

Dismal Western Snowpack Is a Climate "Warning Sign"

The potential for drought and large wildfires looms over the summer

By Chelsea Harvey, E&E News on May 14, 2018

Credit: Danita Delimont Getty Images

It's only May, and it's already shaping up to be a stressful summer for many western states.

Low mountain snowpack is a big part of the problem.

Both the mighty Rio Grande and the Colorado River are experiencing low flow in places, prompting concerns about everything from water shortages to the plight of suffocating fish. U.S. officials have already launched rescue missions for an endangered minnow in New Mexico, where parts of the Rio Grande have already started to run dry—an unusual event so early in the season. And officials are urging states in the Colorado River Basin to finalize drought contingency plans before the end of the year, as the possibility of future shortages loom (*Climatewire*, May 10).

Meanwhile, states across the Southwest are bracing for what may well turn out to be an above-average fire season, due to dry conditions and an early start to the summer blazes. At least 10 major wildfires have already burned tens of thousands of acres in the western states, with the Arizona Tinder Fire—which sprang up two weeks ago in the Coconino National Forest—claiming more than 16,000 acres alone (*Climatewire*, May 2).

The unusual conditions come on the heels of a dismal season for mountain snowpack in both the Sierra Nevada and the Rocky Mountains. Snow in the Sierras had approached a record low earlier this spring, before a series of late winter storms helped bolster its levels—but even so, an early April survey by the California Department of Water Resources found that snowpack was still only at 52 percent of its historical average. And as of May 10, snow levels throughout California were at about 20 percent of their typical averages for this time of year.

Meanwhile, the Rocky Mountains have faced a similarly dry season. As of January, Colorado snowpack levels were among their lowest in decades. And as of this month, much of the Colorado River Basin was seeing snowpack at levels less than 50 percent—and in some places less than 25 percent—of their typical averages.

The implications, even for a single season, are concerning.

Snowpack from the Sierra Nevada supplies about 30 percent of California's water resources as it melts in the spring and summer. And the Rio Grande and Colorado River, both fed by runoff from the Rocky Mountains, each supply drinking water for millions of people. Additionally, spring runoff helps to moisten and recharge the soil—shortages can stress the local vegetation and cause the landscape to dry out faster, potentially increasing the likelihood of earlier and more severe wildfires.

But research suggests this season is hardly an anomaly. Studies show that snowpack has been declining throughout the western United States for decades. And climate change is expected to worsen the problem in the coming years.

LONG-TERM TREND

Throughout the western United States, snowpack is declining year over year.

A study published in March found that 90 percent of all snow monitoring sites throughout the western states—from the Four Corners west to California—have been experiencing some degree of loss since 1955, with about a third of them showing significant declines. By comparison, just 2 percent of sites seemed to be significantly gaining snow. Overall, the researchers found that western snowpack has declined by about 21 percent, or 36 cubic kilometers, since 1915—that's more than the amount of water stored in the Colorado River Basin's Lake Mead, the West's largest reservoir, they noted.

Other research places the recent conditions in a similar context. One notable 2011 study used data from tree rings, which can tell scientists about past disturbances affecting forests in a given region, to reconstruct snowpack levels in the western United States hundreds of years back in time. They found that recent snowpack declines are nearly unprecedented in the last millennium—a phenomenon the researchers attributed to “unparalleled springtime warming.”

A more recent paper from 2015, also relying on tree ring data, focused on the Sierra Nevada. It found that spring snowpack levels that year were at their lowest in 500 years.

Clearly, western snowpack is declining long term—and it's breaking records in the process. And scientists suggest it will only get worse if climate change continues to progress unabated.

Last year, a modeling study in *Nature Communications* concluded that recent snowpack declines could not be explained by natural climate variations alone—human-caused global warming is certainly a prime contributor. And if current conditions are allowed to continue, losses throughout the western states, from the Rockies to the Sierras, could be as high as 60 percent in the next 30 years.

Scientists from UCLA just projected a similar future for California, alone, in a new report on climate change in the Sierra Nevada. Under a business-as-usual climate trajectory, they suggest the state's snowpack may decline by up to 64 percent by the end of the century.

"There's been a growing body of evidence that there have been some long-term declines in Sierra snowpack," said UCLA climate scientist Neil Berg, one of the report's authors, noting that this year's below-average snowpack may present a look at what typical conditions may be like in the coming decades.

While rising temperatures have a lot to do with both past and projected declines, they're not the whole story. Another big factor involves changes in overall precipitation patterns and a shift from snowstorms to rain.

Climate models suggest that under future climate change, California and other parts of the western United States may experience greater variability in the types of climate events they experience—more severe droughts, for example, but also more severe precipitation events (*Climatewire*, April 24). Dry years will have an obvious effect on mountain snowpack. But even years marked by heavy precipitation events can contribute to snowpack declines if the winter experiences more rainstorms than snow.

This year is a prime example of what that future might look like, Berg suggested.

"There was a really large atmospheric river event just a few weeks ago—but it was very warm in California at the time, so much of that precipitation fell as rain instead of snow," he told E&E News. "And that's the type of scenario we'll see going forward, where these types of storms will deliver more rain than snow."

Even in years when snowfall is high, higher temperatures are likely to cause earlier spring melts, Berg added, which can cause water supplies to dry up sooner in the season.

THREATS TO WATER SUPPLIES, EARLIER FIRE SEASON

As this year would indicate, falling snowpack levels produce fallout in a number of ways. Declines in freshwater resources for human communities are among the biggest of these concerns.

While both California and the Colorado River Basin may escape serious shortages this year, the future of water resources in the West remains in question. The Bureau of Reclamation recently warned that there's a 52 percent chance of shortage conditions at Lake Mead, the West's largest freshwater reservoir, by 2020, and the risk only increases after that point.

"Over the past decade, the risk of declining to critical reservoir levels has approximately tripled," the agency noted. But there are other risks, as well. Trees and other plants may suffer if there's not enough spring runoff or if the melt occurs too early. Dry soil and vegetation may also influence the length or severity of the western fire season.

"When you have snowpack disappearing really early, the soil will dry out faster and the plants also," said Donald Falk, an ecologist and wildfire expert at the University of Arizona. Falk led a study, published in December in *PLOS ONE* that investigated the links between the area burned by western wildfires with trends in temperatures and snow cover.

"The big effect that we've found is that it's affecting how early the fire season starts," he told E&E News. "So when you have low snowpack and warm temperatures, and everything is drying out fast, the real effect is that the fire season starts earlier."

It's hard to speculate on whether any of the individual fires already blazing this year were directly influenced by the low snowpack, Falk noted. Wildfires are notoriously difficult to attribute to any single cause—they can be influenced by so many factors, from human land-use practices to climate variables. But in general, he suggests that long-term snowpack declines will have an influence on the western fire season—and likely have already, given that research suggests the fire season is lengthening over time.

But he also notes that many of the other factors affecting western wildfires, such as rising temperatures and changing precipitation patterns, are also driving the snowpack declines—the whole system is interrelated.

"I think that snowpack would be like melting glaciers," he said. "It's like a warning sign that's being sent up by the climate and terrestrial ecosystems that something is changing and possibly something is wrong. I really have come

around to thinking that's the important way to think about it—as like a symptom of the bigger things.”