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Stakeholder Driven Analysis

Spring 2023

# Snowpack Accumulation and Forest Thinning Treatments in The Zuñi Mountains

## Question 1: (proposed by stakeholder)

How have the thinning treatments affected the snowpack accumulation potential in the Zuñi mountains?

## Hypothesis 1:

Forest service thinning treatments will have the net effect of reducing snowpack accumulation potential because they are prescribed to reduce canopy cover. This thinning prescription is specified in such a way that it creates more land that is greater than 15m from canopy cover, which is predicted to have reduced snowpack accumulation compared to land that is within 15m of canopy cover (Broxton et al., 2015).

**Comments**: This is the most tractable question/hypothesis because it only involves analyzing tree spatial distribution before and after thinning treatments.

## Question 2:

How have forest service thinning treatments affected snowpack accumulation in the forest?

## Hypothesis 2:

Thinning treatments have reduced snowpack accumulation because they have created more land that is exposed to solar irradiation (negative impact on snowpack accumulation), which has a stronger effect than the reduced canopy-interception of snow (positive impact on snowpack accumulation) (Broxton et al., 2015).

**Comments:** This would require a good record of the spatial distribution of snow before and after thinning. So far I have found google earth images that do include snowpack, but they are not consistently distributed over time. Controlling for differences in precipitation between season would be important. It is also possible that a good record may be found in a different mountain range, and spatial patterns of snowpack accumulation could be extrapolated to the study region.

## Question 3:

How have the thinning treatments impacted Zuñi Mountains’ spring flow rates?

## Hypothesis 3:

The thinning treatments had the net impact of reducing Zuñi Mountains’ spring flow rates because more snow that landed on the ground was exposed to elevated solar irradiation, leading to a net increase in water losses to the atmosphere.

**Comments:** I have yet to find out if there are any data sets that could answer this. Livia (the stakeholder) mentioned that the primary reason she is interested in snowpack accumulation is that it is an important source of water for the springs.

## Question 4:

How do thinning treatments interact with landscape aspect and slope to alter snowpack accumulation?

## Hypothesis 4:

Thinning treatments that A) create more land that is >15m from canopy cover and B) occur at high slope, south facing aspects will *increase* snowpack accumulation. Similar treatments at low slope of any aspect will *decrease* snowpack accumulation. This is because north facing high-slope areas are well shaded for much of the winter and solar irradiation is the primary driver of snowpack reduction.

**Comments**: From poking around google earth images of the Zuñi Mountains that include snow, it appears that slope aspect and angle are important factors for snow accumulation/longevity. The major ridge of the mountains runs roughly NW to SE, so there may be a pronounced difference between the effect of thinning on the south face and the north face of the mountain.

Reference

Broxton, P. D., Harpold, A. A., Biederman, J. A., Troch, P. A., Molotch, N. P., & Brooks, P. D. (2015).

Quantifying the effects of vegetation structure on snow accumulation and ablation in

mixed-conifer forests. Ecohydrology, 8(6), 1073–1094. https://doi.org/10.1002/eco.1565