Westside Species

Cascade regions

Rainforest conditions may be found in limited areas near the Cascade Crest in eastern Washington. Here, annual precipitation may reach 4 m (13 ft), most of which falls as snow. Most of these wet, mountain forests occur in three primary vegetation zones: the mountain hemlock, Pacific silver fir, and Cascade western hemlock zones—all of which are more abundant in western Washington (Figure 138). The dominant patterns of the trees and forests in these zones are similar to those west of the crest. Refer to the companion guide, *Identifying Mature and Old Forests in Western Washington* (Van Pelt 2007), for more information on these stand types.

Figure 138. Rainforests of western hemlock and Pacific silver fir near the Cascade Crest behave very similarly, whether east or west of the divide.

The strength of these three zones weakens dramatically as one moves down the valleys and into the drier, montane environment more typical of eastern Washington. Thus, the zones are compressed into relatively small spaces in some of these high, Cascade valleys (Figure 3). The eastern Cascade distribution of mountain hemlock, Pacific silver fir, western hemlock,

western redcedar, yellow cedar, and noble fir (noble fir is found only in the South Cascades region) is limited to these zones.

These common Westside species react differently to the conditions east of the Cascade Crest. Pacific silver fir is the most shade-tolerant, but also the most sensitive to dry air. In many forested areas just east of the Cascade Crest, Pacific silver fir is abundant in the understory yet uncommon in the canopy. Pacific silver fir reproduces well in the cool, dark, moist understory environment, but grows extremely slowly (Figure 139). Individuals may reach the main canopy, but often cannot survive the desiccating conditions. Mountain hemlock is more tolerant of desiccating air, growing as an alpine tree in many parts of its range. As such, it persists in the main canopy, often at lower elevations than Pacific silver fir, even though the fir is still present in the understory. Western hemlock can also persist in the understory to high elevations. All three species are commonly present in many of these Eastside Cascade forests. Western redcedar is also common, often extending down river valleys further than its shade-tolerant associates.

Figure 139. Short, flat-topped Pacific silver fir trees growing slowly in the understory of rain forests near the Cascade Crest can easily be 100–200 years old.

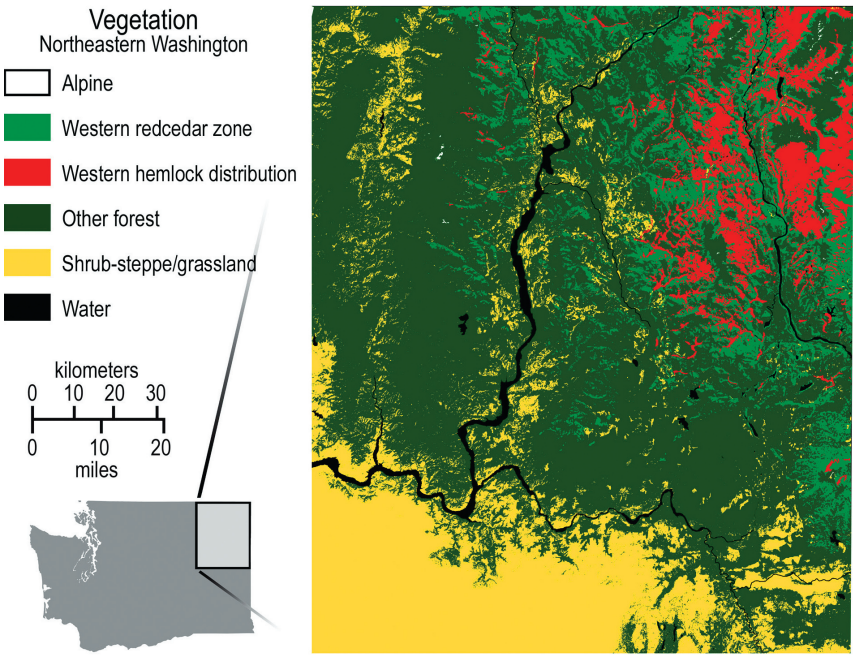
Another difference between these Eastside Cascade forests and their Westside counterparts is the addition of the common montane species from eastern Washington. In these steep mountain valleys just east of the Cascade Crest it is not

uncommon to see eight or more species of conifers, from both east and west, all sharing dominance (Figure 8).

Columbia Rocky Mountain region

Far northeastern Washington receives more precipitation than the Okanogan Highlands of north central Washington, and western hemlock, western redcedar, and mountain hemlock reappear in Inland Empire forests. However, fire regimes are different than in similar sites in the Cascades, due to increased lightning frequency and the adjacency of other stand types. The result is a higher likelihood of other, more fire-adapted species being present with the hemlocks and redcedars. In addition, precipitation patterns are not quite as dramatic as they are in the Cascades (Figure 1). As a result, the distributions of western hemlock and western redcedar are quite different from each other, warranting the formation of a separate vegetation zone (Figure 140). Western redcedar/grand fir forests extend well beyond the western hemlock forests throughout this region (Figure 141). Even though redcedar is tolerant of wet and

Figure 140. Forested vegetation in the Columbia Rocky Mountain province. Western hemlock occupies only a small portion of the Columbia Rocky Mountain western redcedar zone.



sometimes saturated soils, it can also tolerate drier soils than western hemlock. The roots of western redcedar penetrate soils to a deeper extent than western hemlock, and similar-sized trees have greater root mass.

More frequent fire regimes allow ponderosa pine and western larch to play a larger role in these vegetation zones than in similar forests in the Cascades. In many cases, an overstory remnant of ponderosa pine, western larch, or Douglas fir will be present to help determine the age of a forest rather than relying on the shade-tolerant component. In situations where only the shade-tolerant component remains, the patterns of development will be similar to those of Cascade forests.

Figure 141. Extensive areas of grand fir–western redcedar forest exist within the Columbia Rocky Mountain western redcedar zone, well beyond the range of western hemlock.

Patterns in mature and old forests

Wildfires in the Columbia Rocky Mountain Region are often high-severity, stand-replacing events due to fuel accumulations and relatively long fire return intervals. To age such stands, use the key to stand development stages following stand-replacement events, presented on page 52. Use any combination of western hemlock, western redcedar, Pacific silver fir, or mountain hemlock as the shade-tolerant cohort. Old-growth forests are any that key to the vertical diversification stage or older. Because of the cool to cold environment of the Pacific silver fir and mountain hemlock vegetation zones, forest growth is slow and stands that key to the maturation stage will often be more than 200 years old.

Conclusion

The great diversity and ages of forests found in eastern Washington makes the task of creating a comprehensive guide difficult. There will be occasional forests that do not fit the keys properly and others where the ages are difficult to discern. Each stand is unique and presents its own set of challenges. There are sure to be cases when informed judgment will substitute for certainty. The ecological information contained in this guide is intended to narrow the range of possibilities and give the user increased confidence when making age determinations in the forests of eastern Washington.

English Equivalents

When you know:	Multiply by	To find
Centimeters (cm)	.39	Inches (in)
Meters (m)	3.28	Feet (ft)
Kilometers (km)	.62	Miles (mi)
Square kilometers (km^2)	.386	Square miles (mi^2)
Square kilometers (km^2)	247.1	Acres (ac)
Hectares (Ha)	2.47	Acres
Cubic meters (m^3)	35.3	Cubic feet (ft^3)

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Glossary

Biological legacy – structures left behind after a disturbance. After a stand-replacing event like a wildfire, the snags and logs are biological legacies. ***Legacy trees*** are a type of ***living biological legacy*** – trees that survived a major disturbance.

Cambium – in trees, the cambium is responsible for the secondary growth of stems and roots. It consists of a layer of actively dividing cells located between the bark and wood. Layers of sapwood (xylem) are produced to the inside of the cambium, and layers of bark (phloem) are produced to the outside of the cambium. The innermost bark is living tissue and responsible for the transport of sugars to all of the non-photosynthetic parts of the tree, such as the roots.

Canopy – the collective unit describing all of the photosynthetically active portions of an ecosystem. A forest ecosystem can be divided into three main components: the forest soil, the forest floor, and the forest canopy. A forest canopy can be further divided into other useful categories, such as the understory canopy, upper tree canopy, even a shrub canopy. However, the term is typically used in its narrow sense, referring to the tree canopy.

Climax – a theoretical term for the endpoint of forest succession. In reality, no such conditions actually exist, because of the ever-changing background conditions (climate, soils, geology, disturbance regime). In the Pacific Northwest, climax forests are thought of as those where all of the canopy layers are composed of shade-tolerant trees, such as western hemlock or Pacific silver fir.

Cohort – a generation of trees, or a group of trees with similar functional ages. The most common cohort is the generation of trees planted after clearcutting, or the generation of trees that seed in after a wildfire. Both of these examples are often referred to as the ***original cohort*** or ***pioneer cohort.***

Crown – the collective term for the space occupied by all of the leaves on a tree. Thus the crown includes not only all of the leaves, but also the twigs, branches, limbs, and trunks occupying that space.

Disturbance – any perturbation that causes changes in a vegetation community. In forests, disturbances are frequently caused by external factors, such as wildfires, floods, windstorms, logging, or insect outbreaks. Disturbances can be small, such the death of a canopy tree, or large, such as a volcanic eruption.

Ecological amplitude – the boundaries of environmental conditions at which an organism can live and function. Species with low ecological amplitudes are often rare or live in specialized habitats.

Epicormic branch – any branch that develops from the cambium. In model-conforming conifers, these would include all branches that are not produced by the leader of the main trunk. As such, the pith of an epicormic branch will not extend all the way to the pith of its trunk of origin. Since these are forming from the cambium, their orientation is often tangential to the main trunk, in contrast to the radial orientation of original branches.

Fire regime – the level of fire severity. Severity levels are often related to the percentage of trees that are killed. A low-severity fire kills 20% or less of the basal area of a stand; a high-severity fire kills at least 70% of the basal area; and a mixed-severity fire kills between 20% and 70% of the basal area.

Fire-return interval – the time between fire events within a stand, often calculated from fire-scarred trees. Naturally, the fire regime is closely related to the fire return-interval. Fire return-intervals for ***low-severity*** fire regimes are often defined as anything 25 years or less, fire return-intervals for ***mixed-severity*** fire regimes are often defined as anything between 25 and 100 years, and fire return-intervals for ***high-severity*** fire regimes are often defined as anything at least 100 years.

Fuel loading – the availability of combustible materials to feed a fire. Higher fuel loads generally mean higher temperatures and greater flame lengths. The amount of available fuels is related to the severity of a subsequent fire.

Functional age – the age since release. Many shade-tolerant trees are able to survive in the forest understory for decades or even centuries. If conditions change, such as the opening up of the canopy, many of these trees can dramatically increase their growth rates and ascend into the main canopy. In some situations such as after logging, surviving understory trees may form a new cohort along

with seedlings. These trees will all have the same functional age, yet their actual ages may vary by a century or more.

Heartwood – the inner, dead portion of wood that no longer actively transports water and nutrients (see sapwood). The heartwood in many tree species is richly colored, such as in redwood (*Sequoia sempervirens*) or black walnut (*Juglans nigra*). Since sapwood of all trees is pale in color, it is the heartwood that gives value to the lumber for woodworking. Many tree species deposit complex compounds in the heartwood that make it resistant to decay. Decay-resistant heartwood is the primary reason so many conifer species can live past the millennium mark.

Highgrading – a logging practice in which only the most valuable trees are removed. This practice is common in areas where many species are present within a forest, such as mixed-conifer forests or tropical rain forests.

Krummholtz – dwarfed, stunted, and often deformed trees growing in arctic or alpine situations. From a German word meaning ***twisted wood,*** krummholtz forms when conditions are too severe for normal tree growth. In the Pacific Northwest, it is common to see treeline krummholtz of whitebark pine, subalpine fir, or Engelmann spruce, although many other species can also form krummholtz.

Layering – a means of vegetative propagation in which an aerial shoot comes in contact with the soil and develops roots of its own. If later separated from the parent plant, shoots that have layered can often survive. Layering is common in alpine environments where plants are small and often spend months under a blanket of snow.

Old-growth – a term often used to describe structurally complex forests that have individual trees older than approximately 200 years. In forests that originated through a stand-replacing event, old-growth occurs when the stand has reached the vertical diversification stage of stand development (page 48). Other terms that are sometimes used as synonyms include virgin, ancient, primary, overmature, decadent, or primeval. Ecologists tend to favor the term old-growth since it refers to a process and has less emotional bias.

Original branch – any branch whose initial bud was produced by the terminal leader of a trunk and thus has a pith that reaches the pith of the trunk.

Pioneer – in ecology, pioneer refers to the plants that are the first to arrive after a stand-replacing event such as wildfire, clearcutting, floods, volcanic eruptions, or even glacial retreat. In the Pacific Northwest, many weedy species of herbaceous plants often are pioneers following fire or logging. Pioneer tree species are frequently intolerant of shade and grow rapidly in full sun, such as western larch or lodgepole pine.

Reiterated trunk – any trunk on a tree other than the main trunk. The term 'reiterate' means 'to repeat,' hence a reiterated trunk is a secondary trunk that repeats the primary architectural model of tree growth within a tree crown. In many conifers, reiterated trunks retain the appearance of young trees growing within the crown of a larger tree.

Release – the dramatic increases in growth that follow when a suppressed tree is relieved of the factors that were suppressing it. For understory trees in forests, release usually comes in the form of the removal of some canopy trees, which lets more light into the understory, allowing increased growth. Suppressed trees are naturally walking a fine line between life and death, and the shock of increased light levels could kill them. However, release is what happens if a suppressed tree is able to respond positively to increases in light.

Sapwood – the outer portion of wood in a tree that conducts water and nutrients from the roots to the other living portions of the tree. All wood starts out as sapwood but is eventually converted to heartwood when no longer needed. The amount of sapwood needed by a tree is species specific, but is related to how many leaves the tree carries—healthy trees with full crowns of a given species will have more sapwood than suppressed trees with small crowns.

Stand – a patch of vegetation that represents a homogeneous unit with respect to its surroundings. Stand boundaries are often where forests of different ages are adjacent—ridgelines, streams, species changes, changes in soil characteristics, or changes in vegetation type can all demarcate a stand boundary. Stands can be smaller than a hectare to many hundreds of hectares.

Succession – the changes to a vegetation community following disturbance. The disturbance can be as small as the death of a single tree to as large as an entire landscape being consumed in wildfire. In forests, many aspects of succession

follow predictable patterns, based on shade tolerance and the ecologies of the species involved.

Suppression – extremely slow growth in trees, which can be caused by any number of factors. In forests, the most common form of suppression is due to lack of light. The forest understory can be very dark, and few trees can tolerate these conditions without dying. Many shade-tolerant trees, however, can persist in low light levels for decades or even centuries with very little growth. Growth consists of producing a few leaves and root hairs each year, but height growth may cease and even the deposition of wood may or may not occur in suppressed trees. In old-growth forests of the Pacific Northwest, it is not difficult to find understory trees of western hemlock, Pacific silver fir, or mountain hemlock 100–200 years old and only a few centimeters in diameter.

Trunk – in most conifers, any vertically-growing appendage. The main trunk is the primary stem that emerges from the ground, and reiterated trunks are those whose origin is a limb or other trunk within the crown.

Whorl-based – a growth form common in many conifers in which the terminal shoot produces several buds at the tip, one of which retains the role of terminal shoot, and the remaining all become branches. Conifers exhibiting whorl-based growth include *Abies, Picea, Pinus,* and *Pseudotsuga*. Other conifers, like *Larix* and *Tsuga,* produce branches more or less continuously from the terminal shoot.

Windthrow – a term often used when a tree is blown over and a portion of the root system remains attached to the trunk and is tipped over as well. Depending on the species, the size of the root plate can indicate the presence of root decay.

About the author

Robert Van Pelt is a research ecologist at the University of Washington in Seattle, where he received both his Ms and PhD. A native of the Midwest, he has lived in Seattle for more than 20 years. He has extensively studied old-growth forests across North America, particularly in California and the Pacific Northwest.

Currently, he is involved in canopy research on the structure and physiology of the world's tallest trees—coast redwood, Douglas fir, Sitka spruce, giant sequoia, and mountain ash in Australia. Always fascinated with facts and figures, his passion for trees led him to start the Washington Big Tree Program in 1987, which keeps records on the largest of each species of tree in the state. This ultimately led Robert to write *Forest Giants of the Pacific Coast (2001),* which chronicles in detail the largest trees in western North America.

Author, Robert Van Pelt 52m (170') up in a pine tree.
Photo: Will Blozan

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