Fire Severity Increases Snow Accumulation in Mixed Conifer Forests

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Introduction

- Snow is an important water source for human civilizations. In fact, 75% of the water used throughout the summer in the Western part of North America comes from snowpack. Snow accumulation and ablation in North America varies from 57-72% due to changes in forest cover and composition (Varhola, Coops, Weiler, & Moore, 2010, p. 224).
- Forest systems that are modified by fire, are increasing in frequency and the impact on snow development remains largely unknown.

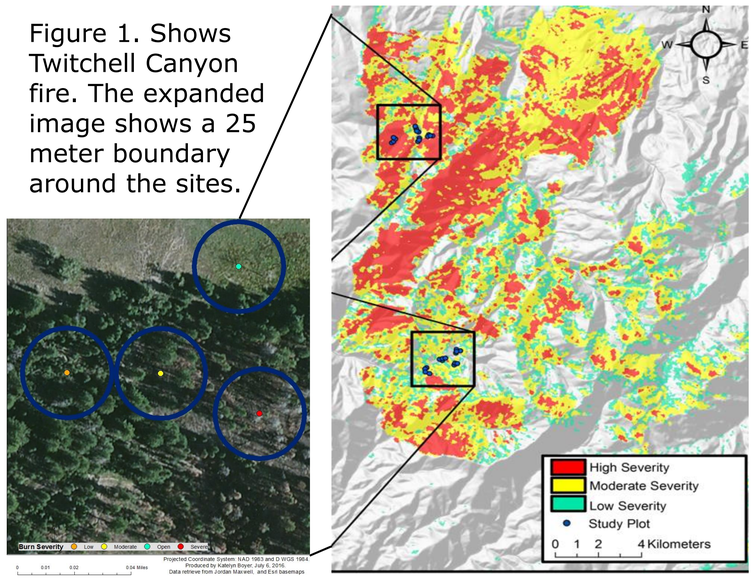

Figure 1. Shows Twitchell Canyon fire. The expanded image shows a 25 meter boundary around the sites.

Objective

- The objective of this study is to characterize how snow accumulation varies along forest burn severity gradients.
- This study addresses the following: how snowpack is affected along gradients of burn severity, and how topographical variables interact with burn severity to change snowpack.
- We hypothesize that areas with high burned severity receive a greater amount of snow accumulation during peak snowpack due reductions in snow interception due to reduced forest cover

Research Methods

- In 2010, in the Twitchell Canyon Fire area, six study sites were established in both Indian Creek Canyon and Shingle Creek Canyon for a total of 12 study sites.
- **Experimental design:** To characterize the relationship between snow accumulation and burn severity in forests, we arranged each block to consist of either a meadow or an area with low, moderate, or severe fire damage. Each site consisted of a 20 m diameter circular plot.
- **Sampling design:** In each block, the peak snow depth and SWE was recorded and stand composition, density and mortality were characterized using the point quarter method.

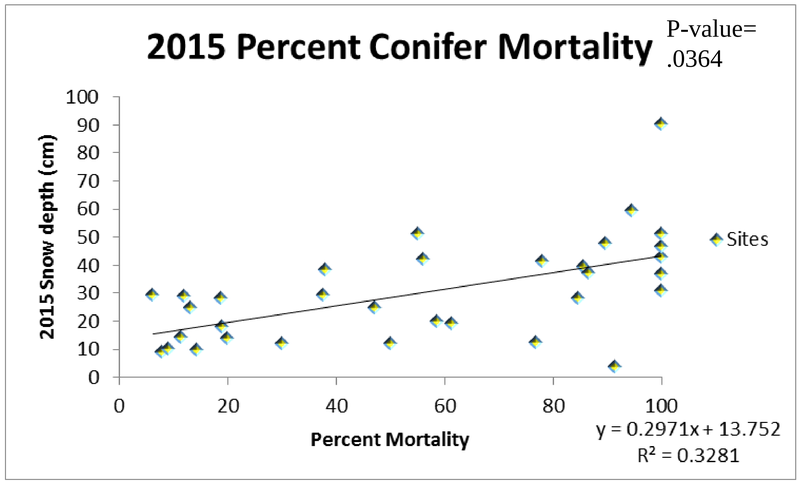

Figure 2. shows percent conifer mortality compared to snow depth in the winter 2015.

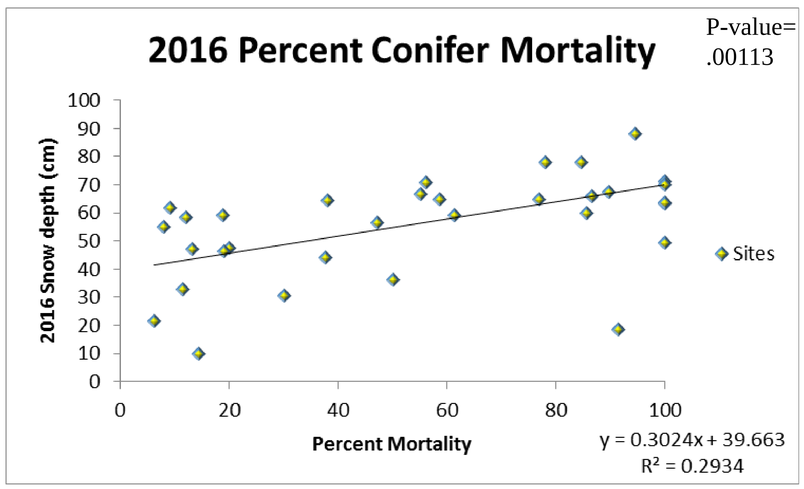

Figure 3. shows percent conifer mortality compared to snow depth in the winter 2016.

Results

- Conifer mortality was positively associated with snow depth and explained approximately 30% of the variation in snow accumulation for 2015 and 2016. The slope of the data for 2015 is .2971 with an R2 value of 0.33 (figure 3) and a p-value of .036. The slope of the data for 2016 is .3024 with an R2 value of 0.29 (figure 2) and a p-value of .00113. Overall we found that as burn severity increases, peak snow depth increases.
- As shown in Figure 4 there is a greater percent conifer mortality conifers as burn severity increases.

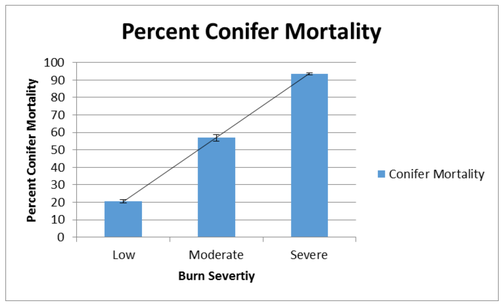

Figure 4. Shows burn severity relating to percent conifer mortality.

Why Does This Matter?

- Our results indicate that increasing occurrences of fires in the western United States may affect water resources in complex ways. Here we show an increase in peak snow accumulation in severely burned forested areas due to high conifer mortality, but whether that translates to more available water resources still remains unknown.
- With more open stands due to higher burn severity we would also expect more solar radiation, greater wind speeds, and higher vapor pressure deficits which tend to increase losses to sublimation and evaporation which may offset higher rates of snow accumulation in areas with higher burn severity.

Reference: Varhola, A., Coops, N. C., Weiler, M., & Moore, R. D. (2010). Forest canopy effects on snow accumulation and ablation: An integrative review of empirical results. Journal of Hydrology, 392. 219-233. Retrieved from www.elsevier.com/locate/jhydrol