

# Living with Fire: *Surviving the forest wildfires of California*

California wildfires can cause devastating damage to property and human lives. But for plant species that have lived for thousands of years in the fire-prone Sierra Nevada, forest fires are an expected part of the natural environment. These species have unique adaptations to withstand fire - and some even depend on fire to survive. This infographic introduces six different California plant species, all with different adaptations to fire.

## Giant Sequoia • *Sequoiadendron giganteum*

The giant sequoia is the quintessential example of a fire-adapted plant species. One of the largest trees in the world, giant sequoias grow particularly well in the mineral soil exposed by wildfire. Giant sequoias also have thick bark that protects them from low-severity fires. Because younger trees are very susceptible to fire, giant sequoia trees grow quickly as another adaptation to fire-prone environments.

### Fire-Resistant Bark

Mature trees can have bark up to 2 feet thick, although 6-8 inches is more common. This species grows to a height of 250 feet - about the wingspan of a Boeing 747.

### Seed Germination

Giant sequoia seeds germinate particularly well in mineral soil - the soil layer below the needles and decomposed material on forest floor that is exposed after fires burn.



## Fireweed • *Chamerion angustifolium*

After a wildfire, fireweed is one of the first plants to re-grow in burned areas. Like many other plants that grow in openings created by fire, fireweed seeds are dispersed by wind. This allows the plant to spread to newly burned areas, even if the parent plant is far away. Fireweed is an important post-disturbance species because it can recycle nutrients from burned soil. In fact, it was one of the most abundant species to recolonize Mount St. Helens after the 1980 volcanic eruption.

### Restoration Ecology

In some cases, ecologists replant damaged lands with species that naturally thrive after disturbance. These first plants help prevent erosion and rebuild damaged soil. Fireweed is one of the many species used for this purpose. In Alberta and Alaska, fireweed successfully grew on former coal strip mines. In other areas, fireweed has been used to re-plant oil spills, roadways, logged land, and pipeline trenches.

### Wind-Dispersed Seeds

Each fireweed plant can produce 80,000 seeds per year. These small seeds are dispersed by wind, allowing fireweed to quickly establish colonies in newly disturbed areas.



## California Black Oak • *Quercus kelloggii*

California black oak trees are quick to regrow from the stumps or snags left behind after a fire. These trees have extensive root systems that support this resprouting process. Sprouting stems can take advantage of the parent tree's well developed root system. Even one-year-old seedlings, which are 2-6 inches tall, have long taproots that extend up to three feet below the ground. Historically, California black oak trees were an important source of food for Native American communities. Native Americans regularly burned these areas to remove other species and promote the growth of California black oak woodlands.

### Historical Fire Pattern

Before modern fire suppression practices, California black oak forests experienced low-severity fires at least once every 10 years.



### Growth After Fire

Fire also thins the forest canopy, providing the light required for sprouts and seedling to thrive.

## Ponderosa Pine • *Pinus ponderosa*

Ponderosa pine has thick bark plates that protect the tree's interior and help the tree survive most fires. Mature trees can withstand high-severity fires, and even saplings can survive low-intensity fires. These trees also drop their lower branches as they grow. With less fuel near the ground, there's less chance that fire will spread from the ground up into the living canopy tree, destroying the pine needles required for photosynthesis. Finally, ponderosa pine trees have deep roots that are less susceptible to fire damage.



### Fire-Resistant Bark

The bark of mature ponderosa pine trees is thick and plated. This fire-resistant bark covers a very moist core that also helps to dissipate heat from wildfires.

## California Lilac • *Ceanothus cordulatus*

California lilac seeds are covered by an extremely hard seed coat. Wildfires crack open this coating, which then allows water to reach the seed and begin the sprouting process. Seedlings seldom sprout if there is no fire to begin the process of germination. In fact, California lilac seeds can lie dormant for hundreds of years until the next wildfire, although the areas where California lilac grows naturally experience fire every one or two decades.

### Buried Seeds

California lilac seeds buried within the soil can withstand fires as hot as 220 °F (105 °C).

### Soil Seed Bank

Because seeds require fire to germinate, dropped seeds accumulate in soil "seed banks" every year. In some forests, there are almost 2 million California lilac seeds per acre of soil.



## Knobcone Pine • *Pinus attenuata*

Knobcone pine requires fire to reproduce - their cones will not open without a fire of ~397 degrees Fahrenheit (203 degrees Celsius). Unlike ponderosa pine, the branch structure of knobcone pine actually promotes the spread of fire further up the tree. The open and low branch pattern helps direct fire to the cones in the crown of the tree. Knobcone pines reach maturity and produce cones quickly (after 10 to 12 years), an important characteristic in areas with frequent fire. The pine cones do not fall from the tree without fire, ensuring that a large number of accumulated seeds can be released during the next wildfire.

### Burnt Pine Cone

Wildfires vaporize the resin that seals knobcone pine cones shut. These cones are extremely fire resistant, and can germinate even after severe forest fires. In contrast, the parent tree itself has thin bark and can rarely survive a fire of any severity.



### Unburnt Pine Cone

Unlike other pine species with fire-aided reproduction, unburnt cones from the knobcone pine will not open even after the tree has died.