

Drought in the West

What is Drought?

The West is defined by water, both in terms of its abundance and its absence. Water moves through every ecosystem in what is called the “hydrologic cycle,” as it flows between soils and bodies of waters to plants and into the atmosphere. This cycle naturally ebbs and flows, and when available water is scarce, a drought may occur.

The National Weather Service defines drought as “a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area.” For more specificity, drought is sometimes broken down into a few types. First, there are two general categories:

- **Meteorological drought:** When dry weather dominates an area. Meteorological drought is generally determined by comparing short- and medium-term precipitation levels with historical averages. This type of drought can begin or end relatively quickly, but may contribute to other, more persistent types of drought.
- **Hydrological drought:** When an entire water system has low water supply. While precipitation plays an important role in recharging water supply, other natural reservoirs also provide water, such as mountain snowpack, groundwater aquifers, and soil moisture. Hydrological drought occurs when these other reservoirs begin to deplete, and can have significant effects on ecological and human systems. This type of drought generally takes longer to begin, but also take longer to resolve.



There are also categories of drought that are defined by their effects:

- **Agricultural drought:** When crops are affected by drought.
- **Socioeconomic drought:** When human supplies and demands are affected by drought.
- **Ecological drought:** When ecosystems are affected by drought.

Often, a long-term drought will affect many sectors. It is helpful to distinguish types of drought, as some systems may be more affected than others. For example, a drought may affect grass production and rangeland productivity, but not be sufficiently intense to affect forest health by lowering tree growth rate and resilience to insect outbreaks.

It is also important to remember that drought refers to the relative lack of water at a specific time and place, not a standard threshold. Drought in an area like western Washington, which is adapted to a high average amount of moisture, differs from a drought in an area like the much drier Mojave Desert in hydrologic terms and vegetation effects.

What Drives Drought?

There are multiple factors that cause a drought to occur, but there are two main drivers:

Low precipitation: Generally, this is associated with meteorological drought, and has historically been the main driver of drought throughout the Western U.S., although this has changed in recent years.

Heat: Higher temperatures can cause high evapotranspiration (both evaporation from surface water and soil, as well as transpiration from plants), which results in higher overall water demand from the entire water system. Increased temperature and subsequent moisture demand have now emerged as the primary driver of drought in the Western U.S. With high temperatures, droughts can occur even when there are normal precipitation patterns. These hot droughts put significantly more stress on plants, and have been linked to a number of tree die offs across the Western U.S.



Hot droughts are a growing problem in some parts of the Western U.S., including the tree mortality seen here in the 2012–2015 California drought. Photo courtesy of [Nathan Stephenson, USGS](#).

Snow and Snow Drought

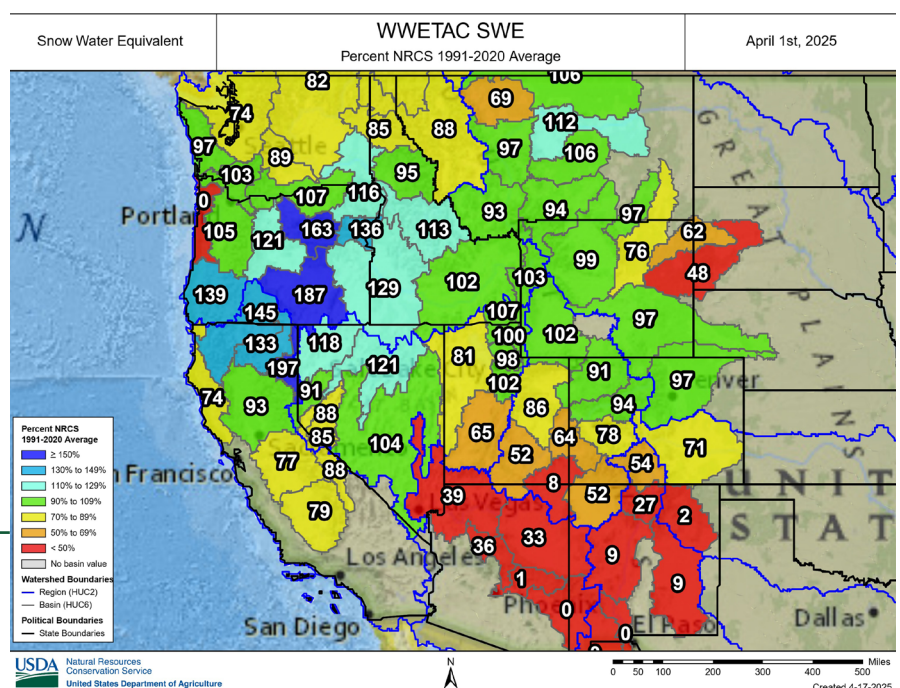
Snow also plays a significant role in drought and the hydrology of the Western U.S. Accumulated snow in mountainous areas, or snowpack, slowly melts through the summer and fall, releasing water into lowlands even when precipitation is not present. A snowpack acts as a natural reservoir, and requires both sufficient precipitation and consistently cold temperatures to allow precipitation to accumulate.

An abundant snowpack will likely continue to provide water for the entire dry season depending on weather conditions. However, a low snowpack may run out of water before more precipitation replaces it, resulting in a water shortage and potentially contributing to regional drought.

There are generally two types of snow drought:

- **Dry snow drought:** Less snow than normal falls during the winter, so a historically normal snowpack never forms.
- **Warm snow drought:** Snow doesn't accumulate despite normal precipitation. This is caused by warm winter or spring temperatures, resulting in precipitation falling as rain rather than snow or an earlier than normal snowmelt.

The map to the right shows data from an interactive dashboard from the [USDA Natural Resources Conservation Service](#). Networks of manned and automated sampling stations keep information about snowpack levels up to date across the West.



Disturbance Interactions

Wildfire

Droughts do not directly cause wildfires, but they can create conditions that lead to more frequent and severe fires. Short- to moderate-term droughts dry out existing fuels like grasses, shrubs, and dead wood, which makes them more susceptible to ignition. In addition, widespread droughts can reduce natural water sources that could otherwise slow fire spread, as well as municipal water sources used in fire management. However, long term drought can actually reduce wildfire frequency, since extended water stress can reduce the amount of biomass plants produce, thus reducing total available fuels.

Insects and Disease

Like wildfire, the effects of forest insects and diseases are often magnified under drought conditions. The exact relationship between drought, insects, diseases, and specific tree species is complex and still being studied. In general, though, water-stressed trees have fewer resources to devote to their natural defenses against outbreaks, and higher overall stress increases the damage insect and disease outbreaks cause.

However, extreme drought conditions may also affect the success of insects and diseases, and can increase resistance to some outbreaks.

Invasive Plants

Drought may drive species distribution change or even full-scale ecosystem transformation if it is sufficiently long-term or repeated. While plants, native and non-native alike, are affected by drought conditions, some are better adapted than others. If invasive species are better adapted to drier or hotter conditions, they may be able to take advantage of the disturbance those conditions cause to outcompete native species. Many invasive species are also able to establish more quickly than native species, so increases in other disturbances like fire or insect outbreaks driven by drought increase potential invasion by these species.

Resources

There are many excellent resources for learning more about drought causes, conditions, and effects. Sources for reliable, up-to-date drought data including the following:

- General information about current drought conditions is available at the National Oceanic and Atmospheric Administration's [National Integrated Drought Information System Dashboard](#). This has information about current drought conditions throughout the U.S., future drought outlooks, fire outlooks, and effects by sector and location.
- Fact sheets on disturbance interaction for wildfire, insects and disease, and invasive plants as well as seasonal drought status outlooks are available at the [WWETAC website](#).

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. To learn more, visit <https://research.fs.usda.gov/pnw/centers/wwetac>.

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