

WHAT TO REPLANT AFTER THE TREES DIE

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Background: California, and the Sierra Nevada in particular, is experiencing an unprecedented die off of trees on both private and public lands. Aerial detection surveys done in 2016 showed that over 102 million trees have died since 2010 coinciding with four years of drought, including over 62 million in 2016 alone. The scale of tree mortality is the largest in the southern Sierra, significant in the central Sierra, and patchy in the northern Sierra. Mortality is concentrated at lower elevations though significant mortality is also occurring at higher elevations in the southern Sierra. The hardest hit species has been ponderosa pine (*Pinus ponderosa*), but many incense cedars (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), and some oaks have experience mortality as well. At higher elevations, Jeffrey pine (*Pinus jeffreyi*) and lodgepole pine (*Pinus contorta*) have also died.



Die off of trees at this scale is a result of two intertwining factors, the historic drought and the overstocked condition of our forests and woodlands. Decades of fire suppression and harvesting of the largest and most resilient trees means that the Sierran landscape has become overcrowded with vegetation vulnerable to wildfire and insect epidemics. Western pine beetle (*Dendroctonus brevicomis*) is the primary culprit this time, though mountain pine beetles (*Dendroctonus ponderosae*) and pine engravers (*Ips paraconfusus*) have also been active.

Tree death and removal: Removing dead trees from your landscape is important, especially around the home. Dead trees should be removed in order to reduce the danger of falling on homes and infrastructure. Dead trees will also eventually fall and become large fuels on the forest floor leading to more intense fires. After tree removal by heavy equipment, branches, needles or even parts of the tree trunk may have been left behind. Usually this debris must be cleaned up or burned before starting a new landscape. Also, dragging the trees out may have disturbed the soil and some raking out of the forest floor around the home may be a good idea.



Assessing the landscape: It is important to assess what is left after tree removal before considering replanting, as there is often a lot of live vegetation remaining. Making a survey of your property and mapping what is growing and where is a good approach, marking where you find living trees and identify them by species and size.

Ponderosa pine grow well only in sunny conditions and do not tolerate shade. You may find young pines have naturally regenerated in gaps created by canopy trees dying resulting in more sunlight. Other trees including incense cedar and white fir do tolerate shade and are often found growing in the understory. In addition, oaks may be doing well where nearby conifers have died. Oaks have the ability to drop leaves during drought and re-leaf in the spring. Oaks can also re-sprout if their tops are killed. So, even oaks that look dead may be able to rebound after the drought is over.

Nurturing existing trees: If you have a significant number of trees left, you may not need to replant. Instead you may want to promote the smaller trees left after the dead ones have been removed. These young trees may benefit from some nurturing. You may want to thin trees out so that available sun and soil moisture is focused on the healthiest individuals. Some watering of these trees in the summer may help counter stress caused by increased solar radiation. Consider clearing out shrubs, grass and other competition around seedlings to help them grow as competition from these types of vegetation are especially difficult for pine seedlings. Digging up natural conifer seedlings and moving them is not recommended as it is very difficult to do without harming the tree's already developed root system.

Replanting trees: If you have fewer living trees than you want, or would like more pine than you currently have, replanting native conifers is a good strategy. Native trees are best adapted to our local climates. Though many pines have died, this is not necessarily a sign that conifers are no longer adapted to your location, even with a warming climate. There may be some locations where trees were at the farthest south (warmest) and lowest elevation (driest) that they could tolerate, meaning that they may not do well in the future. However, for most areas, local growing conditions should support native conifers in the near future. Planting individuals and species from slighter lower elevations may be a good way to hedge against warmer temperatures in the future. Although some native shrubs and plants may have died during the drought (or been battered during the tree removal process), these plants are generally hardy and come back on their own without planting. Shrubs can re-sprout while native herbaceous plants generally store seed in the soil and should be able to regrow during non-drought conditions

You have a few options for replanting trees. These include:

Large nursery tree saplings – Since large trees are more expensive to purchase, they should be placed in the most advantageous locations possible near the home for visual screening or wind breaks. These require the most care including soil amendments and weekly watering in the dry season for the first few years.



Small container growing tree seedlings – Small container grown seedlings (picture to left) are much less expensive to purchase although they also require some care including watering during the dry season. Therefore they are best planted around the home landscape or within a distance that allows for watering. These are typically planted in the early spring or late fall during periods of high soil moisture.

Bare root seedlings – These are least expensive option and do not require soil amendments or watering after they have been planted during periods of high soil moisture. They are the best option for planting numerous trees on large acreages.

Oaks – Native oaks extend very deep roots in their first few years of growth thus are best planted using acorns gathered locally in the fall. This method is inexpensive and germination can be high if done right.

Soil conditions may have been adversely affected by post-mortality activities such as tree removal and debris clearing. Soil amendments such as compost, Driwater¹, and mulch may be helpful before planting any of these tree types.

Where to plant trees: Planting trees in the right location is one of the most important factors in their long term success. Take care to plant trees to not create future problems:

- Spacing – It's important not to plant trees too densely or you may create a need to thin them out in the future. Trees should be planted at least 10-14 feet apart.
- Defensible space - All new landscaping will need to conform to defensible space requirements. Trees and flammable vegetation should be kept at least 10 feet from the home and thin within 30 feet. In the 30-100 foot zone, trees should be widely spaced so their crowns will not touch when they are mature. Trees can fill in to a more natural looking forest 100 feet from the home.
- Power line clearance - Trees should be planted at least 10 feet from power lines. Trees planted too close to power lines will eventually need to be trimmed or topped.
- Road right of way - Trees should not be planted within the road right away so there is no interference with snow clearance, maintenance or construction projects.
- Sun availability – Plant pines where there is now a lot of sun because trees were removed. The potential for future solar energy generation should also be assessed before planting. Do not plant sugar pine on the driest sites
- Views – Consider future views and don't plant tree that will block these desired views.

¹Driwater or similar products is a time released irrigation solution that can help provide irrigation to remote tree plantings.

For more information about tree mortality visit <http://cecentralsierra.ucanr.edu/> or <http://ucanr.edu/barkbeetle/> or call University of California Cooperative Extension Central Sierra office at 530-621-5502.