United States
Department of
Agriculture

Forest Service

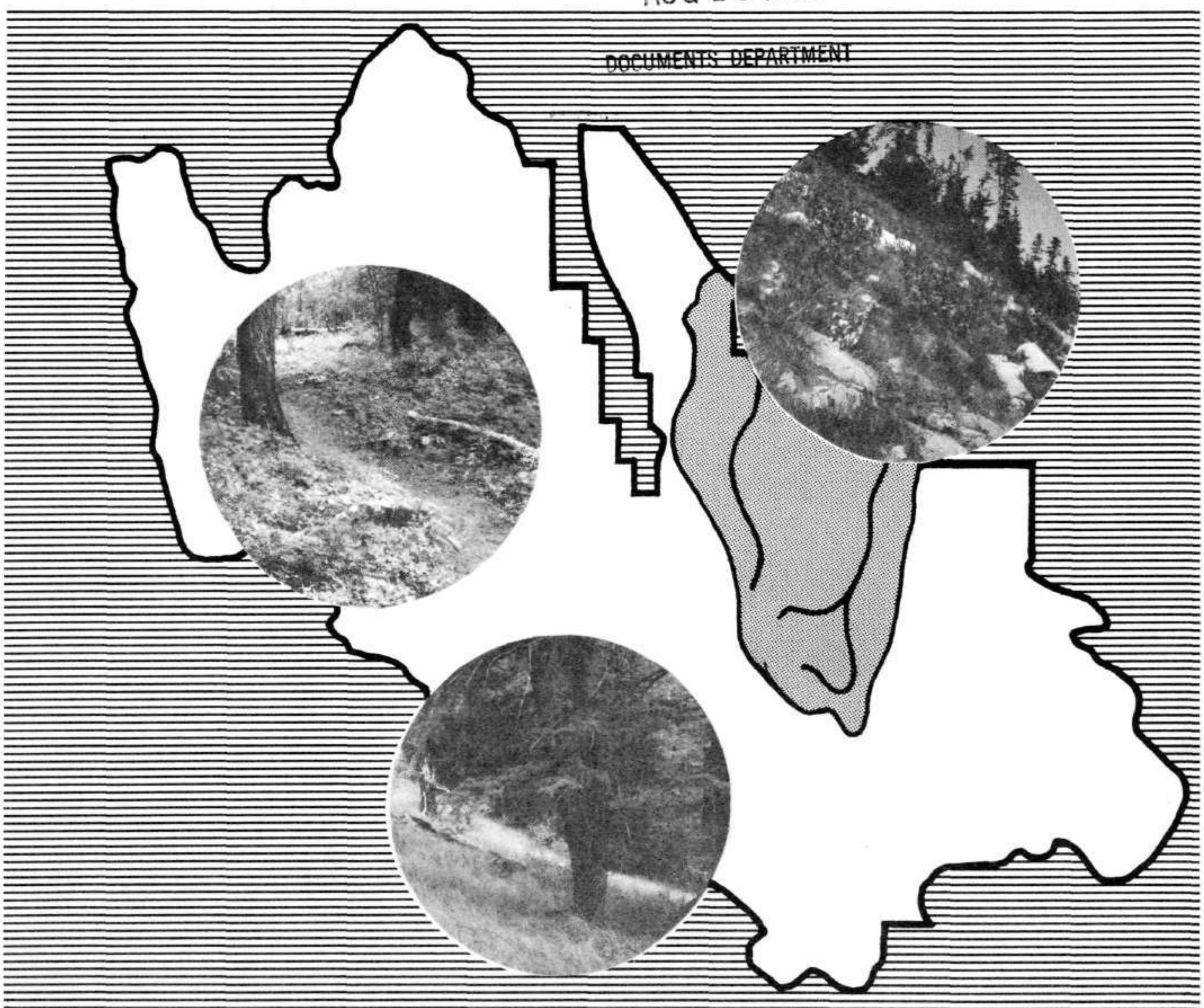
**Intermountain
Forest and Range
Experiment Station
Ogden, UT 84401**

Research Paper
INT-288

May 1982

Vegetation of Two Drainages in Eagle Cap Wilderness, Wallowa Mountains, Oregon

David N. Cole



THE AUTHOR

DAVID N. COLE is research ecologist with the Wilderness Management Research Work Unit, located at the Forestry Sciences Laboratory on the University of Montana campus at Missoula. He is on a temporary assignment from the University of Oregon in Eugene. Dr. Cole received his B.A. (1972) in geography from the University of California at Berkeley and his Ph.D. (1977), also in geography, from the University of Oregon.

RESEARCH SUMMARY

A classification of vegetation is presented for part of the Eagle Cap Wilderness. Compositional data and descriptions are supplied for 14 coniferous forest types and nine other community types. An additional four communities are described. Under each type the author discusses implications for wilderness management: campsite and trail suitability, unusual problems, fire management, and so on. This work should be expanded to include the entire Wallowa Mountains and incorporated into a habitat type classification while still retaining information on seral vegetation types.

CONTENTS

Page

United States
Department of
Agriculture

Forest Service

**Intermountain
Forest and Range
Experiment Station
Ogden, UT 84401**

Research Paper
INT-288

May 1982

Vegetation of Two Drainages in Eagle Cap Wilderness, Wallowa Mountains, Oregon

David N. Cole

INTRODUCTION

When the National Wilderness Preservation System was established in 1964, Congress stated explicitly that each wilderness area was to be "protected and managed so as to preserve its natural condition." In order to provide this protection, the Forest Service requires that a wilderness management plan be developed for each area. Three of the six specifications for management plans mentioned in the Forest Service Manual (FSM 2322.1) are to: (1) "describe the current condition of all resources and biotic associations"; (2) "describe the interrelationships of all resources, existing uses, and activities and highlight unique ecological situations"; and (3) "identify problems associated with maintaining an enduring wilderness resource and the reasons for the problem."

Classification and description of vegetation is an important step in this direction. Classification provides an organizational framework for research and the communication of information about different plant communities and environments. It would be particularly valuable to collect information about specific problems resulting from various types of use and organize this information by vegetation type.

Descriptions of vegetation structure and floristic composition and their relation to selected environmental characteristics, such as elevation and aspect, will provide baseline data about "current conditions" and allow managers to evaluate and respond to future vegetational changes. This information also reveals unique ecological situations that might require special management strategies for preservation.

Successional relationships are an important component of these descriptions. Succession in response to "natural" disturbances will have to be distinguished from changes resulting from human activities. In particular, successional changes resulting from fire suppression need to be understood, as suppression is causing uncharacteristically rapid changes in vegetation structure and composition over large tracts of wilderness (see, for example, Heinselman 1973; Vankat and Major 1978).

This paper classifies and describes the vegetation of a part of the Eagle Cap Wilderness in the Wallowa Mountains of northeastern Oregon (fig. 1). Aside from several theses (Sturges 1957; Head 1959; Johnson 1959; Woodland 1965), little information is available on the community ecology of the Wallowa Mountains. Information on vegetation is usually extrapolated from a study by Hall (1973) who worked in the neighboring Blue Mountains, which are topographically and geologically different from much of the Wallowa Mountains.

The primary purpose of this paper, however, is to present wilderness management implications for each vegetation type. Each type responds uniquely to recreational use and management practices and offers distinctive recreational opportunities. Although these implications are specific to the study area, they can be cautiously applied to floristically similar and, to a lesser extent, morphologically similar types which occur elsewhere. For example, in a recent study of trampling impact in the Tyrolean Alps, alpine meadows dominated by *Carex curvula* were found to be resistant to damage, a response quite similar to that of the morphologically similar *Carex nigricans* meadows in the Wallowas (personal communication, Dr. G. Grabherr).

The implications presented here should serve as a foundation on which an increasingly accurate and detailed information base can be developed for the Eagle Cap Wilderness and for other areas. Information of this type will ultimately lead to management that is sensitive to inherent differences in the character of land types, the opportunities they provide, and the management problems they present.

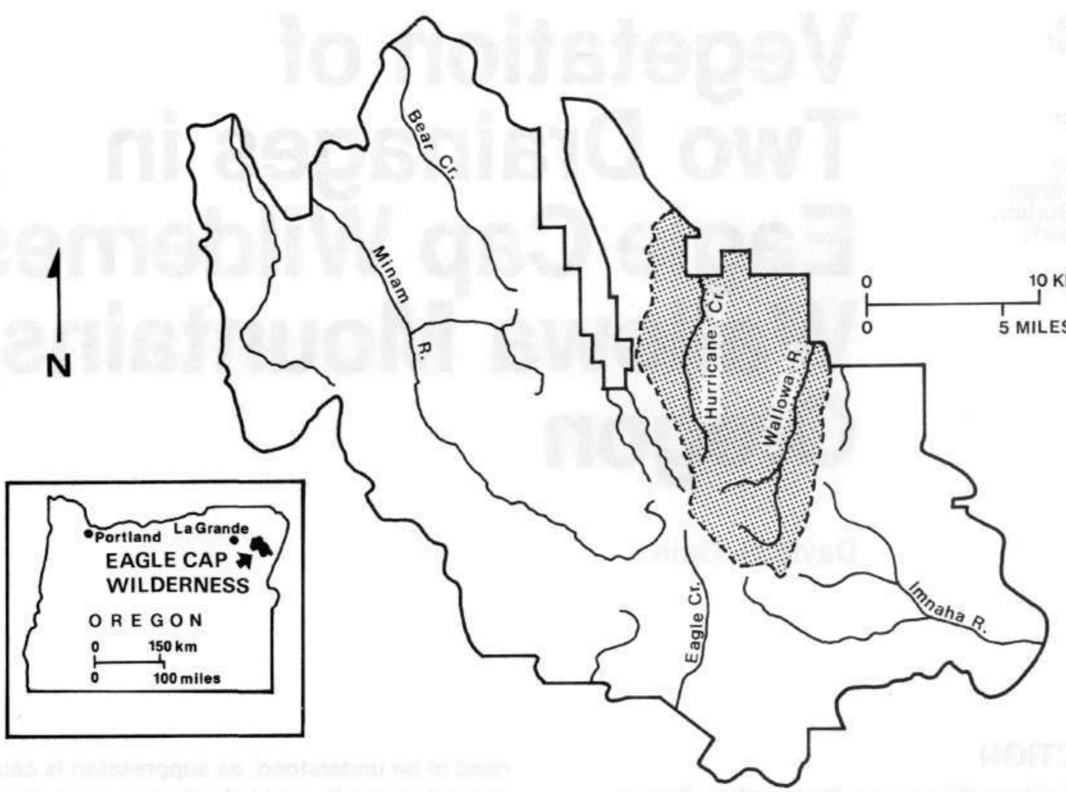


Figure 1.—Location of the study area within the Eagle Cap Wilderness in northeastern Oregon.

THE STUDY AREA

The Wallowa Mountains are the highest and most rugged range in the Blue Mountain Province of northeastern Oregon. The Wallowas are bordered on the south and west by the basins of the Powder and Grande Ronde Rivers. On the east they are separated from the mountains of Idaho by the Hells Canyon of the Snake River and, to the north, they drop off abruptly to the Wallowa River Valley and dissected plateau country.

The Wallowa Mountains, uplifted along faults to the northeast and south, have a central core of granitic rocks. These are surrounded by folded, partially metamorphosed limestones, shales, and greenstones. Basalts cover extensive areas except around the granitic core of the range where they are only occasionally found on some of the higher peaks (Smith and Allen 1941). The tallest peaks exceed 9,500 feet (2 850 m) and tower more than 5,000 feet (1 500 m) above the surrounding plains. Extensive glaciation occurred during the Pleistocene, with glaciers reaching out to the edge of the range on the northeast side. Consequently, the range is characterized by numerous lakes and meadows in cirque basins (fig. 2) and steep, jagged ridges separating deep valleys, which radiate from the granitic core of the range (fig. 3).

The area experiences short, mild summers and long, cold winters. At Joseph, Oreg., immediately to the north of the mountains, mean minimum and maximum temperatures have averaged 12° F (– 11° C) and 32° F (0° C) in January and 46° F (8° C) and 79° F (26° C) in July. Temperatures at higher elevations in the mountains are undoubtedly cooler. Mean annual precipitation in the mountains probably varies between 20 and 80 inches (50 and 200 cm). Except for a short summer dry season, precipitation is distributed equitably throughout the year (U.S. Department of Commerce 1965).

An approximately 15 000-ha area was selected for intensive study (fig. 4). The area consisted of the contiguous drainage basins of Hurricane Creek and the West Fork of the Wallowa River within the Eagle Cap Wilderness.[1] This area was chosen because it contained a particularly wide range of rock types that outcrop over the complete elevational range of the mountains and because it is the most heavily used part of the wilderness (fig. 5). The study area is unrepresentative of the range as a whole in that its location to the north of the core resulted in particularly intensive glacial oversteepening of slopes and an underrepresentation of southerly aspects. In addition, basalt rocks, common elsewhere in the Wallowa Mountains, are rare in the study area. Observations also suggest that high-elevation species extend downward to unusually low elevations, perhaps in response to cold air drainage.

[1]Several sample stands were located outside of, but within a mile of the wilderness.

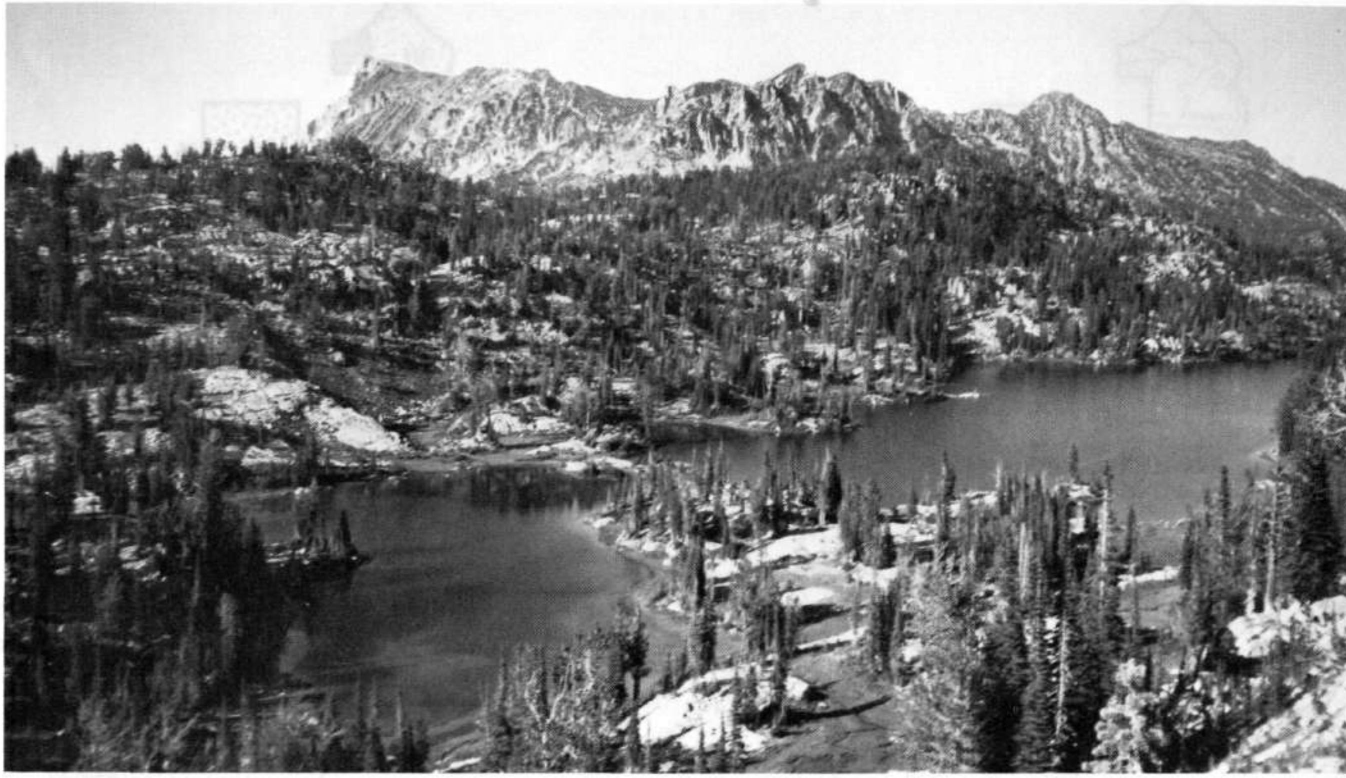


Figure 2.—Moccasin Lake is typical of the numerous lakes scattered throughout the subalpine zone of the Wallowa Mountains.

Figure 3.—The Matterhorn (right) and Sacajawea (left) tower more than 3,000 ft above Hurricane Creek. The contact between calcareous and noncalcareous bedrock coincides with the upper limit of continuous forest.

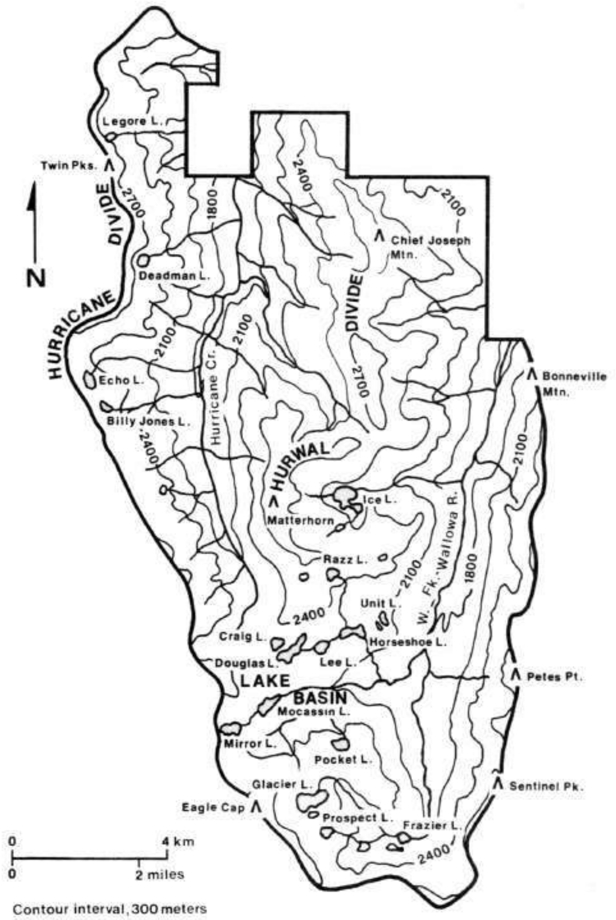


Figure 4.—Topographic map of the study area.

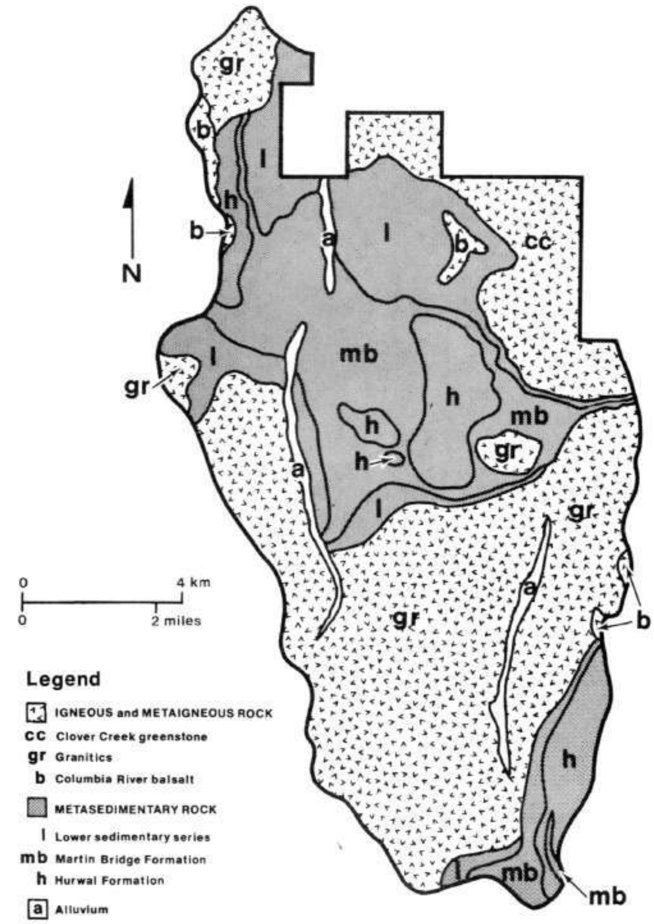


Figure 5.—Geologic map of the study area.

METHODS

A reconnaissance survey of the vegetation in the study area was conducted during the summer of 1974. This resulted in a first approximation of possible plant community types and identification of stands suitable for more intensive sampling. During the summers of 1975 and 1976, 90 coniferous forest stands were sampled. Stands were selected that were representative of broadly distributed community types. Within each type, stands were dispersed throughout the range of rock types, elevations, aspects, and localities. This led to less similar stand compositions, but it more fully described the variation within each type.

An additional 38 stands were sampled in community types other than coniferous forest. This coverage was not as comprehensive as the survey of coniferous forests, but it did identify the major types.

Within each stand, a macroplot was located in a relatively homogeneous area away from ecotones and areas of direct human disturbance. Each 32.8 - × - 65.6-ft (10- × - 20-m) macroplot contained ten, 3.28-×-3.28-ft (1- × -1-m) microplots, located at 9.8-ft (3-m) intervals along strips 9.8 and 19.7 ft (3 and 6 m) upslope from the lower boundary of the macroplot. Long dimensions were oriented parallel to contours.[2]

On forested macroplots, species and diameter at breast height were recorded for each tree. Trees less than 4.5 ft (137 cm) in height were counted as seedlings and included with the trees less than 0.8-inch (2-cm) d.b.h. Data on tree size class were combined by community type and presented as mean values per macroplot (table 2, appendix 2).

Within the microplots, canopy coverage of each understory species was recorded in one of six coverage classes (0-5, 6-10, 11-25, 26-50, 51-75, and 76-100 percent). The midpoints of coverage classes were used to derive mean percent coverage for each understory species. Frequency of occurrence in the 10 microplots was also recorded. Frequency and mean coverage for each species are presented in table 3 in appendix 2. Voucher specimens of these species have been deposited in the herbarium at the University of Oregon, Eugene. Nomenclature follows Hitchcock and Cronquist (1973).

[2]Classification methods in forests of the western United States have become increasingly standardized. In the future it would be more appropriate to utilize the sample design of Pfister and Arno (1980).

The name assigned to each community type is usually a binomial consisting of the mature tree species and undergrowth species that are currently most abundant. Where several tree species commonly codominate, the type is named after the codominant that is reproducing most frequently. Details on composition are provided in the descriptions. Exceptions to this are the *Pinus albicaulis-Abies lasiocarpa* type and several nonforested types named after the type of environment they occupy (for example, avalanche slope).

This concept of a community type should not be confused with the habitat type concept, which also uses a nomenclature based on combinations of overstory and undergrowth species. A habitat type is the collection of geographic areas capable of being occupied by the same "association," a **climax** plant community type named for potential climax tree species and indicator species in the undergrowth (Daubenmire and Daubenmire 1968). The community types described here are named for **currently dominant** species and do not imply any particular successional stage. Several distinct community types may occupy the same habitat type, either as different seral stages in a predictable sere or as different responses to perturbations. A community type may also overlap several habitat types, if the type is climax in one area and seral in another (fig. 6). Inferences about successional relationships both within and between community types are included in the descriptions of the coniferous forest types.

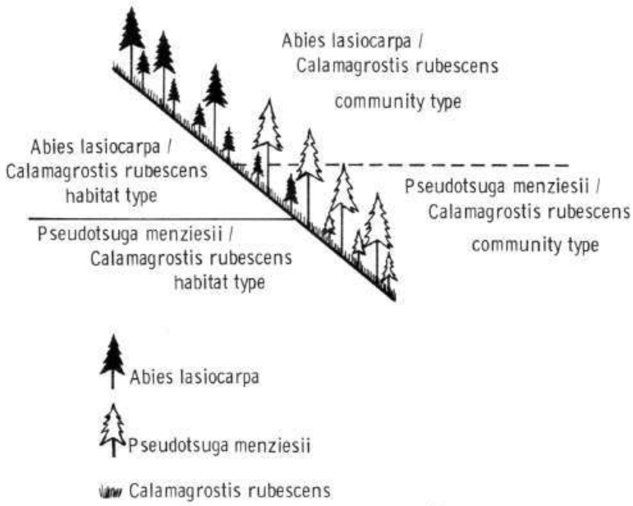


Figure 6.—Example of how community types and habitat types overlap along an environmental gradient. In the middle portion of the gradient, the *Pseudotsuga menziesii/Calamagrostis rubescens* community type occurs as a seral stage on the *Abies lasiocarpa/Calamagrostis rubescens* habitat type. (Modified from Layser and Schubert 1979.)

Some of the management implications provided are supported by research data, while others are based on personal judgment. Most of the comments on trail and campsite location are based on detailed studies reported elsewhere (Cole 1977, 1981). Comments on the magnitude of successional change resulting from fire suppression are inferences drawn from analysis of stand structure rather than research on actual burns. No other research results are available, so additional suggestions should be treated as personal judgment.

A key to the community types is presented in appendix 1.

THE COMMUNITY TYPES

Pseudotsuga menziesii/Agropyron spicatum (PSME/AGSP)

Description.—This community type (c.t.) is occasionally encountered on droughty south-facing slopes, usually below 5,300 ft (1 600 m). It is more common on the partially metamorphosed rocks than on the granitics.

Trees are widely spaced, creating relatively open stands (fig. 7). *Pseudotsuga menziesii* is the most abundant tree species, although large, old *Pinus ponderosa* are more abundant here than in any other c.t. *Pinus* is no longer establishing seedlings, however, so that the seedling and sapling population consists almost entirely of *Pseudotsuga.*

Figure 7.—*Pseudotsuga menziesii/Agropyron spicatum* stand located on a south slope above Hurricane Creek.

The understory is dominated by *Agropyron spicatum.* Associates are highly variable, as indicated by the dissimilar composition of the two stands sampled. *Achillea millefolium, Balsamorhiza sagittata,* and *Lomatium grayi* are particularly abundant. Annuals and exotics, such as *Bromus tectorum,* are more prominent in this c.t. than in any other.

Most of these stands are mature and the overstory composition appears to be relatively stable. Observations suggest that tree density is often increasing, probably in response to suppression of formerly frequent surface fires. This often coincides with a decline in *Pinus* regeneration and a decrease in the cover of bunchgrass.

Management implications.—Low moisture and early snowmelt make this c.t. a particularly good trail location. Moreover, the open canopy provides scenic vistas and the diversity of wild flowers is high. Suitability for campsites is low because the c.t. is limited to steep slopes. Recreational values will tend to decline with increasing tree density, a trend observed in some areas, apparently in response to recent fire suppression. Rehabilitation of disturbances will be difficult due to soil drought and steep, unstable slopes.

Other studies.—Similar vegetation has been described in central Idaho (Steele and others, 1981), Montana (Pfister and others 1977), and interior British Columbia (McLean 1970; McLean and Holland 1958). It has not been described in the published literature elsewhere in Oregon and Washington, although *Pinus ponderosa/Agropyron spicatum* types without any *Pseudotsuga* have been reported in the Blue Mountains of Oregon, in eastern Washington and northern Idaho, and in the Bighorn Mountains of Wyoming (Hall 1973; Daubenmire and Daubenmire 1968; Hoffman and Alexander 1976).

Pseudotsuga menziesii/Physocarpus malvaceous (PSME/PHMA)

Description.—This type occurs below 6,000 ft (1 800 m), particularly on slopes with large concentrations of boulders. It is uncommon on calcareous substrates. *PSME/PHMA* occurs on all aspects, but is somewhat more common on slopes with a northerly aspect. In the study area, it is most frequent on lower slopes above the West Fork of the Wallowa River.

The overstory is relatively open and dominated by *Pseudotsuga menziesii. Larix occidentalis* is the only associate of any significance. *Pseudotsuga* is the most abundant seedling. *Abies grandis*[3] is also establishing seedlings in some locations, but *Larix* seedlings are essentially nonexistent.

This type is easily distinguished by its dense shrub cover (59 percent mean cover — see table 4, appendix 2) and complex vertical structure (fig. 8). In addition to the 4- to 6-ft (1.5- to 2.0-m) tall layer of *Physocarpus malvaceous,* there is typically a low shrub layer of *Symphoricarpos albus* and *Spiraea betulifolia,* and a layer of herbaceous species such as *Calamagrostis rubescens* and *Thalictrum occidentale. Acer glabrum* frequently rises above the *Physocarpus* layer. Total canopy coverage is unusually high (76 percent), while species richness is only moderate (table 4, appendix 2).

Management implications.—This type is usually too steep, rocky, and brushy for campsites. It appears to be a good location for trails. Soils are well drained and the rough topography and brush confine the hiker to the trail tread. Fall colors are quite attractive and the relatively open canopy allows frequent distant views.

Figure 8.—Widely spaced trees and undergrowth dominated by tall shrubs typify the *Pseudotsuga menziesii/ Physocarpus malvaceous* community type.

Other studies.—Similar vegetation has been described as representative of community types in the Blue Mountains of eastern Oregon (Hall 1973), and habitat types in eastern Washington and northern Idaho (Daubenmire and Daubenmire 1968), central Idaho (Steele and others 1981), Montana (Pfister and others 1977), northeastern Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station), and northern Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station).

Pseudotsuga menziesii/Calamagrostis rubescens (PSME/CARU)

Description.—This type is common on midelevation—5,300 to 6,700 ft (1 600 to 2 000 m)—slopes, with well-developed soils and little exposed rock. It occurs on various aspects and in the study area is most common on lower slopes. If the topography of the area were less rugged, it would probably be more widespread.

Pseudotsuga menziesii is the most abundant species in the overstory, although *Larix occidentalis* and *Pinus ponderosa* are locally important. Individual trees are usually large and often exhibit an open-grown growth habit, even where currently surrounded by dense forests (fig. 9). Fire scars are common. Of the eight stands sampled, regeneration is primarily *Pseudotsuga* in two, primarily *Abies lasiocarpa* in three, and a mixture of the two in three stands. *Abies* reproduction is greater at higher elevations, on more protected sites, and on granitic rocks. *Larix* and *Pinus* seedlings are seldom encountered.

The understory can easily be distinguished by the luxuriant growth of *Calamagrostis rubescens* (mean cover of 32 percent). Tall shrubs are conspicuously absent, but low shrubs particularly *Berberis repens* and

[3]Many of these individuals appear to be *Abies grandis* × *A. concolor* hybrids similar to those in central Idaho studied by Daniels (1969). I will refer to them as *A. grandis.*

Figure 9.—Typical *Pseudotsuga menziesii/Calamagrostis rubescens* stand displays the parklike stand structure and luxuriant growth of grass.

Symphoricarpos albus, and forbs, such as *Thalictrum occidentale* and *Arnica cordifolia,* occasionally interrupt the grass cover. Species richness is quite low and despite the high graminoid cover, very few graminoid species occur in this type.

Some of these stands (14 and 92) have relatively stable, self-perpetuating population structures. In others, *Pseudotsuga* is a seral dominant while *Abies* appears to be the major climax species. No mature *Abies lasiocarpa/ Calamagrostis rubescens* stands could be found in the area, however. Stand densities appear to be increasing. Increased density, in conjunction with an increase in the relative abundance of *Abies,* is often associated with decreased *Calamagrostis* cover and increased cover of shade-tolerant forbs, particularly *Thalictrum occidentale.*

Management implications.—These parklike stands are particularly attractive sites to locate trails or campsites. Drainage is generally good and little more than basic construction should be necessary. The visibility and gentle topography suggest that hikers leaving the trail, particularly to shortcut switchbacks, could be a problem. Although the ground cover is relatively resistant to damage from trampling, damaged sites are particularly obvious and esthetically displeasing when adjacent to the nearly continuous cover of undisturbed sites. This suggests that these sites are durable, but that efforts should be made to reduce the obtrusiveness of impacts. Dispersed camping, that is rotation of use among a large number of sites, may be preferable to concentration of use on a few sites, provided use of individual sites is very infrequent and low impact camping techniques are practiced. Suitably flat sites for camping may be hard to find, however. Recovery of these sites is facilitated by the rhizomatous habit of *Calamagrostis* and the lack of shade on many of these sites. Increasing canopy closure and successional trends toward *Abies lasiocarpa,* probably resulting in large part from fire suppression, may decrease the natural attractions, durability, and regenerative abilities of this type.

Other studies.—Generally similar vegetation has been described from interior British Columbia (McLean and Holland 1958; Tisdale and McLean 1957; McLean 1970) and Alberta (Ogilvie 1962), south through eastern Washington, Idaho (Daubenmire and Daubenmire 1968; Steele and others 1981), and Montana (Pfister and others 1977) to the Blue Mountains of eastern Oregon (Hall 1973), the southern Wallowa Mountains (Head 1959), and the mountains of northwestern Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station) and northern Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station).

Pseudotsuga menziesii/Thalictrum occidentale (PSME/THOC)

Description.—This c.t. can be found on moderately moist, lower slopes, between 5,200 and 6,700 ft (1 550 and 2 000 m). It often grades to *Pseudotsuga menziesii/ Calamagrostis rubescens* on drier sites and to *Abies lasiocarpa/Thalictrum occidentale* in valley bottoms or on more mesic exposures.

The overstory consists of *Pseudotsuga menziesii* and *Larix occidentalis,* with the seedling and sapling size classes consisting almost exclusively of *Abies lasiocarpa* and *Picea engelmannii.* All of these stands are seral and related to the successionally more advanced *Abies lasiocarpa/Thalictrum occidentale* c.t. (see below), with which this type could probably be grouped on the basis of site potential.

The understory is distinguished by its lush cover of shade-tolerant, moist-site forbs (mean cover of 47 percent). Medium-sized forbs—8 to 32 inches (2 to 8 dm)—particularly *Thalictrum occidentale* and *Arnica cordifolia,* provide most of the cover, but there is also a ground-level layer of plants (such as *Pyrola secunda* and *Viola adunca)* as well as a patchy shrub layer. Species richness is high.

Management implications.—The forb ground cover of this type is rapidly destroyed by trampling; recreation sites are frequently invaded by exotic species, such as *Taraxacum officinale* and *Trifolium repens.* Consequently, the number of trails and campsites in this type should be minimized by discouraging the dispersal of campsites and trails.[4] Rehabilitation of disturbances should be moderately rapid, if assisted, because of relatively long growing seasons and adequate soil moisture. A more serious problem is maintenance of this seral type. With continued fire suppression, *Pseudotsuga* and *Larix* will be replaced by *Abies lasiocarpa,* and yet successful burning in these dense forests, particularly after years of fuel accumulation, will be difficult. Prescribed underburning may be the only solution.

Other studies.—No similar types have been described because other studies have focused attention on near climax stands.

[4]Dispersal of use is most practical on durable sites. On fragile sites, unless use levels are very low, use should be either curtailed or concentrated on as few sites as possible.

Pseudotsuga menziesii/Berberis repens (*PSME/BERE*)

Description.—This is a common c.t. below 6,000 ft (1 800 m) on calcareous rock types, although it occasionally occurs on noncalcareous metamorphic rocks as well. It is usually found in valley bottoms and on lower slopes, particularly in areas disturbed at periodic but infrequent intervals by debris slides and mudflows. It is essentially restricted to the lower part of Hurricane Creek.

Pseudotsuga menziesii is usually the most abundant tree species, but *Picea engelmannii* is abundant in concavities and on protected sites, while *Juniperus scopulorum* frequently occurs on dry, open sites, particularly on colluvial fans. All of these species, in addition to *Abies lasiocarpa*, are reproducing abundantly.

The ground cover is characterized by various combinations of low shrubs, particularly *Berberis repens, Symphoricarpos albus, S. oreophilus,* and *Spiraea betulifolia. Calamagrostis rubescens* and *Thalictrum occidentale* are common, but usually subordinate to the shrubs, particularly on more xeric sites. Total cover is only moderately dense (50 percent mean cover), but species richness is very high.

This type is highly variable and not well defined. It is also difficult to draw conclusions about the successional status of these stands. Some seem to be stable and self-perpetuating, while *Abies lasiocarpa* appears to be climax in others. More work on this type would clarify successional relationships and might lead to the recognition of several distinct types.

Management implications.—The ground cover of this type is quickly destroyed by camping, but the esthetic impact of the ground cover loss is not striking. This suggests that concentrated use of a few sites might be acceptable, if the use cannot be diverted to the more desirable avalanche slopes (see below). There appears to be little potential for trail deterioration problems (fig. 10).

Figure 10.—Trails in the *Pseudotsuga menziesii/Berberis repens* community type seldom deteriorate. This stand, in the valley bottom adjacent to Hurricane Creek, has unusually luxuriant undergrowth.

Moreover, there are no widespread successional trends among tree species, so maintenance of this type does not appear to be a problem.

Other studies.—No other community descriptions appear to be highly similar, although *PSME/BERE* habitat types have been described in southern and eastern Idaho, western Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station), the Bighorn Mountains of north-central Wyoming (Hoffman and Alexander 1976), and northern Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station).

Pinus flexilis (*PIFL*)

Description.—This type is confined to calcareous bare rock and unstable slopes of weathered limestone. It extends from 5,000 ft (1 500 m) to timberline, which is rarely above 7,000 ft (2 100 m) on calcareous rocks in the study area. Only two stands were sampled and these were highly dissimilar. Consequently, there was no attempt to define an understory union.

The most common associates of *Pinus flexilis* are *Pseudotsuga menziesii* and *Juniperus scopulorum,* and all of these species are capable of maintaining stable populations. The understory is sparse and characterized by xeric low shrubs and forbs (fig. 11). The only species common to both stands are *Achillea millefolium, Erigeron chrysopsida* var. *brevifolius,* and *Phacelia hastata* var. *leucophylla*.

Management implications.—This type is not suitable for campsites and trail construction is difficult due to the extent of bare rock and the rapid downslope movement of colluvium. Although not significantly threatened, this unique type deserves special protection because of its botanical interest. These are some of the westernmost stands of *Pinus flexilis* within the Pacific Northwest as defined by Hitchcock and Cronquist (1973).

Other studies.—*Pinus flexilis* has not been described elsewhere in Oregon and Washington. Apparently, there are stands in the Strawberry Mountains (Charlie Johnson, personal communication), however. Stands have been described in east-central Idaho (Steele and others 1981), Montana, along and east of the Continental Divide (Pfister and others 1977), and south into Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station), and Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station). None of the stand descriptions appear to be very similar to these in the Wallowa Mountains.

Figure 11.—Widely spaced, stunted trees and sparse undergrowth characterize *Pinus flexilis* stands.

Abies grandis/Thalictrum occidentale (ABGR/THOC)

Description.—This type is uncommon in the study area, as it is confined to valley bottoms below 5,300 ft (1 600 m). These sites are probably warmer than those occupied by *PSME/THOC* or *ABLA/THOC*. It is probably more widespread in other parts of the range. For example, Head (1959) describes similar vegetation along the East Fork of Eagle Creek in the southern part of the range.

Abies grandis is the most abundant species in all size classes (fig. 12). *Pseudotsuga menziesii* and *Larix occidentalis* are the most common associates in the overstory, but they are no longer establishing seedlings consistently. The most common associates in the smaller size classes are *Abies lasiocarpa* and *Picea engelmannii.*

The understory is similar to *PSME/THOC,* although the diversity of species is lower and total cover is less (40 percent). This may reflect the denser tree canopy coverage in this type. Occasionally, *Linnaea borealis* dominates the ground cover, but these sites were not sufficiently numerous to warrant separate classification.

Management implications.—Implications are generally similar to those of the *PSME/THOC* type. Although these sites are warmer than *PSME/THOC* sites, rehabilitation of disturbances may be more difficult due to the greater canopy coverage of these stands. Because these stands are more successionally advanced, however, maintenance of *Abies grandis,* at least, should not be difficult.

Figure 12.—*Abies grandis* is the most abundant seedling, sapling, and mature tree in this *Abies grandis/ Thalictrum occidentale* stand. The undergrowth of shade-tolerant forbs is unusually dense for this type.

Other studies.—This type has not been described elsewhere. Many of the common species in this understory union are members of the *Pachistima myrsinites* union and other moist site unions that occur in *Abies grandis* forests from eastern Oregon (Hall 1973) and Washington (Daubenmire and Daubenmire 1968) through Idaho (Steele and others 1981) to western Montana (Pfister and others 1977). In the Wallowa Mountains, however, many of the indicator species from these other locations are either infrequent (for example, *Clintonia uniflora* and *Pachistima myrsinites*) or only locally abundant (for example, *Linnaea borealis*).

Abies lasiocarpa/Thalictrum occidentale (ABLA/THOC)

Description.—This widespread type occupies moist valley bottoms and north slopes between 5,200 and 7,000 ft (1 550 and 2 100 m). Topography is usually smooth and soils are relatively well developed. This appears to be an extension of the *ABGR/THOC* c.t. on higher elevation sites that are cool and moist enough to support more abundant *Abies lasiocarpa*. It differs from *PSME/THOC* in that *PSME/THOC* is a seral stage on sites near the warm, dry limit of those sites capable of being occupied by the *ABLA/THOC* c.t.

The overstory is unusually dense and either *Picea engelmannii* or *Abies lasiocarpa* may be the most abundant mature tree. Typically, more of the large trees are *Picea*, while most of the trees less than 12 to 16 inches (3 to 4 dm) d.b.h. are *Abies*. The abundance of *Picea*, in relation to *Abies*, tends to decrease with increasing elevation and decreasing soil moisture. *Picea* is also much more abundant on calcareous rocks. *Pseudotsuga menziesii* and *Larix occidentalis* occur in the overstory, but seldom establish seedlings.

The understory is broadly similar to the other *Thalictrum* types, but species richness and total cover are even lower than in the *ABGR/THOC* type. Shrubs and graminoids are less important than in other types. Characteristic associates of *Thalictrum* include *Arnica cordifolia, Chimaphila umbellata, Fragaria vesca, Osmorhiza chilensis, Pyrola secunda, Viola adunca*, and *Viola orbiculata* (fig. 13). On some sites, *Thalictrum* may be less abundant than *Arnica* and *Pyrola* or even absent. These are usually extremely dense stands with thick organic soil horizons and a total understory cover of 20 percent or less.

Figure 13.—*Abies lasiocarpa/Thalictrum occidentale* stand located along Hurricane Creek at 6,000 ft.

Management implications.—This type is not very durable for campsites, because the lush vegetative cover is quickly eliminated and the soil becomes compacted (fig. 14). Such changes are not particularly displeasing esthetically, however, and many campsites are located in this type. If permitted in this type, camping should be concentrated on as few sites as possible to prevent widespread damage. These sites are well watered, hence rehabilitation should be relatively rapid for forested sites. Scarification and either seeding or transplanting may be necessary to overcome extreme soil compaction. A seasonally high water table leads to bog formation on some of the trails in this type. Additional work could probably identify a phase of this type that is particularly susceptible to trail deterioration. *Streptopus amplexifolius* and *Senecio triangularis* are common indicators of high water tables. These areas should be avoided whenever possible. Otherwise it will be necessary to construct corduroy or turnpikes and to maintain natural drainage. Continued fire suppression will probably lead to increased prominence of *Abies lasiocarpa,* increased stand density, and reduced diversity.

Other studies.—An *ABLA/THOC* type has been specifically identified from Yellowstone National Park south to the Wind River Range, Wyo. (Steele and others 1979, preliminary draft, USDA Forest Service Intermountain Station). The stands in the Wallowas, however, are probably more similar to other types named for less abundant indicator species. The stands with a depauperate ground cover and little *Thalictrum* appear to be similar to *Abies lasiocarpa/Arnica cordifolia* types described in east-central Idaho (Steele and others 1981), Montana (Pfister and others 1977), and northwestern (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station) and north-central Wyoming (Hoffman and Alexander 1976).

Figure 14.—Undergrowth is easily destroyed on campsites located in the *Abies lasiocarpa/Thalictrum occidentale* community type. On many sites, damage to trees is also severe.

Abies lasiocarpa/Vaccinium membranaceum (ABLA/VAME)

Description.—This rather infrequent type is most common on granitic soils at moderate elevations—5,300 to 7,000 ft (1 600 to 2 100 m). It occupies various exposures but occurs most frequently on flats, benches, and northerly aspects.

Abies lasiocarpa and *Picea engelmannii* are codominant, with *Picea* the more abundant large tree and *Abies* the more abundant smaller tree. *Pseudotsuga menziesii, Larix occidentalis,* and *Pinus contorta* are occasional associates that seldom establish seedlings. These stands are considerably less dense than other *Abies lasiocarpa* types (fig. 15).

The understory is characterized by high shrub coverage, with a mean *Vaccinium membranaceum* cover of 31 percent. Total cover and species richness are also quite high. The most common associated species are *Thalictrum occidentale, Viola orbiculata,* and *Arnica cordifolia.* As stand density increases, *Vaccinium* cover decreases and these forbs become increasingly prominent.

Management implications.—*Vaccinium membranaceum* berries are an attraction in this type, but berry crops are usually poor, particularly under a dense canopy. The brittleness of *Vaccinium* makes this type extremely susceptible to trampling damage. Again, such damage is seldom esthetically displeasing, and campers appear to be willing to clear off enough of the shrub cover to set up tent pads. There appears to be little potential for trail deterioration problems and rehabilitation of these sites should be easier than in higher elevation *Abies lasiocarpa* types, but more difficult than on *THOC* and meadow sites. Increasing stand density will probably inhibit the future establishment of tree species other than *Abies,* and cause reduction in both *Vaccinium* cover and berry production.

Other studies.—Similar vegetation has been described by Hall (1973) in the Blue Mountains of eastern Oregon and Mauk and Henderson (1980, preliminary draft, USDA Forest Service, Intermountain Station) in northern Utah. Related types, in which *Vaccinium membranaceum* is replaced by *V. globulare,* have been described in central Idaho (Steele and others 1981), south-central Montana (Pfister and others 1977), and northwestern Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station).

Figure 15.—*Abies lasiocarpa/Vaccinium membranaceum* stand on a slope above the West Fork of the Wallowa River. *Picea engelmannii* is less abundant than usual.

Abies lasiocarpa/Vaccinium scoparium (*ABLA/VASC*)

Description.—This is the most common forested type in the study area, occupying most noncalcareous forested sites between 6,700 ft and 7,600 ft (2 000 and 2 300 m). Glacial scouring was extreme in these areas and, consequently, soils are poorly developed and exposed bedrock is widespread.

The tree stratum is dominated by both *Abies lasiocarpa* and *Picea engelmannii,* but again the importance of *Abies* appears to be increasing with time. The only other associates are *Pinus albicaulis,* at higher elevations, and *Pinus contorta,* at lower elevations.

Although the understory is strongly dominated by *Vaccinium scoparium* (fig. 16), the great environmental diversity encompassed by this type is reflected in a wide variety of understory species that associate with *Vaccinium.* Fifty vascular species were identified in the 19 stands sampled, despite low species richness. In addition to *Vaccinium,* only *Phyllodoce empetriformis, Lonicera utahensis,* and *Ledum glandulosum* have mean percent coverages of more than 1 percent, and only *Phyllodoce* is present in more than 50 percent of the stands sampled.

In a preliminary subdivision of this type, four "subtypes" were identified: (1) a *Ledum glandulosum* subtype on particularly moist sites, such as streambanks and lakeshores (stands 81, 72, 69, and 1); (2) a *Phyllodoce empetriformis* subtype in well-drained areas that experience late snowmelt (stands 93, 82, 79, 80, 74, and 71); (3) a *Juncus parryi-Carex rossii* subtype on dry, open, rocky sites (stands 94, 130, 78, and 75); and (4) a *Vaccinium scoparium* subtype on modal sites (stands 77, 10, 2, 76, and 34).

Management implications.—Vegetation is quickly destroyed with recreational use, as *Vaccinium scoparium* is notably susceptible to trampling (Dale and Weaver 1974; Cole 1981). Of the subtypes, the *Ledum glandulosum* and *Phyllodoce empetriformis* subtypes are most susceptible to damage, particularly from early season use during snowmelt. Campsite use should be discouraged on these subtypes; and, where allowed, it should be concentrated rather than dispersed. Visitors should be encouraged to camp on the *Juncus-Carex* subtype, which has little ground cover to be destroyed and soils that are seldom wet. Dispersed use is more appropriate here, except in areas that are heavily used (around the lakes in the Lake Basin, for example). Rehabilitation will be an extremely difficult and slow process throughout this type, however. Maintenance of stand composition, in areas which do not receive much recreational use, should not require much management effort.

Other studies.—Similar vegetation has been recognized from British Columbia (McLean 1970), south through Idaho (Daubenmire and Daubenmire 1968; Steele and others 1981), eastern Oregon (Hall 1973), and Montana (Pfister and others 1977), to Wyoming (Wirsing and Alexander 1975; Hoffman and Alexander 1976; Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station), Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station), and Colorado (Daubenmire and Daubenmire 1968).

Figure 16.—*Abies lasiocarpa/Vaccinium scoparium* stand, with abundant *Phyllodoce empetriformis.*

Pinus albicaulis-Abies lasiocarpa (PIAL-ABLA)

Description.—This type occurs at the highest elevations reached by erect trees, occupying most of the sites between 7,600 and 8,500 ft (2 300 and 2 550 m) that are suitable for tree establishment. It is both widespread and environmentally variable. Further study might allow the differentiation of several types.

These stands are codominated by *Pinus albicaulis* and *Abies lasiocarpa* (fig. 17). The oldest and largest trees are usually *Pinus,* which has a much longer lifespan than *Abies.* With increasing elevation, the height attained by *Abies* decreases, and *Pinus* may occur alone in the highest stands. *Abies* also grows poorly on the partially metamorphosed rocks, where *Pinus* often dominates all size classes. *Picea engelmannii* may be present at lower elevations.

The understory is highly variable. On most, but not all sites, the most consistently abundant species is *Vaccinium scoparium. Vaccinium* is particularly common on granitic rocks, where it commonly associates with graminoids such as *Carex rossii, Juncus parryi,* and *Oryzopsis exigua.* Other species which can be locally common include *Juniperus communis, Carex geyeri, Festuca viridula, Arnica cordifolia,* and *Linanthastrum nuttallii.* Mean cover is quite low (28 percent), as is species richness.

Management implications.—Most of the ground cover species are susceptible to trampling damage, and rehabilitation at these high elevations is a long, slow process. Moreover, the low productivity of these forests means that supplies of downed wood for fires are quickly eliminated close to campsites. Many of the most popular lakes in the Eagle Cap Wilderness are located in this type, however, suggesting that bare campsites, devoid of downed wood, may have to be accepted, with management striving to limit these impacted areas in size and number. Encouraging the use of stoves or prohibiting fires would help, as would encouraging use of adjacent *Carex nigricans* meadows (see below). Trails, in contrast, are well suited to this type, although in some places the openness of the forest allows hikers to leave the trail. Maintenance of stand composition, in areas which do not receive much recreational use, should not require much management effort.

Other studies.—Similar vegetation has been described elsewhere in the Wallowa Mountains (Head 1959) and from eastern Washington (Daubenmire and Daubenmire 1968), Idaho (Steele and others 1981), and Montana (Pfister and others 1977) south to northwestern Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station). The *Pinus albicaulis-Abies lasiocarpa* stands in the Blue Mountains (Hall 1973) have an understory dominated by *Carex geyeri,* which is only occasionally important in the stands in the study area.

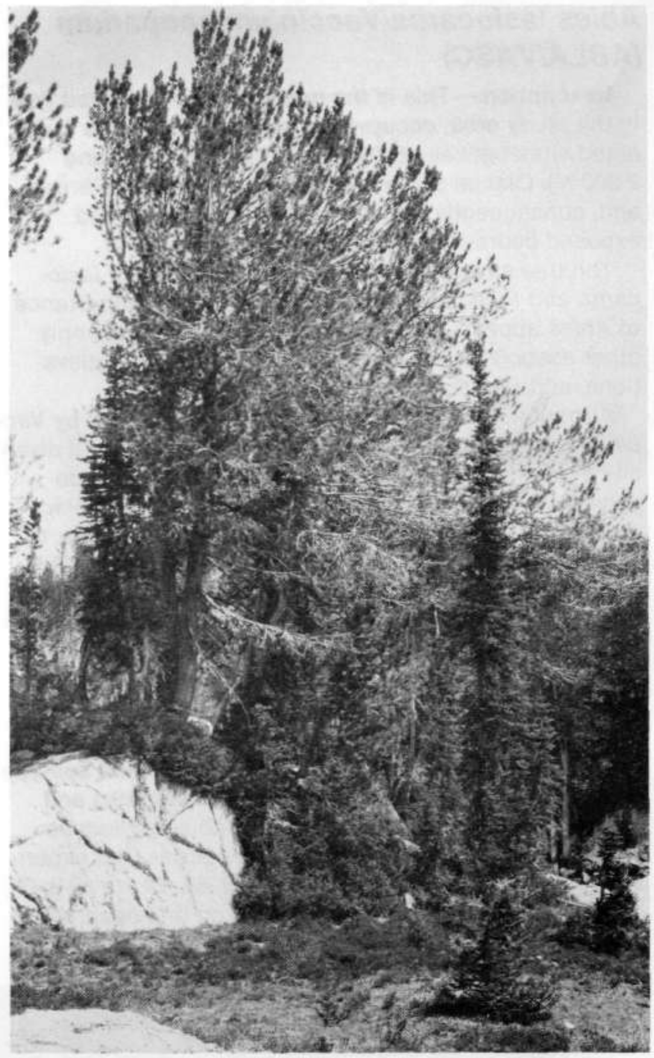


Figure 17.—*Pinus albicaulis-Abies lasiocarpa* stand located near Moccasin Lake. The most abundant undergrowth species are *Vaccinium scoparium, Juncus parryi,* and *Carex* sp.

Pinus contorta/Calamagrostis rubescens (PICO/CARU)

Description.—This type is most common on flat benches below 6,000 ft (1 800 m), although it occasionally occurs on other topographic positions and at higher elevations.

The overstory is usually a dense stand of polelike *Pinus contorta* (fig. 18), with widely scattered *Pseudotsuga menziesii* and *Larix occidentalis* individuals. In some of these stands *Pinus contorta* is the only species regenerating; in others *Abies lasiocarpa* is the most abundant seedling. Apparently, *Abies lasiocarpa* is the potential climax tree species in some stands while *Pinus contorta* may be capable of perpetuating itself in others. *Pseudotsuga menziesii* seldom establishes seedlings in these stands, suggesting that very few of these stands are successional to *Pseudotsuga.*

Figure 18.—Pole-sized trees are characteristic of most *Pinus contorta* stands, such as this representative of the *Pinus contorta/Calamagrostis rubescens* community type.

The undergrowth is dominated strongly by *Calamagrostis rubescens. Spiraea betulifolia* and *Arnica cordifolia* are the only other species found in more than 50 percent of the stands.

Management implications.—Implications are similar to those for the *PSME/CARU* type, except that these dense stands do not seem as attractive as the *Pseudotsuga* stands with their well-spaced large trees. They are also commonly located in areas of cold air accumulation which makes them less desirable campsite locations. Some type of fire management, other than total suppression, will be necessary to maintain stands of this type.

Other studies.—Similar vegetation, whether clearly seral or not, has been described in the Blue Mountains of Oregon (Hall 1973), Idaho (Steele and others 1981), Montana (Pfister and others 1977), northwestern Wyoming (Steele and others 1979, preliminary draft, USDA Forest Service, Intermountain Station), and northern Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station).

Pinus contorta/Vaccinium membranaceum (*PICO/VAME*)

Description.—This type occupies midelevation—5,300 to 7,000 ft (1 600 to 2 100 m)—rocky benches, as the *ABLA/VAME* type does, but is more common and widely distributed.

Pinus contorta is the most consistently abundant mature tree, although *Pseudotsuga menziesii* may be locally abundant and *Larix occidentalis* can occasionally be found. *Abies lasiocarpa* is the most abundant seedling in all stands. *Picea engelmannii* and *Pinus contorta* seedlings can also be found in some places.

The undergrowth is less diverse than that associated with an *Abies lasiocarpa* overstory; species richness is less and the predominance of *Vaccinium* is greater. Forb cover, in particular, is quite low and variable. Only *Arnica cordifolia, Chimaphila umbellata,* and *Viola orbiculata* were found in more than one of the three stands sampled.

Management implications.—Implications are similar to those of the *ABLA/VAME* type. Perpetuation of these stands will require modification of current fire suppression policies.

Other studies.—Similar seral stands have been described by Hall (1973) in the Blue Mountains of Oregon.

Pinus contorta/Vaccinium scoparium (*PICO/VASC*)

Description.—This type is common on relatively flat, but rocky sites on granitic substrates, mostly between 6,000 and 7,000 ft (1 800 and 2 100 m). In the study area it is most extensive on the flat valley floor of the West Fork of the Wallowa River below its junction with Lake Creek.

Pinus contorta usually forms extremely dense stands, with many fallen trees on the forest floor. In most of these stands *Abies lasiocarpa* is the most abundant seedling (fig. 19), although *Pinus contorta* is establishing seedlings more frequently than in the other *Pinus contorta* types. The stands in which *P. contorta* exhibits climax behavior are most common on granitic benches where soils are particularly shallow and, therefore, probably droughty and infertile. *Picea engelmannii* is also regenerating frequently in some stands; *Larix occidentalis* can be found scattered through the overstory but is not establishing seedlings.

The undergrowth is sparse and dominated by *Vaccinium scoparium.* Other shrubs are usually absent. Species richness is extremely low. Common associates include *Carex rossii, Juncus parryi, Oryzopsis exigua,* and *Arnica cordifolia.*

Management implications.—Implications are similar to those of the *ABLA/VASC* type. Perpetuation of these stands will require modification of current fire suppression policies.

Other studies.—Similar vegetation, whether obviously seral or not, has been described in Idaho (Daubenmire and Daubenmire 1968; Steele and others 1981), Montana (Pfister and others 1977), eastern Oregon (Hall 1973), Wyoming (Wirsing and Alexander 1973; Hoffman and Alexander 1976; Steele and others 1979, preliminary draft,

Figure 19.—*Abies lasiocarpa* is the most abundant seedling in this *Pinus contorta/Vaccinium scoparium* stand.

USDA Forest Service, Intermountain Station), and Utah (Mauk and Henderson 1980, preliminary draft, USDA Forest Service, Intermountain Station).

Acer glabrum (ACGL)

Description.—This type occupies the more stable parts of boulder fields below 6,900 ft (2 100 m). It is particularly common on granitics and the Clover Creek greenstone, which produce extensive boulder fields (fig. 20).

Below the *Acer glabrum* layer there commonly is a layer of medium-sized shrubs including *Philadelphus lewisii, Physocarpus malvaceous,* and *Rubus idaeus* var. *gracilipes.* Beneath these shrubs are shade-tolerant forbs (e.g., *Galium triflorum, Arenaria macrophylla,* and *Arnica cordifolia*), while more xerophytic species (e.g., *Cystopteris fragilis, Heuchera cylindrica,* and *Penstemon venustus*) inhabit the openings between shrubs.

Management implications.—This type is not suitable for camping, and trail construction requires removal of boulders and surfacing with sand or gravel. Where this has been done, it does provide a highly stable surface, and trails through this type contribute beauty and diversity to the visitor's experience.

Other studies.—No similar types have been described elsewhere.

Figure 20.—*Acer glabrum* shrublands are common on lower elevation boulder slopes.

Alnus sinuata (ALSI)

Description.—This type is found on seepage areas kept free of trees by persistent avalanching. It is most common on granitic rocks between 5,700 and 7,000 ft (1 700 and 2 100 m).

The undergrowth, below the tangle of *Alnus* stems, is characteristically a lush growth of forbs. The most consistently abundant species are *Urtica dioica* var. *lyallii, Mertensia paniculata* var. *borealis,* and *Heracleum lanatum.* Total cover is extremely high, as is species richness.

Management implications.—The dense tangle of shrubs makes this type poorly suited for any type of recreational use (fig. 21). Nevertheless it can provide a source of water for people camping on adjacent slopes. Trail deterioration can be a common problem, as a result of trampling impact on moist soils and frequent erosion by debris avalanches. Great care should be taken so that trails cross drainages at right angles and water is not diverted down the trails.

Other studies.—Similar vegetation has been described in the Cascade Mountains of Oregon and Washington (Franklin and Dyrness 1973) and in eastern Washington and northern Idaho (Daubenmire and Daubenmire 1968). Hall (1973) describes a similar type, dominated by *Alnus incana,* in the Blue Mountains of eastern Oregon.

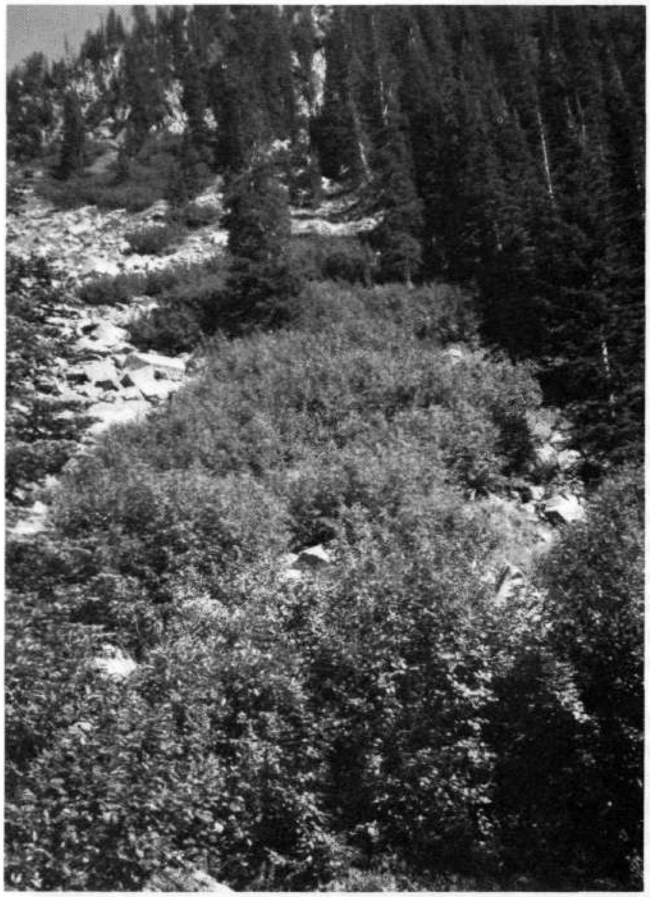


Figure 21.—*Alnus sinuata* shrublands often provide a source of water on dry slopes.

Cercocarpus ledifolius (CELE)

Description.—This type is largely confined to highly exposed, rocky bluffs and south slopes below 7,000 ft (2 100 m). In the study area, it is seldom found on granitic rocks and is particularly conspicuous on calcareous rocks and the Clover Creek greenstones.

Cercocarpus ledifolius creates a prominent layer about 10 ft (3 m) above the ground, which may also include some *Juniperus scopulorum.* The most abundant ground cover species is usually *Agropyron spicatum.* Consistent associates include *Symphoricarpos oreophilus, Berberis repens, Achillea millefolium,* and *Phacelia hastata* var. *leucophylla.*

Management implications.—This is an attractive and relatively durable type for trails, although construction may be difficult. It is usually too steep and rocky for camping. Rehabilitation would be difficult due to droughty conditions.

Other studies.—Similar vegetation has been described in the Blue Mountains of eastern Oregon (Hall 1973), Idaho (Scheldt and Tisdale 1970), and western Montana (Mueggler and Stewart 1980).

Avalanche Slopes

Description.—Distinctive grassland communities are found on colluvial fans at the base of avalanche paths in the major valley bottoms. These are primarily found below 7,000 ft (2 100 m). Composition varies with rock type and distance from water.

On granitic rocks, these grasslands are usually dominated by *Carex hoodii, Elymus glaucus,* and *Bromus carinatus* (fig. 22). Forb cover is dense and diverse, particularly close to watercourses. *Mertensia paniculata* var. *borealis, Urtica dioica* var. *lyallii,* and *Agastache urticifolia* are especially common.

On calcareous rocks, *Stipa occidentalis* is the most abundant graminoid, although *Agropyron caninum* var. *majus, Agropyron spicatum,* and *Carex geyeri* may be locally abundant. Shrubs, such as *Potentilla fruticosa, Symphoricarpos albus,* and *Berberis repens,* are more common than on the granitics.

Communities on other rock types often combine features of these two rather distinct types. Below 5,300 ft (1 600 m), particularly on the Clover Creek greenstone, *Symphoricarpos albus* is prominent.

Management implications.—This type is generally a durable and attractive location for trails and campsites (fig. 23). It offers the best views in the valley bottoms. The graminoid ground cover is relatively resistant to trampling, so that bare areas around campsites are small. Dispersal and rotation of sites is usually preferable to concentration of use. As in all open vegetation types, there is a tendency for people to leave trails. This has resulted in the development of parallel trails in some places. It is also important to insure that seasonal surface drainage is not intercepted by the trail tread. Rehabilitation will probably vary from easy to moderately difficult as soil moisture decreases.

Other studies.—I have found no comparable types described in the literature.

Figure 22.—Abundant tall forbs such as *Mertensia paniculata* and *Heracleum lanatum* characterize the avalanche slope grasslands on granitic substrates.

Figure 23.—Trails through avalanche slope grasslands are usually in good condition. This grassland located along Hurricane Creek has developed on calcareous colluvial material.

High Elevation Grasslands

Description.—This type occurs on dry, exposed ridges and south slopes above 7,000 ft (2 100 m). Such grasslands are considerably more common on the metamorphic rocks than on granitics. Daubenmire and Daubenmire (1968) attribute many of these xerophytic parks to excessive wind transfer of snow from these slopes to the leeward side of the ridges.

Species composition varies with conditions such as rock type and exposure. Although *Festuca viridula* is the most common dominant (fig. 24), *Festuca* grasslands are much more abundant outside of the study area where basalt rock is more widespread. *Carex geyeri* and *Agropyron spicatum* also dominate some of these grasslands, particularly on metamorphic rocks. Shrubs are conspicuously absent among associated species which include *Stipa occidentalis, Carex microptera, Linanthastrum nuttallii, Polygonum phytolaccaefolium,* and *Arenaria aculeata.*

Most of these grasslands were severely overgrazed by sheep in the decades around the turn of the century. Most researchers suggest that originally graminoids were more dominant than today (Sampson 1909; Pickford and Reid 1942; Strickler 1961; Hall 1973). The forb component is considered to be largely an artifact of this period of overgrazing. *Stipa* spp., *Linanthastrum nuttallii, Eriogonum* spp., and *Polygonum phytolaccaefolium,* among others, are indicative of overgrazing. Fair amounts of these species occur in the stands sampled and illustrate the seral nature of the majority of this community type.

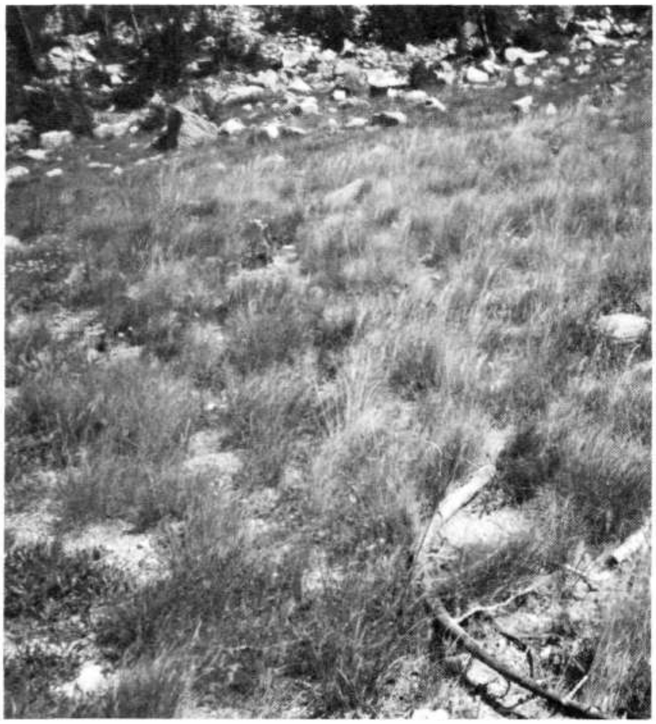


Figure 24.—*Festuca viridula* is the most abundant species in this high-elevation grassland.

Management implications.—This type provides a relatively durable location for trails and campsites. Trail grades should be gentle, however, because the deep soils are prone to erosion. Dispersal and rotation of campsites should be encouraged. The availability of campsites, however, is often limited by lack of water and the infrequency of level ground. Rehabilitation will be a slow process and continued grazing by pack stock will prolong recovery from the period of sheep grazing.

Other studies.—Similar vegetation has been described in the Blue Mountains (Hall 1973) and in eastern Washington and northern Idaho (Daubenmire and Daubenmire 1968). *Festuca viridula* grasslands have also been described in rain shadow areas in western Washington (Franklin and Dyrness 1973) and western Oregon (Van Vechten 1960), but the associated species are usually quite different.

Phyllodoce empetriformis (PHEM)

Description.—This type is common between 7,500 and 9,000 ft (2 250 and 2 700 m), on gently concave slopes that are well drained but have a short snow-free period. It is most common on north-facing microtopography in cirque basins. At its lower extremity, it intermingles with subalpine forest and meadow (fig. 25), but also extends above timberline.

The two heathers, *Phyllodoce empetriformis* and *Cassiope mertensiana,* form a consistent low shrub layer. *Phyllodoce* is always more abundant but *Cassiope* increases in abundance with elevation. In some places, *Vaccinium scoparium* is also conspicuous.

Consistent forb associates include *Potentilla flabellifolia, Veronica cusickii, Erigeron peregrinus* var. *scaposus, Ligusticum tenuifolium, Antennaria lanata,* and *Castilleja chrysantha.* Graminoids are less abundant than forbs, but *Carex nigricans* and *Luzula hitchcockii* were found in four of the five stands sampled.

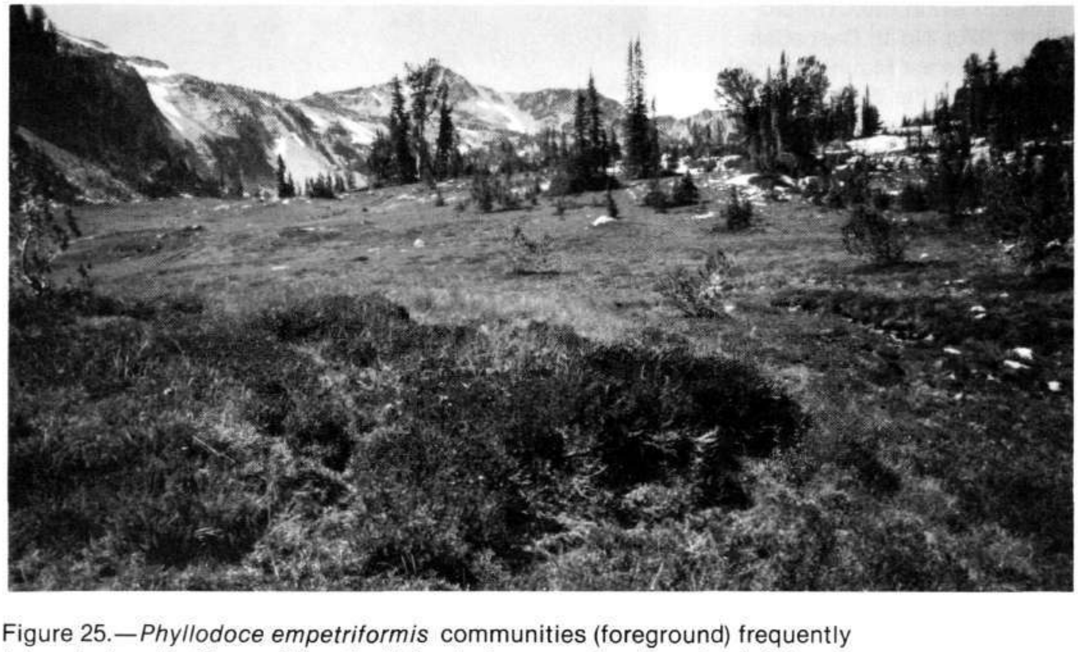


Figure 25.—*Phyllodoce empetriformis* communities (foreground) frequently intermingle with *Pinus albicaulis-Abies lasiocarpa* stands and subalpine meadows.

Management implications.—This type is particularly susceptible to damage, because the brittle stems of the heathers are easily broken when trampled. Because the attractiveness of this type encourages leaving the trail for a closer view, campsites and trails should avoid this type as much as possible. Trails through this type also tend to deteriorate, particularly in response to early season use, because the late snowmelt keeps the soil saturated. Although recovery of grasses and forbs should be relatively rapid, recovery of the heathers should be a slow process.

Other studies.—Similar vegetation has been described in western Oregon and Washington (Kuramoto and Bliss 1980; Henderson 1973; Campbell 1973; Douglas and Bliss 1977; del Moral 1979). They also occur, but have not been described, in the Northern Rocky Mountains.

Carex spectabilis (CASP)

Description.—This type occurs most frequently on steep, north slopes, between 7,500 and 9,000 ft (2 250 to 2 700 m), where the snow melts late in the summer. Soils remain saturated for much of the summer and slopes are usually unstable (fig. 26).

Although *Carex spectabilis* is the most abundant species, *Luzula hitchcockii* is consistently conspicuous. Species richness is quite high, but total cover is low (45 percent). The most consistent forb associates are *Antennaria lanata, Aster alpigenus,* and *Veronica cusickii.*

Management implications.—Late snowmelt and unstable slopes make this a poor location for trails or campsites. Saturated soils contribute to a high potential for soil erosion when subjected to heavy use. Usually these sites can be avoided by relocating trails on drier, more stable slopes. The potential for revegetation is probably greater than on some of the drier adjacent sites, such as *PIAL-ABLA* sites, but it will be necessary to guard against continued erosion first.

Other studies.—Plant communities dominated by *Carex spectabilis* have been described in the Olympic Mountains (Kuramoto and Bliss 1970), North Cascades (Douglas and Bliss 1977), and Wenatchee Mountains (del Moral 1979) of Washington. Except for the Wenatchee communities, these occupy very different environments from the Wallowa type, however.

Figure 26.—*Carex spectabilis* communities occupy steep, north slopes close to timberline, such as this slope along the trail between Moccasin Lake and Glacier Pass. Trail deterioration is a common problem in this community type.

Carex nigricans (CANI)

Description.—This type occurs between 7,500 and 9,000 ft (2 250 and 2 700 m), in poorly drained depressions where snowmelt is late. Although it occurs frequently, it never covers a very large area.

Carex nigricans forms a dense, tough sod that affords little growing space for other plants (fig. 27). *Carex spectabilis* and *Juncus drummondii* var. *subtriflorus* are consistent graminoid associates. The most consistently abundant forbs are *Antennaria alpina, Erigeron peregrinus* var. *scaposus, Potentilla flabellifolia, Veronica cusickii,* and *Viola adunca* var. *bellidifolia.* Total cover is high (79 percent), but species richness is relatively low.

Figure 27.—The dense *Carex nigricans* sod in this small depression near Glacier Lake is occasionally interrupted by other species such as *Antennaria alpina,* the light-colored forb in the foreground.

Management implications.—This type provides a good location for campsites, provided that use occurs after soils drain. Although impacts are highly visible, impacted areas are usually small (fig. 28) because *Carex nigricans* is resistant to trampling. In all but the most heavily used areas, impacts at high elevations could probably be reduced by encouraging dispersed, infrequent camping on *CANI* meadows. Campers should be careful not to leave fire scars and should dispose of their wastes in adjacent *PIAL-ABLA* forests. *Carex nigricans* has also been successfully used to revegetate recreation sites. Trails are subject to deterioration if used when soils are still saturated, but they are less prone to disturbance than adjacent *PHEM* and *CASP* sites. Where possible, trails in this landscape should be located on rocky, *PIAL-ABLA* sites.

Other studies.—Similar vegetation has been described throughout the Pacific Northwest, north to southern Alaska (see Douglas and Bliss 1977 for references), and south to Colorado (Cox 1933).

Figure 28.—The minimal amount of vegetation loss on this well-developed campsite is characteristic of campsites located in the damage-resistant *Carex nigricans* community type.

Bare Rock and Fell-field

Description.—A wide variety of species and vegetation types occur at the highest elevations in the study area. Vegetation varies with rock type and geomorphic type, from bare rock to fell-fields and talus slopes (fig. 29). The five stands sampled include a broad range of this variability. Wiry graminoids and cushion and matted forbs are most abundant. The species most consistently present are *Trisetum spicatum, Aster alpigenus,* and *Ivesia gordonii. Dryas octopetala* var. *hookeriana* may be locally dominant. Total cover is usually low.

Management implications.—Although many of these communities are relatively resistant to trampling damage, many are not and recovery is an extremely slow process in all types. Willard and Marr (1971) estimated that recovery of similar communities in Colorado could take as long as 1,000 years. Therefore, recreational use in these types should not be encouraged. Where use is heavy, such as on the climb to the top of Eagle Cap, trails should be constructed and hikers should be encouraged to stay on the trail.

Figure 29.—The short stature of the plants growing on this fell-field above Ice Lake is characteristic of high-elevation sites.

Krummholz[5]

Description.—Toward the upper limits of tree growth, trees exhibit a stunted, wind-shorn growth form. Depending upon slope, aspect, and substrate this type can occur at varied elevations. For example, meter-high *Pinus albicaulis* survive above 9,500 ft (2 850 m) on the gentle, granitic, south slope of Eagle Cap. On the calcareous rocks, *Pinus flexilis* is the major krummholz tree species, but is seldom found above 7,000 ft (2 100 m) in the study area. *Abies lasiocarpa* is the other common krummholz tree species. Although it is not found at elevations as high as *Pinus albicaulis,* it is more prevalent than *Pinus* on talus slopes.

Of the various understory species, the most consistently common include *Ribes montigenum, Juniperus communis, Vaccinium scoparium, Polemonium pulcherrimum, Valeriana sitchensis,* and *Thalictrum occidentale.*

Management implications.—While this type is a good location for trails, the susceptible ground cover, paucity of downed wood, and slow recovery rates makes it a poor choice for campsites. These sites are often windy, which encourages campers to construct shelters from the wind.

[5]The following community types were observed but not sampled, either because of their limited extent or their great variability.

Populus tremuloides (POTR)

Description.—This type is occasionally found below 6,000 ft (1 800 m), usually on boulder slopes which appear to be more stable and moist than those occupied by the *Acer glabrum* type (fig. 30). Both types occur in close proximity but usually remain separated. Associates of *Populus* are varied but usually consist of species from both the *Acer glabrum* and *Alnus sinuata* types (for example, *Galium triflorum, Arnica cordifolia, Urtica dioica* var. *lyallii,* and *Rubus parviflorus*).

Management implications.—Trails and campsites should not be constructed in this type because people carve their initials in the trees. The trees are thin-barked and extremely susceptible to damage (Hinds 1976). This type is highly scenic, however, so trails might be routed around these types but within viewing distance.

Figure 30.—*Populus tremuloides* stands usually occupy bouldery sites and occasionally occupy other disturbed situations.

Artemisia tridentata (ARTR)

This uncommon type occurs sporadically over a wide elevational range. It is most common on south slopes on the metamorphic rocks. The dominant shrub, *Artemisia tridentata* var. *vaseyana,* is usually associated with an abundant graminoid such as *Agropyron spicatum, Carex geyeri,* or *Festuca viridula. Berberis repens, Achillea millefolium, Eriogonum heracleoides,* and *Hieracium albertinum* are also frequently encountered.

Subalpine Meadows

Description.—These meadows are common between 7,000 and 8,000 ft (2 100 and 2 400 m) in depressions carved by the glaciers. They commonly occur adjacent to lakes or on the sites of former lakes that have been filled with alluvium and organic material (fig. 31). They are perennially moist, with some parts inundated for most of the year. Although they are seldom all present in one area, the following zones can be delimited:

1. At low elevations (below 7,200 ft [2 160 m]) *Carex rostrata* is usually the most abundant species in standing water.
2. Elsewhere, *Eleocharis pauciflora* is the most abundant species in standing water.
3. *Carex scopulorum* dominates sites surrounding standing water, which are always wet but rarely inundated.
4. *Allium validum* often dominates soils further removed from standing water, but below seepage areas. A distinctive group of forbs is common in this and the following zone. It consists of *Veronica cusickii, Ligusticum tenuifolium, Viola adunca* var. *bellidifolia, Castilleja chrysantha, Senecio cymbalarioides, Erigeron peregrinus* var. *scaposus, Potentilla flabellifolia, Dodecatheon alpinum,* and *Pedicularis groenlandica.*
5. Drier parts of the meadow may be dominated by the previously mentioned forbs, with or without *Deschampsia caespitosa,* which is often thought to have been the dominant in meadows of this type under pristine conditions.
6. Before entering forest there is often a zone dominated by *Kalmia microphylla, Gaultheria humifusa,* and *Vaccinium caespitosum.*

Figure 31.—Subalpine meadow adjacent to Little Frazier Lake, elevation 7,500 ft. The north slope in the background has *Phyllodoce empetriformis* communities around the base and krummholz above.

Management implications.—The vegetation of these meadows is not as fragile as many people have thought (fig. 32). Vegetation change in campsites and along trails is usually less than in adjacent forested types (Cole 1981). Nevertheless, trail erosion can be a severe problem due to perennially moist and uniformly fine-textured soils. Sets of parallel, deep, narrow trails are common in these meadows (fig. 33). Trampling by pack stock can be particularly damaging. Moreover, impacts are highly visible and these meadows are one of the prime scenic resources of the area. Recovery rates vary from rapid, in the moister types, to moderate. Even on drier sites they are generally more rapid than in the forests.

Figure 32.—Trail along the shore of Glacier Lake is quite evident where the ground cover consists of *Vaccinium scoparium*. The trail disappears when it enters subalpine meadow on the left, illustrating the relative resistance of this community type.

GENERAL DISTRIBUTION OF COMMUNITY TYPES

The distributional patterns of forested community types are broadly similar on the noncalcareous rock types. *Pseudotsuga menziesii* is the most common tree species on lower elevation slopes, although *Pinus ponderosa, Pinus contorta,* and *Larix occidentalis* may be locally abundant. Community types with *Physocarpus malvaceous* and *Calamagrostis rubescens* understories are the most common, with *C. rubescens* types on smooth sloping benches, and *P. malvaceous* types on the boulder-strewn slopes that alternate with these benches. The *Thalictrum occidentale* type occurs on some north-facing slopes and *Agropyron spicatum* types occur on some south-facing slopes, especially on the nongranitic rocks.

Adjacent valley bottoms are most frequently populated by *Abies grandis* (below 5,300 ft [1 600 m]), *Picea engelmannii*, or *Pinus contorta. Abies lasiocarpa* is usually the most abundant seedling. *Pinus contorta* appears to be capable of self-perpetuation in some stands, particularly on dry, shallow granitic soils. This situation appears similar to that in the Canadian Rockies, where LaRoi and Hnatiuk (1980) report *P. contorta* may be "an edaphic climax on certain dry, poor sites in the lower subalpine." *Thalictrum occidentale* and *Vaccinium scoparium* are the most abundant understory types, although *Vaccinium membranaceum* may be abundant on some rough, rocky sites.

Above 7,000 ft (2 100 m), *Abies lasiocarpa* dominates stands in valley bottoms, on lower slopes, and on upper north-facing slopes. *Pinus contorta* and *Picea engelmannii* are associates in some locales. The *Vaccinium scoparium* understory type occurs throughout these forests, extending to lower elevations in valley bottoms, usually in conjunction with *Pinus contorta.* The *Pinus albicaulis-Abies lasiocarpa* type dominates high elevation rocky ridges and south-facing slopes.

Figure 33.—Multiple trails are common in the fine-textured, perennially moist soils of subalpine meadows. As many as six parallel trails can be distinguished in this photograph.

Despite these general similarities, the relative importance of several community types differs between granitic and noncalcareous metamorphic rocks. *Pinus contorta* forms monospecific stands over much of the midelevation forest, but almost exclusively on granitic substrates. Most of the stands occur on flat, rocky benches, where soils are poorly developed and where cold air often collects. *Vaccinium scoparium* and, less frequently, *Vaccinium membranaceum* are the most common understory types.

Pseudotsuga menziesii occurs on granitic rocks, but is much more common on the metamorphics where it extends to higher elevations and occupies more varied topographic sites. *Calamagrostis rubescens, Physocarpus malvaceous,* and *Agropyron spicatum* understory types are more common than understories dominated by ericads. Similar differences in the distribution of tree species have been noted by Despain (1973) in the Bighorn Mountains of Wyoming.

On calcareous rocks, altitudinal zonation is less well developed, largely because forests seldom extend above 7,000 ft (2 100 m) (fig. 3). *Picea engelmannii* is the most abundant tree species in the valley bottoms, although *Abies lasiocarpa* is a frequent associate above 6,000 ft (1 800 m). *Thalictrum occidentale* is the most common understory type in these forests. *Pseudotsuga menziesii,* usually in conjunction with the *Berberis repens* understory type, occurs locally in valley bottoms, but this c.t. is most characteristic of lower slopes. *Calamagrostis rubescens* types can also be found on slopes above the valley bottom, while *Pinus flexilis* dominates the steep, rocky upper slopes.

Two other coniferous tree species are occasionally encountered in the Wallowa Mountains. *Juniperus scopulorum* is locally common on xeric sites, particularly on calcareous rocks. *Tsuga mertensiana,* although infrequently noted in the Wallowa Mountains, is a rare associate of *Abies lasiocarpa* on some north-facing slopes at about 7,000 ft (2 100 m), elsewhere in the Wallowas. I found no *Tsuga* in the study area.

The nonforested community types at lower elevations are usually found on boulder slopes, steep south-facing slopes, and avalanche paths. *Acer glabrum* and, less frequently, *Populus tremuloides* types are most common on boulder slopes. The *Cercocarpus ledifolius* type is most common on steep, rocky south-facing slopes, particularly on nongranitic rock types. Various communities, classified under avalanche slope types, and the *Alnus sinuata* type occur on avalanche slopes, with the *Alnus* most common around seeps.

In the subalpine zone, 7,000 to 8,000 ft (2 100 to 2 400 m), meadows are interspersed with forest, occupying depressional areas which are perennially moist. At higher elevations alpine types are widespread. The *Carex nigricans* type occurs in depressional areas with late snowmelt. *Carex spectabilis* types are common on adjacent slopes with late snowmelt and on unstable gravelly substrates. *Phyllodoce empetriformis* occupies warmer slopes with earlier snowmelt, usually with a more southerly aspect. Grassland communities, most frequently dominated by *Festuca viridula,* occur on the warmest and driest exposures and are most common on substrates other than granite. Bare rock and fell-field communities occupy the highest ridgetops and other highly exposed sites.

CONCLUSIONS

As emphasized in the introduction, this classification system is a preliminary one. It is presented here for two reasons—to provide species data and descriptions of common plant community types in an area which has been largely neglected in the literature and to provide brief management suggestions for major community types. In the future this system should be refined and expanded to include the entire Wallowa Mountains. Ideally, it should be developed into a habitat type classification system that stratifies land according to site potential. Maps based on habitat types have the advantage of changing less over time. A careful documentation of all existing vegetation types, regardless of their successional status, should supplement the habitat type classification, however.

Several of the types described above need additional work. Of the coniferous forest types, those with *Berberis repens, Thalictrum occidentale,* and *Vaccinium scoparium* ground covers occupy broad environmental spectra and could probably be subdivided on the basis of indicator species. The *Berberis repens* type also needs to be more adequately delimited from other types. Additional nonconiferous types could be identified, and some of the environmentally grouped types, such as high elevation grasslands, could be floristically defined (for example *Festuca viridula* type).

With this stratification, observation of and research into impact problems could be organized by habitat type. As information accumulates it should be possible to relocate trails on durable types, close campsites on fragile sites, avoid sensitive wildlife habitat, direct pack stock to productive but durable grazing areas, and adapt a rehabilitation program to the specific needs of a damaged site. Management actions could incorporate an ever-increasing understanding of site differences.

Furthermore, the baseline data on existing vegetation types, such as the stand data provided here, will be increasingly valuable as a measure of conditions in the 1970's. It can be used to monitor changes in conditions over time and to evaluate the success of management programs, such as a natural fire policy, designed to perpetuate natural conditions.

PUBLICATIONS CITED

Campbell, Alcetta Gilbert.
1973. Vegetative ecology of Hunt's Cove, Mt. Jefferson, Oregon. M.S. thesis. Oreg. State Univ., Corvallis. 89 p.

Cole, David Naylor.
1977. Man's impact on wilderness vegetation: an example from Eagle Cap Wilderness, northeastern Oregon. Ph.D. diss. Univ. Oreg., Eugene. 307 p.

Cole, David N.
1981. Vegetational changes associated with recreational use and fire suppression in the Eagle Cap Wilderness, Oregon: some management implications. Biol. Conserv. 20:247-270.

Cox, C. F.
1933. Alpine plant succession on James Peak, Colorado. Ecol. Monogr. 3:299-372.

Dale, D., and T. Weaver.
1974. Trampling effects on vegetation of the trail corridors of north Rocky Mountain forests. J. Appl. Ecol. 11:767-772.

Daniels, J. D.
1969. Variation and intergradation in the grand fir-white fir complex. Ph.D. diss. Univ. Idaho, Moscow. 235 p.

Daubenmire, R., and Jean B. Daubenmire.
1968. Forest vegetation of eastern Washington and northern Idaho. Wash. Agric. Exp. Stn. Tech. Bull. 60, 104 p. Pullman.

Despain, D. G.
1973. Vegetation of the Bighorn Mountains, Wyoming, in relation to substrate and climate. Ecol. Monogr. 43:329-355.

Douglas, George W., and L. C. Bliss.
1977. Alpine and high subalpine plant communities of the North Cascades Range, Washington and British Columbia. Ecol. Monogr. 47:113-150.

Franklin, Jerry F., and C. T. Dyrness.
1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8, 417 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Hall, Frederick C.
1973. Plant communities of the Blue Mountains in eastern Oregon and southeastern Washington. USDA For. Serv. Pac. Northwest Reg., R-6 Area Guide 3-1, 62 p. Portland, Oreg.

Head, Serge Conrade.
1959. Plant taxonomy and ecology of the East Eagle Creek drainage of the Wallowa Mountains, northeastern Oregon. Ph.D. diss. Oreg. State Univ., Corvallis. 249 p.

Heinselman, Miron L.
1973. Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota. Quat. Res. 3:329-382.

Henderson, Jan Alan.
1973. Composition, distribution, and succession of subalpine meadows in Mt. Rainier National Park, Washington. Ph.D. diss. Oreg. State Univ., Corvallis. 150 p.

Hinds, T. E.
1976. Aspen mortality in Rocky Mountain campgrounds. USDA For. Serv. Res. Pap. RM-164, 20 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Hitchcock, C. Leo, and Arthur Cronquist.
1973. Flora of the Pacific Northwest. 730 p. Univ. Wash. Press, Seattle.

Hoffman, George R., and Robert R. Alexander.
1976. Forest vegetation of the Bighorn Mountains, Wyoming: a habitat type classification. USDA For. Serv. Res. Pap. RM-170, 38 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Johnson, Walter Van-Gale.
1959. Forage utilization estimates in relation to ecological units in the Wallowa Mountains of northeastern Oregon. M.S. thesis. Oreg. State Univ., Corvallis. 138 p.

Kuramoto, R. T., and L. C. Bliss.
1970. Ecology of subalpine meadows in the Olympic Mountains, Washington. Ecol. Monogr. 40:317-347.

LaRoi, George H., and Roger J. Hnatiuk.
1980. The *Pinus contorta* forests of Banff and Jasper National Parks: a study in comparative synecology and syntaxonomy. Ecol. Monogr. 50:1-29.

Layser, Earle F., and Gilbert H. Schubert.
1979. Preliminary classification for the coniferous forest and woodland series of Arizona and New Mexico. USDA For. Serv. Res. Pap. RM-208, 27 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

McLean, Alastair.
1970. Plant communities of the Similkameen Valley, British Columbia, and their relationship to soils. Ecol. Monogr. 40:403-423.

McLean, A., and W. D. Holland.
1958. Vegetation zones and their relationship to soils and climate of the upper Columbia Valley. Can. J. Plant Sci. 38:328-345.

Moral, Roger del.
1979. High elevation vegetation of the Enchantment Lakes Basin, Washington. Can. J. Bot. 57:1111-1130.

Mueggler, W. F., and W. L. Stewart.
1980. Grassland and shrubland habitat types of western Montana. USDA For. Serv. Gen. Tech. Rep. INT-66, 154 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Ogilvie, Robert T.
1962. Ecology of spruce forests on the east slope of the Rocky Mountains in Alberta. Ph.D. diss. Wash. State Univ., Pullman. 189 p.

Pfister, Robert D., and Stephen F. Arno.
1980. Classifying forest habitat types based on potential climax vegetation. For. Sci. 26:52-70.

Pfister, Robert D., Bernard L. Kovalchik, Stephen F. Arno, and Richard C. Presby.
1977. Forest habitat types of Montana. USDA For. Serv. Gen. Tech. Rep. INT-34, 174 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Pickford, G. D., and Elbert H. Reid.
1942. Basis for judging subalpine grassland ranges of Oregon and Washington. U.S. Dep. Agric. Circ. 655, 38 p. Washington, D.C.

Sampson, A. W.
1909. Natural revegetation of mountain grazing land. USDA For. Serv. Circ. 169. Washington, D.C.

Scheldt, R. S., and E. W. Tisdale.
1970. Ecology and utilization of curl-leaf mountain mahogany in Idaho. Univ. Idaho, For., Wildlife and Range Exp. Stn., Moscow, Note 15, 2 p.

Smith, W.D., and J. E. Allen.
1941. Geology and physiography of the northern Wallowa Mountains. Oreg. State Dep. Geol. and Min. Ind. Bull. 12, 64 p.

Steele, Robert, Robert D. Pfister, Russell A. Ryker, and Jay A. Kittams.
1981. Forest habitat types of central Idaho. USDA For. Serv. Gen. Tech. Rep. INT-114. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Strickler, Gerald S.
1961. Vegetation and soil condition changes on a subalpine grassland in eastern Oregon. USDA For. Serv. Res. Pap. PNW-40, 46 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Sturges, Franklin W.
1957. Habitat distributions of birds and mammals in Lostine Canyon, Wallowa Mountains, northeast Oregon. Ph.D. diss. Oreg. State Univ., Corvallis. 130 p.

Tisdale, E. W., and A. McLean.
1957. The Douglas-fir zone of southern interior British Columbia. Ecol. Monogr. 27:247-266.

U.S. Department of Commerce, Weather Bureau.
1965. Climatic summary of the United States—Oregon. Climatography of the United States 86-31. 96 p.

Vankat, John L., and Jack Major.
1978. Vegetation changes in Sequoia National Park, California. J. Biogeogr. 5:377-402.

Van Vechten, George Wendell, III.
1960. The ecology of the timberline and alpine vegetation of the Three Sisters, Oregon. Ph.D. diss. Oreg. State Univ., Corvallis. 111 p.

Willard, Beatrice E., and John W. Marr.
1971. Recovery of alpine tundra under protection after damage by human activities in the Rocky Mountains of Colorado. Biol. Conserv. 3:181-190.

Wirsing, John M., and Robert R. Alexander.
1975. Forest habitat types on the Medicine Bow National Forest, southeastern Wyoming: preliminary report. USDA For. Serv. Gen. Tech. Rep. RM-12, 11 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Woodland, Dennis W.
1965. A vegetational study of Unit and Razz Lakes in the Wallowa Mountains, northeastern Oregon. M.A. thesis. Walla Walla Coll., College Place, Wash. 74 p.

APPENDIXES

APPENDIX 1— KEY TO MAJOR COMMUNITY TYPES

Key to Coniferous Forest Types

1.	Trees stunted, generally not more than 16 ft (5 m) tall	Krummholz
1.	Not as above	2
2.	*Pinus flexilis* dominant or co-dominant in overstory	*PIFL*
2.	Not as above	3
3.	*Pinus albicaulis* dominant or co-dominant in overstory	*PIAL-ABLA*
3.	Not as above	4
4.	*Abies grandis* dominant or co-dominant in overstory	*ABGR/THOC*
4.	Not as above	5
5.	*Abies lasiocarpa* or *Picea engelmannii* dominant in overstory	6
5.	Not as above	8
6.	*Vaccinium membranaceum* cover greater than 10 percent	*ABLA/VAME*
6.	Not as above	7
7.	*Vaccinium scoparium* dominant in undergrowth	*ABLA/VASC*
7.	Not as above, *Thalictrum occidentale, Arnica cordifolia,* or *Pyrola secunda* dominant in undergrowth	*ABLA/THOC*
8.	*Pinus contorta* dominant in overstory	9
8.	Not as above	11
9.	*Calamagrostis rubescens* dominant in undergrowth	*PICO/CARU*
9.	Not as above	10
10.	*Vaccinium membranaceum* dominant in undergrowth	*PICO/VAME*
10.	Not as above, *Vaccinium scoparium* abundant	*PICO/VASC*
11.	*Agropyron spicatum* dominant in undergrowth	*PSME/AGSP*
11.	Not as above	12
12.	*Physocarpus malvaceous* dominant in undergrowth	*PSME/PHMA*
12.	Not as above	13
13.	*Calamagrostis rubescens* dominant in undergrowth	*PSME/CARU*
13.	Not as above	14
14.	*Thalictrum occidentale* dominant in undergrowth	*PSME/THOC*
14.	*Thalictrum occidentale* less abundant than *Berberis repens, Spiraea betulifolia, Symphoricarpos albus,* or *S. oreophilus*	*PSME/BERE*

Key to Nonconiferous Types

1.	Dominants are shrubs or broadleaf trees greater than 3 ft (1 m) tall	2
1.	Not as above	7
2.	*Cercocarpus ledifolius* abundant	*CELE*
2.	Not as above	3
3.	*Populus tremuloides* dominant	*POTR*
3.	Not as above	4
4.	*Acer glabrum* dominant	*ACGL*
4.	Not as above	5
5.	*Artemisia tridentata* abundant	*ARTR*
5.	Not as above	6
6.	*Alnus sinuata* abundant	*ALSI*
6.	Not as above	Undifferentiated type
7.	Community occurs on avalanche slopes	Avalanche slopes
7.	Not as above	8
8.	*Phyllodoce empetriformis* dominant	*PHEM*
8.	Not as above	9
9.	*Carex spectabilis* dominant	*CASP*
9.	Not as above	10
10.	*Carex nigricans* dominant	*CANI*
10.	Not as above	11
11.	Graminoids dominant, elevation greater than 7,000 ft (2 100 m)	12
11.	Not as above	13
12.	Community occupies xeric exposures; *Agropyron spicatum, Carex geyeri,* or *Festuca viridula* abundant	High elevation grasslands
12.	Community occupies mesic or hydric sites	Subalpine meadows
13.	Community occurs on bare rock or fell-field; elevation greater than 7,900 ft (2 400 m)	Bare rock and fell-field
13.	Not as above	Undifferentiated type

APPENDIX 2 — BASIC DATA ON COMMUNITY TYPES

Table 1.—Dynamic status of tree species as interpreted from sample stand data. C = major climax, c = minor climax, S = major seral, s = minor seral, ( ) = in certain areas of the type, a = accidentals

Community type	*Pinus ponderosa*	*Pseudotsuga menziesii*	*Larix occidentalis*	*Abies grandis*	*Abies lasiocarpa*	*Picea engelmannii*	*Pinus albicaulis*	*Pinus contorta*	*Juniperus scopulorum*	*Pinus flexilis*
PSME/AGSP	S	C	—	—	—	—	—	—	—	—
PSME/PHMA	a	C	s	a	a	a	—	a	—	—
PSME/CARU	s	(C)	S	—	(C)	s	a	s	a	(s*)
PSME/THOC	—	S	S	—	C	S*	—	—	(s)	—
PSME/BERE	a	C	—	a	(c)	(c)	—	—	s*	—
PIFL	—	c	—	—	—	—	—	—	c	C
ABGR/THOC	—	s	s	C	(c)	(s*)	—	—	—	—
ABLA/THOC	a	s	s	—	C	C*	a	s	—	—
ABLA/VAME	—	s	s	—	C	S*	—	s	—	—
ABLA/VASC	—	—	—	—	C	S*	(c)	s	—	—
PIAL-ABLA	—	—	—	—	C	s	C	—	—	—
PICO/CARU	—	s	s	—	C	s	—	S*	—	—
PICO/VAME	—	s	s	—	C	s	—	S	—	—
PICO/VASC	—	—	s	—	C	S*	—	S*	—	—

*Status difficult to determine. May be climax in some places.

Table 2.—Tree population structure by community type. Mean number of trees by species per 200 m² macroplot and stems/ha

Community type	No. of stands sampled	Mean no. of trees per 200 m² macroplot — Diameter (at breast height) classes in dm											Total
		<0.2	.2-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	>9	
PSME/AGSP	2												
Pipo		—	—	—	—	0.5	—	—	—	—	1.0	—	1.5
Psme		3.5	0.5	2.0	1.0	.5	1.0	—	—	—	—	—	8.5
Stems/ha		*175*	*25*	*100*	*50*	*50*	*50*	—	—	—	*50*	—	*500*
PSME/PHMA	6												
Pipo		—	—	—	—	—	0.2	—	—	—	—	—	0.2
Psme		2.8	5.3	3.0	2.0	1.3	1.7	0.7	0.2	—	0.2	—	17.2
Laoc		—	—	.2	.5	.5	—	—	—	—	—	—	1.2
Abgr		.2	—	.7	—	—	—	—	—	—	—	—	.9
Abla		—	.8	—	—	—	.2	—	—	—	—	—	1.0
Pien		—	.2	.5	—	—	—	—	—	—	—	—	.7
Pico		—	—	—	.2	—	—	—	—	—	—	—	.2
Stems/ha		*150*	*315*	*220*	*135*	*90*	*105*	*35*	*10*	—	*10*	—	*1 070*
PSME/CARU	8												
Pipo		—	—	—	—	—	0.3	0.3	0.1	0.5	—	—	1.2
Psme		3.3	2.1	1.6	1.6	2.5	1.5	.8	.6	.1	0.1	—	14.2
Laoc		—	—	.3	—	.4	.5	.1	.6	.1	—	—	2.0
Abla		9.4	1.0	.6	.3	.1	.1	—	—	—	—	—	11.5
Pien		1.0	—	.1	.1	—	—	—	—	—	—	—	1.2
Pial		—	—	.1	—	—	—	—	—	—	—	—	.1
Pico		.4	.3	.3	.6	.1	—	—	—	—	—	—	1.7
Jusc		.1	—	—	—	—	—	—	—	—	—	—	.1
Pifl		.1	.1	.1	—	.1	—	—	—	—	—	—	.4
Stems/ha		*715*	*175*	*155*	*130*	*160*	*120*	*60*	*65*	*35*	*5*	—	*1 620*
PSME/THOC	4												
Psme		.8	0.3	0.3	1.3	0.5	2.3	3.0	0.3	0.3	—	—	9.1
Laoc		—	—	—	—	.3	.5	1.5	1.0	—	—	—	3.3
Abla		9.3	2.8	1.3	.3	—	—	—	—	—	—	—	13.7
Pien		4.0	1.3	.3	.3	—	—	—	—	—	—	—	5.9
Jusc		.3	.8	—	—	—	—	—	—	—	—	—	1.1
Stems/ha		*720*	*260*	*95*	*95*	*40*	*140*	*225*	*65*	*15*	—	—	*1 655*
PSME/BERE	3												
Pipo		—	—	—	—	—	—	—	—	0.3	—	—	0.3
Psme		2.7	5.0	3.7	3.3	3.3	1.3	0.7	—	—	—	—	20.0
Abgr		—	.3	—	—	—	—	—	—	—	—	—	.3
Abla		.7	—	—	—	—	—	—	—	—	—	—	.7
Pien		.7	.3	1.7	.7	—	—	—	—	—	—	—	3.4
Jusc		4.0	1.7	1.0	—	—	—	—	—	—	—	—	6.7
Stems/ha		*405*	*365*	*320*	*200*	*165*	*65*	*35*	—	*15*	—	—	*1 570*
PIFL	2												
Psme		—	0.5	0.5	0.5	0.5	—	—	—	—	—	—	2.0
Jusc		4.0	1.0	—	.5	—	—	—	—	—	—	—	5.5
Pifl		2.0	1.0	.5	1.0	1.0	0.5	1.0	—	—	—	—	7.0
Stems/ha		*300*	*125*	*50*	*100*	*75*	*25*	*50*	—	—	—	—	*725*
ABGR/THOC	3												
Psme		—	—	—	—	—	1.3	0.3	—	—	—	—	1.6
Laoc		1.3	—	—	—	0.7	0.3	.7	0.3	—	—	—	3.3
Abgr		4.7	6.7	14.3	2.0	1.3	1.3	.3	—	—	—	—	30.6
Abla		1.3	.3	.3	.7	—	—	—	—	—	—	—	2.6
Pien		2.7	4.0	3.3	—	—	—	—	—	—	—	—	10.0
Stems/ha		*500*	*550*	*895*	*135*	*100*	*145*	*65*	*15*	—	—	—	*2 405*

(con.)

Table 2. (con.)

Community type	No. of stands sampled	Mean no. of trees per 200 m² macroplot											Total
		Diameter (at breast height) classes in dm											
		<0.2	.2-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	>9	
ABLA/THOC	18												
Pipo		—	—	—	—	—	+	—	—	—	—	—	+
Psme		0.1	0.1	0.3	+	0.3	0.2	0.4	+	0.1	+	—	1.5
Laoc		—	—	+	—	.2	.4	+	0.2	+	+	0.1	.9
Abla		51.7	12.4	7.0	3.3	1.7	.4	.2	+	—	—	—	76.7
Pien		3.4	1.5	2.6	1.2	1.6	1.7	.9	+	+	0.1	+	13.0
Pial		—	—	.1	.2	.1	—	—	—	—	—	—	.4
Pico		.3	—	.4	.5	.4	—	—	—	—	—	—	1.6
Stems/ha		*2 775*	*700*	*520*	*260*	*215*	*135*	*75*	*10*	*5*	*5*	*5*	*4 705*
ABLA/VAME	3												
Psme		—	0.3	—	—	0.7	1.3	—	—	—	—	—	2.3
Laoc		—	—	—	—	—	—	0.3	—	—	—	—	.3
Abla		12.7	6.7	6.0	2.3	1.3	—	—	—	—	—	—	29.0
Pien		8.7	3.0	1.3	1.0	2.7	0.3	—	—	—	—	—	17.0
Pico		—	—	—	1.0	.3	—	—	—	—	—	—	1.3
Stems/ha		*1 070*	*500*	*365*	*215*	*250*	*80*	*15*	—	—	—	—	*2 495*
ABLA/VASC	19												
Abla		41.3	10.4	5.4	4.2	2.3	0.5	0.1	—	—	—	—	64.2
Pien		2.9	.8	1.3	1.4	1.9	.6	.2	0.2	0.1	—	—	9.4
Pial		1.7	.5	—	.1	.1	.2	+	+	—	+	+	2.6
Pico		1.2	.3	.4	.8	.1	—	—	—	—	—	—	2.8
Stems/ha		*2 355*	*600*	*355*	*325*	*220*	*65*	*15*	*10*	*5*	+	+	*3 950*
PIAL/ABLA	10												
Abla		31.0	12.2	6.0	1.2	0.4	0.3	—	—	—	—	—	51.1
Pien		.5	.5	—	.3	—	—	—	—	—	—	—	1.3
Pial		14.8	5.1	3.5	2.4	1.9	0.6	—	—	0.1	0.1	0.1	28.6
Stems/ha		*2 315*	*890*	*475*	*195*	*115*	*45*	—	—	*5*	*5*	*5*	*4 050*
PICO/CARU	4												
Laoc		—	—	—	0.3	—	0.3	—	—	—	—	—	0.6
Psme		—	0.5	0.3	—	—	—	0.3	—	—	—	—	1.1
Abla		7.0	1.0	1.7	—	—	—	—	—	—	—	—	9.7
Pien		1.3	—	—	—	—	—	—	—	—	—	—	1.3
Pico		17.8	26.0	9.3	11.5	.5	.3	—	—	—	—	—	65.4
Stems/ha		*1 305*	*1 375*	*565*	*590*	*25*	*30*	*15*	—	—	—	—	*3 905*
PICO/VAME	3												
Laoc		—	—	—	0.3	—	—	0.3	—	—	—	—	0.6
Psme		1.3	—	—	—	—	0.3	1.0	—	—	—	—	2.6
Abla		37.3	8.3	0.7	—	—	—	—	—	—	—	—	46.3
Pien		3.7	1.3	—	0.7	—	—	—	—	—	—	—	5.7
Pico		1.7	.3	9.0	5.3	0.3	—	—	—	—	—	—	16.6
Stems/ha		*2 200*	*495*	*485*	*315*	*15*	*15*	*65*	—	—	—	—	*3 590*
PICO/VASC	5												
Laoc		—	—	—	—	—	0.8	0.2	—	—	—	—	1.0
Abla		52.0	8.4	2.0	1.2	—	0.2	—	—	—	—	—	63.8
Pien		10.0	1.6	0.8	—	—	—	—	—	—	—	—	12.4
Pial		1.0	—	—	—	—	—	—	—	—	—	—	1.0
Pico		22.6	18.8	11.8	5.2	1.2	—	—	—	—	—	—	59.6
Stems/ha		*4 280*	*1 440*	*730*	*320*	*60*	*50*	*10*	—	—	—	—	*6 890*

Table 3.—Undergrowth and stand data. Number to left varies from 1 to 10 and is the number of microplots in which the species occurs. Number in parentheses is mean percent canopy coverage (in all microplots). + indicates less than 0.5 percent cover. Refer to figure 5 for key to rock types

SPECIES	PSME/AGSP		PSME/PHMA						PSME/CARU							
Stand number	63	120	62	44	65	3	121	20	14	92	36	41	19	37	57	7
Township and section	3S10	3S20	3S10	3S9	3S29	3S22	3S20	3S32	4S7	3S22	4S25	4S18	4S5	4S25	4S9	3S33
Range	44E	45E	44E	44E	45E	44E	45E	45E	45E	44E	44E	45E	45E	44E	44E	44E
Elevation (meters)	2000	1400	1590	1500	1510	1820	1530	1510	1750	1680	1890	1720	1740	2000	1980	1920
Azimuth (degrees)	240	150	340	80	110	95	105	250	130	110	140	270	275	140	280	285
Slope (percent)	50	30	30	50	45	25	25	35	30	35	45	40	45	40	45	50
Rock Type	I	cc	I	I	cc	mb	cc	cc	mb	mb	gr	gr	gr	gr	mb	I
SHRUBS AND SUBSHRUBS																
Acer glabrum	—	—	10(9)	10(12)	—	2(2)	—	4(16)	—	—	—	—	5(1)	1(+)	—	5(1)
Amelanchier alnifolia	1(2)	—	—	—	—	—	1(1)	—	—	—	—	1(+)	—	—	—	—
Berberis repens	—	2(1)	—	1(+)	—	9(6)	—	—	10(10)	—	4(1)	2(1)	3(1)	6(2)	4(1)	2(2)
Clematis columbiana	—	—	—	—	—	1(2)	—	—	—	—	—	—	—	—	—	—
Holodiscus discolor	—	—	4(3)	—	—	—	—	1(4)	—	—	—	—	—	—	—	—
Pachistima myrsinites	—	—	—	—	—	—	—	—	—	—	—	3(1)	—	—	—	—
Penstemon fruticosus	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—
Physocarpus malvaceus	—	—	10(52)	9(48)	9(42)	6(40)	6(28)	7(21)	—	—	—	—	—	—	—	—
Ribes cereum	1(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ribes inerme	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Ribes lacustre	—	—	—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—
Ribes viscosissimum	—	—	—	—	—	—	—	2(2)	—	—	—	—	—	1(+)	—	—
Rosa woodsii	—	—	1(1)	—	—	—	—	—	—	—	—	—	—	—	—	—
Rubus parviflorus	—	—	—	—	—	—	—	1(2)	—	—	—	—	—	—	—	—
Spiraea betulifolia	—	5(2)	10(6)	8(11)	9(10)	3(3)	7(3)	—	6(4)	4(2)	3(1)	—	—	5(3)	9(4)	—
Symphoricarpos albus	—	—	3(1)	10(16)	2(1)	8(11)	6(2)	—	1(2)	1(1)	1(+)	—	—	—	—	2(1)
Symphoricarpos oreophilus	5(3)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vaccinium membranaceum	—	—	—	—	—	—	—	1(2)	—	—	—	—	—	1(4)	—	—
Vaccinium scoparium	—	—	—	—	—	—	—	—	—	—	—	6(3)	—	3(6)	—	—
GRAMINOIDS																
Agropyron spicatum	9(15)	10(28)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bromus tectorum	—	6(7)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bromus vulgaris	—	—	8(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Calamagrostis rubescens	—	4(2)	1(4)	5(5)	9(7)	—	2(2)	2(2)	10(76)	10(61)	10(26)	10(25)	8(20)	9(18)	10(17)	6(15)
Carex geyeri	—	5(6)	—	—	—	—	7(6)	—	6(7)	—	5(3)	—	—	—	—	—
Elymus glaucus	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—
Poa pratensis	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stipa occidentalis	—	3(3)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
FORBS																
Achillea millefolium	7(2)	8(3)	—	—	—	—	—	—	—	3(1)	3(1)	—	—	—	1(+)	—
Anemone sp.	—	—	—	—	—	—	5(2)	—	—	—	—	—	—	—	—	—
Antennaria microphylla	—	—	—	—	—	—	—	—	—	2(1)	—	—	—	—	—	—
Apocynum androsaemifolium	—	9(3)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arenaria macrophylla	—	—	—	7(2)	—	—	—	—	—	4(1)	2(1)	—	—	1(+)	2(1)	—
Arnica cordifolia	—	—	3(1)	8(3)	2(1)	1(+)	3(1)	—	—	8(2)	10(6)	8(9)	6(2)	8(7)	9(8)	3(3)
Artemisia ludoviciana	2(1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aster conspicuus	—	2(1)	4(1)	5(1)	—	4(1)	—	1(+)	1(+)	—	—	—	—	—	—	3(1)
Balsamorhiza sagittata	—	7(6)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Castilleja hispida	1(+)	2(1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chimaphila umbellata	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	3(1)	1(+)	—
Clarkia pulchella	—	3(1)	—	—	3(1)	—	—	—	—	—	—	—	—	—	—	—
Disporum trachycarpum	—	—	3(1)	7(2)	—	—	3(1)	—	—	—	—	—	—	—	—	—
Epilobium angustifolium	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Epilobium paniculatum	2(1)	6(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Eriogonum heracleoides	—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Fragaria vesca	—	—	1(+)	1(+)	3(1)	—	—	2(1)	6(4)	1(+)	2(2)	2(1)	1(+)	—	—	5(1)
Fragaria virginiana	—	—	—	—	—	—	—	—	—	3(3)	—	3(1)	—	—	—	—
Galium triflorum	—	—	1(+)	3(+)	—	—	—	1(+)	—	—	—	—	—	—	—	—
Galium sp.	—	—	—	—	—	—	—	—	—	—	—	—	6(2)	—	—	3(1)
Gayophytum diffusum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(1)	—
Goodyera oblongifolia	—	—	2(1)	5(2)	—	2(1)	2(1)	—	—	1(+)	—	—	6(2)	—	—	1(+)
Helianthus cusickii	—	1(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hieracium albertinum	—	—	—	—	—	—	—	—	—	1(+)	1(+)	1(+)	2(1)	—	3(1)	—
Lesquerella occidentalis	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Linanthastrum nuttallii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7(2)	—
Lomatium grayi	9(5)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lupinus leucophyllus	—	7(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Monardella odoratissima	8(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Osmorhiza chilensis	—	—	5(1)	2(1)	—	1(+)	1(+)	—	—	—	—	—	4(1)	—	—	1(+)
Oxytropis viscida	—	—	—	—	—	—	—	—	—	9(4)	—	—	—	—	—	—
Phacelia hastata	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polygonum douglasii	—	6(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pyrola picta	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—
Pyrola secunda	—	—	1(+)	—	2(1)	—	—	—	—	—	—	—	2(+)	—	—	—
Sedum lanceolatum	1(+)	1(+)	—	—	—	—	—	—	—	1(+)	1(+)	—	—	—	6(2)	—
Senecio integerrimus	1(+)	2(1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Silene oregana	3(1)	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Smilacina racemosa	—	—	2(1)	—	—	—	—	—	—	—	—	—	—	—	—	—
Smilacina stellata	—	—	—	—	1(+)	2(1)	—	—	—	—	—	—	1(+)	—	—	—
Streptopus amplexifolius	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—
Thalictrum occidentale	—	—	7(13)	7(4)	—	8(18)	6(8)	1(2)	2(1)	1(1)	—	—	10(17)	4(11)	3(6)	8(9)
Valeriana sitchensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1(2)
Viola adunca	—	—	—	2(+)	—	—	—	—	—	1(+)	—	3(1)	2(1)	—	—	7(3)
Viola orbiculata	—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—	—
Zigadenus elegans	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(con.)

Table 3. (con.)

SPECIES	PSME/THOC				PSME/BERE			PIFL		ABGR/THOC			ABLA/THOC	
Stand number	58	46	53	42	47	90	22	48	149	66	12	11	55	99
Township and section	4S9	3S16	3S33	4S7	3S16	3S27	3S22	3S21	3S28	3S29	3S9	3S9	3S33	4S7
Range	44E	44E	44E	45E	44E	44E	44E	44E	44E	45E	44E	44E	44E	45E
Elevation	1980	1590	1830	1660	1590	1870	1650	1740	1720	1560	1530	1590	1770	1680
Azimuth (degrees)	300	70	290	330	75	120	90	100	160	30	3	95	120	310
Slope (percent)	20	10	50	40	15	45	15	50	60	10	5	25	5	10
Rock type	l	l	mb	gr	l	mb	mb	mb	mb	cc	l	l	l	gr
SHRUBS AND SUBSHRUBS														
Acer glabrum	—	3(1)	—	5(3)	7(3)	1(+)	3(1)	1(1)	—	—	1(+)	2(1)	—	—
Arctostaphylos uva-ursi	—	—	—	—	—	—	—	—	2(1)	—	—	—	—	—
Berberis repens	—	7(3)	—	—	9(5)	9(3)	3(1)	10(4)	—	—	—	—	—	—
Clematis columbiana	—	7(3)	1(+)	—	2(1)	—	2(1)	—	—	2(1)	—	—	—	—
Juniperus communis	—	—	—	—	—	—	—	3(6)	—	—	—	—	—	—
Linnaea borealis	—	2(6)	—	—	—	—	1(+)	—	—	1(1)	3(3)	10(22)	2(1)	—
Lonicera utahensis	—	—	—	—	—	—	—	—	—	—	2(1)	1(+)	—	—
Physocarpus malvaceus	—	—	—	2(8)	—	—	—	1(6)	—	—	—	—	—	—
Potentilla fruticosa	—	—	—	—	—	—	—	—	2(1)	—	—	—	—	—
Ribes inerme	—	2(1)	—	—	1(1)	—	—	—	—	—	—	—	—	—
Ribes lacustre	1(+)	—	—	1(1)	—	—	—	—	—	—	1(2)	1(2)	1(+)	1(2)
Ribes viscosissimum	1(+)	—	—	—	—	1(2)	—	—	—	—	—	—	—	—
Rosa gymnocarpa	—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—
Rubus idaeus	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—
Spiraea betulifolia	—	2(1)	3(1)	—	3(2)	10(11)	6(6)	—	—	2(1)	2(1)	1(+)	—	—
Symphoricarpos albus	—	6(4)	1(+)	—	8(9)	—	5(6)	2(2)	1(+)	3(1)	—	—	—	—
Symphoricarpos oreophilus	2(4)	—	—	—	5(14)	6(11)	—	—	—	—	—	—	—	—
GRAMINOIDS														
Agropyron spicatum	—	—	—	—	—	—	—	—	7(3)	—	—	—	—	—
Bromus vulgaris	2(1)	1(+)	1(+)	8(9)	4(2)	—	—	—	—	3(+)	—	—	7(4)	5(4)
Calamagrostis rubescens	1(+)	2(1)	6(9)	1(+)	1(+)	3(4)	3(1)	—	—	—	—	7(16)	—	—
Carex geyeri	—	—	—	—	—	2(2)	—	1(+)	1(+)	—	—	—	—	4(2)
Carex rossii	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Sitanion hystrix	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Stipa occidentalis	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	1(+)
FORBS														
Achillea millefolium	—	—	—	—	—	6(2)	—	2(1)	—	—	—	—	—	—
Actaea rubra	—	—	—	—	1(1)	—	—	—	4(+)	—	—	—	4(5)	—
Adenocaulon bicolor	—	—	—	—	—	—	—	—	—	1(1)	—	—	—	—
Anemone multifida	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Anemone sp.	—	—	—	8(2)	—	—	—	—	—	3(1)	—	—	—	—
Apocynum androsaemifolium	—	—	—	—	—	—	—	6(2)	—	—	—	—	—	—
Aquilegia flavescens	6(2)	2(1)	1(+)	—	5(2)	—	1(+)	—	—	—	—	—	—	3(3)
Arabis holboellii	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—
Arenaria macrophylla	2(+)	1(1)	9(2)	2(4)	2(1)	5(2)	—	7(2)	—	2(1)	—	—	1(+)	7(6)
Arnica cordifolia	8(4)	—	—	6(4)	—	—	8(6)	—	—	6(3)	7(3)	5(4)	—	9(11)
Aster conspicuus	1(+)	3(2)	3(1)	—	3(3)	5(2)	—	1(+)	—	—	—	—	—	—
Astragalus canadensis	1(+)	—	3(1)	—	—	—	—	—	—	—	—	1(+)	6(3)	—
Campanula rotundifolia	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Castilleja hispida	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—
Chimaphila umbellata	—	—	—	—	—	1(1)	1(+)	—	—	—	—	1(2)	—	—
Clintonia uniflora	—	—	—	1(+)	—	—	—	—	—	1(+)	—	—	—	—
Crepis acuminata	—	—	—	—	—	5(3)	—	1(+)	—	—	—	—	—	—
Descurainia richardsonii	—	—	—	—	—	—	—	—	2(+)	—	—	—	—	—
Disporum trachycarpum	—	2(1)	—	1(+)	3(1)	—	—	—	—	—	—	—	—	—
Erigeron chrysopsida	—	—	—	—	—	1(+)	—	2(1)	1(+)	—	—	—	—	—
Eriogonum heracleoides	—	—	—	—	—	—	—	—	4(+)	—	—	—	—	—
Fragaria vesca	—	3(1)	8(3)	—	5(2)	1(1)	2(1)	—	—	1(+)	4(2)	7(4)	6(2)	—
Fragaria virginiana	1(+)	6(2)	6(2)	2(1)	8(3)	—	4(1)	—	—	—	—	—	—	—
Galium triflorum	—	6(2)	—	7(2)	—	—	—	—	—	5(2)	2(1)	—	6(2)	8(4)
Gilia aggregata	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—
Goodyera oblongifolia	—	—	—	2(1)	3(1)	—	5(1)	—	—	4(1)	2(2)	1(+)	—	—
Hackelia micrantha	—	—	3(1)	—	—	—	—	—	—	—	—	—	—	—
Hieracium albertinum	—	—	2(1)	—	—	—	—	—	—	—	—	—	—	—
Hieracium albiflorum	—	5(2)	7(2)	—	—	—	3(1)	—	—	—	—	—	—	—
Lesquerella occidentalis	—	—	—	—	—	1(+)	—	1(+)	—	—	—	—	—	—
Linanthastrum nuttallii	—	1(+)	6(3)	—	—	1(+)	—	2(+)	—	—	—	—	1(+)	—
Linum perenne	—	—	—	—	—	—	—	2(1)	—	—	—	—	—	—
Listera caurina	—	—	—	—	1(+)	—	—	—	—	—	—	—	1(+)	—
Mitella pentandra	—	—	1(+)	1(+)	—	—	—	—	—	—	—	—	3(1)	—
Osmorhiza chilensis	1(+)	8(2)	7(2)	1(1)	6(2)	—	7(4)	—	—	1(+)	1(+)	—	—	3(1)
Oxytropis viscida	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Pedicularis racemosa	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Penstemon globosus	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—
Penstemon wilcoxii	—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—
Phacelia hastata	—	—	—	—	—	3(1)	—	3(1)	1(+)	—	—	—	—	—
Polemonium pulcherrimum	5(3)	—	—	5(3)	—	—	—	—	—	—	—	—	—	3(1)
Pyrola asarifolia	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Pyrola chlorantha	—	—	—	—	1(+)	—	1(+)	—	—	—	—	—	—	—
Pyrola secunda	—	1(+)	—	5(3)	1(+)	—	—	—	—	2(1)	7(3)	3(3)	3(1)	—
Pyrola uniflora	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—
Ranunculus uncinatus	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—
Sedum lanceolatum	—	—	—	—	—	3(1)	—	—	3(+)	—	—	—	—	—
Senecio pseudaureus	—	2(1)	3(1)	—	—	3(1)	—	—	—	—	—	—	5(2)	—
Smilacina stellata	—	—	—	—	—	—	—	2(1)	—	1(+)	—	—	1(+)	—
Solidago multiradiata	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Streptopus amplexifolius	—	—	—	—	—	—	—	—	—	—	—	—	—	2(1)
Thalictrum occidentale	10(49)	10(24)	10(24)	7(16)	8(12)	3(1)	6(2)	1(+)	—	6(7)	8(8)	6(14)	10(61)	10(33)
Valeriana sitchensis	2(1)	—	6(3)	—	—	—	—	—	—	—	—	—	7(3)	—
Viola adunca	4(2)	6(2)	6(2)	5(1)	7(2)	—	6(2)	—	—	—	—	—	1(+)	2(1)
Viola glabella	—	—	—	—	—	—	—	—	—	2(1)	—	—	—	1(+)
Viola orbiculata	—	—	—	1(+)	—	—	—	—	—	8(2)	6(3)	2(1)	7(2)	—

(con.)

Table 3. (con.)

SPECIES	ABLA/THOC															
Stand number	4	6	8	25	54	9	124	15	83	39	127	29	85	137	51	126
Township and section	3S35	4S9	3S33	4S5	3S33	3S33	4S19	4S7	4S25	4S30	4S30	4S19	4S25	5S6	3S22	4S30
Range	44E	44E	44E	45E	44E	44E	45E	45E	44E	45E	45E	46E	44E	45E	44E	45E
Elevation	2180	1920	1830	1620	1810	1880	1770	2160	1850	1800	1830	1800	1890	1980	1650	1830
Azimuth (degrees)	85	290	280	280	275	285	300	110	280	285	290	270	185	350	120	210
Slope (percent)	5	20	40	10	45	30	25	40	10	25	20	10	25	15	10	5
Rock type	mb	l	l	gr	mb	l	gr	l	gr	gr	gr	gr	gr	gr	mb	gr
SHRUBS AND SUBSHRUBS																
Acer glabrum	—	—	7(2)	—	1(4)	—	—	—	—	—	—	1(+)	—	—	3(1)	—
Amelanchier alnifolia	—	—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—	—
Berberis repens	—	—	—	2(+)	—	—	—	—	—	—	—	—	2(1)	—	—	—
Clematis columbiana	—	—	—	1(+)	1(+)	—	—	—	—	—	—	—	—	—	2(1)	—
Linnaea borealis	—	—	—	—	2(1)	4(8)	—	—	—	—	—	—	—	—	—	—
Lonicera involucrata	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	1(1)	—
Lonicera utahensis	—	1(+)	2(1)	—	—	—	—	1(+)	—	—	—	—	—	—	—	1(1)
Pachistima myrsinites	—	—	—	—	—	—	4(1)	—	—	—	—	—	—	—	—	—
Ribes lacustre	—	2(6)	—	1(+)	—	—	—	—	1(+)	1(+)	—	—	—	—	1(+)	1(+)
Ribes viscosissimum	—	—	1(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Spiraea betulifolia	—	—	—	—	—	—	1(+)	—	—	—	—	2(1)	2(1)	—	—	—
Symphoricarpos albus	—	1(+)	6(3)	—	—	1(+)	—	—	—	—	—	—	—	—	—	—
Symphoricarpos oreophilus	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—
Vaccinium membranaceum	—	—	—	4(7)	—	—	4(3)	—	—	—	—	—	—	3(1)	—	—
Vaccinium scoparium	—	—	—	—	1(+)	2(1)	4(2)	5(5)	—	1(+)	—	1(+)	—	—	—	3(1)
GRAMINOIDS																
Bromus vulgaris	—	—	—	4(3)	—	—	—	—	—	3(1)	—	—	—	—	—	—
Calamagrostis rubescens	—	—	—	4(1)	—	—	4(5)	—	—	—	—	—	1(+)	—	—	—
Carex geyeri	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—
Carex rossii	—	—	—	—	—	—	—	—	4(1)	—	—	—	—	—	—	4(2)
FORBS																
Achillea millefolium	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Actaea rubra	—	—	—	1(+)	1(+)	—	—	—	—	—	—	—	—	—	—	—
Anemone oregana	—	—	—	1(+)	—	—	8(3)	—	7(3)	5(1)	—	1(+)	—	—	—	—
Aquilegia flavescens	—	2(1)	—	—	2(1)	—	—	—	—	—	—	—	—	—	1(+)	—
Arenaria macrophylla	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	2(1)	6(4)
Arnica cordifolia	10(9)	2(2)	1(+)	8(2)	—	—	4(1)	7(10)	8(10)	7(8)	9(7)	6(2)	4(2)	1(2)	—	—
Aster conspicuus	—	1(+)	5(4)	4(1)	2(1)	2(1)	—	—	—	—	—	1(1)	—	—	—	—
Chimaphila umbellata	1(+)	—	1(+)	2(1)	2(+)	6(3)	2(1)	—	1(1)	—	3(1)	—	1(+)	1(+)	1(+)	—
Disporum trachycarpum	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	1(+)	—
Fragaria vesca	—	3(1)	2(2)	1(+)	1(+)	1(+)	3(2)	2(2)	—	—	—	—	—	—	—	—
Fragaria virginiana	—	—	—	—	—	—	—	—	2(1)	2(1)	—	2(+)	—	—	—	—
Galium triflorum	—	4(1)	—	2(1)	—	—	—	1(+)	—	1(+)	—	—	—	—	5(2)	—
Goodyera oblongifolia	—	—	1(+)	—	3(1)	1(+)	2(1)	1(+)	—	3(1)	—	—	—	—	1(+)	—
Hieracium albiflorum	—	—	—	—	—	—	—	—	3(1)	—	—	—	—	—	—	—
Listera caurina	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	1(+)	—
Mertensia paniculata	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Osmorhiza chilensis	—	—	—	1(+)	—	1(+)	3(1)	1(+)	1(+)	2(1)	6(2)	—	1(+)	—	6(2)	—
Polemonium pulcherrimum	3(1)	—	1(2)	—	—	—	—	1(2)	—	—	—	—	—	—	—	3(1)
Pyrola chlorantha	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(+)	—
Pyrola secunda	2(1)	3(1)	—	4(1)	8(2)	6(2)	10(4)	—	—	5(2)	7(4)	3(1)	4(1)	7(5)	7(3)	5(5)
Pyrola uniflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(1)	—
Smilacina stellata	—	—	—	1(2)	—	—	—	—	—	—	—	—	—	—	—	—
Streptopus amplexifolius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)
Thalictrum occidentale	9(33)	10(27)	8(17)	7(15)	7(13)	10(10)	9(9)	6(7)	—	3(2)	7(6)	2(2)	—	3(3)	3(1)	2(1)
Tiarella trifoliata	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Valeriana sitchensis	—	4(1)	1(+)	—	—	—	—	3(2)	—	—	—	—	—	—	—	—
Veratrum viride	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—
Viola adunca	—	2(1)	7(2)	—	1(+)	6(3)	1(+)	3(1)	—	—	—	1(+)	—	—	3(1)	—
Viola glabella	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Viola orbiculata	—	—	—	6(1)	8(2)	—	9(3)	—	2(1)	6(2)	3(1)	4(1)	1(+)	—	—	7(3)

(con.)

Table 3. (con.)

SPECIES	ABLA/VAME			ABLA/VASC												
Stand number	60	27	123	81	72	69	1	93	82	79	80	74	71	94	130	78
Township and section	3S32	4S7	4S7	4S26	4S26	4S24	4S27	4S21	4S22	4S23	4S23	4S27	4S24	4S34	5S6	4S23
Range	44E	45E	45E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	45E	44E
Elevation	2040	1740	1710	2160	2190	2130	2250	2200	2220	2280	2250	2230	2130	2280	2100	2310
Azimuth (degrees)	360	290	310	190	20	340	130	30	50	350	40	350	50	150	160	280
Slope (percent)	25	25	15	5	20	30	5	50	30	15	10	10	20	20	5	30
Rock type	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr	gr
SHRUBS AND SUBSHRUBS																
Alnus sinuata	—	—	1(4)	—	—	—	—	—	—	—	—	—	—	—	—	—
Amelanchier alnifolia	—	1(1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cassiope mertensiana	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Gaultheria humifusa	—	—	—	3(5)	—	—	1(2)	1(+)	—	—	—	—	—	—	—	—
Ledum glandulosum	3(1)	—	—	8(33)	6(14)	7(10)	3(9)	—	2(1)	—	—	2(3)	1(4)	—	—	—
Lonicera utahensis	—	—	—	2(1)	2(1)	1(1)	—	—	—	1(+)	1(+)	—	—	—	—	—
Pachistima myrsinites	—	4(1)	3(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Phyllodoce empetriformis	—	—	—	—	2(1)	1(2)	7(10)	9(21)	7(18)	8(18)	7(8)	7(7)	5(6)	—	1(1)	—
Ribes lacustre	—	1(1)	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Sorbus sitchensis	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Spiraea betulifolia	—	4(2)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vaccinium membranaceum	9(37)	9(36)	10(19)	—	—	—	—	—	—	—	—	—	1(+)	—	—	—
Vaccinium scoparium	3(1)	6(6)	—	10(25)	10(30)	10(39)	10(39)	10(34)	10(28)	10(17)	9(16)	10(25)	10(39)	10(14)	10(20)	8(6)
GRAMINOIDS																
Bromus vulgaris	—	2(1)	7(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Calamagrostis rubescens	—	5(5)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Carex geyeri	—	—	2(1)	2(1)	—	—	—	—	—	—	—	—	—	—	—	—
Carex rossii	—	—	—	—	—	—	—	1(+)	5(2)	—	2(1)	—	—	7(2)	5(2)	2(1)
Festuca viridula	—	—	—	—	—	—	—	—	—	—	—	—	—	1(1)	1(+)	—
Juncus parryi	—	—	—	—	—	—	—	—	2(1)	—	1(+)	—	—	7(3)	1(+)	—
Luzula campestris	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Luzula hitchcockii	—	—	—	—	3(1)	—	—	9(17)	—	—	2(1)	5(7)	3(2)	—	—	—
Muhlenbergia filiformis	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Oryzopsis exigua	—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—	—
Poa sp.	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
FORBS																
Allium validum	—	—	—	3(1)	—	—	1(+)	—	—	—	—	—	—	—	—	—
Anaphalis margaritacea	—	—	—	4(2)	—	—	—	—	—	—	—	—	—	—	—	—
Anemone oregana	—	—	7(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Antennaria lanata	—	—	—	—	—	—	2(1)	5(3)	4(2)	3(1)	6(2)	—	—	—	2(1)	—
Arenaria aculeata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—
Arenaria macrophylla	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arnica cordifolia	4(1)	9(5)	8(5)	—	—	2(1)	—	—	—	—	—	—	2(1)	—	—	—
Arnica mollis	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—
Aster conspicuus	—	3(1)	2(1)	—	—	—	—	—	—	—	—	—	—	—	—	—
Chimaphila umbellata	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Dodecatheon alpinum	—	—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—	—
Epilobium angustifolium	—	—	—	2(1)	—	—	—	—	—	—	—	—	—	—	—	—
Erigeron peregrinus	—	—	—	4(2)	—	—	—	1(+)	1(+)	1(+)	5(2)	—	—	—	—	—
Fragaria vesca	—	2(1)	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Galium triflorum	—	3(1)	5(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Goodyera oblongifolia	1(+)	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Hieracium albiflorum	—	—	1(+)	—	—	2(1)	—	—	—	—	3(1)	—	1(+)	—	—	—
Hieracium gracile	—	—	—	—	—	1(+)	—	4(2)	1(+)	—	3(1)	—	—	—	—	—
Hypericum formosum	—	—	—	3(1)	—	—	—	—	—	—	—	—	—	—	—	—
Ligusticum tenuifolium	—	—	—	1(+)	1(+)	—	2(1)	—	—	—	—	1(+)	—	—	—	—
Listera caurina	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lupinus polyphyllus	—	—	—	1(1)	—	—	—	—	—	—	—	—	—	—	—	—
Osmorhiza chilensis	4(1)	5(1)	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Pedicularis racemosa	—	—	—	4(2)	2(1)	—	—	—	—	—	—	1(+)	—	—	1(+)	—
Polemonium pulcherrimum	1(1)	—	—	—	—	—	1(+)	—	—	—	1(+)	—	2(1)	—	1(+)	—
Polygonum phytolaccaefolium	—	—	—	—	—	—	—	—	—	—	—	—	—	3(2)	—	—
Potentilla flabellifolia	—	—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—	—
Pyrola secunda	4(1)	1(+)	9(5)	—	—	—	—	—	—	—	—	—	—	—	—	—
Ranunculus alismaefolius	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—
Thalictrum occidentale	8(20)	6(15)	9(6)	—	—	—	—	—	—	—	—	—	—	—	—	—
Valeriana sitchensis	4(1)	—	—	10(5)	1(+)	2(1)	—	—	—	—	4(1)	—	—	—	—	—
Veratrum viride	1(+)	—	—	4(1)	—	—	—	—	—	—	—	—	—	—	1(+)	—
Veronica cusickii	—	—	—	3(1)	—	—	2(1)	2(1)	—	2(1)	4(2)	—	—	—	1(+)	—
Viola adunca	—	3(1)	—	2(1)	—	—	—	—	—	—	—	—	—	—	—	—
Viola orbiculata	8(2)	5(2)	9(4)	—	—	—	—	—	—	—	—	—	—	—	—	—

(con.)

Table 3. (con.)

SPECIES		ABLA/VASC						PIAL-ABLA									
	Stand number	75	77	10	2	76	34	5	73	133	119	18	96	95	97	17	16
	Township and section	4S23	4S23	3S33	4S28	4S23	4S25	4S21	4S27	5S1	4S12	4S11	4S35	4S34	5S1	4S11	4S11
	Range	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E
	Elevation	2160	2280	1830	2160	2220	1830	2280	2310	2220	2340	2400	2460	2250	2520	2410	2370
	Azimuth (degrees)	320	260	290	320	220	0	330	130	195	105	280	310	190	220	205	185
	Slope (percent)	25	20	15	20	25	0	40	30	30	25	45	30	40	45	35	35
	Rock type	gr	gr	l	gr	gr	gr	gr	gr	gr	h	gr	gr	gr	gr	l	h
SHRUBS AND SUBSHRUBS																	
Berberis repens		—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Gaultheria humifusa		—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Juniperus communis		—	—	—	—	—	—	—	—	3(8)	—	—	—	—	—	2(10)	2(7)
Ledum glandulosum		—	—	—	—	—	4(3)	—	—	—	—	—	—	—	—	—	—
Linnaea borealis		—	—	2(2)	—	—	2(1)	—	—	—	—	—	—	—	—	—	—
Lonicera utahensis		—	—	—	—	—	—	—	—	1(1)	—	—	—	—	—	—	—
Penstemon fruticosus		—	—	—	—	—	—	—	—	2(1)	—	—	—	2(1)	—	5(3)	3(1)
Phyllodoce empetriformis		—	—	—	3(2)	—	—	3(8)	—	—	—	—	—	—	—	—	—
Potentilla fruticosa		—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(2)	—
Ribes lacustre		—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—
Ribes montigenum		—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Vaccinium scoparium		9(29)	10(41)	10(36)	10(32)	10(20)	8(18)	8(31)	10(24)	10(25)	10(25)	7(12)	9(11)	4(8)	3(5)	1(+)	—
GRAMINOIDS																	
Bromus vulgaris		—	—	—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—
Carex geyeri		—	—	—	—	1(4)	—	—	—	—	—	2(1)	1(+)	1(+)	—	7(2)	6(2)
Carex rossii		3(1)	—	—	—	3(1)	—	—	2(1)	5(2)	6(2)	—	6(2)	5(3)	1(1)	—	—
Carex spectabilis		—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Festuca viridula		—	—	—	1(+)	—	—	—	—	—	2(1)	—	—	1(+)	6(4)	2(1)	—
Juncus parryi		—	1(+)	—	—	—	—	—	—	—	1(1)	1(+)	4(3)	—	4(5)	—	—
Oryzopsis exigua		—	—	—	—	—	—	—	—	2(1)	—	—	2(1)	7(4)	—	—	—
Poa gracillima		—	—	—	—	—	—	—	—	—	—	—	1(+)	—	3(1)	—	—
Poa nervosa		—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Sitanion hystrix		—	—	—	—	—	—	—	—	—	—	—	—	—	—	4(1)	—
Stipa occidentalis		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)
Trisetum spicatum		—	—	—	—	—	—	—	—	—	—	—	—	—	1(+)	—	—
FORBS																	
Achillea millefolium		—	—	—	—	—	—	—	—	3(1)	1(+)	—	—	—	—	3(1)	1(+)
Anaphalis margaritacea		—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Antennaria alpina		—	—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Antennaria lanata		—	—	—	2(1)	—	—	—	—	1(+)	—	—	—	—	—	—	—
Arenaria aculeata		—	—	—	—	—	—	—	—	—	3(2)	—	3(1)	5(3)	—	—	1(+)
Arenaria macrophylla		—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Arnica cordifolia		—	—	—	5(9)	7(4)	8(2)	—	—	5(2)	10(11)	6(3)	—	—	3(1)	—	4(1)
Arnica latifolia		—	—	—	—	—	—	—	—	2(1)	—	—	—	—	—	—	—
Arnica mollis		—	—	—	2(1)	—	—	—	—	—	—	—	—	—	—	—	—
Aster conspicuus		—	—	3(2)	—	—	—	—	—	—	—	—	—	—	—	—	—
Castilleja miniata		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(1)
Catilleja rhexifolia		—	—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—
Chimaphila umbellata		—	—	1(2)	—	—	2(+)	—	—	—	1(+)	—	—	—	—	—	—
Epilobium angustifolium		—	—	1(+)	—	—	—	—	—	4(2)	1(+)	—	1(+)	—	—	—	3(1)
Erigeron peregrinus		—	3(1)	—	3(1)	—	—	—	—	—	1(+)	—	—	—	—	—	—
Eriogonum flavum		—	—	—	—	—	—	—	—	—	—	—	2(1)	—	—	1(+)	—
Fragaria vesca		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2(1)
Fragaria virginiana		—	—	1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—
Goodyera oblongifolia		—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Hieracium albertinum		—	—	—	—	—	—	—	—	2(1)	—	1(+)	—	—	—	—	—
Hieracium albiflorum		—	—	1(+)	—	8(2)	—	—	—	—	—	—	—	—	—	—	—
Hieracium gracile		1(+)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Linanthastrum nuttallii		—	—	—	—	1(+)	—	—	—	—	5(2)	—	4(2)	—	—	4(2)	8(5)
Listera caurina		—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—	—	—
Osmorhiza chilensis		—	—	—	—	—	2(1)	—	—	—	—	—	—	—	—	—	—
Pedicularis contorta		—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	1(+)	—
Pedicularis racemosa		—	1(1)	—	3(2)	—	—	—	—	—	—	—	—	—	—	—	—
Penstemon globosus		—	—	—	—	—	—	—	—	—	—	—	2(1)	—	—	—	—
Polemonium pulcherrimum		—	—	—	—	—	1(+)	—	—	1(+)	1(1)	—	—	—	1(+)	—	—
Polygonum phytolaccaefolium		—	—	—	—	—	—	—	—	—	—	—	4(1)	—	—	—	1(+)
Potentilla glandulosa		—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—	—
Pyrola secunda		—	—	1(+)	—	—	3(1)	—	—	—	—	—	—	—	—	—	—
Solidago multiradiata		—	—	—	—	—	—	—	—	—	3(1)	5(1)	—	—	—	—	7(3)
Spraguea umbellata		—	—	—	—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Thalictrum occidentale		—	—	2(2)	—	1(+)	6(1)	—	—	—	—	—	—	—	—	—	—
Valeriana sitchensis		—	—	—	1(+)	1(+)	1(+)	—	—	2(2)	—	—	—	—	—	—	—
Veratrum viride		—	—	—	—	—	—	—	—	—	3(2)	—	—	—	—	—	—
Viola orbiculata		—	—	5(1)	—	—	6(2)	—	—	—	—	—	—	—	—	—	—

(con.)

Table 3. (con.)

SPECIES		PICO/CARU				PICO/VAME			PICO/VASC				
	Stand number	**23**	**59**	**24**	**35**	**100**	**61**	**26**	**30**	**31**	**33**	**70**	**68**
	Township and section	**3S29**	**3S32**	**3S32**	**4S25**	**4S7**	**3S33**	**4S7**	**4S19**	**4S19**	**4S25**	**4S24**	**4S24**
	Range	**45E**	**44E**	**45E**	**44E**	**45E**	**44E**	**45E**	**45E**	**45E**	**44E**	**44E**	**44E**
	Elevation	**1490**	**2250**	**1500**	**1800**	**1740**	**2010**	**1680**	**1800**	**1830**	**1850**	**2160**	**2130**
	Azimuth (degrees)	**55**	**180**	**270**	**175**	**280**	**60**	**100**	**260**	**120**	**320**	**195**	**150**
	Slope (percent)	**20**	**45**	**15**	**20**	**30**	**20**	**20**	**15**	**10**	**5**	**25**	**20**
	Rock type	**cc**	**l**	**cc**	**gr**	**gr**	**gr**	**gr**	**gr**	**gr**	**gr**	**gr**	**gr**
SHRUBS AND SUBSHRUBS													
Acer glabrum		—	—	1(+)	—	1(1)	—	—	—	—	—	—	—
Amelanchier alnifolia		—	—	—	—	2(5)	—	—	—	—	—	—	—
Berberis repens		—	2(1)	—	6(2)	1(+)	—	—	2(1)	1(+)	—	—	—
Lonicera utahensis		—	—	—	—	—	—	1(+)	—	—	—	—	—
Pachistima myrsinites		—	—	—	—	4(1)	—	1(+)	—	—	—	—	—
Ribes lacustre		—	—	—	—	1(+)	—	—	—	—	—	—	—
Rosa gymnocarpa		1(+)	—	—	—	—	—	—	—	—	—	—	—
Spiraea betulifolia		6(3)	—	2(1)	8(2)	7(4)	—	1(+)	6(4)	—	—	—	—
Symphoricarpos albus		6(1)	—	—	—	—	—	—	—	—	—	—	—
Vaccinium membranaceum		—	—	8(7)	2(1)	10(61)	10(48)	10(35)	—	—	1(1)	—	—
Vaccinium scoparium		—	—	—	6(3)	—	3(2)	2(6)	10(32)	10(29)	8(28)	10(28)	9(6)
GRAMINOIDS													
Bromus vulgaris		—	—	—	—	6(2)	—	—	—	—	—	—	—
Calamagrostis rubescens		19(50)	10(48)	10(32)	9(23)	—	—	4(1)	1(1)	—	—	—	—
Carex geyeri		—	2(1)	—	—	6(4)	—	—	—	—	—	—	—
Carex rossii		—	—	—	—	—	—	—	2(1)	—	2(2)	8(3)	8(3)
Elymus glaucus		—	—	—	—	1(+)	—	—	—	—	—	—	—
Juncus parryi		—	—	—	—	—	—	—	—	—	—	1(1)	4(2)
Oryzopsis exigua		—	—	—	—	—	—	—	—	—	—	1(+)	6(2)
FORBS													
Anaphalis margaritacea		—	2(1)	—	—	—	—	—	—	—	—	—	—
Anemone sp.		2(+)	—	6(2)	—	—	—	—	—	2(1)	—	—	—
Arenaria aculeata		—	—	—	—	—	—	—	—	—	—	1(+)	3(1)
Arenaria macrophylla		—	—	—	—	2(1)	—	—	1(+)	—	—	—	—
Arnica cordifolia		10(12)	—	2(1)	6(2)	1(+)	3(1)	—	10(5)	4(1)	6(2)	6(2)	1(+)
Astragalus canadensis		—	1(+)	2(1)	—	—	—	—	—	—	—	—	—
Aster conspicuus		2(+)	1(+)	—	—	2(1)	—	—	—	—	—	—	—
Chimaphila umbellata		1(+)	—	2(1)	—	1(+)	—	7(4)	—	4(1)	1(+)	—	—
Epilobium angustifolium		—	3(1)	—	—	—	—	—	—	—	—	—	—
Fragaria vesca		—	5(3)	—	—	6(3)	—	—	—	—	—	—	—
Fragaria virginiana		9(5)	—	—	2(2)	1(+)	—	—	1(+)	—	—	—	—
Galium triflorum		—	—	—	—	2(1)	—	—	—	—	—	—	—
Galium sp.		1(+)	—	—	—	—	—	—	—	—	—	—	—
Goodyera oblongifolia		—	—	—	—	—	—	1(+)	—	—	—	—	—
Hieracium albertinum		—	8(2)	—	4(1)	—	—	—	—	—	—	—	—
Hieracium albiflorum		—	—	—	—	—	—	—	—	3(1)	—	—	1(+)
Osmorhiza chilensis		2(+)	—	—	—	5(2)	—	—	—	—	—	—	—
Polygonum phytolaccaefolium		—	—	—	—	—	—	—	—	—	—	1(+)	1(+)
Pyrola secunda		—	—	—	—	2(1)	—	—	—	—	—	—	—
Smilacina stellata		1(+)	—	—	—	—	—	—	—	—	—	—	—
Thalictrum occidentale		7(6)	—	—	—	6(7)	—	—	—	—	—	—	—
Valeriana sitchensis		—	—	—	—	—	—	—	—	—	—	1(1)	—
Viola adunca		—	2(1)	—	—	2(1)	—	—	—	—	—	—	—
Viola orbiculata		—	—	—	—	9(4)	—	5(1)	—	2(1)	—	—	—

(con.)

Table 3. (con.)

SPECIES		AGCL	ALSI	AVALANCHE SLOPES						
	Stand number	64	86	40	28	43	21	49	89	45
	Township and section	3S32	4S30	4S19	4S18	4S5	3S28	3S22	3S15	3S16
	Range	45E	45E	45E	45E	45E	44E	44E	44E	44E
	Elevation	1500	1950	1740	1710	1560	1770	1590	1590	1620
	Azimuth (degrees)	310	320	290	280	295	160	130	80	110
	Slope (percent)	50	40	30	20	20	25	20	15	20
	Rock type	cc	gr	gr	gr	cc	l	mb	mb	mb
SHRUBS AND SUBSHRUBS										
Acer glabrum		4(23)	—	—	—	—	—	—	—	—
Alnus sinuata		—	10(90)	—	—	—	—	—	—	—
Arctostaphylos uva-ursi		—	—	—	—	—	—	—	1(4)	2(1)
Berberis repens		—	—	—	—	—	1(+)	2(1)	9(3)	9(6)
Clematis columbiana		—	—	—	—	—	—	—	2(1)	—
Holodiscus discolor		1(4)	—	—	—	—	—	—	—	—
Philadelphus lewisii		4(4)	—	—	—	—	—	—	—	—
Physocarpus malvaceus		3(12)	—	—	—	—	—	—	—	—
Potentilla fruticosa		—	—	—	—	—	1(3)	3(1)	5(8)	5(6)
Prunus emarginata		—	—	—	—	—	—	—	—	2(3)
Ribes cereum		—	—	—	—	—	—	1(2)	—	—
Ribes inerme		—	—	—	—	—	—	—	1(+)	—
Ribes lacustre		—	2(1)	—	—	—	—	—	—	—
Rosa gymnocarpa		—	—	—	—	5(4)	—	2(1)	—	4(2)
Rosa woodsii		—	—	—	—	1(4)	—	—	—	—
Rubus idaeus		4(5)	—	—	—	—	—	—	—	—
Rubus parviflorus		1(1)	1(+)	—	—	—	—	—	—	—
Sambucus racemosa		—	—	3(8)	—	—	—	—	—	—
Symphoricarpos albus		—	—	1(1)	1(+)	8(37)	—	10(7)	7(5)	4(2)
Symphoricarpos oreophilus		—	—	—	—	—	1(2)	1(6)	1(+)	—
GRAMINOIDS										
Agropyron caninum		—	—	—	—	—	—	2(1)	7(11)	—
Agropyron spicatum		—	—	—	—	—	—	2(1)	6(7)	10(11)
Bromus carinatus		—	—	7(5)	6(6)	7(4)	—	—	—	—
Bromus vulgaris		—	3(1)	—	—	—	—	—	—	—
Carex geyeri		1(+)	—	—	—	—	8(18)	1(1)	—	—
Carex hoodii		—	—	6(3)	10(32)	10(12)	3(1)	—	—	—
Elymus glaucus		—	—	—	8(13)	3(3)	—	—	—	1(1)
Poa pratensis		—	—	—	—	—	2(1)	—	—	—
Poa scabrella		—	—	—	—	—	—	1(1)	—	—
Stipa occidentalis		—	—	—	—	—	9(35)	10(29)	7(15)	9(8)
FORBS										
Achillea millefolium		1(+)	—	—	8(3)	8(3)	6(2)	3(1)	7(2)	5(2)
Agastache urticifolia		—	—	6(10)	10(15)	1(2)	—	—	—	—
Agoseris glauca		—	—	—	—	—	—	—	1(+)	—
Anemone multifida		—	—	—	—	—	—	1(+)	5(2)	3(1)
Antennaria microphylla		—	—	—	—	—	3(1)	—	—	—
Arabis holboellii		—	—	—	—	—	—	—	—	1(+)
Arenaria macrophylla		5(2)	—	—	—	—	—	—	—	—
Arnica cordifolia		3(1)	—	—	—	—	—	—	—	—
Aster perelegans		—	—	—	—	—	—	—	2(2)	—
Castilleja miniata		—	—	—	5(1)	—	1(+)	—	—	—
Clematis hirsutissima		—	—	—	—	—	—	3(1)	—	—
Delphinium occidentale		—	5(2)	—	—	—	—	—	—	—
Descurainia richardsonii		—	—	—	—	—	—	3(1)	—	—
Epilobium angustifolium		—	—	1(+)	—	—	6(2)	—	—	—
Epilobium minutum		—	1(+)	—	—	—	—	—	—	—
Erigeron pumilis		—	—	—	—	—	2(1)	1(+)	2(1)	7(3)
Eriogonum flavum		—	—	—	—	—	—	1(+)	—	6(4)
Eriogonum heracleoides		—	—	—	—	—	—	7(7)	—	—
Fragaria vesca		4(1)	—	—	—	—	—	—	—	—
Fragaria virginiana		—	—	1(+)	9(6)	3(3)	6(5)	—	1(+)	—
Frasera speciosa		—	—	—	—	—	—	—	—	1(1)
Galium asperrimum		1(+)	—	—	—	—	—	—	—	—
Galium triflorum		5(2)	4(1)	6(3)	4(2)	3(2)	—	—	—	—
Geranium viscosissimum		—	—	—	—	—	9(6)	—	—	—
Hackelia micrantha		—	—	2(1)	8(5)	5(4)	9(23)	—	—	4(1)
Hedysarum boreale		—	—	—	—	—	—	3(1)	—	—
Heracleum lanatum		—	4(4)	10(5)	—	2(1)	—	—	—	—
Linanthastrum nuttallii		—	—	—	—	—	—	—	—	2(1)
Mertensia paniculata		—	7(9)	10(41)	3(1)	—	—	—	—	—
Mimulus lewisii		—	2(1)	—	—	—	—	—	—	—
Mitella pentandra		1(+)	—	—	—	—	—	—	—	—
Osmorhiza chilensis		—	5(2)	—	—	—	—	—	—	—
Oxytropis viscida		—	—	—	—	—	—	—	1(+)	3(1)
Parnassia fimbriata		—	1(+)	—	—	—	—	—	—	—
Penstemon procerus		—	—	—	—	—	2(3)	3(2)	1(+)	—
Penstemon venustus		2(1)	—	—	—	—	—	—	—	—
Potentilla glandulosa		—	—	—	1(+)	—	—	—	—	—
Potentilla gracilis		—	—	—	7(3)	—	5(3)	3(1)	—	—
Saxifraga arguta		—	3(2)	—	—	—	—	—	—	—
Sedum lanceolatum		1(+)	—	—	—	—	—	—	—	—
Senecio canus		—	—	—	—	—	1(+)	—	1(+)	1(+)
Senecio serra		—	—	—	—	2(1)	—	—	—	—
Senecio streptanthifolius		—	—	—	4(1)	—	—	—	—	—
Senecio triangularis		—	1(+)	—	—	—	—	—	—	—
Smilacina stellata		—	—	2(1)	—	1(+)	2(+)	—	—	2(1)
Solidago missouriensis		—	—	—	—	—	1(+)	—	—	5(3)
Thalictrum occidentale		2(1)	2(1)	2(1)	2(1)	—	—	—	—	—
Urtica dioica		—	10(25)	8(14)	3(1)	5(9)	—	—	—	—
Viola glabella		—	7(3)	—	—	—	—	—	—	—
FERNS AND FERN ALLIES										
Cystopteris fragilis		5(3)	—	—	—	—	—	—	—	—
Equisetum laevigatum		—	—	—	—	—	—	—	1(+)	2(1)

(con.)

Table 3. (con.)

SPECIES		CELE			HIGH - ELEVATION GRASSLANDS							
	Stand number	88	143	91	141	101	129	114	117	145	140	102
	Township and section	3S9	3S27	3S27	4S12	4S12	5S6	4S12	4S12	4S11	4S31	4S11
	Range	44E	44E	44E	44E	44E	45E	44E	44E	44E	45E	44E
	Elevation	1650	1860	1830	2130	2100	2100	2430	2400	2400	2280	2400
	Azimuth (degrees)	180	170	170	175	195	155	195	115	160	250	190
	Slope (percent)	45	50	40	40	30	30	45	40	45	35	50
	Rock type	l	mb	mb	mb	mb	gr	h	gr	l	h	h
SHRUBS AND SUBSHRUBS												
Arctostaphylos uva-ursi		—	—	3(8)	—	—	—	—	—	—	—	—
Artemisia tridentata		1(2)	—	—	—	—	—	—	—	—	—	—
Berberis repens		3(1)	2(1)	1(+)	9(3)	8(2)	—	—	—	—	—	—
Cercocarpus ledifolius		4(33)	6(40)	6(38)	—	—	—	—	—	—	—	—
Happlopappus greenei		—	—	—	—	—	—	1(+)	—	—	4(2)	3(3)
Penstemon fruticosus		—	—	1(+)	—	—	—	—	—	—	—	—
Potentilla fruticosa		—	—	—	—	—	—	—	—	1(1)	—	—
Prunus virginiana		1(4)	—	—	—	—	—	—	—	—	—	—
Rosa woodsii		1(4)	—	—	—	—	—	—	—	—	—	—
Spiraea betulifolia		—	1(+)	3(2)	—	—	—	—	—	—	—	—
Symphoricarpos albus		1(+)	—	—	—	—	—	—	—	—	—	—
Symphoricarpos oreophilus		6(12)	3(5)	2(1)	—	—	—	—	—	—	—	—
Vaccinium scoparium		—	—	—	—	—	—	3(1)	—	—	—	—
GRAMINOIDS												
Agropyron spicatum		10(30)	7(5)	3(4)	10(18)	—	—	—	—	—	—	—
Bromus carinatus		—	—	—	—	—	—	—	1(+)	—	3(1)	—
Carex geyeri		—	—	—	3(1)	10(15)	—	—	—	1(+)	—	3(2)
Carex hoodii		—	—	—	—	—	—	—	1(+)	—	—	1(+)
Carex microptera		—	—	—	—	—	5(7)	—	9(8)	—	—	1(+)
Carex paysonis		—	—	—	—	—	—	3(1)	2(1)	—	—	—
Carex phaeocephala		—	—	—	—	—	2(3)	—	—	—	—	—
Carex rossii		—	—	1(+)	—	—	—	2(1)	—	—	—	—
Festuca viridula		—	—	—	—	—	10(36)	9(19)	7(17)	10(14)	6(2)	8(5)
Juncus parryi		—	—	—	—	—	5(3)	9(15)	4(4)	—	—	—
Melica bulbosa		—	—	—	—	—	—	1(+)	1(+)	—	—	—
Oryzopsis exigua		—	—	—	—	8(2)	—	2(2)	2(2)	—	—	—
Poa nervosa		—	—	—	—	—	—	1(+)	—	—	—	—
Sitanion hystrix		—	—	1(+)	—	—	1(+)	1(+)	3(1)	—	6(2)	—
Stipa occidentalis		—	—	—	—	1(+)	—	2(3)	5(7)	6(3)	6(4)	4(3)
Trisetum spicatum		—	—	—	—	—	—	—	2(1)	1(+)	—	—
FORBS												
Achillea millefolium		7(2)	2(1)	5(2)	5(1)	7(2)	—	—	5(2)	7(2)	—	4(1)
Agoseris aurantiaca		—	—	—	—	—	—	1(+)	—	—	—	—
Anemone multifida		—	—	—	—	—	—	—	—	1(+)	—	—
Antennaria anaphaloides		—	—	—	4(3)	—	—	—	—	—	—	—
Antennaria lanata		—	—	—	—	—	4(1)	—	—	1(+)	—	—
Apocynum androsaemifolium		1(+)	—	1(+)	—	—	—	—	—	—	—	—
Arabis lemmonii		—	—	—	—	—	—	—	—	—	—	1(+)
Arenaria aculeata		—	—	—	1(+)	3(1)	1(+)	7(4)	—	7(3)	—	6(4)
Arenaria macrophylla		—	—	3(1)	—	—	—	—	—	—	—	—
Artemisia ludoviciana		—	—	—	—	3(2)	—	—	—	—	7(8)	1(+)
Balsamorhiza sagittata		2(1)	—	—	—	—	—	—	—	—	—	—
Calochortus macrocarpus		—	—	—	—	—	7(2)	—	—	—	—	—
Castilleja hispida		—	—	—	—	1(+)	—	—	—	—	—	—
Castilleja miniata		—	—	—	—	—	—	—	—	—	—	1(+)
Crepis acuminata		—	1(+)	—	1(+)	—	—	—	—	—	—	—
Epilobium minutum		1(+)	—	—	1(+)	—	—	—	—	—	—	—
Erigeron chrysopsida		—	4(1)	1(+)	—	—	—	—	—	—	—	—
Erigeron speciosus		—	—	—	1(+)	6(2)	—	—	—	1(+)	2(1)	—
Eriogonum flavum		—	—	—	7(3)	—	2(1)	—	—	3(1)	7(3)	7(4)
Eriogonum heracleoides		—	—	—	5(3)	1(1)	—	—	—	—	—	—
Eriogonum umbellatum		2(6)	—	—	—	—	—	—	—	—	—	—
Fragaria vesca		1(+)	—	—	—	—	—	—	—	—	—	—
Fragaria virginiana		—	—	—	—	3(1)	—	—	—	1(+)	—	—
Frasera speciosa		—	—	—	—	—	—	—	—	3(1)	—	3(1)
Galium multiflorum		3(1)	—	—	2(1)	—	—	—	—	—	—	—
Gilia aggregata		—	—	2(1)	1(+)	—	—	—	—	—	7(2)	—
Hackelia micrantha		—	—	—	—	—	—	—	—	3(1)	—	4(3)
Hieracium albertinum		—	—	—	—	8(5)	—	—	—	—	—	—
Hypericum formosum		—	—	—	—	—	—	—	—	8(4)	—	7(13)
Lesquerella occidentalis		—	3(1)	1(+)	5(1)	—	—	—	—	1(+)	—	—
Linanthastrum nuttallii		—	—	—	—	5(3)	—	8(8)	10(12)	9(11)	9(2)	7(2)
Linum perenne		—	—	1(+)	—	8(2)	—	—	—	1(+)	2(1)	—
Lupinus argenteus		—	—	—	—	—	—	—	—	—	8(8)	—
Machaeranthera canescens		—	—	5(2)	—	—	—	—	—	—	—	—
Monardella odoratissima		—	—	—	—	4(2)	—	—	—	—	6(3)	—
Penstemon globosus		—	—	—	—	—	7(10)	—	—	8(7)	—	—
Penstemon rydbergii		—	—	—	—	—	—	—	3(1)	—	—	—
Penstemon wilcoxii		—	1(+)	—	1(+)	—	—	—	—	—	—	—
Phacelia hastata		7(2)	1(+)	1(+)	5(1)	—	—	—	—	1(+)	2(+)	—
Polygonum douglasii		—	—	—	2(1)	1(+)	—	—	—	—	—	—
Polygonum phytolaccaefolium		—	—	—	—	—	7(8)	—	3(2)	9(17)	10(16)	9(25)
Potentilla glandulosa		—	—	—	—	3(1)	3(1)	—	—	4(3)	—	—
Sedum lanceolatum		—	—	3(1)	7(2)	3(1)	—	—	—	—	—	—
Sedum stenopetalum		—	2(1)	—	—	—	—	—	—	—	—	—
Senecio canus		—	—	—	2(1)	3(1)	—	—	—	—	1(+)	—
Senecio integerrimus		—	—	3(1)	—	—	—	—	—	—	—	—
Silene oregana		1(+)	—	—	—	4(1)	—	—	—	—	—	—
Smilacina stellata		—	1(+)	1(+)	—	—	—	—	—	—	—	—
Solidago multiradiata		—	—	—	—	—	—	3(1)	—	—	—	—
Veronica cusickii		—	—	—	—	—	3(1)	—	—	—	—	—
Viola purpurea		—	—	—	—	—	—	—	2(+)	3(+)	—	2(1)

(con.)

Table 3. (con.)

SPECIES		PHEM					CASP					CANI		
	Stand number	134	110	132	116	148	105	108	131	113	112	111	115	118
	Township and section	5S6	4S11	5S12	4S12	4S11	4S11	4S11	5S12	4S12	4S11	4S11	4S12	4S12
	Range	45E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E	44E
	Elevation	2190	2530	2250	2400	2460	2640	2670	2250	2400	2530	2520	2400	2430
	Azimuth (degrees)	60	30	5	60	150	65	360	10	50	15	30	100	90
	Slope (percent)	5	20	25	15	30	45	35	40	30	50	5	5	5
	Rock type	gr	gr	gr	gr	gr	l	l	gr	l	gr	gr	gr	gr
SHRUBS AND SUBSHRUBS														
Cassiope mertensiana		—	6(4)	5(4)	6(6)	1(1	—	2(1)	—	—	—	—	—	—
Gaultheria humifusa		—	—	6(6)	—	1(2)	—	—	—	—	—	—	—	—
Kalmia microphylla		—	1(+)	6(2)	—	—	—	—	—	—	—	1(+)	—	—
Phyllodoce empetriformis		10(46)	10(39)	10(33)	9(33)	9(28)	—	—	—	—	—	—	2(2)	—
Phyllodoce glanduliflora		—	—	—	—	—	—	1(+)	—	—	—	—	—	—
Salix cascadensis		—	—	—	—	—	4(5)	3(2)	—	—	—	—	—	—
Vaccinium caespitosum		—	—	2(1)	—	—	—	—	—	—	—	—	—	—
Vaccinium scoparium		—	—	2(2)	1(+)	9(15)	—	—	—	—	—	—	—	—
GRAMINOIDS														
Carex nigricans		8(8)	6(3)	5(2)	3(4)	—	2(1)	—	—	1(+)	—	10(66)	10(58)	10(56)
Carex rossii		—	—	—	1(+)	2(1)	—	—	—	1(+)	—	—	—	—
Carex spectabilis		1(+)	1(+)	—	2(1)	—	9(30)	9(21)	9(21)	9(17)	9(16)	1(+)	2(1)	3(5)
Juncus drummondii		—	2(1)	2(1)	1(+)	—	—	6(4)	3(1)	2(1)	—	3(1)	5(6)	3(4)
Juncus parryi		—	—	—	3(2)	9(8)	—	—	—	1(+)	—	—	—	—
Luzula hitchcockii		—	5(4)	9(6)	1(+)	1(+)	6(2)	5(7)	9(11)	6(5)	8(9)	—	—	—
Luzula spicata		—	—	—	—	—	2(1)	1(+)	—	—	—	—	—	—
Muhlenbergia filiformis		4(1)	—	—	—	—	—	—	—	—	—	—	2(1)	2(2)
Phleum alpinum		1(+)	—	3(1)	—	—	4(1)	—	1(+)	—	—	—	—	2(1)
Poa alpina		—	1(+)	1(+)	—	—	—	—	—	—	1(+)	—	—	—
Trisetum spicatum		—	—	—	—	—	2(1)	1(+)	—	—	—	—	—	—
FORBS														
Achillea millefolium		—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Allium validum		—	—	5(2)	—	—	—	—	—	—	—	—	—	—
Antennaria alpina		—	—	—	1(+)	—	5(2)	—	—	—	—	4(1)	2(1)	1(1)
Antennaria lanata		5(2)	7(2)	2(+)	6(3)	9(7)	1(+)	2(1)	—	8(7)	7(6)	1(+)	—	2(1)
Arabis lyallii		—	—	—	—	—	—	2(1)	2(1)	2(1)	1(+)	—	—	1(+)
Arenaria aculeata		—	—	—	1(+)	—	—	—	1(+)	—	1(+)	—	—	—
Arenaria obtusiloba		—	—	—	—	—	—	1(2)	—	—	—	—	—	—
Arnica latifolia		—	—	—	—	—	—	—	6(2)	—	1(+)	—	—	—
Arnica mollis		—	—	—	—	1(+)	1(1)	—	1(+)	—	—	—	—	—
Aster alpigenus		—	1(+)	—	6(4)	—	2(1)	—	1(+)	4(1)	2(1)	—	1(+)	1(+)
Astragalus alpinus		—	—	—	—	—	4(1)	—	—	—	—	—	—	—
Castilleja chrysantha		3(1)	6(2)	1(+)	5(1)	2(1)	—	—	—	—	—	1(+)	—	—
Castilleja rhexifolia		—	—	—	—	3(1)	—	—	—	—	—	—	—	—
Castilleja rubida		—	—	—	—	—	—	—	—	2(+)	—	—	—	—
Dodecatheon alpinum		—	—	—	—	—	3(1)	—	—	—	—	—	—	—
Epilobium alpinum		—	—	—	—	—	—	—	—	—	—	—	—	1(+)
Erigeron peregrinus		8(4)	5(2)	5(2)	3(1)	8(4)	8(5)	—	—	1(+)	—	2(1)	3(1)	4(1)
Happlopappus lyallii		—	—	—	—	—	—	—	—	—	4(1)	—	—	—
Hieracium gracile		1(+)	1(+)	3(1)	9(4)	—	—	1(+)	—	5(1)	—	—	—	—
Lewisia pygmaea		—	1(+)	—	—	—	—	—	—	—	—	—	—	—
Ligusticum tenuifolium		3(1)	10(8)	6(2)	5(1)	8(3)	9(5)	—	—	—	—	4(1)	—	6(2)
Oxyria digyna		—	—	—	—	—	—	—	3(1)	—	—	—	—	—
Parnassia fimbriata		—	—	4(1)	—	—	—	—	—	—	—	—	—	—
Pedicularis contorta		—	—	—	—	—	2(1)	—	—	—	—	—	—	—
Potentilla diversifolia		—	—	—	—	—	—	—	—	—	2(1)	—	—	—
Potentilla flabellifolia		9(7)	4(2)	10(6)	—	1(+)	—	—	—	—	—	9(5)	1(+)	1(2)
Ranunculus eschscholtzii		—	—	—	—	—	—	—	3(1)	3(1)	—	—	—	—
Saxifraga bronchialis		—	—	—	—	—	—	1(+)	—	—	1(+)	—	—	—
Saxifraga occidentalis		—	—	—	—	—	3(1)	1(+)	—	—	—	—	—	—
Sedum stenopetalum		—	—	—	2(+)	—	1(+)	2(+)	—	1(+)	—	—	—	—
Senecio cymbalarioides		—	—	5(2)	—	—	5(2)	—	—	—	—	—	—	—
Sibbaldia procumbens		7(3)	—	—	2(+)	—	1(+)	3(1)	—	2(1)	—	—	5(4)	2(+)
Thalictrum occidentale		—	—	—	—	—	—	—	1(+)	—	—	—	—	—
Veronica cusickii		6(2)	9(3)	7(3)	9(5)	8(3)	5(2)	—	3(1)	10(10)	8(2)	3(1)	6(2)	5(5)
Viola adunca		—	—	4(2)	—	2(1)	5(2)	—	—	—	—	2(1)	1(+)	4(2)

(con.)

Table 3. (con.)

SPECIES		Fell-field and bare rock			
	Stand number	103	104	107	106	109
	Township and section	4S11	4S11	4S11	4S11	4S11
	Range	44E	44E	44E	44E	44E
	Elevation	2640	2670	2700	2700	2580
	Azimuth (degrees)	120	115	230	20	180
	Slope (percent)	5	20	6	45	30
	Rock type	mb	mb	l	l	gr
SHRUBS AND SUBSHRUBS						
Potentilla fruticosa		1(6)	3(2)	—	—	—
Salix arctica		—	—	1(+)	—	—
Salix cascadensis		—	—	2(+)	5(10)	—
GRAMINOIDS						
Carex scirpoidea		—	—	6(8)	—	—
Carex spectabilis		—	—	6(5)	—	3(1)
Oryzopsis exigua		—	—	—	—	3(1)
Poa alpina		2(1)	—	—	—	—
Sitanion hystrix		5(3)	1(+)	—	—	—
Trisetum spicatum		10(5)	1(+)	2(1)	2(1)	—
FORBS						
Achillea millefolium		5(3)	1(+)	—	—	—
Agoseris glauca		5(3)	—	—	—	—
Anemone multifida		1(+)	—	—	—	—
Antennaria alpina		—	—	—	—	4(3)
Antennaria lanata		—	—	6(6)	—	1(+)
Arabis lyallii		—	—	—	—	1(+)
Arenaria aculeata		—	—	—	—	5(3)
Aster alpigenus		2(1)	1(+)	2(1)	—	5(3)
Astragalus alpinus		5(8)	—	1(+)	—	—
Castilleja rubida		—	—	—	1(+)	—
Delphinium nuttallianum		4(1)	—	—	—	—
Dryas octopetala		—	5(10)	—	9(19)	—
Erigeron chrysopsida		4(1)	4(1)	—	—	—
Eriogonum flavum		5(3)	—	—	—	1(+)
Eriogonum ovalifolium		—	—	—	—	1(+)
Eritrichium nanum		—	—	—	1(+)	—
Erysimum asperum		3(1)	—	—	—	—
Ivesia gordonii		—	5(2)	1(+)	1(+)	9(8)
Lewisia pygmaea		—	—	4(1)	—	—
Linum perenne		9(3)	3(1)	—	—	—
Oxytropis campestris		—	2(1)	—	1(+)	—
Pedicularis contorta		1(+)	—	3(1)	2(1)	—
Phacelia hastata		3(1)	—	—	—	—
Phlox caespitosa		—	4(4)	—	2(1)	5(4)
Sedum stenopetalum		4(1)	—	—	—	—
Senecio streptanthifolius		10(6)	—	—	—	—
Silene acaulis		—	—	2(1)	2(1)	—
Solidago multiradiata		2(1)	2(+)	—	1(+)	—
FERNS AND FERN ALLIES						
Selaginella wallacei		—	—	—	—	4(2)

Table 4.—Selected characteristics of each community type

Characteristic	PSME/ AGSP	PSME/ PHMA	PSME/ CARU	PSME/ THOC	PSME/ BERE	PIFL	ABGR/ THOC	ABLA/ THOC	ABLA/ VAME	ABLA/ VASC	PIAL/ ABLA	PICO/ CARU
Mean shrub cover (percent)	5	59	6	9	26	10	12	3	37	36	18	5
Mean graminoid cover (percent)	31	5	35	5	3	2	5	1	3	2	4	38
Mean forb cover (percent)	19	12	16	47	21	5	23	27	26	5	6	10
Mean total cover (percent)	55	76	57	61	50	17	40	31	66	43	28	53
Total No. shrub species	5	15	9	12	9	7	8	15	9	8	8	7
Total No. graminoid species	6	3	3	2	3	5	2	5	3	10	11	2
Total No. forb species	19	17	25	30	30	18	16	36	18	32	26	15
Total No. vascular species	30	35	37	44	42	30	26	56	30	50	45	24
Mean No. vascular species per 10 m² (species richness)	19	14	12	21	22	17	16	12	17	9	10	10

	PICO/ VAME	PICO/ VASC	ACGL	ALSI	Avalanche slope	CELE	High grass	PHEM	CASP	CANI	Fell-field
Mean shrub cover (percent)	54	26	49	91	17	50	2	44	2	1	4
Mean graminoid cover (percent)	2	3	+	1	31	13	26	9	30	67	5
Mean forb cover (percent)	9	3	8	50	33	8	30	20	13	11	21
Mean total cover (percent)	65	32	60	142	81	71	58	73	45	79	30
Total No. shrub species	9	4	6	3	12	11	4	6	3	2	3
Total No. graminoid species	4	4	1	1	9	3	16	9	10	5	6
Total No. forb species	13	10	10	13	35	21	41	19	28	12	28
Total No. vascular species	26	18	18	17	57	35	61	34	41	19	38
Mean No. vascular species per 10 m² (species richness)	11	7	18	17	18	18	18	18	16	13	13

Cole, David N.
1982. Vegetation of two drainages in Eagle Cap Wilderness, Wallowa Mountains, Oregon. USDA For. Serv. Res. Pap. INT-288, 42 p. Intermt. For. and Range Exp. Stn., Ogden, Utah 84401.

Describes plant communities in two drainages of the Eagle Cap Wilderness, Wallowa Mountains, Oreg. Compositional data and implications for wilderness management are provided for 14 coniferous forest types and nine other community types. Four additional plant communities are described, but were not sampled.

KEYWORDS: wilderness management, plant communities, Oregon, Wallowa Mountains