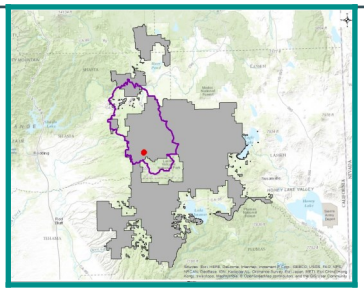
*Forest thinning does affect the timing and magnitude of water fluxes into and out of the forest soils. However, as soils in all treatments dry out, there was no **significant** 'gain' of water to the **watershed.***

Monitoring hydrologic responses to forest management treatments: *preliminary results from the Panner Timber Sale.*

The purpose of this project was to monitor the water balance and hydrologic changes in response to several thinning treatments implemented under the Panner Timber Sale. Treatments included diversity thinning and group selection, as well as no thinning in a spotted owl Home Range Core Area (HRCA), which serves as a control.

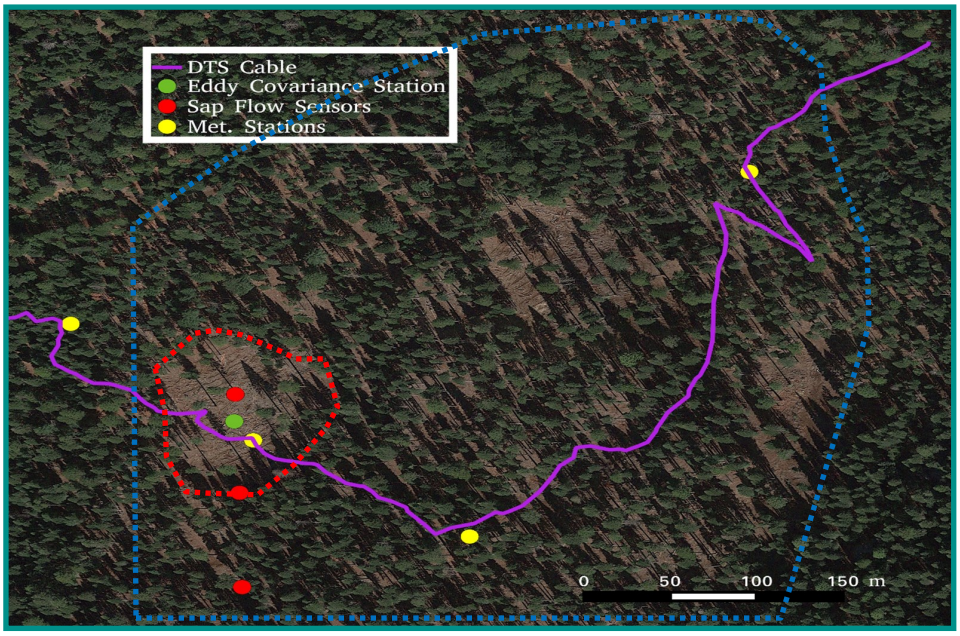
Key Findings

- The study site, situated in the southwestern portion of the *Basins* CFLR Project area, appears to have transitioned from having primarily snow-dominated precipitation to a rain-dominated one.
- Thinning was shown to postpone the onset of the growing season, due primarily to cooler conditions in the canopy.
- Thinning preserves soil water for late summer, as compared to an unthinned forest, and therefore improves drought resilience.
- The Group Selection treatment resulted in slightly higher soil moistures at the end of the summer season, however legacy trees within the Group Selection treatment continued to show signs of stress from the lack of moisture.
- All soils dry out, so there was no net water 'gain' to the system by thinning.



Project Location, the Basins CFLRP, and Lassen N.F.

*Thinning operations are expected to preserve soil moisture longer **into the summer**, **improving drought resilience and reducing tree mortality.***



Google Earth image of the treatment sites, showing locations of the wireless weather stations, tree sap flux monitoring and distributed fiber optic cable for monitoring snowmelt across the sites. The Group Selection and Diversity Thinning areas are roughly outlined in red and blue, respectively.

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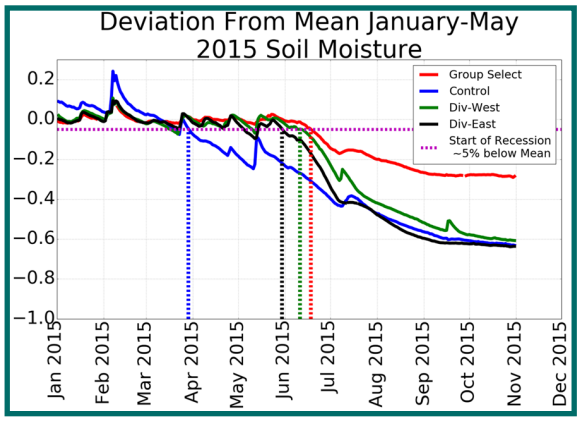
Project Overview

Forest thinning for fuel reduction and habitat restoration has become standard practice, yet its affect on the annual hydrologic budget of forests with maritime-dominated snowpack is not well quantified. Thinning should reduce the amount of rain and snow that is intercepted by the canopy, however changes in the amount of light and long wave radiation on the forest floor post-thinning may lead to earlier snowmelt and a possible earlier onset of fire season. At the Panner Site, a series of thinning treatments were conducted in 2011, ranging from no thinning in a spotted owl HRCA, to radial thinning with retention islands (Diversity Thin), to near-complete overstory removal in a group selection.



The beginning of forest transpiration (when soil moistures drop below the purple dashed line) was significantly earlier in the unthinned (Control) plot. However, both the Control and Diversity thinning areas fully deplete the soil moisture reservoir by the end of the water year.

Continuous monitoring of the treatments began in late 2013, with four installations of wireless-linked hydrologic monitoring stations measuring air temperature, humidity, solar radiation, wind speed, soil moisture and soil temperature. These stations report to a central computer, and data are streamed by cellular modem four times per day (publically available at http://data.cuahsi.org/). Each station has a dedicated automatic camera to record snow depth and passive samplers to monitor snow melt. In 2014, monitoring was expanded to include tree sap flux measurements on four ponderosa pine trees in the Group Selection and Diversity treatments as well as snow sublimation monitoring using an eddy covariance tower.

Although the site was initially chosen to monitor the effects of thinning on snow retention, it has received primarily rain since monitoring began in 2014 and has not had a permanent winter snowpack. Because of this apparent change in the rain/snow transition elevation, continuous monitoring of rainfall was initiated in 2016 to begin to assess the hydrologic impacts of thinning in a *rain-dominated* forest.

Game camera image of the control site. The dense canopy results in average winter temperatures warmer than any of the other treatments.

The Group Selection treatment had warmer daytime winter temperatures, however during spring and summer, elevated radiation and greater mean wind speeds led to greater water stress of the isolated seed trees.

The Diversity Thinned site shows much higher levels of light penetration, but also had cooler daily temperatures during the winter and early spring.