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Forest Plants of the Eastern Siskiyous: Their Environmental and Vegetational Distribution

The Siskiyou Mountains, extending on both sides of the California-Oregon border, are the most northern mountain range in the Klamath Geological Province (Irwin, 1966). Across the Siskiyous, from the Coast Range to the Cascades, a steep climatic gradient is exhibited. For example, precipitation decreases from over 250 cm (100 inches) in a year to less than 50 cm (20 inches). Superimposed on the climatic gradient is extreme geological diversity, unexcelled in any comparable area of the West. Because of its geographic setting, the Klamath Province is of central significance to the evolution, migration, and representation of western forest flora (Whittaker, 1961). For at least the last 100 million years, the area has escaped decimation of its flora through flooding, volcanic activity, or glaciation. These combinations of circumstances have permitted the development of a large and diverse flora, rich in endemics and relics (Chaney, *et al.*, 1944, Stebbins and Major, 1965, Whittaker, 1961).

For five years I have made intensive ecological studies in the Siskiyou Mountains in an attempt to interpret the distribution of plants as they respond to differences in the availability of water, light, essential nutrients, and varying temperature. An initial survey of 150 forest stands suggested that at least two floristic subdivisions should be recognized. Environmental measurements in 25 stands substantiated this view and provided a framework for describing distributions of individual species and vegetation.

My objectives in this paper are: (1) to distinguish two subdivisions in the Siskiyous; and (2) to examine the forest flora and vegetation in one of these subdivisions as they appear related to moisture and temperature gradients.

The Eastern Siskiyous, a Distinct Floristic and Environmental Unit

Whittaker (1960), in his monograph on the vegetation of the Siskiyous, recognized a climatic gradient from the coast inland, but made no formal distinction between a western and eastern region. Most of his field work was conducted in the region designated as the Western Siskiyous (Figure 1), and only for that area is his vegetational treatment really appropriate.

By sampling the vegetation across the entire area more uniformly, I found that many species present in the Western Siskiyous do not extend into the eastern portion of the geological formation. The three endemics, *Picea breweriana, Quercus sadleriana,* and *Ribes marshallii,* listed by Whittaker (1961) as representative of the entire Klam-

ath Province, are notably absent. Other species occur in the western region and reappear in the Cascades. The absence of important diagnostic species common to adjacent areas (Table 1) gives the vegetation of the Eastern Siskiyous a less stratified appearance.

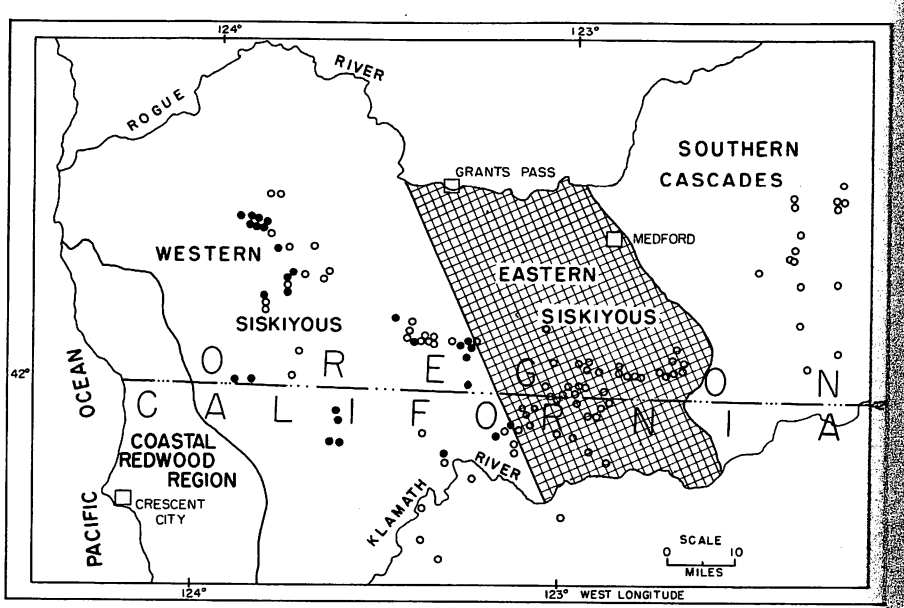

Figure 1. Map showing location of Eastern Siskiyous. Small circles indicate reconnaissance plots. Filled circles indicate where *Quercus sadleriana* was found.

Floristically, the western boundary of the Eastern Siskiyous is defined by the eastern limits of *Picea breweriana* and *Quercus sadleriana* (Figure 1). Some other diagnostic species drop out earlier in the transition from the Western to Eastern Siskiyous. The Rogue River and Cascade Mountains serve as northern and eastern boundaries, agreeing with limits set by Howell (1957), Jepson (1925), Stebbins and Major (1965), and Whittaker (1960). The Klamath River is a convenient southern boundary separating the Siskiyous from other parts of the Klamath Geological Province.

The absence of many mesophytic species in the Eastern Siskiyous suggests that it is physiologically drier than adjacent areas to the west or east. The precipitation pattern suggests this, but the full explanation is complex. Soils throughout the Siskiyous are fully charged with water during the winter, and, consequently, no water deficits exist at the start of the growing season. Summer precipitation is ineffective, coming as an occasional thunder shower.

Field temperature records indicate transpirational stress increases abruptly just inside the western boundaries of the Eastern Siskiyous. A simple comparison of daily extremes from June through mid-September shows the Eastern Siskiyous have daily temperature ranges greater than 11°C (20°F) more than 95 per cent of the time. Just over the boundary to the west, one day in three, variation averaged less than 11°C. For many species, lower transpiration rates associated with such temperature patterns favor growth by preventing development of critical water deficits in leaves.

TABLE 1. Diagnostic species of areas adjacent to the Eastern Siskiyous

Trees	Western Siskiyous	Eastern Siskiyous	Southern Cascades
Abies lasiocarpa	—	*	X
Chamaecyparis lawsoniana	X	—	—
Lithocarpus densiflora	X	—	—
Picea breweriana	X	—	—
Picea engelmannii	—	*	X
Pinus attenuata	X	—	—
Populus tremuloides	—	*	X
Shrubs			
Acer circinatum	X	*	X
Arctostaphylos uva-ursi	—	—	X
Gaultheria ovatifolia	X	—	X
Gaultheria shallon	X	*	X
Kalmiopsis leachiana	X	—	—
Ledum glandulosum	X	—	X
Leucothoe davisiae	X	—	—
Quercus sadleriana	X	—	—
Rhamnus californica	X	—	—
Rhododendron macrophyllum	X	—	X
Rhododendron occidentale	X	—	—
Umbellularia californica	X	—	—
Vaccinium membranaceum	X	*	X
Vaccinium ovatum	X	—	X
Herbs			
Achlys triphylla	X	—	X
Asarum hartwegii	—	—	X
Aster occidentalis	X	—	—
Boykinia ela'a	X	—	X
Cornus canadensis	X	—	X
Darlingtonia californica	X	—	—
R bes marshallii	X	—	—
Sarcodes sanguinea	X	—	—

X Present
— Absent
* Rare, often in only a single location

Measurements of Forest Environments and Their Interpretation

Environment affects each plant species differently, but the kinds of stimuli are similar: moisture, chemical, temperature, light, and mechanical. The effect of each of these stimuli upon plant distribution was investigated, and moisture and temperature proved to be of leading importance. The other stimuli were significant at extremes. For example, where soils were derived from ultrabasic rocks, only plants with low nutritional requirements dominate. At higher elevations, mechanical stress from ice and snow may eliminate brittle-limbed species of trees. This paper deals mainly with plant distribution in relation to moisture and temperature gradients. If growth rates were being considered, all five physical variables would have to be considered. This is the subject of a separate paper.

The effect of moisture upon plants depends upon the supply and the demand. The supply resides in the soil and the demand is determined by transpirational stress. Where transpirational stress is consistently high, as in the Eastern Siskiyous during the growing season, plant distribution reflects the availability of soil moisture. Availability of soil moisture can be assessed by measuring the moisture stress of a plant after a full night's

recovery, and, where growing season precipitation is negligible, determination of the influence of soil moisture requires measurements only at the peak of drought. Measurements of this type often show that shallow or coarse-textured soils are depleted of water, in contrast to fine-textured soils or soils in seepage or late snow-melt sites.

During 1967, moisture stress in the Eastern Siskiyous reached a maximum in September. On September 1, *Pseudotsuga menziesii* and *Abies magnifica* var. *shastensis*, 1-2 m tall, exhibited values ranging from 5 to over 25 atm.[1] Moisture stress measurements were taken with a pressure bomb, as outlined by Waring and Cleary (1967).

Plants growing in a saturated atmosphere and with their roots in water are under no stress, but such conditions were not found in the Siskiyous during September. A tree growing beside a stream recovered to about 2 atm during the night, but trees in most forested areas exceeded 5 atm. Cambial growth appears to cease if moisture stress exceeds 18 atm at sunrise, regardless of other conditions. Above 26 atm, essentially no nightly recovery takes place, at least not on coarse-textured soils. Douglas-fir seedlings die at about 45 atm, depending upon the genetic race (Cleary, 1968).

Certain plants are confined to narrow portions of the gradient from low to high soil-moisture stress. They may be used to pin-point where a particular stand or vegetation type lies along a moisture gradient. For example, occurrence of *Lathyrus polyphyllus* and *Acer macrophyllum* (Table 2) suggests moisture is not a problem, because stresses were less than 10 atm in the reference plants. In contrast, presence of *Lonicera hispidula* and *Arctostaphylos viscida* signifies sites where the highest moisture stresses were recorded.

Let us now consider temperature. In the Siskiyous, extreme temperatures appear to have little influence upon plant distribution. In 1965 through 1967, minimum temperatures at 2,100 m (7,000 ft) did not fall below −15°C (5°F). No temperatures above 43°C (110°F) were recorded under a forest canopy. During the winter most species are dormant, and many remain protected beneath the snow. The highest temperatures occur at lower elevations during the summer, often after many species have set seed and are already dormant. The critical influence of temperature is during the growing season—that period during which new cells are laid down. This period was determined by inspecting samples from the secondary cambium.

Growing-season temperature data were obtained from instruments placed with sensing probes 20 cm above and below ground in 25 forest stands. Averages of day, night, and soil temperature were obtained by computer analysis. Day length was defined monthly as the period between sunrise and sunset at latitude 42½° N.

These data on growing-season temperatures were interpreted in light of studies of growth responses of Douglas-fir seedlings to controlled laboratory temperatures (Cleary and Waring, 1968). In the laboratory, optimum growth occurred with average day temperatures of 30°C (86°F) in the air and 20°C (68°F) in the soil. Night temperatures had little effect upon growth, but root (soil) temperatures were critical. For example, root temperatures of 10°C (50°F) reduced growth to less than 60 per cent of the maximum observed, regardless of shoot temperature.

The potential effect of temperature was estimated by summing the fractions of growth possible during a growing season in which water does not become limiting. The actual temperature effect cannot be estimated without knowledge of interaction between moisture and temperature. The temperature-effect index developed, expressed in units equivalent to Optimum Temperature Days (OTD), ranged from 34 to 98 in the 25 stands evaluated. At the higher elevations, from 2 to 3 days were required to yield the equivalent of 1 OTD. Where cambial growth was prematurely arrested by high moisture stress, the potential and actual temperature effects differ by at least 10 OTD.

Plant species that may be used to identify specific points along the temperature gradient are listed in Table 3.

[1] One atmosphere is equivalent to 14.7 lbs/in² or 10^6 ergs/cc.

Distribution of Vegetation Types

Although many species have overlapping environmental distributions (Tables 2 and 3), a generalized vegetation or community classification is possible and desirable. At least eight major types should be recognized. Identified by a component tree, they may be named accordingly: Mountain Hemlock, Shasta Red Fir, White Fir, Mixed Conifer, Ponderosa Pine, Black Oak, Yew, and Jeffrey Pine. One type may grade into another, although their approximate distribution along moisture and temperature gradients is

TABLE 2. Plant indicators of moisture stress

Species	Plant Moisture Stress, Atm* 5-10	10-15	15-20	20-25
Lathyrus polyphyllus	X			
Lupinus andersonii	X			
Clintonia uniflora	X			
Valeriana sitchensis	X			
Veratrum californicum	X			
Tiarella unifoliata	X			
Whipplea modesta	X			
Viola glabella	X			
Viola sempervirens	X			
Phlox adsurgens	X			
Acer macrophyllum	X	X		
Campanula scouleri	X	X		
Linnaea borealis	X	X		
Adenocaulon bicolor	X	X		
Antennaria neglecta	X	X		
Arnica latifolia	X	X		
Trillium ovatum	X	X		
Disporum hookeri	X	X		
Goodyera oblongifolia	X	X		
Galium triflorum	X	X		
Pedicularis racemosa	X	X		
Rubus parviflorus	X	X		
Anemone deltoidea	X	X		
Pyrola secunda	X	X		
Ribes viscosissimum	X	X		
Senecio triangularis	X	X	X	
Amelanchier pallida		X	X	
Monardella odoratissima		X	X	
Ceanothus prostratus			X	
Phlox diffusa			X	
Gordylanthus viscidus			X	
Abies diversiloba			X	X
Agoseris retrorsa			X	X
Quercus kelloggii			X	X
Arctostaphylos viscida			X	X
Lonicera hispidula				X
Galium aparine				X

* Measured on 1-2 meter high Douglas-fir and Shasta red fir trees before dawn on 1 September 1967.

TABLE 3. Plant indicators of temperature effectiveness

Species	Optimum Temperature Days* 30-40	40-50	50-60	60-70	70-80	80-90	90-100
Galium bifolium	X						
Polygonum davisiae	X						
Valeriana sitchensis	X	X					
Polemonium californicum	X	X					
Tsuga mertensiana	X	X					
Smilacina racemosa var. *glabra*	X	X	X				
Abies magnifica var. *shastensis*	X	X	X				
Pyrola secunda	X	X	X				
Eriogonum umbellatum	X	X	X	X			
Phacelia mutabilis	X	X	X	X			
Veratrum californicum	X	X	X	X			
Ribes viscosissimum		X	X	X			
Anemone quinquefolia var. *oregana*		X	X	X			
Paxistima myrsinites		X	X	X	X		
Antennaria neglecta		X	X	X	X		
Xerophyllum tenax		X	X	X	X		
Rubus parviflorus			X	X	X		
Eriogonum latifolium			X	X	X		
Linnaea borealis			X	X	X		
Eburophyton austinae				X	X		
Whipplea modesta				X	X	X	
Rubus ursinus				X	X	X	
Acer macrophyllum					X	X	
Adenocaulon bicolor					X	X	
Corylus cornuta					X	X	X
Apocynum pumilum					X	X	X
Rhus diversiloba						X	X
Agoseris retrorsa						X	X
Quercus kelloggii						X	X
Galium aparine							X
Arctostaphylos viscida							X
Lonicera hispidula							X

* Defined for Douglas-fir seedlings under controlled temperatures, expressed for the entire growing season by summing the effectiveness of each day as a fraction of the optimum.

defined discretely in Figure 2. The Jeffrey Pine Type is not shown in Figure 2 because its occurrence is related to particularly infertile soils, not moisture and temperature. These vegetation types serve as a reference for the distributions of other forest plants. Therefore a brief description of each is in order.

The Mountain Hemlock (*Tsuga mertensiana*) Type occurs above 2,000 m (6,500 ft) where snow creep and low temperatures discourage the establishment of most other conifers. A few Shasta red fir (*Abies magnifica* var. *shastensis*) and western white pine (*Pinus monticola*) may be present. Winter temperatures fall to about −12°C (10°F). Because (1) the growing season does not start until July, (2) soil temperatures rarely exceed 10°C (50°F), and (3) air temperatures remain below 25°C (77°F), this type is characterized by the equivalent of less than 40 OTD. The moisture regime is favorable, although no understory plants may be present. Of those few plants that do occur, *Polygonum davisiae, Valeriana sitchensis,* and *Pyrola secunda* are most common. A variant of this type occurs on very shallow soils where soil moisture stress may reach critical levels. The trees occur in patches with openings occupied by such species as *Eriogonum umbellatum, Calyptridium umbellatum, Arenaria congesta, Haplopappus suffruticosus,* and *Hieracium cynoglossoides.*

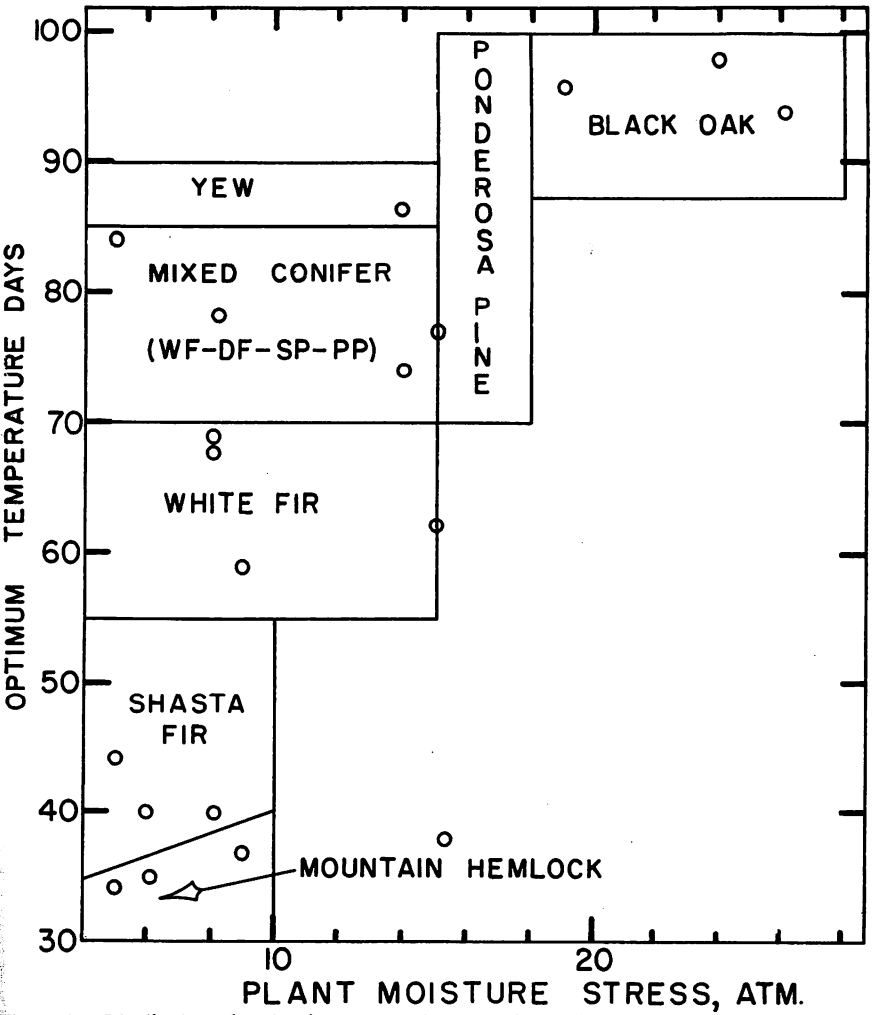

Figure 2. Distribution of major forest vegetation types in relation to moisture and temperature gradients.

The Shasta Red Fir (*Abies magnifica* var. *shastensis*)[2] Type is found at slightly lower elevations than the Mountain Hemlock Type. Snow depth may exceed 2 m, but snow creep has less importance here. The growing season usually does not start until July; soil temperatures remain below 15°C (59°F). Environments with the equivalent of 35 to 55 OTD may support this type. Moisture stress never reaches critical levels. Pure stands of fir are common, although mountain hemlock and western white pine may occasionally be found. Shrub cover is sparse and normally limited to *Ribes vis-*

[2] Although Parker (1963), from cone studies, suggested *Abies procera* is the common true fir at high elevations in the Siskiyous, recent studies of cotyledon number (Franklin and Greathouse, 1968) suggest a taxon closer to *Abies magnifica* var. *shastensis.*

cosissimum, Arctostaphylos patula, and *Castanopsis chrysophylla. Valeriana sitchensis, Pyrola secunda, Polemonium californicum,* and *Anemone quinquefolia* var. *oregana* are among the more common herbaceous plants.

The White Fir (*Abies concolor*) Type occurs between 1,650-1,800 m (5,400-5,900 ft). Snow creep is not a problem, but heavy, wet snowfalls place brittle-limbed species such as ponderosa pine (*Pinus ponderosa*) and madrone (*Arbutus menziesii*) at a disadvantage. Douglas-fir (*Psuedotsuga menziesii*) is usually a major component of the stand; sugar pine (*Pinus lambertiana*) and incense-cedar (*Libocedrus decurrens*) are less common. The growing season begins in early June; soil temperatures reach 16°C (60°F). Moisture stress does not exceed 15 atm and the temperature regime provides the equivalent of 55 to 70 OTD. *Acer glabrum* is the most definitive shrub species, but *Amelanchier pallida, Castanopsis chrysophylla, Holodiscus discolor, Salix scouleriana,* and *Corylus cornuta* occur in openings. Saxifragaceae, Rosaceae, and Liliaceae are families with their highest representation in this type. *Berberis nervosa, Campanula scouleri,* and *Lathyrus polyphyllus* are almost always encountered.

The Mixed Conifer Type consists of white fir, Douglas-fir, sugar pine, and ponderosa pine. Incense-cedar occurs infrequently; madrone and big-leaf maple (*Acer macrophyllum*) are normal hardwood associates. Usually, the growing season begins in late May. Soil temperatures reach 19°C (66°F) and air temperatures will rarely reach 32°C (90°F), yielding environments with 70-85 OTD. Where moisture stress remains below 10 atm, trees will reach heights of 60 m (200 ft) to 75 m (250 ft) depending on soil fertility. *Corylus cornuta, Holodiscus discolor,* and *Castanopsis chrysophylla* are shrubs usually present, but *Arctostaphylos patula, Quercus chrysolepis,* and *Salix scouleriana* occur infrequently. *Symphoricarpos mollis, Rubus ursinus, Rosa gymnocarpa,* and *Adenocaulon bicolor* are present in the White Fir Type, but exhibit their highest frequency in the Mixed Conifer Type.

The Ponderosa Pine (*Pinus ponderosa*) Type is extremely rare in the Siskiyous and may be only a variant of the Mixed Conifer Type, for white fir are occasionally found in the understory. The type is found on steep slopes of south or southwestern exposures between 1,100-1,650 m (3,500-5,400 ft). The forest canopy is open and Douglas-fir regeneration may be abundant in spots. Tree seedlings are subjected to sufficient moisture stress to force the cessation of cambial growth nearly every summer. One or more species of *Arctostaphylos* is always present. *Achillea lanulosa, Solidago canadensis, Apocynum pumilum,* and small perennial lupines are common.

The Black Oak (*Quercus kelloggii*) Type is found as high as 1,350 m (4,400 ft) on steep south and southwestern exposures, but is common from 600-900 m (2,000-3,000 ft). Douglas-fir and ponderosa pine dominate; madrone and an occasional Oregon white oak (*Quercus garryana*) may also be found. Snow cover is intermittent during the winter and soil temperatures do not fall below 4°C (40°F). The growing season may start in April; soil temperatures reach 20°C (70°F) and air temperatures exceed 38°C (100°F), which is above the optimum for Douglas-fir. The temperature environment usually exceeds 90 OTD. Critical moisture stresses are common, exceeding 25 atm at times. Productivity is low; maximum height of trees is only 30 m (100 ft). The understory is dominated by grasses, *Rhus diversiloba,* and *Lonicera hispidula.*

The Yew (*Taxus brevifolia*) Type occurs infrequently at lower elevations (w

more than 80 OTD) where adequate water is available throughout the growing season and physiographic conditions produce a sheltered situation with low transpirational stress. Here the dominant, Douglas-fir, may exceed 60 m (200 ft). *Acer circinatum, Cornus nuttallii* and *Philadelphus lewisii* are almost restricted to this type in the Eastern Siskiyous. Yew is also found along small streams at higher elevations.

The Jeffrey Pine (*Pinus jeffreyi*) Type is not shown in Figure 2 because it occurs only upon extremely infertile soils derived from peridotite or serpentinite. Such soils are very high in iron and magnesium and exceedingly low in phosphorus, potassium, nitrogen, and, usually, calcium. High concentrations of chromium and nickel may also be present. Plants adapted to these soils have low calcium requirements and a resistance to, or demand for, large amounts of magnesium. Soils are not only infertile but shallow and generally droughty. Where this type occurs at higher elevations, white fir and western white pine are stand components. Incense-cedar and Douglas-fir are generally present at all elevations; mountain hemlock and Shasta red fir are absent. On cooler, more moist sites, *Lupinus leucophyllus, Xerophyllum tenax,* and *Arctostaphylos nevadensis* are present. On drier sites, *Silene campanulata, Garrya fremontii, Onychium densum, Astragalus whitneyi, Quercus vaccinifolia, Arenaria nutallii,* and *Frasera albicaulis* occur.

Some forest vegetation types, common elsewhere, are represented only as relict populations in the Eastern Siskiyous. In this category are a small patch of *Abies lasiocarpa* and larger patches of *Populus tremuloides* on Mount Ashland, a stand of *Pinus murrayana* (*P. contorta* var. *murrayana*) along Tamarack Creek at 1,900 m (6,200 ft) (T41S., R2W., Sec. 14) and an extensive stand of *Picea engelmannii* along the east fork of Ashland Creek between 1,430-1,790 m (4,700 and 5,000 ft) (T. 40S., R. 1 E., Sec. 9).

Within the forest, certain species are found restricted to specific microsites. For example, *Astragalus whitneyi, Polystichum lonchitis, Ipomopsis congesta, Phlox diffusa,* and *Haplopappus suffruticosus* are in openings near rock outcrops; *Petasites palmatus, Athyrium filix-femina, Aralia californica, Asarum caudatum,* and *Oxalis oregana* are restricted to shaded seepage areas. Included in the checklist are a few non-forest species collected above timberline, in alpine meadows, or chaparral vegetation types.

The checklist of plants is arranged alphabetically by family. Abbreviated reference to the vegetation types just described is made when sufficient data were available. Nomenclature follows Munz (1965); Peck (1961) was used as supporting reference. An asterisk denotes species reported by Dennis (1959) from Mount Ashland and not collected in this study. Voucher specimens are on file in the Oregon State University Herbarium.

Checklist of Forest Plants

[Distribution of types: BO, Black Oak; JP, Jeffrey Pine; MH, Mountain Hemlock; Mixed C, Mixed Conifer; PP, Ponderosa Pine; SF, Shasta Red Fir; WF, White Fir; and, Y, Yew.]

	Habitat
ACERACEAE	
Acer circinatum Pursh	Y
Acer glabrum Torr. var. *torreyi* (Greene) Smiley	SF, WF
Acer macrophyllum Pursh	WF, Mixed C, Y
ANACARDIACEAE	
Rhus diversiloba T. & G.	BO, Y
APOCYNACEAE	
Apocynum pumilum (Gray) Greene	Mixed C, PP, BO

	Habitat
ARALIACEAE	
Aralia californica Wats.	Near water
ARISTOLOCHIACEAE	
Asarum caudatum Lindl.	Seepage areas
ASCLEPIADACEAE	
Asclepias cordifolia (Benth.) Jeps.	PP
BERBERIDACEAE	
Berberis nervosa Pursh	SF, WF, Mixed C, BO, Y, JP
Berberis piperiana (Abrams) McMinn	Mixed C, Y
Vancouveria hexandra (Hook.) Morr. & Dec.	SF, WF, Mixed C
BETULACEAE	
Alnus rhombifolia Nutt.	Near water
Corylus cornuta Marsh. var. *californica* (A.DC.) Sharp	WF, Mixed C, BO, Y
BORAGINACEAE	
Cryptantha hendersonii (A. Nels.) Piper	PP
Cryptantha simulans Greene*	
Cynoglossum occidentale Gray	Mixed C
Hackelia jessicae (McGreg.) Brand	Above timberline
Mertensia bella Piper	
CAMPANULACEAE	
Campanula prenanthoides Durand	MH, WF, Mixed C, BO
Campanula scouleri Hook.	SF, WF, Mixed C
CAPRIFOLIACEAE	
Linnaea borealis L. ssp. *longiflora* (Torr.) Hult.	SF, WF, Mixed C
Lonicera hispidula Dougl. var. *vacillans* Gray	BO
Lonicera ciliosa (Pursh) Poir.	Mixed C
Lonicera conjugialis Kell.	MH, WF
Sambucus caerulea Raf.	
Sambucus callicarpa Greene	
Symphoricarpos mollis Nutt. in T. & G.	WF, Mixed C, PP, JP, BO
CARYOPHYLLACEAE	
Arenaria congesta Nutt. ex T. & G.	Timberline
Arenaria douglasii Fenzl. ex. T. & G.	PP
Arenaria macrophylla Hook.	SF, MH, Mixed C, PP, BO, JP
Arenaria nuttallii Pax. ssp. *gregaria* (Heller) Maguire	JP
Silene campanulata Wats. ssp. *glandulosa* Hitchc. & Maguire	JP
Silene campanulata Wats. ssp. *greenei* (Wats.) Hitchc. & Maguire	BO
Silene hookeri Nutt. ex. T. & G.	BO
Silene lemmonii Wats.	PP
Spergularia rubra (L.) J. & C. Presl	
Stellaria crispa Cham. & Schlect.	MH
Stellaria jamesiana Torr.	
CLASTRACEAE	
Paxistima myrsinites (Pursh) Raf.	SF, WF, Mixed C
COMPOSITAE	
Achillea lanulosa Nutt.	MH, PP, BO, JP
Adenocaulon bicolor Hook.	WF, Mixed C, Y
Agoseris aurantiaca (Hook.) Greene	
Agoseris elata (Nutt.) Greene*	
Agoseris glauca (Pursh) Greene var. *monticola* (Greene) Q. Jones*	
Agoseris heterophylla (Nutt.) Greene	
Agoseris retrorsa (Benth.) Greene	PP, BO
Anaphalis margaritacea (L.) Benth. & Hook.	
Antennaria argentea Benth.	PP, JP
Antennaria neglecta Greene var. *howellii* (Greene) Cronq.	SF, WF, Mixed C
Antennaria rosea Greene	Timberline
Arnica cordifolia Hook.	SF
Arnica latifolia Bong.	MH, SF, WF, Mixed C
Arnica nevadensis Gray	SF
Artemisia douglasiana Bess. in Hook.	High elev. seepage areas
Artemisia tridentata Nutt.	Rocky areas, higher elev.
Aster brickellioides Greene	PP
Aster foliaceus Lindl.	High elev. seepage areas
Aster integrifolius Nutt.	High elev. seepage areas
Aster oregonensis (Nutt.) Cronq.	
Aster radulinus Gray	PP

	Habitat
Balsamorhiza deltoidea Nutt.	BO
Brickellia greenei Gray	JP
Chaenactis douglasii (Hook.) H. & A.	Rocky areas, high elev.
Chrysopsis oregona (Nutt.) Gray var. *rudis* (Greene) Jeps.	MH, SF, WF, Mixed C, JP
Chrysothamnus nauseosus (Pall.) Britton ssp. *albicaulis* (Nutt.) Hall & Clem.	JP
Crepis pleurocarpa Gray	JP
Erigeron aliceae Howell	MH
Erigeron compositus Pursh var. *glabratus* Macoun.*	
Erigeron foliosus Nutt. var. *hartwegii* (Greene) Jeps.	
Erigon peregrinus (Pursh) Greene ssp. *callianthemus* (Greene) Cronq.*	
Eriophyllum lanatum (Pursh) Forbes var. *lanceolatum* (Howell) Jeps.	Mixed C, PP, JP
Haplopappus greenei Gray*	
Haplopappus suffruticosus (Nutt.) Gray	Timberline
Helenium bigelovii Gray	Seepage areas
Hieracium albiflorum Hook.	MH, SF, WF, Mixed C, PP, BO
Hieracium cynoglossoides Arv.-Touv. ex Gray var. *nudicaule* Gray	Timberline
Hieracium horridum Fries	Above timberline
Hieracium parryi Zahn	PP
Machaeranthera canescens (Pursh) Gray*	
Madia glomerata Hook.*	
Madia madioides (Nutt.) Greene	WF, Mixed C, PP, BO
Nothocalais alpestris (Gray) Chamb.	MH, PP, BO
Petasites palmatus (Ait.) Gray	Seepage areas
Raillardella argentea (Gray) Gray*	
Rudbeckia occidentalis Nutt.	Seepage areas
Senecio integerrimus Nutt. var. *exaltatus* (Nutt.) Cronq.	JP
Senecio triangularis Hook.	WF, Mixed C, PP
Solidago canadensis L.	PP
Taraxacum officinale Wiggers*	
CORNACEAE	
Cornus glabrata Benth.	
Cornus nutallii Aud.	WF, Mixed C, Y
CRASSULACEAE	
Sedum divergens Wats.	Rocky areas
Sedum lanceolatum Torr.	Timberline
Sedum obtusatum Gray	JP
Sedum oregonense (Wats.) Peck*	
Sedum stenopetalum Pursh ssp. *radiatum* (Wats.) Clausen	Rocky areas
CRUCIFERAE	
Arabis divaricarpa A. Nels.	SF
Arabis holboellii Hornem.*	
Arabis lyallii Wats.*	
Arabis oregana Roll.	BO
Arabis platysperma Gray*	
Arabis puberula Nutt.	JP
Dentaria tenella Pursh var. *palmata* Detl.	MH, SF
Descurainia pinnata (Walt.) Britton*	
Erysimum capitatum (Dougl.) Greene	Rocky areas
Erysimum perennne (Wats. ex Cov.) Abrams*	
Thlaspi glaucum A. Nels. var. *hesperium* Pays.	JP
CUPRESSACEAE	
Libocedrus decurrens Torr.	WF, Mixed C, PP, JP
CYPERACEAE	
Carex brevipes W. Boott*	
Carex festivella Mkze.*	
Carex gymnoclada Holm.*	
Carex luzulina Olney*	
Carex phaeocephala Piper*	
Carex subfusca W. Boott*	
Carex teneraeformis Mkze.*	
Scirpus microcarpus Presl*	
ERICACEAE	
Allotropa virgata T. & G. ex Gray	
Arbutus menziesii Pursh	Mixed C, PP, BO, Y

	Habitat
Arctostaphylos nevadensis Gray	SF, PP, JP
Arctostaphylos patula Greene	MH, SF, Mixed C, PP, JP
Arctostaphylos viscida Parry	PP, BO
Chimaphila menziesii (R. Br. ex D. Don) Spreng.	SF, WF, Mixed C, PP
Chimaphila umbellata (L.) Barton var. *occidentalis* (Rybd.) Blake	MH, SF, WF, Mixed C, PP, JP
Gaultheria shallon Pursh	Y (rare)
Monotropa hypopithys L.*	
Pterospora andromedea Nutt.	
Pleuricospora fimbriolata Gray	BO
Pyrola picta Sm.	SF, WF, Mixed C, PP
Pyrola picta Sm. forma *aphylla* (Sm.) Camp.	WF, Mixed C, PP, Y
Pyrola picta Sm. ssp. *dentata* (Sm.) Piper	JP
Pyrola secunda L.	MH, SF, WF
Vaccinium membranaceum Dougl.	With Engelmann spruce (rare)
FAGACEAE	
Castanopsis chrysophylla (Dougl.) A. DC.	SF, WF, Mixed C, JP
Quercus chrysolepis Liebm.	Mixed C, BO, Y
Quercus garryana Dougl.	BO
Quercus garryana Dougl. var. *breweri* (Engelm. in Wats.) Jeps.	
Quercus kelloggii Newb.	BO
Quercus vacciniifolia Kell.	JP
FUMARIACEAE	
Dicentra formosa (Andr.) Walp.	
Dicentra uniflora Kell.	MH openings
GARRYACEAE	
Garrya fremontii Torr.	JP
GENTIANACEAE	
Frasera albicaulis (Griseb. in Hook.) Kuntze ssp. *nitida* (Benth.) Post	PP, JP
GRAMINEAE	
Agropyron spicatum (Pursh) Scribn. & Sm.	
Agrostis diegoensis Vasey*	
Agrostis exarata Trin.	
Bromus carinatus H. & A.	
Bromus marginatus Nees	
Bromus rigidus Roth	
Bromus vulgaris (Hook.) Shear	
Deschampsia elongata (Hook.) Munro ex. Benth.	
Elymus glaucus Buckl.	
Festuca californica Vasey	BO
Festuca idahoensis Elm.	
Festuca megalura Nutt.	
Festuca occidentalis Hook.	
Festuca rubra L.	
Festuca subulata Trin. in Bong.	
Glyceria elata (Nash) Hitchc.*	
Hordeum jubatum L.*	
Koelaria cristata (L.) Pers.	
Melica bulbosa Geyer ex Porter & Coult.*	
Melica harfordii Bol.*	
Melica subulata (Griseb.) Scribn.	
Muhlenbergia filiformis (Thurb.) Rydb.*	
Phleum alpinum L.*	
Phleum pratense L.*	
Poa bulbosa L.*	
Poa fendleriana (Steud.) Vasey*	
Sitanion hansenii (Scrib.) J. G. Sm.*	
Sitanion hystrix (Nutt.) J. G. Sm.	
Stipa californica Merr. & Davy*	
Trisetum cernuum Trin.	
HYDROPHYLLACEAE	
Eriodictyon californicum (H. & A.) Torr.	JP Lower elev.
Hydrophyllum fendleri (Gray) Heller var. *albifrons* (Hel.) Macbr.	SF
Hydrophyllum occidentale (Wats.) Gray	
Nemophila parviflora Dougl. ex. Benth.	BO

	Habitat
Phacelia frigida Greene	JP
Phacelia hastata Dougl. ex Lehm.*	
Phacelia heterophylla Pursh*	
Phacelia mutabilis Greene	MH, SF, WF, JP
Phacelia procera Gray	
HYPERICACEAE	
Hypericum anagalloides Cham. & Schlect.*	
IRIDACEAE	
Iris chrysophylla Howell	WF, Mixed C, PP, BO, Y, JP
Sisyrinchium douglasii A. Dietr.	
JUNCACEAE	
Juncus effusus L. var. *pacificus* Fern. & Wieg.*	
Juncus mertensianus Bong.*	
Luzula comosa E. Mey.	
Luzula parviflora (Ehrh.) Desv.	
Luzula spicata (L.) DC.	
Luzula subsessilis (Wats.) Buch.	
LABIATAE	
Agastache urticifolia (Benth.) Kuntze	
Monardella odoratissima Benth.	MH, WF, PP, JP
Satureja douglasii (Benth.) Briq.	
Stachys rigida Nutt. ex. Benth.*	
LEGUMINOSAE	
Astragalus whitneyi Gray var. *siskiyouensis* (Rydb.) Barneby	JP, rocky areas
Lathyrus polyphyllus Nutt. ex T. & G.	WF, Mixed C
Lotus crassifolius (Benth.) Greene	PP, Mixed C, in openings
Lotus micranthus Benth.	PP, BO
Lotus subpinnatus Lag.	Mixed C, PP
Lupinus albicaulis Dougl. ex Hook.	
Lupinus albicaulis Dougl. ex. Hook. var. *shastensis* (Heller) C.P. Sm.	Timberline
Lupinus albifrons Benth.	BO
Lupinus albifrons Benth. var. *flumineus* C. P. Sm.	PP
Lupinus andersonii Wats.	WF, Mixed C
Lupinus leucophyllus Dougl. ex Lindl.	JP
Lupinus lyallii Gray*	
Lupinus polyphyllus Lindl.*	
Trifolium longipes Nutt.*	
Vicia californica Greene	WF, Mixed C, PP, BO
Vicia villosa Roth	
LILIACEAE	
Allium validum Wats.*	
Brodiaea crocea (Wood) Wats.	
Brodiaea hendersonii Wats.	BO, JP
Brodiaea multiflora Benth.	BO
Calochortus tolmiei H. & A.	BO
Clintonia uniflora (Schult.) Kunth	MH, SF, WF, Mixed C
Disporum hookeri (Torr.) Nichols.	SF, WF, Mixed C
Erythronium grandiflorum Pursh var. *pallidum* St. John	JP
Erythronium hendersonii Wats.	Mixed C, BO
Erythronium oregonum Appleg. ssp. *leucandrum* Appleg.	Y
Fritillaria adamantina Peck*	
Fritillaria atropurpurea Nutt.	
Lilium bolanderi Wats.	
Lilium pardalinum Kell.	
Smilacina racemosa (L.) Desf. var. *amplexicaulis* (Nutt.) Wats.	WF, BO, Y
Smilacina racemosa (L.) Desf. var. *glabra* (Macbr.) St. John	MH, SF, JP
Smilacina stellata (L.) Desf. var. *sessilifolia* (Baker) Henders.	WF, Mixed C, BO
Streptopus amplexifolius (L.) DC. var. *denticulatus* Fassett	
Tofieldia glutinosa (Michx.) Pers. ssp. *occidentalis* (Wats.) C. L. Hitchc.*	
Trillium ovatum Pursh	SF, WF, Mixed C
Veratrum californicum Durand	MH, WF, moist meadows
Veratrum viride Ait.*	

	Habitat
Xerophyllum tenax (Pursh) Nutt.	SF, Mixed C, JP, PP
Zigadenus micranthus Eastw.	PP, JP
LINACEAE	
Linum perenne L. ssp. *lewisii* (Pursh) Hult.	
MALVACEAE	
Sidalcea oregana (Nutt.) Gray ssp. *spicata* (Regel) Greene*	
OLEACEAE	
Fraxinus latifolia Benth.	Near water
ONAGRACEAE	
Circaea alpina L. var. *pacifica* (Asch. & Magnus) Jones	Seepage areas
Clarkia rhomboidea Dougl.	PP, BO
Epilobium angustifolium L.	
Epilobium glandulosum Lehm.*	
Epilobium lactiflorum Hausskn.*	
Epilobium minutum Lindl. ex Hook.	
Epilobium paniculatum Nutt. ex. T. & G.*	
Gayophytum nutallii T. & G.	MH
ORCHIDACEAE	
Calypso bulbosa (L.) Oakes	BO, Y
Corallorhiza maculata Raf.	MH, SF, WF, Mixed C, JP
Corallorhiza mertensiana Bong.*	
Corallorhiza striata Lindl.	WF
Eburophyton austinae (Gray) Heller	WF, Mixed C
Goodyera oblongifolia Raf.	SF, WF, Mixed C, Y, JP
Habenaria dilatata (Pursh) Hook. var. *leucostachys* (Lindl.) Ames	Seepage areas
Habenaria elegans (Lindl.) Boland	Mixed C, PP, BO
Listera caurina Piper	SF
Spiranthes romanzoffiana C. &. S.	Seepage areas
OROBANCHACEAE	
Boschniakia strobilacea Gray	BO
OXALIDACEAE	
Oxalis oregana Nutt.	Seepages and near water
Oxalis trilliifolia Hook.	
PINACEAE	
Abies concolor (Gord. & Glend.) Lindl.	SF, WF, Mixed C
Abies lasiocarpa (Hook.) Nutt.	Timberline (rare)
Abies magnifica A. Murr. var. *shastensis* Lemmon	MH, SF
Picea engelmannii Parry ex Engelm.	Near water (rare)
Pinus albicaulis Engelm.	Timberline (rare)
Pinus jeffreyi Grev. & Balf. in A. Murr.	JP
Pinus lambertiana Dougl.	WF, PP, Mixed C, BO
Pinus monticola Dougl.	MH, SF, JP
Pinus murrayana Grev. & Balf. in A. Murr.	Near water (rare)
Pinus ponderosa Dougl. ex P. & C. Lawson	Mixed C, PP, BO
Pseudotsuga menziesii (Mirb.) Franco	WF, Mixed C, PP, BO, Y, JP
Tsuga mertensiana (Bong.) Carr.	MH, SF
POLEMONIACEAE	
Collomia grandiflora Dougl. ex. Lindl.	BO
Collomia heterophylla Dougl. ex. Hook.	BO, Y
Collomia tinctoria Kell.*	
Gilia capitata Sims	BO
Ipomopsis aggregata (Pursh) V. Grant	Rocky areas
Ipomopsis congesta (Hook.) V. Grant	Timberline
Microsteris gracilis (Dougl. ex. Hook.) Greene ssp. *humilis* (Greene) V. Grant	MH
Phlox adsurgens Torr.	SF, WF, Mixed C
Phlox diffusa Benth.	JP, timberline
Phlox speciosa Pursh ssp. *occidentalis* (Durand) Wherry	
Polemonium californicum Eastw.	MH, SF
Polemonium pulcherrimum Hook.*	
POLYGALACEAE	
Polygala californica Nutt.	
POLYGONACEAE	
Eriogonum compositum Dougl. ex Benth.	
Eriogonum elatum Dougl. ex Benth.	
Eriogonum latifolium Sm. ssp. *nudum* (Dougl. ex Benth.) S. Stokes	PP, JP

	Habitat
Eriogonum latifolium Sm. ssp. *sulphureum* (Greene) S. Stokes	
Eriogonum marifolium T. & G. var. *incanum* (T. & G.) Jones*	
Eriogonum umbellatum Torr. ssp. *polyanthum* (Benth.) S. Stokes	MH, JP, timberline
Polygonum bistortoides Pursh*	
Polygonum davisiae Brew. ex Gray	MH, in openings
Polygonum douglasii Greene	MH
Polygonum phytolaccaefolium Meissn.	SF cutovers
Rumex acetosella L.*	
POLYPODIACEAE	
Athyrium alpestre (Hoppe) Rylands var. *americanum* Butters*	
Athyrium felix-femina (L.) Roth var. *californicum* Butters	Seepage areas
Cheilanthes gracillima D.C. Eaton in Torr.	Rocky areas (rare)
Cystopteris fragilis (L.) Berhn.	BO in shade
Onychium densum Brack. in Wilkes.	JP
Pityrogramma triangularis (Kaulf.) Maxon	Rocky areas (rare)
Polystichum lemmonii Underw.	Timberline (rare)
Polystichum munitum (Kaulf.) Presl	WF, Mixed C, Y
Polystichum munitum (Kaulf.) Presl var. *imbricans* (D. C. Eat.) Maxon	PP, BO
Pteridium aquilinum (L.) Kuhn var. *lanuginosum* (Bong.) Fern.	WF, Mixed C, PP, JP
PORTULACACEAE	
Calyptridium umbellatum (Torr.) Greene	MH, openings
Lewisia cotyledon (Wats.) Rob. in Gray	JP
Lewisia leana (Porter) Rob. in Gray	JP
Montia cordifolia (Wats.) Pax. & K. Hoffm.*	
Montia perfoliata (Donn.) Howell var. *depressa* (Gray) Jeps.	
Montia siberica (L.) Howell	WF
PRIMULACEAE	
Dodecatheon alpinum (Gray) Greene*	
Dodecatheon hendersonii Gray	PP
Dodecatheon jeffreyi Van Houtte	Near water, high elev. (rare)
Trientalis latifolia Hook.	WF, Mixed C, PP, BO, Y
RANUNCULACEAE	
Aconitum columbianum Nutt.* in T. & G.	
Actaea rubra (Ait.) Willd. ssp. *arguta* (Nutt.) Hult.	WF
Anemone deltoidea Hook.	SF, WF, Mixed C
Anemone drummondii Wats.	JP
Anemone quinquefolia L. var. *oregana* (Gray) Rob.	SF, WF, Mixed C
Aquilegia formosa Fisch. in DC.	
Caltha howellii (Huth.) Greene	Near water, snowmelt
Delphinium decorum F. & M.*	
Delphinium glaucum Wats.	
Delphinium menziesii DC.*	
Delphinium sonnei Greene	
Ranunculus alismaefolius Geyer ex. Benth var. *alismellus* Gray*	
Ranunculus populago Greene*	
RHAMNACEAE	
Ceanothus cuneatus (Hook.) Nutt.	Dry slopes at lower elev.
Ceanothus integerrimus H. &. A. var. *macrothyrsus* (Torr.) G. T. Benson	Mixed C, PP in openings
Ceanothus prostratus Benth.	PP, JP
Ceanothus sanguineus Pursh	
Ceanothus velutinus Dougl. ex Hook.	Mixed C in openings, cutovers
Rhamnus purshiana DC.	
ROSACEAE	
Amelanchier pallida Greene	WF, Mixed C, Y, JP
Aruncus vulgaris Raf.	Near water (rare)
Cercocarpus betuloides Nutt. ex T. & G.	Rocky areas (rare)
Cercocarpus ledifolius Nutt.	Above timberline, Dutchman's Peak
Frageria bracteata Heller*	
Fragaria californica Cham. & Schlecht.	WF, Mixed C, PP, BO

	Habitat
Geum macrophyllum Willd.*	
Holodiscus discolor (Pursh) Maxim.	SF, WF, Mixed C, PP, BO, Y
Horkelia hendersonii Howell	Timberline
Horkelia tridentata Torr.	PP
Osmaronia cerasiformis (T. & G.) Greene	
Potentilla fruticosa L.	
Potentilla glandulosa Lindl. ssp. *ashlandica* (Greene) Keck*	
Potentilla glandulosa Lindl. ssp. *globosa* Keck	PP
Prunus emarginata (Dougl.) Walp.	MH, timberline
Purshia tridentata (Pursh) DC.	JP, rocky areas
Rosa gymnocarpa Nutt. ex T. & G.	SF, WF, Mixed C, PP, BO, Y
Rubus lasiococcus Gray*	Rare
Rubus leucodermis Dougl. ex T. & G.	
Rubus parviflorus Nutt.	SF, WF, Mixed C, Y
Rubus ursinus Cham. & Schlecht.	WF, Mixed C, Y
Sorbus californica Greene	
RUBIACEAE	
Galium aparine L.	BO
Galium bifolium Wats.	MH, SF, PP
Galium bolanderi Gray	PP, BO, JP
Galium nuttallii Gray	
Galium triflorum Michx.	WF, Mixed C, Y
Kelloggia galioides Torr.	
SALICACEAE	
Populus tremuloides Michx.	High elev. (rare)
Salix commutata Bebb*	
Salix scouleriana Barr.	WF, Mixed C, PP
SAXIFRAGACEAE	
Boykinia major Gray*	
Heuchera micrantha Dougl. ex Lindl.	WF, Y
Lithophragma affinis Gray	BO
Mitella caulescens Nutt. in T. & G.	Mixed C, WF
Mitella diversifolia Greene	SF, WF, Mixed C, Y
Mitella pentandra Hook.*	
Mitella trifida Grah.	SF
Parnassia palustris L. var. *californica* Gray	Seepage areas (rare)
Philadelphus lewisii Pursh ssp. *gordonianus* (Lindl.) Munz	Y
Ribes binominatum Heller	
Ribes cereum Dougl.	MH, Above timberline in openings
Ribes lacustre (Pers.) Poir.	WF
Ribes lobbii Gray	WF, Mixed C, JP
Ribes sanguineum Pursh	WF
Ribes viscosissimum Pursh	SF, WF
Saxifraga oregana Howell*	
Saxifraga punctata L. ssp. *arguta* (D. Don) Hult.	In seepages (rare)
Tiarella unifoliata Hook.	Mixed C
Whipplea modesta Torr.	WF, Mixed C
SCROPHULARIACEAE	
Castilleja affinis H. & A.	BO
Castilleja arachnoidea Greenm.	Timberline
Castilleja brevilobata Piper	
Castilleja miniata Dougl.* ex Hook.	
Castilleja applegatei Fern.	BO
Castilleja pruinosa Fern.	BO
Collinsia grandiflora Dougl. ex. Lindl.	BO
Collinsia linearis Gray	PP, BO
Collinsia parviflora Dougl. ex Lindl.	
Collinsia torreyi Gray var. *latifolia* Newsom*	
Cordylanthus viscidus (Howell) Pennell	PP, JP
Mimulus guttatus Fisch. ex. DC.*	
Mimulus nanus H. & A.*	
Orthocarpus copelandii Eastw.	Rocky areas, timberline
Orthocarpus cuspidatus Greene*	
Pedicularis racemosa Dougl. ex Hook.	MH, SF, WF, Mixed C
Penstemon anguineus Eastw.	SF, WF
Penstemon azureus Benth.	SF, JP
Penstemon davidsonii Greene	Above timberline
Penstemon laetus Gray ssp. *sagittatus* Keck	

	Habitat
Penstemon nemorosus (Dougl. ex. Lindl.) Trautv.	SF, WF
Penstemon parvulus (Gray) Krautter	SF
Scrophularia californica Cham. & Schlecht.	Seepage areas
Synthyris reniformis (Dougl.) Benth. var. *cordata* Gray	SF, WF, Mixed C, BO, Y
Veronica serpyllifolia L.*	
TAXACEAE	
Taxus brevifolia Nutt.	Y, near water
UMBELLIFERAE	
Angelica arguta Nutt. ex T. & G.*	
Heracleum lanatum Michx.	
Ligusticum apiifolium (Nutt.) Gray	
Lomatium californicum (Nutt.) Math. & Const.*	
Osmorhiza chilensis H. & A.	MH, SF, WF, Mixed C, PP, BO, Y
Osmorhiza occidentalis (Nutt.) Torr.*	
Sanicula crassicaulis Poepp. ex DC.	BO
Sanicula graveolens Poepp. ex DC.*	
Sphenosciadium capitellatum Gray*	
URTICACEAE	
Urtica lyallii Wats.	Seepage areas
VALERIANACEAE	
Plectritis macrocera T. & G.	BO
Valeriana capitata Pall. ex Link ssp. *californica* (Heller) F. G. Mey.*	
Valeriana sitchensis Bong.	MH, SF
VIOLACEAE	
Viola glabella Nutt.	MH, SF, WF, Mixed C
Viola purpurea Kell.*	
Viola sempervirens Greene	SF, WF, Mixed C
VITACEAE	
Vitis californica Benth.	

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