Grand Fir (*Abies grandis*)

Grand fir is a lovely, graceful, montane tree that is maligned by many due to its vigorous regeneration on some sites. It is one of the world's tallest trees, with living trees recorded to 81.4 m (267 ft) (Figure 112). With one of the fastest growth rates among native conifers in eastern Washington, it can surpass Douglas fir in both height and wood volume on productive sites (Figure 113). On an alluvial site in western Washington, a 38 year-old tree was 40.2 m (132 ft) tall, and early growth rates in plantations have been recorded up to 1.22 m (4 ft) per year.

Figure 112. The classic form of a mature grand fir.

Foresters may dislike grand firs for stealing growing space from more valuable pine and larch species. Unplanted and often unwanted, grand fir regenerates in great numbers, requiring considerable investment in time and resources for vegetation management (Figure 114). Unchecked growth of grand fir can lead to future problems. The wood is soft, weak, prone to decay, and carries a lower stumpage price than associated trees. Losses from decay fungi are significant—it is not uncommon for mature stands of grand fir to

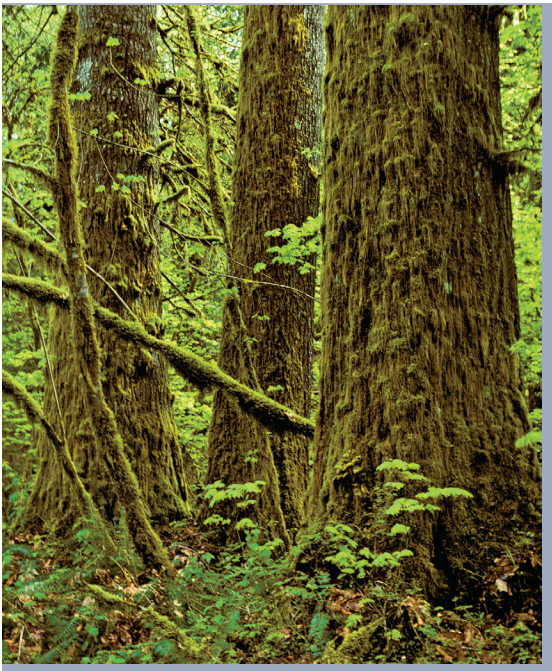

Figure 113. Grand fir may exhibit extremely rapid growth on alluvial soils. Under ideal conditions, grand fir may grow faster than nearly any other of our native trees, including Douglas fir.

Figure 114. An old-growth larch stand being replaced by grand fir. Nearly all of the green foliage pictured here is that of grand fir – most from trees less than 100 years old. The new foliage has yet to emerge on the larch in this early spring photograph.

Figure 115. After a century of fire suppression in many ponderosa pine forests, grand fir seedlings are often the only tree species able to reproduce.

Figure 116. Fire-scarred grand fir. Thin bark and a susceptibility to low-intensity fires are characteristic of the species – scarred individuals can occasionally survive for a short while. Photo by Keala Hagmann.

Figure 117. A pure stand of grand fir. While uncommon, pure stands can occur in limited areas. This stand is located within an old-growth western larch forest.

have lost 30 to 50 percent of their merchantable wood volume. It makes good pulp, however.

Grand fir was largely ignored during early logging operations in favor of neighboring ponderosa pine and western larch, the wood of which is far more valuable. For this reason, the proportion of grand fir has greatly increased in these stands. In low- and mixed-severity fire regimes, the thin-barked grand fir was naturally kept in low numbers. Decades of fire suppression, however, have allowed abundant

Figure 118. High-severity fire fueled by a dense fir stand. The giant pine was severely weakened by the fire and later succumbed to a bark beetle attack.

regeneration of grand fir and precluded the recruitment of shade-intolerant pine and larch seedlings (Figure 115). As a result, grand fir now flourishes in forest types where it was once a minor component. While lacking the thick-bark of its more fire resistant associates, a mature grand fir will occasionally survive a ground fire (Figure 116). Any wounding of the bark can spell doom for grand firs, as subsequent decay is inevitable and swift.

The grand fir glut resulting from highgrade-logging practices and fire suppres-

Figure 119. A riparian larch stand being invaded by grand fir and Engelmann spruce. All but the larch are less than 100-years old. The larches are being killed by below-ground competition and bark beetles.

sion has additional consequences. Dense stands of grand fir (and Douglas fir on some sites) cause stress on mature and old pines and larches as they compete for below-ground resources, such as water and nutrients (Figure 117). Under stress, the normally resistant pine and larch are vulnerable to bark beetle attack. As the pine and larch of the upper canopy begin to die, they are replaced by firs in the understory. The resulting dense stands of grand fir, now commonplace, are themselves vulnerable to a variety of defoliators, including the western spruce

Figure 120. Grand fir grows best in floodplains. In such locations it can successfully compete with Douglas fir in height growth. High levels of available moisture also allow it to compete with more shade-tolerant species such as western redcedar and western hemlock.

budworm and Douglas fir tussock moth. Large areas of weakened, dead, and dying trees increase the chance of catastrophic wildfire (Figure 118).

For the general public, the success of grand fir has resulted in a transformation of once open pine stands. Gone are favored picnic spots. A grassy glade near a stream, now unrecognizable, has been replaced by dense thickets of small and medium-sized firs, while the pines overhead gradually die from competition-induced stresses (Figure 119).

Tree characteristics

Grand fir is a ***site sensitive*** species—under favorable conditions, it grows and competes extremely well yet performs poorly in dry, cold, or otherwise harsh conditions. Less shade-tolerant than western hemlock or Pacific silver fir, it is either absent from stands containing these species or present only in the main canopy. Moist upland forests, too dry for western hemlock, are its primary habitat. River floodplains are an exception, however. Their slightly open nature and rich soils allow grand fir to grow and compete well alongside western redcedar, western hemlock, and other species (Figure 120).

Figure 121. Bark on two mature grand firs shows the smooth, vertical bark plates typical of this age. Note the pattern of branch whorls still visible in the bark.

Bark on grand fir never develops the thickness of its fire-tolerant associates. The smooth bark of young trees gives way to finely-dissected fissures, isolating the smooth, outer bark plates as tidy, vertical ridges (Figure 121). The transformation that many trees experience from young gray bark to increasingly more colorful mature bark does not occur with grand fir. Instead, the even pattern of gray bark plates remains in maturity (Figure 122). Even in giant old trees, bark characteristics reveal little about age (Figure 123).

Like Douglas fir and western larch, grand fir is an opportunist, using

epicormic branch formation to fill in crowns as conditions permit. As the stand matures and conditions change around a tree, light penetration may allow new branches to grow where they had been previously lost (Figure 124). The increased shade tolerance of grand fir relative to pine, larch, and even Douglas fir allows deeper crowns to form. Rapid growth on productive sites can lead to very tall trees in a century or less. Coupled with relatively weak wood, these factors inevitably result in windthrow or crown damage from wind storms. As with western larch, the ability to produce epicormic branches in combination with the capacity to produce reiterated trunks can re-build damaged portions of the crown. Many old grand firs have forked or otherwise reiterated tops, indicating recovery from earlier crown damage (Figure 125).

Since grand fir is rarely a pioneer tree, it often is of little use in identifying stand age. Instead, the shade-intolerant trees under which it is growing should be the focus of attention. However, in forests established in the wake of a stand-replacing event, the grand fir cohort can help determine the stage of stand development, which in turn can reveal stand age.

Figure 122. Mature bark patterns. The thick, colorful, and rugged bark of a Douglas fir (behind) contrasts nicely with a grand fir of the same age.

Longevity and death

The 'live fast, die young' philosophy has its price. Grand fir has the shortest

Figure 123. Bark on a giant grand fir. Other than size, there is little about the bark that alludes to age in this 2 m (6.6 ft) diameter tree.

lifespan of all of our native conifers. A functional age of 300 years has yet to be recorded, although functional ages of 250 years are not uncommon. To be fair, since it has high relative shade tolerance in many vegetation types, it can survive as a suppressed understory tree for a century or more before release. A grand fir with an actual age of 472 years was recorded in the Blue Mountains, but more than a third of the growth rings occurred in the first few centimeters, indicating growth suppression when the tree was young. This species does not invest in the physiologically expensive compounds that many tree species develop to protect

Figure 124. Epicormic branches are just beginning to develop at the crown base of this maturing tree. Note that fissures are beginning to develop in the bark and that several dead branches have already fallen off.

their wood from decay. Grand fir heartwood and sapwood are basically the same, apart from the role that sapwood plays in water and nutrient transport. Wood-decay fungi readily colonize wounds on mature grand fir. The most aggressive is the Indian paint fungus (*Echinodontium tinctorium*), which enters through old-branch wounds or other openings into the tree and destroys both cellulose and lignin within the heartwood. The hard, woody, nearly black conk announces the presence of an infection center that may extend several meters in both directions (Figure 126).

Figure 125. Upper crowns of several old grand firs reveal various patterns of trunk reiteration and epicormic branching in an effort to maintain a full crown.

Figure 126. Indian paint fungus on grand fir. The distinctive, nearly black hoof-like conk (circled) indicates extensive heart rot. The bright brick red interior of the conk was often used as a pigment by Native Americans.