**Conifers**

Comments on the range maps and treatment organization

The range maps have been created from a collection of sources—most importantly, personal observations. I have walked and driven across the region to verify historical reports and discover range extensions. The sources are referenced on each individual range map. While I believe these maps are highly accurate, trees could be found outside of the shaded regions. For some conifers, I have included labels on the maps to help identify individual populations. For the more common conifers, rivers, wilderness areas, large landmarks, and species treatments are the best way to track down specific locations. These maps will be modified in the future as other populations are discovered, or erased due to fire events or climate change. Please contact me with questions or new discoveries.

Order of the conifer treatments have been arranged to best describe common conifer characteristics. For example, Douglas-fir is presented first because it is the most common conifer and, due to its polymorphic nature, is important to present first and thus compare to other conifers. True firs follow because of their similarities and differences with the Douglas-fir in morphology, ecology, etc.

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**Pinaceae: Douglas-fir, true firs, spruces, hemlocks, pines**

The pine family has leaves that are linear and generally referred to as needles, wood that is relatively soft, and seed cones that are built from scales. Of the 220 or so species of Pinaceae worldwide, 64 species in six genera are native to North America and 32 of those, in five genera, occur in California alone. Twenty-three species occur within the region of the book.

**Pseudotsuga** Trees are single-trunked and evergreen with conical crowns maturing to cylindrical. Bark is divided into thick ridges by deep furrows. Needles are single and arranged spirally around branches. Seed cones are ovoid and oblong, hanging singly with distinct bracts protruding beyond scales. Seven species exist world-wide with three in North America and one regionally.

**Douglas-fir | Pseudotsuga menziesii**

Douglas-fir colonizes a broader range of habitats than any other conifer in the Klamath Mountain region. It is encountered in coastal dune forests, in the rainforest with redwoods, with angiosperms in the mid-elevation mixed-evergreen forests, pioneering disturbed areas, and as *krummholz* individuals along windy ridges near mountain tops. Its ubiquitous nature and economic value currently define it as the West’s all-purpose tree but Douglas-fir has been an important component of western forests since the mid-Pleistocene (Burns et al. 1990). The species achieves tremendous size and, in fact, the coastal variety is the largest member of Pinaceae. Historical data from the early twentieth century recorded heights of 393’ and estimated volumes exceeding 17,000 ft³. If true, the species was once both the tallest and largest living thing (Van Pelt 2001).
Ranging from coast to interior mountains and associating with almost every other regional conifer, Douglas-fir requires a principal understanding in order to meet all conifers in Conifer Country. The primary challenge for identification is the polymorphic nature of Douglas-fir, especially when young. A variety of characteristics exhibited during the life cycle are often shared by other conifers. For instance, when young or in the shade, Douglas-fir needles lay nearly flat in relation to the stem, like those of a white fir. Most often needles are arranged spirally around the entire stem like a spruce. In disturbed areas where it is pioneering newer landscapes, branches appear pendulous, drooping like those of Brewer spruce to maximize sunlight consumption, although this drooping form can be expressed in older trees and in other environments as well. Hyper-droop witch’s brooms (massive conglomerations of branches and needles often in a spherical shape) are induced by dwarf mistletoe (Arceuthobium douglasii) and massive, localized infestations are common across the region, generally at higher elevations. The bark varies in furrowing patterns and color with habitat and age. But once the tree is of reproductive age, the species becomes easy to identify based on the seed cone.

While struggling with a Douglas-fir’s variability, look to the ground—or, if lucky, a branch—to find a seed cone. Astute observation of cone architecture is the basis of conifer classification and is thus pivotal for identifying Douglas-fir and other conifers. A Douglas-fir’s seed cone presents scales (seen on most conifer cones) in addition to bracts (rarely seen in other mature conifer cones). This combination of visible scales and bracts at maturity makes it one of the most distinctive cones in the forest. The bract is a modified leaf that develops at the time of fertilization and protrudes from beyond each scale (Plate 1). In most conifers the bract is overgrown by the scales as the cone develops, but in Douglas-fir the bract remains conspicuous throughout development. Rodents favor cone crops, even before they are ripe. One often finds cones disassembled by these animals—green scales and bracts scattered across the ground, seeds meticulously removed. After a mast ing year, seed cones inevitably remain on the tree through the winter, hanging downward and browning through their second summer.

Basic tree architecture, as well, can be understood by observing Douglas-fir. In undamaged trees a “Christmas tree” silhouette will be the norm for the first several hundred of years of life. With time, the crown rounds out but the likelihood of disturbance from wind, lightning, falling trees, pathogens, or other events increases. After 400 years, on average, a tree’s crown will have increased variability based on the odds of disturbances having occurred. With injury and age a complex assemblage of reiterated trunks, epicormic branches, and even limb formation sculpt twisted, contorted, and individualized crowns. Douglas-fir can live for over 800 years and thus develop crowns which become quite complex. Watch for this variability in all long-lived tree species to appreciate the harsh realities of forest life.

Douglas-fir has the greatest latitudinal range of any conifer in North America, extending 2,800 miles from central British Columbia into the mountains of central Mexico (Burns and Honkala 1990). Douglas-fir is successful across such a wide range of habitats because it has evolved a broad ecological amplitude. From Sonoma County northward, Douglas-fir assumes an increasingly important role in defin-
ing the mixed-evergreen forests. Here, variety *menziezii* grows northward along the Pacific Coast throughout the Sierra Nevada and Cascades. Along the Pacific Slope this variety gets much larger and grows more rapidly than var. *glauca* of the Rocky Mountains.

Douglas-fir is continuing to expand its range regionally because of several factors, including fire exclusion (also known as fire suppression). Before fire exclusion, low-intensity fires would sweep through and kill Douglas-fir seedlings and saplings in oak woodlands. Today, in many areas, shade-tolerant Douglas-firs grow slowly in the understory of oaks and maples and, without cyclical fire, grow up through these angiosperms. Slowly, they overtop and shade out these other species, thus creating a new, higher canopy level. In the absence of wildfire such areas may well become mixed-conifer forests of Douglas-fir and ponderosa pine—rather than mixed-evergreen forests with oaks and maples. Douglas-fir also has the ability to reforest disturbed areas rapidly and may thus displace angiosperms which have historically better-exploited the mid-elevation mountain habitats.

*Figure 2.1 Range of Douglas-fir*
Douglas-fir (*Pseudotsuga menziesii*)

**Pinaceae**

- **Bark**: dark gray to brown and smooth in young trees becoming increasingly furrowed with age, appearing reddish brown to gray; ancient trees develop mounds of detritus at bases
- **Needles**: 0.6”-1.0”, yellowish-green to blue-green, two bands of stomatal bloom on underside and indistinct grooves on upper surface; growing radially around stem in all directions; soft to the touch
- **Seed Cones**: 2.0”-4.0”, soft, semi-woody with distinct three-lobed bract extending from each scale (often described as mouse tail and hind-legs)
- **Habitat**: varied, from sea level to 7000’; coastal dune forests to high elevation mountains

Plate 1

From *Forest Trees of the Pacific Slope* by George Sudworth, 1908.
In the Klamath Mountains, Douglas-fir is common in canyons and hillsides below 4,000 feet, where it associates with tan oak, madrone, incense-cedar, ponderosa pine, and sugar pine in the mixed-evergreen forests. It also finds ample habitat in the coastal redwood forests as well as in coastal dune forests. Above 4,000 feet, white fir begins to share the overstory with Douglas-fir as the transition to mixed-conifer forest begins. Less commonly, above 4,000 feet, specimens grow on dry ridgelines associating with high-elevation conifers. Douglas-fir is surely the defining “charismatic mega-flora” of the West.

### Abies - True Firs

Abies are known as “true firs,” distinguishing them from Douglas-firs. True firs thrive in the cold regions of the Northern Hemisphere, where about 40 species are well-adapted to the snowy environments. For example, short stiff branches are commonly arranged so that pointed crowns shed snow without breaking. Seven species are native to western North America, six of which can be seen in this region: white fir, grand fir, Shasta fir, noble fir, subalpine fir and Pacific silver fir. True firs have the following characteristics:

- Upright cones perched at the top of the tree. These cones do not fall from the tree intact; instead—if they remain uneaten—they fall apart scale-by-scale.
- Single needles are soft to the touch and attached to the branch differently than a "spiky-spruce" needle. When torn away, a circular scar is left on the twig. In a spruce, a peg of woody material will be left behind when a needle is removed.
- Young, fragrant stems have prominent resin blisters. These resins and oils are used in a variety of products such as adhesives and perfumes.
- The buds at the ends of twigs occur in clusters of three or more, are rounded, and covered with resin and wax.

### White fir | Abies concolor

Across the southern Rocky Mountains to the sky islands above the arid Sonoran Desert to the lush Siskiyou Mountains, white fir exhibits variation. Like the Douglas-fir, these varied forms must be understood to avoid confusion and achieve proper identification. Richard S. Hunt (1993) suggests that the common name “white fir” is at best a catchall for western firs with green cones and glaucous undersides to the needles—this description includes grand fir. There are at least two varieties of white fir in the West, if not two species. In the region, white fir and grand fir are ecologically and morphologically different enough to warrant separate species treatments. Throughout the mountains of the region, white fir flourishes in a wide range of habitats, forming common forest associations with Douglas-fir in the mid-elevation (3,500’-5,500’) mixed-conifer forests. White fir/Douglas-fir forests occur on varied soils, generally along streams benches, terraces, slopes, and ridges. At these mid-elevations, white fir is the most common tree in the region. The species’ historic success is due to its shade tolerance, while it owes its more recent success, as does Douglas-fir, to fire suppression.

In the northern Siskiyou Mountains, identification of white fir becomes problematic because a variety of characteristics expressed here are uncommon elsewhere.
(other species express unique morphology in the Siskiyous as well). One theory is that the Sierra Nevada white fir (var. *lowiana*) from the south transitions morphologically toward the Rocky Mountain white fir (var. *concolor*) over the remainder of the West. In the Siskiyous Mountains characteristics similar to var. *lowiana* are seen, like darker needles and deeper quadrilateral furrowing and corking patterns in darker bark (hikes 9 and 10). Most likely what is occurring in the Siskiyous is hybridization with coastal grand fir. This hybrid zone continues across eastern Oregon, through the Blue Mountains, and into the northern Rockies of Idaho.

Other morphological differences between white fir and grand fir are overall tree shape, form and color of foliage, and color of young cones. These differences are characteristics initiated by the varied ecological amplitudes wherein reproductive success is found—based on exposure, elevation, and climate. Ecological gradients have been defined between the varieties based on drought tolerance, where var. *concolor* is thought to be frost and drought tolerant (Zavarin 1975).

Regardless of the classification, trees in the Siskiyou Mountains differ from those in the remainder of the region. Kjirsten Wayman at Humboldt State University is in the early stages of a leaf oil study in which she is comparing the chemical composition of white fir and grand fir. Camphene, a monoterpane, is common in grand fir and has been used to define this species (Rudloff 1975). Camphene occurs in low concentrations in other western white fir populations. However, Wayman is finding high camphene concentrations in populations of white fir in the Siskiyou Mountains. This supports the hybrid hypothesis. These classification mysteries may or may not sort themselves out as scientists undertake studies on these varied populations.

Regionally, the lighter-gray bark of white fir is the most direct way to distinguish it from a common associate, Shasta fir. The bark furrowing patterns in white fir are vertical and do not form blocks, while Shasta fir bark does. The furrows at the base of white fir look like wax dripping from a candle. From beneath the tree, look up through the branches. The white fir has a less distinct pattern against the sky; the needles at the tips of the branches blend together. Shasta fir branch tips are much more defined and form a clearly dissected snowflake pattern in silhouette. The crown in a mature white fir is variable in shape and almost formless, whereas Shasta fir usually has a Christmas tree-like taper. Because it is shade tolerant, white fir holds live sprays of branches low to the ground and is often found in multi-aged forests.

Distinguishing white fir from grand fir is another confusing proposition. All populations of white fir in the region have notched-tipped needles, which is
a characteristic of grand fir across the entirety of its range. This is the only region where notched-tips are found in white fir populations (Hunt 1993). As a general rule, below 1,300’ in mesic habitats, such a tree is a grand fir, whereas above 3,000’, in xeric habitats, one finds white fir. Unlike white fir, grand fir does not have stomatal bloom on the tops of the needles. Another distinguishing characteristic can be found by cutting discreetly into the bark: that of white fir is a mottled yellowish-purple, while grand fir’s bark is purple. Finally, the bark of a mature white fir is thicker (~4’) than that of grand fir (~2’). In the lower elevations of the Klamath River Country a hybrid between white fir and grand fir grows in the Horse Creek Botanical Area (hike 13).

White fir is drought tolerant and therefore grows in the mid-to-upper elevation xeric mountain ranges throughout southwestern North America. In the Rockies of New Mexico, Arizona, Colorado, and Utah, it is common from 2,600’ to 6,000’ depending on latitude. In the Great Basin it is one of the most common mountain conifers (Charlet 2007). Because white fir is drought tolerant it also inhabits xeric mountain ranges in the Sonoran and Mojave deserts—virtually anywhere the elevation entices just enough rainfall. It also thrives in the mountains of northern Baja California, the southern California transverse ranges, and throughout the Sierra Nevada, reaching record size in Yosemite National Park. Regionally, white fir is commonly encountered while climbing upward into the mountains near annual snowline—associating with incense-cedar, sugar pine, Shasta fir, Jeffrey pine, Douglas-fir, and western white pine and on xeric ridgelines, depauperate white fir also share space and time with Brewer spruce.

**Grand fir | Abies grandis**

Grand fir’s range can best be characterized as coastal in northwest California and southwest Oregon, where it is the only fir in coastal forests. Similar to the noble fir and Shasta fir, there is debate about overlap and/or hybridization between grand fir and white fir in this area (as discussed in the white fir treatment). Personally, I have come to the conclusion that hybridization is occurring with white fir on the western flanks of the Klamath Mountains—through the Siskiyou and possibly the extreme western Marble Mountains—but morphologically these trees are more similar to white fir than grand fir. Hybridization continues in the mountains of western and central Oregon and ends in northern Idaho, where grand fir reaches its northern range extension (Van Pelt 2001). Grand fir extends south along the coast of California to Sonoma County.

Though the two species are very similar, the difference between grand fir and white fir can be summarized with respect to three grand fir characteristics: it grows below 1,300’, there is never stomatal bloom on the upper side of its needles (creating a dark glossy-green appearance), and a cut into the bark appears purplish reddish where white fir appears mottled red and white (like bacon). Grand fir needles lay flat relative to the branch, a trait that also can be expressed in white fir, but grand fir needles grow in two distinct flattened rows with the needles on the upper row shorter than those below. Regionally both firs have needles with notches at the tips—a trait common in grand fir across the entirety of its North American range.
Figure 2.2 Range comparison for white fir, grand fir, and hybrids

Range* of

- Abies concolor
- Abies grandis
- grandis x concolor

*based on Griffin and Critchfield (1976), Van Pelt (2001), Calflora (2010), Oregon Flora (2010), and personal observation
**white fir (Abies concolor)**

*Pinaceae*

- Bark: light gray and smooth, with resin blisters when younger becoming ashy gray and deeply furrowed at base with age; vertical “melting” appearance at base; when cut, yellowish or mottled yellow and red, purple in grand fir
- Needles: 1.0’’-2.4’’, grooves on upper surface, stomatal bloom on both surfaces, vary from lying flat (on shaded limbs) to curving upward (with ample sunlight), soft to the touch, *pine scent* when crushed; notched tips only in Klamath Mountain populations
- Seed Cones: 3’’-5’’, standing upright, green in color when fresh, drying to brown
- Habitat: dry and moist sites, varied soil, often in pure stands, 2,000’-6,500’

**grand fir (Abies grandis)**

*Pinaceae*

- Needles: variable in length, grow flatly (relative to the branch) in two rows
- Bark: light brown with pitch blisters when young becoming white and smooth at top of tree, dark gray or even purplish color develops at base with age, shallow linear to blocky furrows on the surface of the bark, inner bark reddish
- Needles: 0.8’’-2’’, dark green above with groove, two rows of stomatal bloom below, lie flat relative to branch in two rows with needles on upper row slightly shorter than those below, notched tip
- Seed Cones: 2.0’’-4.0’’, standing upright, green with purplish hues in maturity
- Habitat: Cool, moist coastal forests south through California to Sonoma County, below 1,500’