



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Western Wildland Environmental Threat Assessment Center

Drought in the West

Interactions with Insects

Drought is a major factor influencing western rangelands and forests. The direct effects of drought are difficult to identify, as they occur in conjunction with other disturbances, including forest insects, and vary widely by species and location on the landscape.

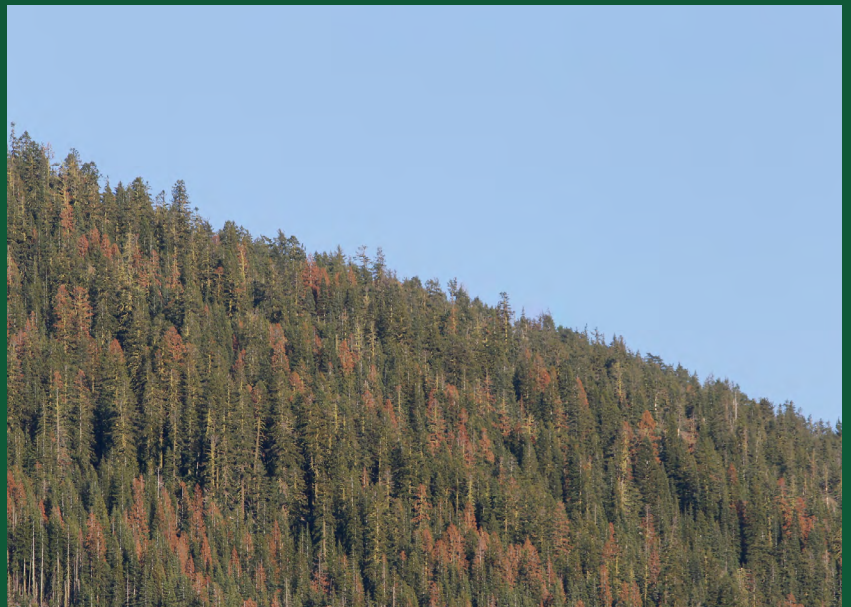
The impacts of forest insects are often magnified under drought conditions. The exact relationship between drought, specific insects, and tree species is complex and still being studied. However, insects cause substantial damage to forests across the West. Bark beetles cause by far the most damage of all insect types in the Western U.S., and recent outbreaks have impacted a larger area than wildfires.

The term “outbreak” is often used when discussing forest insect damage; many forest insects become harmful only when multiple biophysical conditions are met and negative feedbacks no longer limit population growth. Depending on the species and landscape, drought, and especially the heat often associated with drought, can affect these conditions and make outbreaks more likely.

While drought is only one factor in complex ecosystems, there are a few general patterns noted below, such as signs of water stress and increases in insect population, that land managers can look out for in monitoring insect effects on forests.

Water stress reduces natural defenses

Droughts that last more than a growing season can make trees more vulnerable to insect outbreaks by limiting their ability to use their natural defenses. For example, conifers that dominate western forests produce pitch, a sticky resin-like sap which traps insects and seals small wounds in the tree’s bark. Water-stressed trees may produce less pitch in response to attacks from insects like bark beetles. Pitch may also contain fewer insect-repellent compounds like terpenes, which serve as an additional defense.



The combination of drought stress and insect damage can be particularly harmful, like this mortality event in Shasta Trinity National Forest. Photo courtesy of [USDA Forest Service](#).

Overall tree stress increases vulnerability

Many forest insects and diseases attack already stressed trees. Often, insects are able to take advantage of an influx of water- and heat-stressed host trees, which allows insect populations to grow large enough to damage less stressed trees as well and affect a larger area. Damage from insects on already stressed trees can tip them from survival to mortality.

Insects and diseases are also affected

The length and repetition of drought can have a significant effect on the pattern of insect disturbance. Some insect outbreaks, especially bark beetles and defoliators, may be more severe and widespread during short or intermittent drought, since trees are stressed but still retain enough nutrients and moisture to feed an insect population. Recent droughts have occurred with higher temperatures, which can help insects survive through winter, magnifying outbreaks.

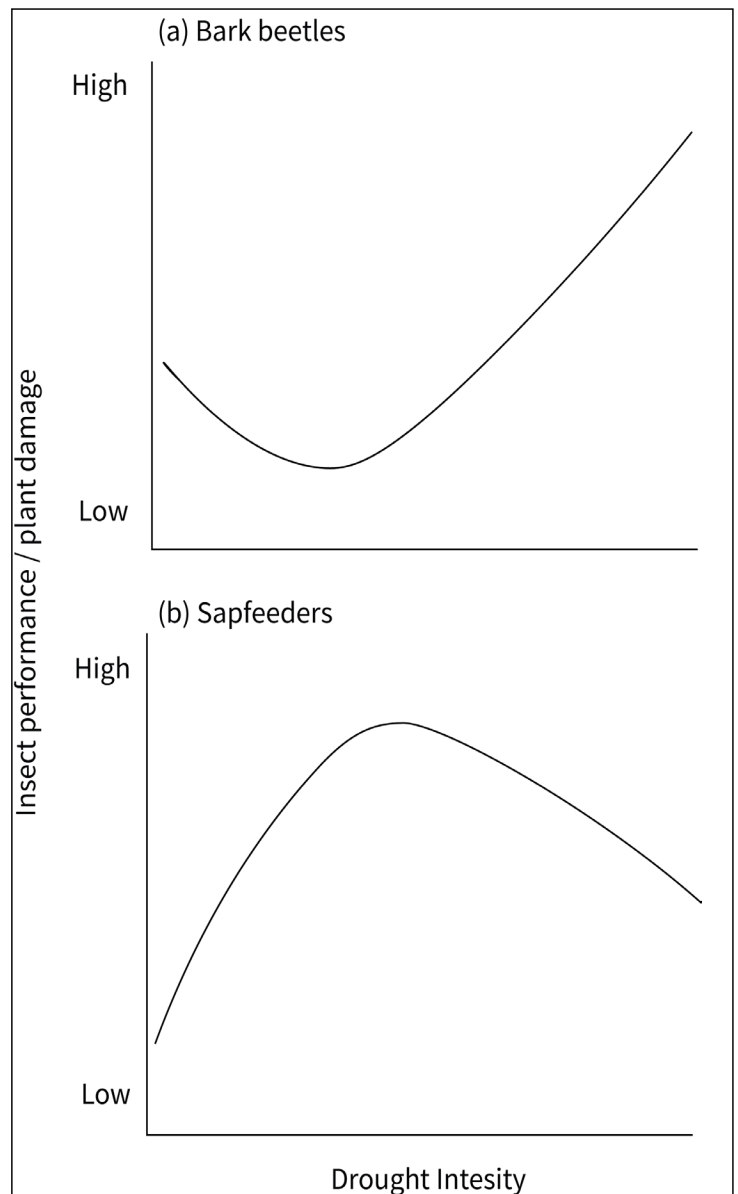
Multi-season droughts, however, may reduce the prevalence of forest insects like defoliators, since some do not prefer drier, more leathery foliage that results from water stressed plants.

Monitoring and management

Knowing when drought is occurring and for how long can inform monitoring of insects. For example, aggressive species like mountain pine beetle and spruce beetle can cause widespread mortality for several years after a drought has ceased, whereas other species like pinyon ips depend on water-stressed trees for success and quickly decline when wetter conditions return.

Resources

- [This paper provides a good overview of how drought and insect types interact throughout the U.S.](#)
- [USDA Forest Service Forest Insect & Disease Leaflets \(FIDLs\)](#) have specific profiles for many forest insects and diseases.
- Use [this link](#) for more information about drought interactions and updates.



This conceptual figure shows how two major insect types generally respond to drought as it intensifies. Figure is adapted from [Kolb et al. 2016](#).

The Western Wildland Environmental Threat Assessment Center (WWETAC) develops and communicates the latest scientific understanding of environmental threats to the western United States. We conduct applied science and provide tools and information to help land managers assess and respond to environmental threats, leading to more resilient landscapes.

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