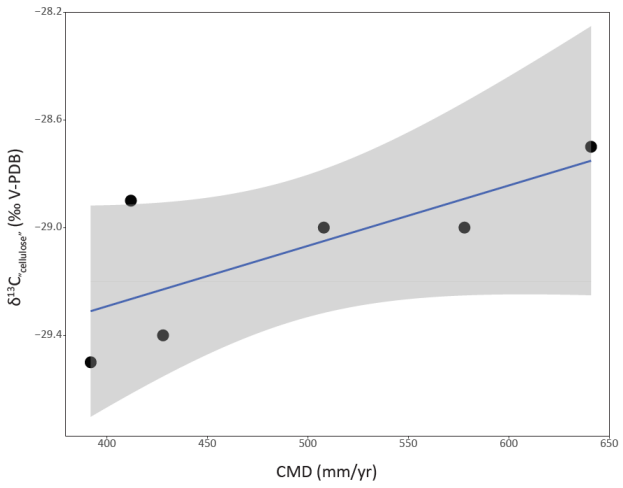
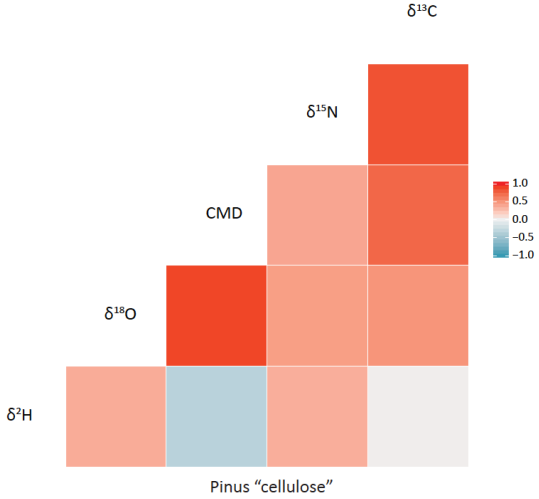
P.I.N.U.S.—Perplexing Isotopes of Needles from Upper Salt-Lake

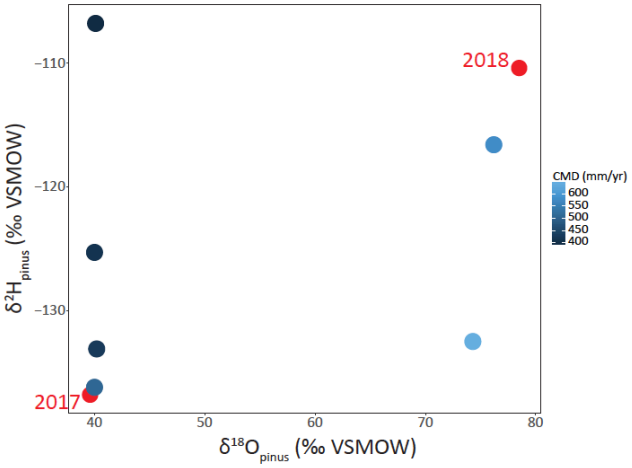
Research Questions: How do $\delta^{18}O$ and δD of bulk organic tissues of lodgepole pine (*Pinus contorta*) needles change across 8 years of needle cohorts? How do $\delta^{13}C$ and $\delta^{15}N$ change in these same needles?

Methods: We collected a lodgepole pine branch from Big Cotton Wood Canyon (~2500m) that had 8 distinct cohorts of needles still intact. We sampled each of these cohorts, representing growth from years 2011-2018. We boiled our needles for 30 minutes to remove soluble carbohydrates.

$\delta^{13}C$ Results: $\delta^{13}C$ was moderately associated with Climatic Moisture Deficit (CMD), which is the sum of the monthly difference between evaporation and precipitation. High CMD values are a proxy for dry climatic conditions. There was a trend of more enriched $\delta^{13}C$ with higher CMD.







$\delta^{18}O$ and δD Results: There was a trend of more enriched $\delta^{18}O$ with higher CMD. Although we did not have CMD data for 2018, our $\delta^{13}C$ suggests it is a dry year. However, our high CMD $\delta^{13}C$ values are beyond what is realistically observed in plants. Typically, 40 per mil is very enriched. Using the cellulose model developed by Roden et al. (2000), however, we can recreate conditions consistent with those of Big Cotton Wood canyon that would explain a 40 per mil leaf $\delta^{18}O$ value assuming the majority of the O in cellulose is sourced from enriched leaf water. The 70 per mil value we have yet to explain, though its correlation with years with higher CMD may indicate that the leaves were sourcing enriched stored waters or maybe remobilizing enriched, stored carbohydrates to make cellulose on those years.