post-disturbance communities through seed stored in the soil and litter layers. Soil scarification favors their establishment while sedge response may be inhibited by burning (Steele and Geier-Hayes 1987b). Western fescue was abundant in some early successional stages but will decline in coverage over time. The CARO LG has two layer types: the CARO-CARO LT and CARO-CAGE LT.

Elk sedge, a rhizomatous sedge, dominates the understory of climax stands in this plant association. It is moderately shade-tolerant and will persist under open tree canopies of the ABGR/CAGE type. CAGE regenerates from rhizomes following fire and scarification. It forms the climax herb layer type for this plant association: the CAGE-CAGE LT.

Successional Dynamics

During the successional process, the herbaceous layer undergoes change from a layer dominated by native and alien annuals and biennials to one dominated by native perennials. While different layers are recognized for classification purposes, the layers interact to drive compositional and structural changes in vegetation. This is displayed in the herbaceous layer as factors such as seedbed condition, litter depth, nutrient status, and shade create conditions that inhibit or facilitate the differential establishment and development of herbaceous species. In the presence of a seed source, bull thistle establishes in recently disturbed stands and represents conditions in which annual and biennials flourish in the absence of competitive factors and environmental conditions which limit these species during latter successional stages.

Differential responses to disturbance type, intensity, frequency, and timing create layer types and determine subsequent successional pathways. The early seral species CARO is favored by conditions created during mechanical scarification while CAGE is favored by burning.

The composition and structure of existing vegetation at the time of disturbance also determines subsequent developmental pathways. Following a low intensity burn, the CIVU-CARO LT could develop as a CIVU-CAGE LT or even a CAGE-CAGE LT depending on the associated species in the CIVU-CARO LT and the severity and timing of the burn. Frequent, low intensity fires in the ABGR/CAGE plant association may drive understory vegetation to climax conditions.

Management Implications

The CARO LG is promoted through soil scarification. Ross sedge is used by ungulates during spring and summer when it is preferred over associated early seral species. Western fescue appears to be an increaser on sites grazed by domestic livestock.

Elk sedge dominates half the layer types described in this plant association. It forms a resilient understory resistant to fire and scarification. CAGE is used early in the spring by wild ungulates as it is one of the first plants to begin growth. Elk sedge competition with planted trees is a management concern in this xeric plant association.

CELE-CELE LT: curlleaf mountain mahogany dominates shrub layer of mid-seral stands; CELE will decline as overstory canopy increases (Burntcabin Creek, Bear Valley RD, Malheur NF)

TABLE 59. Mean canopy coverage and constancy of tree species by layer type in the ABGR/CAGE p.a.

TREE LAYER GROUP	LAOC				PIPO							
TREE LAYER TYPE	LAOC-ABGR				PIPO-PIPO				PIPO-ABGR			
NUMBER OF STANDS	1				13				5			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S
Species												
ABGR	30/100	8/100		3/100	1/38	4/38	3/84	3/84	12/100	15/100	3/100	3/100
ABLA2												
LAOC	8/100				3/7				2/20	1/20		1/20
PIEN												
PICO							2/7					
PIMO												
PIPO					19/84	4/84	11/69	7/69	11/100	1/100		2/40
POTR												
PSME	10/100	2/100			4/38	5/38	1/69	2/69	3/60	2/60		1/20
BASAL AREA (FT²/AC)												

TREE LAYER GROUP	PSME								ABGR			
TREE LAYER TYPE	PSME-PSME				PSME-ABGR				ABGR-ABGR			
NUMBER OF STANDS	1				3				1			
SIZE CLASSES	D	I	P	S	D	I	P	S	D	I	P	S
Species												
ABGR	4/100	16/100		2/100	18/100	23/100	10/100	2/100	50/100	35/100		3/100
ABLA2												
LAOC												
PIEN												
PICO												
PIMO												
PIPO		1/100				1/33		1/33				
POTR												
PSME	30/100	15/100			12/100		2/100	1/100				
BASAL AREA (FT²/AC)												

TABLE 60. Mean canopy coverage and constancy of shrub species by layer type in the ABGR/CAGE p.a.

SHRUB LAYER GROUP	CEVE	ARNE	CELE	SASC	SYOR
SHRUB LAYER TYPE	CEVE-CEVE	ARNE-ARNE	CELE-CAGE	SASC-SASC	SYOR-CAGE
NUMBER OF STANDS	2	1	3	1	4
Species					
ACGL					
ALSI					
AMAL			2/33		1/50
ARNE	11/100	45/100			
ARUV					
BENE					
CAGE	8/100	8/100	42/100	7/100	58/100
CESA					
CEVE	21/100				
CELE			7/100		1/25
CHUM					
HODI					
LIBO2					
LOUT2					
PAMY					
PHMA					
RICE			1/33		1/25
RILA					
RIVI					
ROGY					1/25
RUPA					
SASC				8/100	1/25
SHCA					
SPBE					
SYAL	1/50	1/100	1/33	1/100	45/25
SYOR			7/66		9/100
TABR					
VACA					
VAME					
VAMY					
VASC					

TABLE 61. Mean canopy coverage and constancy of herb species by layer type in the ABGR/CAGE p.a.

HERB LAYER GROUP	CIVU			CARO		CAGE
HERB LAYER TYPE	CIVU-CIVU	CIVU-CARO	CIVU-CAGE	CARO-CARO	CARO-CAGE	CAGE-CAGE
NUMBER OF STANDS	1	2	1	1	5	18
Species						
ACMI		1/50	1/100		1/80	1/44
ADBI				1/100		
AGUR						
ANMA						
ANTEN		2/100	4/100			1/11
APAN	1/100		1/100			2/22
ARCO	1/100	1/50	1/100		2/100	2/50
ASCO					1/20	
ASCA7						
BRVU						
CARU	1/100		3/100		2/100	2/27
CACO		23/100		3/100	8/60	
CAGE	1/100	3/100	10/100	4/100	37/100	33/100
CARO	3/100	1/100	3/100	1/100		1/27
CAMI2						
CIVU	14/100	3/100	1/100		1/60	1/22
CLUN						
ELGL						1/5
FEOC		3/100		15/100	9/100	
FRVE	1/100		1/100		1/80	1/5
FRVI		1/100				3/33
GOOB						
HIAL		2/100	1/100	4/100	2/80	1/33
LUPIN	1/100	1/50		1/100	1/60	3/27
MIST2						
MONTI				1/100		
PONE						
PTAQ						
PYAS						
PYSE						
RUOC						
SMST						
THOC						5/11
THMO						
VETH	4/100				1/20	1/5
VIOR2						

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APPENDIX A

Glossary

Alien (plant) - A species occurring in an area to which it is not native, i.e., one introduced very recently, and usually by man.

Allelopathy - Any direct or indirect inhibitory or stimulatory effect by one plant on another through the production of biochemical compounds that escape into the environment.

Biodiversity (biological diversity) - The variety and variability among living organisms and the ecological complexes in which they occur.

Climax (community) - The stable community in an ecological succession which is able to reproduce itself indefinitely under existing environmental conditions in the absence of disturbance. The final stage of succession.

Climax (vegetation) - The pattern or complex of climax communities in a landscape corresponding to the pattern of environmental gradients or habitats.

Colonization - The process of plant population establishment on a recently bared surface.

Competition - An interaction that occurs whenever two or more living organisms make demands of the ecosystem in excess of supply.

Coverage - The area of ground included in a vertical projection of individual plant canopies.

Depauperate - A stand with sparse ground covering vegetation due to 1) tree overstory density precluding sufficient light for understory plant growth, or 2) a deep restrictive litter of duff layer or, 3) a combination of limiting site factors.

Disclimax - A type of climax community which is maintained by either continuous or intermittent disturbance (i.e. - grazing, burning, logging) to a severity that the natural climax community is altered.

Disturbance - Any event which removes a significant amount of the living biomass from a site; a perturbation.

Dominant - A plant or group of plants which by their collective size, mass, or number exert the most influence on other components of the ecosystem.

Ecosystem - An aggregation of organisms of any size, considered together with their physical environment.

Exotic - A plant introduced from another country.

Forb - An herbaceous plant other than a sedge, grass, or other plant with similar grass-like foliage.

Graminoid (gramineous) - A herbaceous grass or grass-like plant.

Herb - A plant that dies back to the ground surface each year.

Indicator Species - A species which is sensitive to important spatial or temporal variation of vegetation characteristic of a site such that it's constancy or abundance reflect significant changes in abiotic or biotic environmental factors.

Layer - The lifeform (tree, shrub, or herb) which defines the characteristic physiognomy of the vegetation (at any geographic or classification scale) being considered.

Layer group - A unit of successional classification in which a diagnostic seral indicator species occurs at 5% or greater coverage.

Layer type - A unit of successional classification in which a particular plant species dominates a portion of the layer group.

Mesic - A habitat characterized by moderate moisture conditions. Drier than hydric, moister than xeric.

Microclimate - Any set of climatic conditions differing from the macroclimate, owing to closeness to the ground, to vegetation influences, to aspect, to cold air drainage, etc.

Overstory - Collectively, the dominant plant stratum, the plants below are the understory.

Plant Association - A unit of 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 ecological status is implied.

Plant Community Type - An aggregation of all plant communities with similar structure and floristic composition. A unit of vegetation within a classification with no particular successional status implied.

Rhizomatous - Having rhizomes, rootlike stems which grow underground producing above-ground stems and root systems.

Seral - 1. Successional; 2. A species or a community which will be replaced in the successional process.

Seral stage - A step or identifiable stage of a successional sequence (the sere).

Sere - The sequence of stages or communities that develop following a particular disturbance type; e.g., a fire sere.

Series - An aggregation of taxonomically related associations that takes the name of climax species that dominate the principal layer. A taxonomic unit in a classification.

Stand - Vegetation occupying a specific area and sufficiently uniform in species composition, age arrangement, structure and condition as to be distinguished from the vegetation on adjoining areas.

Structure - The physical elements of ecosystems; the size and arrangement (both vertical and horizontal) of trees within a forested stand.

Succession - The unidirectional change in species proportions of a stand or the complete replacement of one community by another. This may be progressive from early seral stages toward climax or retrogressive from late seral stages toward very early seral stages.

Succession (primary) - The change in plant species occurrence or abundance on areas bared by recent physiographic processes.

Succession (secondary) - The sequence of vegetative change initiated when a previously colonized area is disturbed by natural or human caused events.

Successional pathway - The probable course of community development within a defined framework of seral stages for a particular disturbance regime.

Tolerant (shade) - A physiological characteristic that allows a plant to develop and grow in the canopy shade of other plants.

Understory - Collectively, those plants beneath the dominant plants, beneath the overstory.

Ungulate - Cloven hoofed animals.

Xeric - Characterized or pertaining to conditions of scanty moisture supply; drier than mesic.

Zone - The geographic area of uniform macroclimate where the climatic climax associations share the same characteristic species of the principal layer.

APPENDIX B

Listing of Species Encountered

CODE	LATIN NAME	COMMON NAME
Trees		
ABGR	ABIES GRANDIS	GRAND FIR OR WHITE FIR
ABLA2	ABIES LASIOCARPA	SUBALPINE FIR
CHNO	CHAMAECYPARIS NOOTKATENSIS	ALASKA YELLOW CEDAR
JUOC	JUNIPERUS OCCIDENTALIS	WESTERN JUNIPER
LAOC	LARIX OCCIDENTALIS	WESTERN LARCH OR TAMARACK
PIEN	PICEA ENGELMANNII	ENGELMAN 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 OR RED FIR
Shrubs		
ACGL	ACER GLABRUM	ROCKY MOUNTAIN MAPLE
ALRU	ALNUS RUBRA	RED ALDER
ALSI	ALNUS SINUATA	SITKA OR THIN-LEAVED ALDER
AMAL	AMELANCHIER ALNIFOLIA	WESTERN SERVICEBERRY
ARNE	ARCTOSTAPHYLOS NEVADENSIS	PINEMAT MANZANITA
ARTEM	ARTEMISIA	SAGEBRUSH
ARAR	ARTEMISIA ARBUSCULA	LOW SAGEBRUSH
ARRI	ARTEMISIA RIGIDA	STIFF OR SCABLAND SAGEBRUSH
ARTRV	ARTEMISIA TRIDENTATA VASEYANA	MOUNTAIN BIG SAGEBRUSH
BENE	BERBERIS NERVOSA	CASCADE HOLLYGRAPE
BERE	BERBERIS REPENS	CREEPING OREGON GRAPE
BEOC	BETULA OCCIDENTALIS	WATER BIRCH
CEANO	CEANOTHUS	CEANOTHUS
CESA	CEANOTHUS SANGUINEUS	REDSTEM CEANOTHUS
CEVE	CEANOTHUS VELUTINUS	CEANOTHUS, BUCKBRUSH OR STICKY-LAUREL
CELE	CERCOCARPUS LEDIFOLIUS	CURLLEAF MOUNTAIN-MAHOGANY
CHME	CHIMAPHILA MENZIESII	LITTLE PIPSISSEWA
CHUM	CHIMAPHILA UMBELLATA	COMMON PIPSISSEWA OR PRINCE'S PINE
CHNA	CHRYSOTHAMNUS NAUSEOSUS	COMMON OR GRAY RABBITBRUSH
CHVI	CHRYSOTHAMNUS VISIDIFLORUS	GREEN RABBITBUSH
COST	CORNUS STOLONIFERA	RED-OSIER DOGWOOD
CRDO	CRATAEGUS DOUGLASII	BLACK HAWTHORN
HODI	HOLODISCUS DISCOLOR	CREAMBUSH OCEAN-SPRAY
LIBO2	LINNAEA BOREALIS	TWINFLOWER

CODE	LATIN NAME	COMMON NAME
LOIN	LONICERA INVOLUCRATA	BEARBERRY HONEYSUCKLE OR BLACK TWIN-BERRY
LOUT2	LONICERA UTAHENSIS	UTAH HONEYSUCKLE
MEFE	MENZIESIA FERRUGINEA	FOOL'S HUCKLEBERRY
PAMY	PACHISTIMA MYRSINITES	OREGON BOXWOOD
PERA3	PERAPHYLLUM RAMOSSISIMUM	SQUAW APPLE
PHLE2	PHILADELPHUS LEWISII	SYRINGA OR MOCK ORANGE
PHEM	PHYLLODOCE EMPETRIFORMIS	PINK MOUNTAIN HEATH
PHMA	PHYSOCARPUS MALVACEUS	MALLOW NINEBARK
PRUNU	PRUNUS	CHERRY OR CHOKECHERRY
PUTR	PURSHIA TRIDENTATA	BITTERBRUSH
RHPU	RHAMNUS PURSHIANA	CASCARA
RHAL	RHODODENDRON ALBIFLORUM	CASCADES AZALEA
RHGL	RHUS GLABRA	WESTERN OR SMOOTH SUMAC
RIBES	RIBES	CURRANT OR GOOSEBERRY
RICE	RIBES CEREUM	SQUAW CURRANT
RILA	RIBES LASCUSTRE	SWAMP GOOSEBERRY
RIMO	RIBES MONTIGENUM	MOUNTAIN GOOSEBERRY
RIVI	RIBES VISCOSISSIMUM	STICKY CURRANT
ROSA	ROSA	ROSE
ROGY	ROSA GYMNOCARPA	BALDHIP OR LITTLE WILD ROSE
RONU	ROSA NUTKANA	NOOTKA ROSE
RUPA	RUBUS PARVIFLORUS	THIMBLEBERRY
SASC	SALIX SCOULERIANA	SCOULER WILLOW
SARA	SAMBUCUS RACEMOSA	BLACK ELDERBERRY
SHCA	SHEPHERDIA CANADENSIS	CANADA BUFFALOBERRY
SOSI	SORBUS SITCHENSIS	SITKA MOUNTAIN-ASH
SPBE	SPIRAEA BETULIFOLIA	SHINYLEAF OR BIRCHLEAF SPIREA
SYAL	SYMPHORICARPOS ALBUS	COMMON SNOWBERRY
SYOR	SYMPHORICARPOS OREOPHILUS	MOUNTAIN SNOWBERRY
TABR	TAXUS BREVIFOLIA	PACIFIC YEW
TECA	TETRADYMIA CANESCENS	GRAY HORSE-BRUSH
VAME	VACCINIUM MEMBRANACEUM	BIG HUCKLEBERRY
VASC	VACCINIUM SCOPARIUM	GROUSE HUCKLEBERRY OR WHORTLE-BERRY

Grasses and Grass-like

AGSP	AGROPYRON SPICATUM	BLUEBUNCH WHEATGRASS
AGROS	AGROSTIS	BENTGRASS
AGDI	AGROSTIS DIEGOENSIS	THIN OR LEAFY BENTGRASS
BROMU	BROMUS	BROME
BRBR	BROMUS BRIZAEFORMIS	RATTLESNAKE BROME
BRCA	BROMUS CARINATUS	MOUNTAIN BROME
BRCO	BROMUS COMMUTATUS	HAIRY BROME OR HAIRY CHESS
BRIN	BROMUS INERMIS	SMOOTH BROME
BRJA	BROMUS JAPONICUS	JAPANESE BROME
BRTE	BROMUS TECTORUM	CHEATGRASS

CODE	LATIN NAME	COMMON NAME
BRVU	BROMUS VULGARIS	COLUMBIA BROME
CALAM	CALAMAGROSTIS	REEDGRASS OR PINEGRASS
CARU	CALAMAGROSTIS RUBESCENS	PINEGRASS
CAREX	CAREX	SEDGE
CACO	CAREX CONCINNOIDES	NORTHWESTERN SEDGE
CAEU	CAREX EURYCARPA	WIDE-FRUITED SEDGE
CAGE	CAREX GEYERI	ELK SEDGE
CAHO	CAREX HOODII	HOOD'S SEDGE
CAPY	CAREX PYRENAICA	PYRENAEAN SEDGE
CARO	CAREX ROSSII	ROSS SEDGE
CILA2	CINNA LATIFOLIA	DROOPING WOODREED
DAGL	DACTYLIS GLOMERATA	ORCHARD GRASS
DAIN	DANTHONIA INTERMEDIA	TIMBER OATGRASS
DASP	DANTHONIA SPICATA	COMMON WILD OATGRASS
DAUN	DANTHONIA UNISPICATA	ONE-SPIKE OATGRASS
ELYMU	ELYMUS	WILDRYE
ELCI	ELYMUS CINEREUS	GIANT WILDRYE
ELGL	ELYMUS GLAUCUS	BLUE WILDRYE OR WESTERN RYEGRASS
FEID	FESTUCA IDAHOENSIS	IDAHO FESCUE
FEMI	FESTUCA MICROSTACHYS	SMALL FESCUE
FEOC	FESTUCA OCCIDENTALIS	WESTERN FESCUE
FEVI	FESTUCA VIRIDULA	GREEN FESCUE
GLYCE	GLYCERIA	MANNAGRASS
HORDE	HORDEUM	BARLEY
HOJU	HORDEUM JUBATUM	FOXTAIL BARLEY
JUNCU	JUNCUS	RUSH
JUBA	JUNCUS BALTICUS	BALTIC RUSH
JUDR	JUNCUS DRUMMONDII	DRUMMOND'S RUSH
JUPA	JUNCUS PARRYI	PARRY'S RUSH
JUTE	JUNCUS TENUIS	SLENDER RUSH
KOCR	KOELERIA CRISTATA	PRAIRIE JUNEGRASS
LUZUL	LUZULA	WOODRUSH
MELIC	MELICA	ONIONGRASS
MEBU	MELICA BULBOSA	ONIONGRASS
MEFU	MELICA FUGAX	LITTLE ONIONGRASS
MESP	MELICA SPECTABILIS	SHOWY OR PURPLE ONIONGRASS
PHPR	PHLEUM PRATENSE	COMMON TIMOTHY
POA	POA	BLUEGRASS
POBU	POA BULBOSA	BULBOUS BLUEGRASS
POCU	POA CUSICKII	CUSICK'S BLUEGRASS
PONE	POA NERVOSA	WHEELER'S BLUEGRASS
POPR	POA PRATENSIS	KENTUCKY BLUEGRASS
POSA3	POA SANDBERGII	SANDBERG'S BLUEGRASS
PUCCI	PUCCINELLIA	ALKALIGRASS
SIHY	SITANIAN HYSTRIX	BOTTLEBRUSH SQUIRRELTAIL
SIHYH	SITANIAN HYSTRIX HORDEOIDES	BOTTLEBRUSH SQUIRRELTAIL
SPCR	SPOROBOLUS CRYPTANDRUS	SAND DROPSEED
STLE	STIPA LETTERMANII	LETTERMAN'S NEEDLEGRASS
STOC	STIPA OCCIDENTALIS	WESTERN NEEDLEGRASS
TRSP	TRISETUM SPICATUM	SPIKE TRISETUM OR DOWNY OATGRASS

CODE	LATIN NAME	COMMON NAME
Forbs		
ACMIL	ACHILLEA MILLEFOLIUM LANULOSA	COMMON YARROW
ACCO	ACONITUM COLUMBIANUM	COLUMBIA MONKSHOOD
ACRU	ACTAEA RUBRA	WILD RED BANEBERRY
ADBI	ADENOCAULON BICOLOR	TRAIL PLANT OR PATHFINDER
ADPE	ADIANTUM PEDATUM	MAIDENHAIR FERN
AGUR	AGASTACHE URTICIFOLIA	NETTLE LEAF HORSEMINT
AGOSE	AGOSERIS	FALSE DANDELION OR AGOSERIS
AGGL	AGOSERIS GLAUCA	PALE AGOSERIS
ALAC	ALLIUM ACUMINATUM	TAPERTIP ONION
ALTO	ALLIUM TOLMIEI	TOLMIE'S ONION
ALAL	ALYSSUM ALYSSOIDES	PALE ALYSSUM
AMSIN	AMSINKIA	FIDDLENECK
AMRE2	AMSINKIA RETRORSA	RIGID FIDDLENECK
ANMA	ANAPHALIS MARGARITACEA	COMMON PEARLY-EVERLASTING
ANPI	ANEMONE PIPERI	PIPER'S ANEMONE
ANTEN	ANTENNARIA	PUSSYTOES OR EVERLASTING
ANAL	ANTENNARIA ALPINA	ALPINE PUSSYTOES OR EVERLASTING
ANDI	ANTENNARIA DIMORPHA	LOW PUSSYTOES
ANLU	ANTENNARIA LUZULOIDES	WOODRUSH PUSSYTOES
ANRO	ANTENNARIA ROSEA	ROSY PUSSYTOES
ANST	ANTENNARIA STENOPHYLLA	NARROW-LEAF PUSSYTOES
APANP	APOCYNUM ANDROSAEMIFOLIUM PUMILUM	SPREADING DOGBANE
AQFO	AQUILEGIA FORMOSA	RED OR SITKA COLUMBINE
ARAC	ARABIS ACULEOLATA	WALL ROCKCRESS
ARENA	ARENARIA	SANDWORT
ARCA2	ARENARIA CAPILLARIS	MOUNTAIN SANDWORT
ARCO2	ARENARIA CONGESTA	CAPITATE SANDWORT
ARMA3	ARENARIA MACROPHYLLA	BIGLEAF SANDWORT
ARCO	ARNICA CORDIFOLIA	HEARTLEAF ARNICA
ARFO	ARNICA FOLIOSA	LEAFY ARNICA
ARFU	ARNICA FULGENS	ORANGE ARNICA
ARSO	ARNICA SORORIA	TWIN ARNICA
ASCA3	ASARUM CAUDATUM	WILD GINGER
ASTER	ASTER	ASTER
ASAL	ASTER ALPIGENUS	ALPINE ASTER
ASCA2	ASTER CAMPESTRIS	WESTERN MEADOW ASTER
ASCH	ASTER CHILENSIS	LONG-LEAVED ASTER
ASCO	ASTER CONSPICUUS	SHOWY ASTER
ASFOP	ASTER FOLIACEUS PARRYI	LEAFY ASTER
ASIN	ASTER INTEGRIFOLIUS	THICK-STEMMED OR STICKY ASTER
ASTRA	ASTRAGALUS	LOCOWEED OR MILKVETCH
ASFI	ASTRAGALUS FILIPES	BASALT MILKVETCH
ASRE	ASTRAGALUS REVENTUS	BLUE MOUNTAIN MILKVETCH
ATFI	ATHYRIUM FILIX-FEMINA	LADY FERN
BASA	BALSAMORHIZA SAGITTATA	ARROWLEAF BALSAMROOT
BASE	BALSAMORHIZA SERRATA	SERRATE OR TOOTHED BALSAMROOT

CODE	LATIN NAME	COMMON NAME
BERU	BESSEYA RUBRA	RED BESSEYA
BLSC	BLEPHARIPAPPUS SCABER	BLEPHARIPAPPUS
BRHI	BRASSICA HIRTA	WHITE MUSTARD
BRODI	BRODIAEA SPP.	BRODIEA
CALOC	CALOCHORTUS	MARIPOSA OR SEGO LILY
CABU2	CALYPSO BULBOSA	FAIRY-SLIPPER OR VENUS SLIPPER
CAMAS	CAMASSIA	CAMAS
CACU	CAMASSIA CUSICKII	CUSICK'S CAMAS
CAQU	CAMASSIA QUAMASH	COMMON CAMAS
CABU	CAPSELLA BURSA-PASTORIS	SHEPHERD'S PURSE
CAPU2	CARDAMINE PULCHERRIMA	SLENDER TOOTHWORT
CASTI	CASTILLEJA	PAINTBRUSH
CAAR	CASTILLEJA ARACHNOIDEA	COBWEBBY OR COTTON PAINTBRUSH
CACU3	CASTILLEJA CUSICKII	CUSICK'S PAINTBRUSH
CAHI2	CASTILLEJA HISPIDA	HARSH PAINTBRUSH
CALI2	CASTILLEJA LINARIAEFOLIA	NARROW-LEAVED PAINTBRUSH
CEAR	CERASTIUM ARVENSE	FIELD CHICKWEED OR STARRY CERASTIUM
CIAL	CIRCAEA ALPINA	ENCHANTER'S NIGHTSHADE
CIRSI	CIRSIUM	THISTLE
CIUT	CIRSIUM UTAHENSE	UTAH THISTLE
CIVU	CIRSIUM VULGARE	COMMON OR BULL THISTLE
CLPU	CLARKIA PULCHELLA	PINK FAIRIES OR DEER HORN OR
CLLA	CLAYTONIA LANCEOLATA	WESTERN SPRINGBEAUTY
CLUN	CLINTONIA UNIFLORA	QUEENCUP BEADLILY OR BRIDE'S BONNET
COLLI	COLLINSIA	BLUE-EYED MARY
COPA	COLLINSIA PARVIFLORA	SMALL FLOWERED BLUE-EYED MARY
COLLO	COLLOMIA	COLLOMIA
COGR2	COLLOMIA GRANDIFLORA	LARGE-FLOWERED COLLOMIA
COLI2	COLLOMIA LINEARIS	NARROW-LEAVED COLLOMIA
COTE	COLLOMIA TENELLA	DIFFUSE COLLOMIA
COMA3	CORALLORHIZA MACULATA	PACIFIC OR SPOTTED CORALROOT
COCA	CORNUS CANADENSIS	BUNCHBERRY DOGWOOD
CREPI	CREPIS	HAWKSBEARD
CRAC	CREPIS ACUMINATA	LONG-LEAVED OR TAPERTIP HAWKS-BEARD
CROC	CREPIS OCCIDENTALIS	WESTERN HAWKSBEARD
CRAF	CRYPTANTHA AFFINIS	SLENDER CRYPTANHTA
CRAM	CRYPTANTHA AMBIGUA	OBSCURE CRYPTANTHA
CRIN2	CRYPTANTHA INTERMEDIA	COMMON CRYPTANTHA
CYMO	CYPRIPEDIUM MONTANUM	MT. LADY'S-SLIPPER
DELPH	DELPHINIUM	LARKSPUR OR DELPHINIUM
DEDE	DELPHINIUM DEPAUPERATUM	SLIM OR DWARF LARKSPUR
DEME	DELPHINIUM MENZIESII	MENZIES LARKSPUR
DESCU	DESCURAINIA	TANSYMUSTARD
DIHO	DISPORUM HOOKERI	HOOKER FAIRYBELLS
DITR	DISPORUM TRACHYCARPUM	FAIRYBELLS, SIERRA FAIRYBELLS
DODEC	DODECATHEON	SHOOTINGSTAR

CODE	LATIN NAME	COMMON NAME
DOCO	DODECATHEON CONJUGENS	SLIMPOD SHOOTINGSTAR
EPILO	EPILOBIUM	WILLOW-HERB OR WILLOW-WEED
EPAN	EPILOBIUM ANGUSTIFOLIUM	FIREWEED
EPMI	EPILOBIUM MINUTUM	SMALL-FLOWERED WILLOW-HERB
EPPA	EPILOBIUM PANICULATUM	AUTUMN FIREWEED OR TALL ANNUAL WILLOW-WEED
EQAR	EQUISETUM ARVENSE	COMMON HORSETAIL
ERIGE	ERIGERON	DAISY OR FLEABANE
ERBL	ERIGERON BLOOMERI	SCABLAND FLEABANE
ERCH	ERIGERON CHRYSOPSIDIS	DWARF YELLOW FLEABANE OR GOLDEN DAISY
ERCO	ERIGERON COMPOSITUS	CUT-LEAVED DAISY
ERCO3	ERIGERON CORYMBOSUS	FOOTHILL DAISY OR LONG-LEAF FLEA-BANE
EREA	ERIGERON EATONII	EATON'S DAISY
ERSP	ERIGERON SPECIOSUS	SHOWY FLEABANE
ERIOG	ERIOGONUM	BUCKWHEAT OR ERIOGONUM
ERFL	ERIOGONUM FLAVUM	GOLDEN BUCKWHEAT
ERHE	ERIOGONUM HERACLEOIDES	CREAMY OR WYETH'S BUCKWHEAT
ERUM	ERIOGONUM UMBELLATUM	SULFURFLOWER OR SULFUR BUCK-WHEAT
ERLA	ERIOPHYLLUM LANATUM	COMMON ERIOPHYLLUM OR WOOLY SUNFLOWER
ERGR	ERYTHRONIUM GRANDIFLORUM	DOGTOOTH VIOLET OR YELLOW FAWNLILY
FRVEC	FRAGARIA VESCA CRINITA	WOODS STRAWBERRY
FRVIP	FRAGARIA VIRGINIANA PLATY-PETALA	BLUELEAF STRAWBERRY
FRALN	FRASERA ALBICAULIS NITIDA	WHITE STEMMED FRASERA
FRSP	FRASERA SPECIOSA	GIANT FRASERA
FRPU	FRITILLARIA PUDICA	YELLOW BELLS
GALIU	GALIUM	BEDSTRAW
GAAP	GALIUM APARINE	CLEAVERS OR GOOSE-GRASS
GATR	GALIUM TRIFLORUM	SWEETSCENTED OR FRAGRANT BEDSTRAW
GEVI	GERANIUM VISCOSISSIMUM	STICKY GERANIUM
GEMA	GEUM MACROPHYLLUM	LARGELEAVED AVENS
GETR	GEUM TRIFLORUM	OLD MAN'S WHISKERS OR PRAIRIE SMOKE AVENS
GILIA	GILIA	GILIA
GIAG	GILIA AGGREGATA	SCARLET GILIA OR SKYROCKET
GOOB	GOODYERA OBLONGIFOLIA	WESTERN RATTLESNAKE PLANTAIN
GRNA	GRINDELIA NANA	LOW GUMWEED
GRSQ	GRINDELIA SQUARROSA	RESIN-WEED
GYDR	GYMNOCARPIUM DRYOPTERIS	OAKFERN
HAEL	HABENARIA ELEGANS	CALIFORNIA HILLSIDE HABENARIA
HACA	HAPLOPAPPUS CARTHAMOIDES	LARGE-FLOWERED GOLDENWEED OR COLUMBIA GOLDENWEED
HALA	HAPLOPAPPUS LANUGINOSUS	WOOLY GOLDENWEED

CODE	LATIN NAME	COMMON NAME
HELIA	HELIANTHELLA	SUNFLOWER
HEPU	HESPEROCHIRON PUMILIS	DWARF HESPEROCHIRON
HECY	HEUCHERA CYLINDRICA	ROUNDLEAVED OR LAVA ALUMROOT
HEMI	HEUCHERA MICRANTHA	SMALL-FLOWERED ALUMROOT
HIERA	HIERACIUM	HAWKWEED
HIAL2	HIERACIUM ALBERTINUM	WESTERN HAWKWEED
HIAL	HIERACIUM ALBIFLORUM	WHITE-FLOWERED HAWKWEED
HILO	HIERACIUM LONGIBERBE	LONG-BEAKED HAWKWEED
HISC	HIERACIUM SCOULERI	WOOLYWEED
HOFU	HORKELIA FUSCA	TAWNY HORKELIA
HYCA	HYDROPHYLLUM CAPITATUM	WATERLEAF OR WOOLY BREECHES
HYFE	HYDROPHYLLUM FENDLERI	FENDLER'S WATERLEAF
HYGR	HYMENOXYS GRANDIFLORA	OLD-MAN-OF-THE-MOUNTAIN
IRIS	IRIS	IRIS
IRMI	IRIS MISSOURIENSIS	ROCKYMOUNTAIN IRIS
LASE	LACTUCA SERRIOLA	PRICKLY LETTUCE
LACO	LAPSANA COMMUNIS	NIPPLEWORT
LATHY	LATHYRUS	PEAVINE
LALA2	LATHYRUS LANSZWERTII	THICK-LEAVED PEAVINE
LANE	LATHYRUS NEVADENSIS	SIERRAN PEAVINE
LIGUS	LIGUSTICUM	LOVAGE OR LICORICE-ROOT
LICA2	LIGUSTICUM CANBYI	CANBY'S LOVAGE
LIFI	LIGUSTICUM FILICINUM	FERNLEAF LOVAGE
LICA3	LISTERA CAURINA	WESTERN OR NW TWAYBLADE
LITHO	LITHOPHRAGMA	FRINGECUP OR WOODLANDSTAR
LIBU	LITHOPHRAGMA BULBIFERA	BULBIFEROUS FRINGECUP
LIPA	LITHOPHRAGMA PARVIFLORA	SMALL-FLOWERED FRINGECUP
LIRU	LITHOSPERMUM RUDERALE	WAYSIDE GROMWELL
LOMAT	LOMATIUM	BISCUITROOT OR DESERT-PARSLEY
LOGO	LOMATIUM GORMANII	GORMAN BISCUITROOT
LOGR	LOMATIUM GRAYI	GRAY'S LOMATIUM
LOHE	LOMATIUM HENDERSONII	HENDERSON'S LOMATIUM
LOLE	LOMATIUM LEPTOCARPUM	SLENDERFRUIT LOMATIUM OR BICOLOR BISCUITROOT
LONU	LOMATIUM NUDICAULE	BARESTEM LOMATIUM
LOTR	LOMATIUM TRITERNATUM	NINE-LEAF LOMATIUM
LOMI	LOTUS MICRANTHUS	SMALL-FLOWERED DEERVETCH
LUPIN	LUPINUS	LUPINE
LUAR3	LUPINUS ARGENTEUS	SILVERY LUPINE
LUCA	LUPINUS CAUDATUS	TAILCUP LUPINE
LUHO	LUPINUS HOLOSERICEUS	LITTLE-FLOWERED LUPINE
LULET	LUPINUS LEUCOPHYLLUS TENUISPICUS	WOOLY OR VELVET LUPINE
LUSE	LUPINUS SERICEUS	SILKY LUPINE
MACI	MADIA CITRIODORA	LEMON-SCENTED TARWEED
MAGL	MADIA GLOMERATA	CLUSTER TARWEED
MAGR	MADIA GRACILIS	SLENDER OR COMMON TARWEED OR GUMWEED

CODE	LATIN NAME	COMMON NAME
MERTE	MERTENSIA	BLUEBELLS OR MERTENSIA
MEOB	MERTENSIA OBLONGIFOLIA	LEAFY BLUEBELLS
MITR	MICROSERIS TROXIMOIDES	FALSE AGOSERIS
MIGR	MICROSTERIS GRACILIS	PINK MICROSTERIS
MIST2	MITELLA STAUROPETALA	SIDE-FLOWERED MITREWORT
MONTI	MONTIA	MINER'S LETTUCE OR MONTIA
MOPA	MONTIA PARVIFOLIA	LITTLELEAVED MINER'S LETTUCE
NAIN	NAVARRETIA INTERTEXTA	NEEDLELEAVED NAVARRETIA
ORHI	ORTHOCARPUS HISPIDUS	HAIRY OWL-CLOVER
OSMOR	OSMORHIZA	SWEET-CICELY
OSCH	OSMORHIZA CHILENSIS	MOUNTAIN SWEET-CICELY
OSOC	OSMORHIZA OCCIDENTALIS	WESTERN SWEETROOT
PABR	PAEONIA BROWNII	BROWN'S PEONY
PEDIC	PEDICULARIS	LOUSEWORT OR PEDICULARIS
PEGR	PEDICULARIS GROENLANDICA	PINK ELEPHANTS OR ELEPHANT'S HEAD
PERA	PEDICULARIS RACEMOSA	LEAFY OR SICKLETOP LOUSEWORT
PENST	PENSTEMON	PENSTEMON OR BEARDTONGUE
PEDEV	PENSTEMON DEUSTUS VARIABILIS	HOT ROCK PENSTEMON
PEGA	PENSTEMON GAIRDNERI	GAIRDNER'S PENSTEMON
PEGL	PENSTEMON GLANDULOSUS	GLANDULAR OR STICKY-STEM PENSTEMON
PERY	PENSTEMON RYDBERGII	RYDBERG'S PENSTEMON
PEBO	PERIDERIDIA BOLANDERI	BOLANDER'S YAMPAH
PHACE	PHACELIA	PHACELIA
PHHE	PHACELIA HETEROPHYLLA	VARILEAF PHACELIA
PHLOX	PHLOX	PHLOX OR WILD SWEET-WILLIAM
PHPU	PHLOX PULVINATA	CUSHION PHLOX
PHCH	PHOENICAULIS CHEIRANTHOIDES	DAGGERPOD
POPUC	POLEMONIUM PULCHERRIMUM CALYCINUM	SKUNK-LEAVED POLEMONIUM OR JACOB'S LADDER
POLYG	POLYGONUM	KNOTWEED, POKEWEED OR FLEECE-FLOWER
POBI	POLYGONUM BISTORTOIDES	AMERICAN OR WESTERN BISTORT
PODO	POLYGONUM DOUGLASII	DOUGLAS' KNOTWEED
POMA2	POLYGONUM MAJUS	WIRY OR PALOUSE KNOTWEED
POPH	POLYGONUM PHYTOLACCAEFOLIUM	ALPINE KNOTWEED OR POKEWEED OR FLEECEFLOWER
POMU	POLYSTICHUM MUNITUM	CRISTMAS FERN OR SWORD FERN
POTEN	POTENTILLA	CINQUEFOIL OR FIVEFINGER
POGL	POTENTILLA GLANDULOSA	STICKY OR GLAND CINQUEFOIL
POGR	POTENTILLA GRACILIS	SLENDER CINQUEFOIL
PTAQ	PTERIDIUM AQUILINUM	BRAKEN OR BRAKE FERN
PYAS	PYROLA ASARIFOLIA	PINK WINTERGREEN
PYPI	PYROLA PICTA	WHITEVEIN WINTERGREEN
PYSE	PYROLA SECUNDA	SIDEBELLS PYROLA
RANUN	RANUNCULUS	BUTTERCUP OR CROWFOOT
RAPO	RANUNCULUS POPULAGO	BLUE MOUNTAIN BUTTERCUP
RUOC	RUDBECKIA OCCIDENTALIS	WESTERN CONEFLOWER
RUMEX	RUMEX	SORREL OR DOCK

CODE	LATIN NAME	COMMON NAME
RUAC	RUMEX ACETOSELLA	RED OR SHEEP SORREL
SASI	SANGUISORBA SITCHENSIS	SITKA BURNET
SCAN	SCUTELLARIA ANGUSTIFOLIA	NARROWLEAVED SKULLCAP
SELA2	SEDUM LANCEOLATUM	LANCELEAVED STONECROP
SELE	SEDUM LEIBERGII	LEIBERG'S STONECROP
SEST	SEDUM STENOPETALUM	WORMLEAF STONECROP
SENEC	SENECIO	GROUNDSEL OR BUTTERWEED OR RAGWORT
SECR	SENECIO CRASSULUS	THICK-LEAVED GROUNDSEL
SEIN	SENECIO INTEGERRIMUS	WESTERN GROUNDSEL OR
SESE	SENECIO SERRA	BUTTERWEED GROUNDSEL
SIOR	SIDALCEA OREGANA	OREGON CHECKER-MALLOW
SILEN	SILENE	CAMPION OR CATCHFLY OR SILENE
SIOR2	SILENE OREGANA	OREGON CATCHFLY
SIDO	SISYRINCHIUM DOUGLASII	GRASS-WIDOWS
SIIN2	SISYRINCHIUM INFLATUM	PURPLE-EYED GRASS
SMILA	SMILACINA	SOLOMON'S SEAL
SMST	SMILACINA STELLATA	STARRY FALSE SOLOMON'S SEAL
SPRO	SPIRANTHES ROMANZOFFIANA	HOODED LADIES TRESSES OR PEARL-TWIST
SPRAG	SPRAGUEA	PUSSYPAWS
STRO	STREPTOPUS ROSEUS	ROSY TWISTEDSTALK
SYMI	SYNTHERIS MISSURICA	MOUNTAIN KITTENTAILS
TAOF	TARAXACUM OFFICINALE	COMMON DANDELION
THOC	THALICTRUM OCCIDENTALE	WESTERN MEADOWRUE
THMO	THERMOPSIS MONTANA	MOUNTAIN THERMOPSIS OR GOLDEN-PEA
TITRU	TIARELLA TRIFOLIATA UNIFOLIATA	COOLWORT FOAMFLOWER
TRAGO	TRAGOPOGON	SALSIFY OR GOATSBEARD
TRDU	TRAGOPOGON DUBIUS	YELLOW SALSIFY
TRCA3	TRAUTVETTERIA CAROLINIENSIS	FALSE BUGBANE
TRLA2	TRIENTALIS LATIFOLIA	WESTERN STARFLOWER
TRLO	TRIFOLIUM LONGIPES	LONG STALKED CLOVER
TRMA	TRIFOLIUM MACROCEPHALUM	BIG HEAD CLOVER
TRPL	TRIFOLIUM PLUMOSUM	PUSSY CLOVER
URTIC	URTICA	NETTLE
URDI	URTICA DIOICA	STINGING NETTLE
VASI	VALERIANA SITCHENSIS	MT.HELIOTROPE OR SITKA VALERIAN
VECA	VERATRUM CALIFORNICUM	CALIFORNIA FALSE HELLEBORE
VIAM	VICIA AMERICANA	AMERICAN VETCH
VIOLA	VIOLA	VIOLET
VINUM	VIOLA NUTTALLII MAJOR	NUTTALL'S VIOLET
WOOR	WOODSIA OREGANA	OREGON WOODSIA
WYAM	WYETHIA AMPLEXICAULIS	NORTHERN MULE'S EARS
ZIPA	ZIGADENUS PANICULATUS	PANICLED DEATHCAMAS
ZIVEG	ZIGADENUS VENENOSUS GRAMINEUS	DEADLY ZIGADENUS OR MEADOW DEATHCAMAS