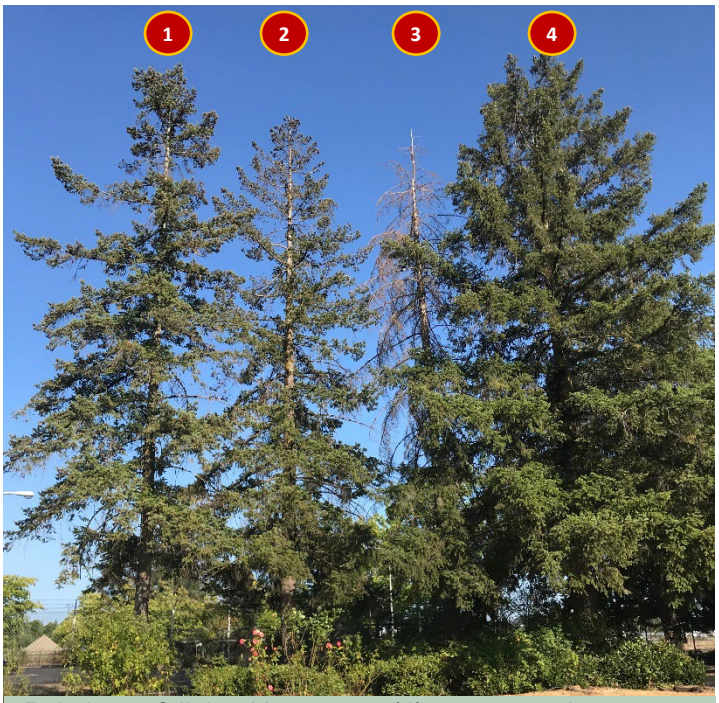
Drought stress in conifers

October 2023



Relative to full, healthy crowns (4), symptoms in droughted trees include: (1) missing or shorter branches, (2) thinning crowns, which may start at the top, and (3) top kill. These symptoms may appear slowly over time.
Christine Buhl, ODF

Ongoing droughts, often accompanied by high temperatures, are impacting all tree species across Oregon. Drought is often the primary cause of thinning crowns, and dead branches or whole crowns. Drought damages trees by killing roots and causing the collapse of vascular tissues, which affects trees' ability to absorb and transport water. A reduction in water then disrupts photosynthesis and defenses against opportunistic pests. Sometimes it can take years for drought to visibly affect a tree but it can also takes years for trees to rebuild damaged tissues following a drought. Some tree species can tolerate short periods of drought but not enduring or repeated drought. Frequency, duration, timing, and rate of change are just as important as record highs and lows for precipitation and temperature.

Stay up to date on drought status and predictions via monthly emails from the Oregon Water Resources Department: *https://tinyurl.com/drought-report-email*

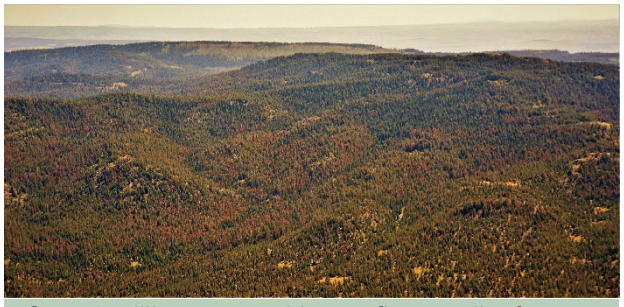
One of the primary reoccurring stressors in Oregon forests has been ongoing drought as a result of climate change. The fact that earth is experiencing changes in temperature is not unprecedented, however the rate at which temperature is changing is unusual. Earth's climate patterns are affected by multiple different variables such as natural, alternating periods of cooling and warming, and currently, earth is in a warmer phase. Climate is also affected by periodic fluctuations in sea surface temperatures and overlying atmosphere called El Niño (warm phase) and La Niña (cool phase), which typically last around two years. Despite these normal patterns, climate trends indicate an unnatural increase in average temperature and less consistency in average precipitation.

These trends in changing temperature and precipitation resulted in a peak period of drought from 2013-2015 across Oregon. Since then, most counties in Oregon have ranked in the highest drought categories ('severe' to 'exceptional') for large parts of the year. Warmer and drier conditions have resulted in lower levels of snowpack which also recede earlier. And sudden and acute events such as the 2021 heat dome and late season snowstorms have added to the stress of ongoing drought being endured by trees.

Frequency, duration, timing, and rate of change are factors that influence how damaging drought can be for trees. Droughts during active growing periods (spring) can be more damaging than if they occur during dormant periods (winter). Short droughts can be tolerated by some species that have evolved the ability to reduce water loss through leaves, but this strategy also limits photosynthesis. If there are back-to-back years of drought and trees don't get a reprieve to rebuild damaged tissues, they may never catch up even if a drought period is punctuated by adequate precipitation. Sudden changes in heat or

precipitation can shock trees even if the changes are moderate.

Drought damage is intensified for tree species that are less drought-tolerant such as western hemlock, true fir, and western redcedar or for any species growing on the fringe of their preferred range. And the preferred range of some less drought-tolerant species appears to be shifting or shrinking due to these changing conditions.



Over 1 million acres with true fir mortality from drought and subsequent bark beetle attack was detected in 2022 aerial surveys. *Danny DePinte, USFS*

Various site factors influence microclimates and may intensify drought conditions. Soil types that are too porous to retain enough moisture or soils that are shallow or rocky can reduce soil moisture availability. Trees growing along roads, ridges, edges, open areas, or on south-facing slopes are more exposed to the drying effects of heat, wind, and other stressors. There are other factors that compound drought damage such as: competing plants, wounding from equipment, construction or grazing near fine roots present in the upper 1-2 feet of soil, fluctuations in the water table or irrigation systems, etc.

Heat and drought stress is one of the main underlying causes of tree dieback and decline and is often followed by attack from opportunistic bark beetles. Healthy trees are able to produce physical and chemical defenses against invading insects and diseases. Droughted trees produce less of these defenses. Further, stressed trees emit volatiles that advertise their lowered defenses and attract opportunistic pest insects. Landscape-level stress conditions from droughts produce a pulse of weakened trees that allow bark beetle population outbreaks which may spill over into healthy trees.

Drought management:

1. Opt for native species and select from genotypes and seed zones that are projected to do well at your site under ongoing drought conditions. Pay attention to which species are doing well and do not continue to replant with species that are struggling to survive. Seedlot Selection Tool using climate projections: *https://seedlotselectiontool.org/sst/*

Relative Drought Tolerance for Tree Species

Tree species	*Drought tolerance (1=high, 5=low)*
Oregon white oak	1
Ponderosa/Valley pine	1
Incense cedar	2
Douglas-fir	3
Grand fir	4
Western redcedar	4

William Emmingham, Extension silviculturist emeritus, OSU

2. Establish seedlings well.
3. Manage a stocking level or stand density that is appropriate for your species and projected drought conditions. Tree species stocking guide: *https://catalog.extension.oregonstate.edu/em9206/html*
4. Reduce competition from other competing plants, especially invasive species.
5. Do not fertilize during droughts; increased growth increases moisture requirements.
6. Prevent damage from mechanical equipment, wildfire, insects, and diseases to increase tree resiliency. And remove weak, injured or extremely stressed trees to make more resources available for healthier trees.
7. If irrigation is possible at your site, ensure that it is sufficient: *https://www.oregon.gov/odf/Documents/forestbenefits/watering-fact-sheet.pdf*

Oregon Department of Forestry | Forest Health
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