Science Brief

Photo: Sabrina Chui

Forest Restoration Impacts on Snowpack

Forest restoration, through ecological thinning, mastication, and prescribed burning, has the potential to increase peak snow accumulation and extend snowpack duration compared to the largely overstocked forest conditions present today.

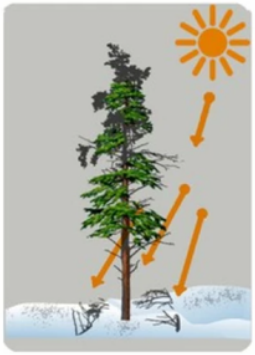
How does forest vegetation affect snowpack?

- Forest density affects the accumulation and melt of snowpack by intercepting falling snow in the canopy and changing how energy reaches the snowpack.[1,2]
- Regions with winter temperatures averaging above 30F, such as the Sierra Nevada and Pacific Northwest, hold snow longer in small forest clearings than under the forest canopy.[3]
- Higher density forests retain more heat during the mid-winter and spring, resulting in smaller peak snowpack and faster snowmelt.

Increasing wildfires threaten the snowpack of the western U.S.

- Wildfires, which have been increasing in nearly all mountain ranges across the western U.S.,[4] can accelerate snowmelt by dropping burned woody debris and black carbon onto the snow in the first years after a fire, reducing the snow's ability to reflect sunlight.[5,6]
- Large open areas created by stand-replacing wildfires also increase snowpack exposure to wind and solar radiation.[7]
- Snow measurements after the 2020 Cameron Peak Fire revealed that burned areas had, on average, an earlier snowmelt date by 18-24 days.[4]

Snow won't accumulate directly under healthy trees where snowfall is blocked by branches.



Wildfire indirectly accelerates snowmelt by producing litter that absorbs energy and heat.

Trees emit low and persistent levels of long-wave energy that melt adjacent drifts.

But big trees also offer lots of shade, which blocks significant amounts of solar energy and keeps surrounding snowdrifts intact longer into the spring and summer months, feeding thirsty forests and reservoirs.

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Tree emit long-wave radiation, melting the snow around their trunks. Photo: Sabrina Chui

While snow has melted under areas of dense vegetation, snow remains in this quarter-acre clearing. Photo: Sabrina Chui

Active Management Solutions

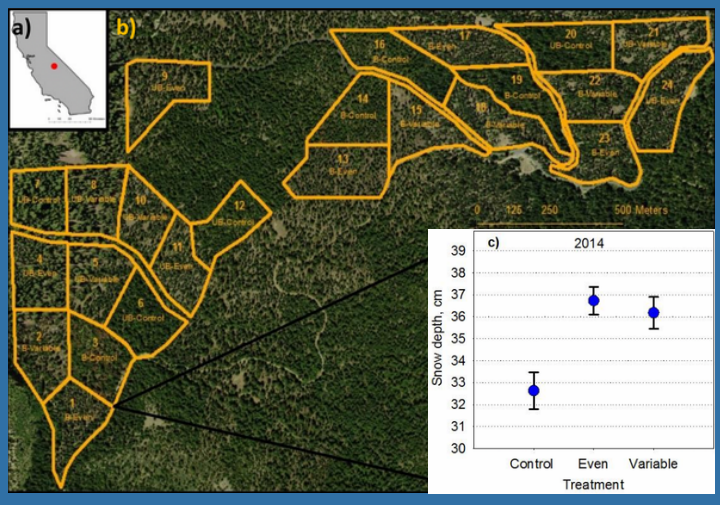
- In regions with warmer winter temperatures, decreasing forest canopy cover through the use of ecological thinning, mastication, and prescribed fire can allow more snow to reach the ground and accumulate while reducing the effect of long-wave radiation emitted by trees. [8]
- These restoration treatments will also impact fire behavior. Thinning treatments and prescribed fire decrease the likelihood of a high-severity fire, [9] so that when a wildfire eventually occurs, the foliage from surviving trees can still protect the snowpack from solar radiation. However, even low- to moderate-severity fires will still leave charred debris that may accelerate snowpack melt.

Why does snowpack matter?

- In the western U.S., snowpack accounts for up to 53% of total runoff, despite only 37% of precipitation falling as snow. [10] Snowpack acts as a natural reservoir for our fresh water supply.
- The delay of spring snowmelt is critical for maintaining freshwater flow and low stream temperatures in the summer, benefiting wildlife such as salmon and steelhead, as well as other sensitive aquatic species. [11]
- At regional scales, snowpack has the potential to delay the onset of the fire season by keeping surface fuels and soils moist longer into the fire season. [12,13]

Case study: Thinning Impacts on Snowpack on the Stanislaus National Forest [14]

- Snow depth surveys were conducted across three different forest treatments in the Pinecrest Experimental Forest on the Stanislaus NF during the 2013-2014 drought years.
- The variable thinning treatment created a heterogenous forest structure with gaps and clumps. The even thinning treatment reduced stems per acre and basal area per acre by a similar amount, but created a homogenous stand structure.
- Peak snowpack depth was 10-20% greater in the two thinning treatments compared to the unthinned (control) stands. There was no statistically significant difference in snowpack depth between the two thinning treatments.



The impacts of forest vegetation on snowpack are unique to each region.

Reach out to learn about the benefits for a specific forest at connect@blueforest.org.

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