News
EarthBeat



Snow pillows used for measuring snow water equivalent are covered with a bear net in the Kaweah Watershed at Southern Sequoia National Park in California, Nov. 18, 2021. (Kelly M. Grow/California Department of Water Resources)

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It's that time of year in the West. Winter enthusiasts have started waxing their skis and crossing their fingers for a plentiful snowpack — something that's been in short supply of late. Of course, it's not just recreation at stake, as a sweeping drought still has a hold over a region that needs a lot more water to replenish depleted reservoirs and ecosystems.

While tourists watch the weekend weather reports, scientists also have their eye on winter conditions further ahead.

A new study in Nature Reviews Earth & Environment sounds the alarm about mounting research showing the West is on track for a future where little to no snow becomes a regular winter occurrence. If greenhouse gas emissions aren't reduced, models show significant reductions in snowpack in the West's mountains over the next 35 to 60 years — with far-reaching implications for ecosystems, agriculture and communities.

Erica Siirila-Woodburn, a research scientist at Lawrence Berkeley National Laboratory and one of the study's lead authors, says these findings shouldn't come as too much of a surprise. The April 1 snow-water equivalent — a common measurement to determine the amount of water in snowpack — has already

declined by 20% since the mid-1950s.

"This isn't a future problem. This is something that's already happening," she says.

While things aren't great now, they're likely to get much worse during the second half of the century, the study explains.

During the second half of the century, the models predict that most years in the West — from 78-94% of winters — will see little to no snow. California will experience this shift first. Five consecutive years with less than half the usual snowpack could occur as early as the late 2040s, compared to the 2060s for other mountain basins in the West.

Despite these troubling predictions, the issue of snowpack declines still doesn't get enough attention in discussions about climate change, says study co-author Alan Rhoades, a hydroclimate research scientist at Lawrence Berkeley.

"We wanted to elevate the urgency of snow loss to the level of some other climate impacts that we often see in the news, like sea-level rise, wildfires and extreme weather events," he says. "We view this as one of the central issues for the Western U.S. in terms of water supply, reliability and ecosystem health."

A significant decline in winter snowpack is likely to have "multibillion-dollar implications," the study explains.

The West's water system was built around reliance on a snowpack that builds up over the winter months and then melts in the late spring or summer, helping to fill reservoirs and irrigate farmland at the driest times of the year.

The accumulation of snow in the mountains function like giant reservoirs — and big ones.



Snow runoff near the California Department of Water Resources snow survey site at Phillips Station in the Sierra Nevada Mountains on Feb. 27, 2020. (Jonathan Wong/California Department of Water Resources)

"The April 1st snow-water equivalent in the Sierra Nevada roughly doubles the surface reservoir storage of California," explains Rhoades. "Not only that, snow is this bridge between when precipitation starts to shut off — like when we start to stop getting atmospheric rivers or these major storm events that drive precipitation — and then when peak demand occurs."

But warmer temperatures from our burning of fossil fuels are changing how much snow falls. It's also leading to runoff occurring earlier in the year, which may not align with when it’s needed most by people — or plants and animals.

Warming temperatures also mean that even less water may reach downstream reservoirs because it's being absorbed by thirstier soil and plants along the way — further diminishing water supply.

> "This isn't a future problem. This is something that's already happening."
> — Erica Siirila-Woodburn
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Sometimes even a seemingly small reduction in snow can have large effects on water availability when combined with higher temperatures and drought conditions — as was the case recently in the Colorado River basin.

"Last year, there was 83% snowpack in the Colorado Rockies that really turned into about 30% hydrology, meaning that by the time the snow melted, only 30% of it actually went into hydrology — into the river and down the basin," Randy Lavasseur, acting superintendent of the Lake Mead National Recreation Area, told the Camas-Washougal Post-Record. "The rest of it, the soils were so dry, it just absorbed in the soil."

Less water available for ecosystems could change what kinds of plants are able to grow. Drier vegetation can also increase wildfire risk. And decreased water in rivers and wetlands could harm a host of aquatic species. Already many species of salmon are struggling to survive in rivers where low flows become too warm in summer months for the cold-water loving fish — a scenario that's likely to get much worse with a diminishing snowpack.

People, too, will feel the pinch.

A major reduction in water supply could dry up millions of acres of irrigated agricultural land and reduce the drinking water available to rural residents and urban dwellers alike, while also reducing power from hydroelectric generation.

While the most significant reductions in snowpack are still decades ahead, planning for potential changes to water availability should start happening right away, the study's authors say.

"The climate is projected to change pretty dramatically over the next 50 years," says Rhoades. "So if we do need more infrastructure or we need to alter how we manage our infrastructure, how do we take into account the changing hydro-climate?"

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We'll need to get creative with ways to reduce how much water we use and stretch water supplies further. Conservation and efficiency will be needed across households and industries. Groundwater reservoirs can be actively managed to increase storage capacity to take better advantage of surplus water when it occurs. And new technologies can help better manage reservoirs, treat polluted water, or transform wastewater into potable water.

Whatever solutions are employed, though, they'll need to be done with the long-term climate picture in mind and other ecological considerations, like preserving biodiversity.

"Decisions and investments made today will extend multiple generations, operate for half-centuries or more, and need to function within rapidly changing hydroclimatic conditions," the researchers write.

Employing different demand and supply-side solutions will also take time, money and a lot of collaboration — which is why the study's authors urge action right away. And not just from water managers. Everyone from academics to stakeholders and policymakers need to get out of their traditional "silos" and work together to address the problem.

"I think partnership shouldn’t be overlooked," says Siirila-Woodburn.

With an entire water infrastructure system built across the West "based on the assumption of an abundant snowpack," he says, "there hasn't been a lot of proactive thought in a concerted way on what we do about that changing."

The time to begin that proactive planning, Siirila-Woodburn says, is now.

"This needs to be an urgent consideration."

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