Abstract #: T3R

t3 t1 t4

Potential effects of tree-to-shrub type conversion on streamflow in California's Sierra Nevada

Sara Baguskas[1*], Ryan Bart[1], Nicole Molinari[1], Naomi Tague[2], Max Moritz[1]

[1] Dept. of Environmental Science, Policy, & Management, College of Natural Resources, UC-Berkeley

[2] Bren School of Environmental Science & Management, UC-Santa Barbara

*contact: sarabee@berkeley.edu

Motivation & Questions

Climate change may lead to vegetation change across California, which in turn can influence watershed hydrology. Yet, sensitivities of hydrologic processes to potential shifts in vegetation type are not well understood. ***The primary objective*** of our research is to generate mechanistically-based projections of how potential type conversion from forested to shrub dominated systems affect streamflow at the snow-rain transition zone in the southern Sierra Nevada by answering the following questions:

1. How does water availability and water use change between early spring and late fall? For trees vs shrubs?

1. How do potential ecophysiological differences between plant functional types affect watershed scale hydrologic fluxes?

Materials and Methods

FIELD MEASUREMENTS

- Sampling window: **April-October 2014**
- **Physiological responses** of two dominant tree and shrub species to changes in seasonal water availability at two sites within the southern Sierra Nevada Critical Zone Observatory.

Conifers

Abies concolor (White fir) = ABCO
Calocedrus decurrens (Incense cedar) =CADE

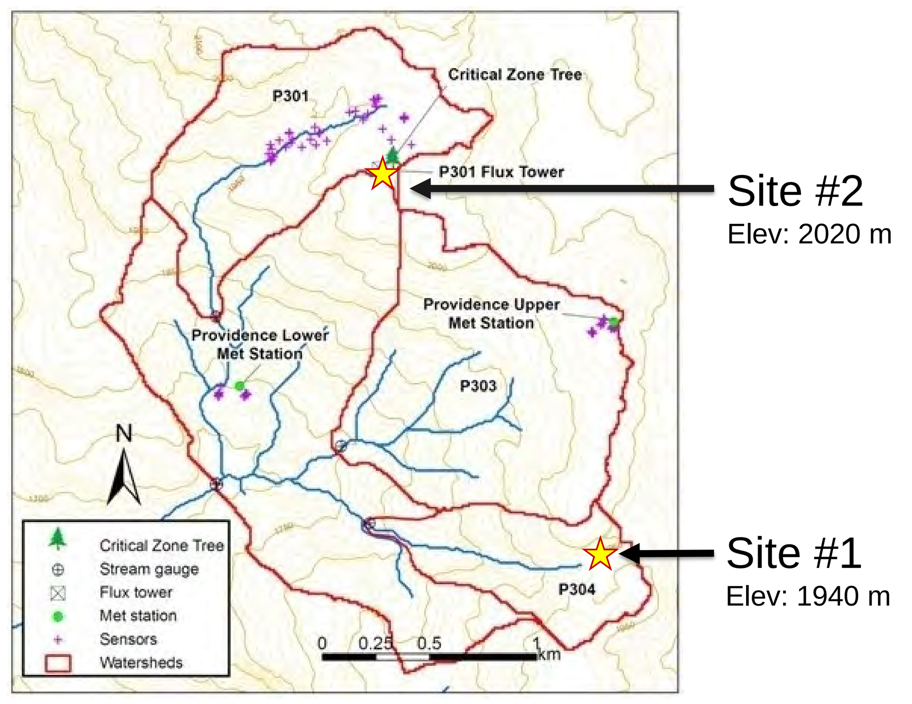
Shrubs

Arctostaphylos patula (Greenleaf manzanita)=ARPA
Ceanothus cordulatus (Mountain whitehorn)=CECO

Plant physiological measurements include:

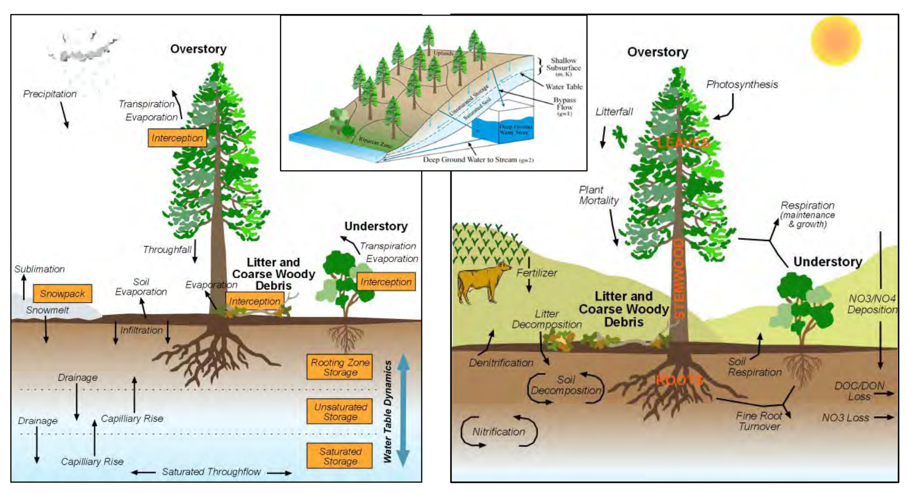
- Predawn xylem pressure potential (XPP, MPa)
- Maximum leaf gas exchange rates using a LiCOR 6400 XT (e.g., maximum photosynthetic rates, Amax)
- Sample size: 5 individual plants/species/site

Sites in the SSCZO



ECOHYDROLOGIC MODELING

Field data will be used to parameterize RHESSys, a physically-based ecohydrologic model for simulating hydrologic and carbon fluxes at watershed scales. Simulations were conducted in watershed P301 using soil parameters previously calibrated by Son 2014.



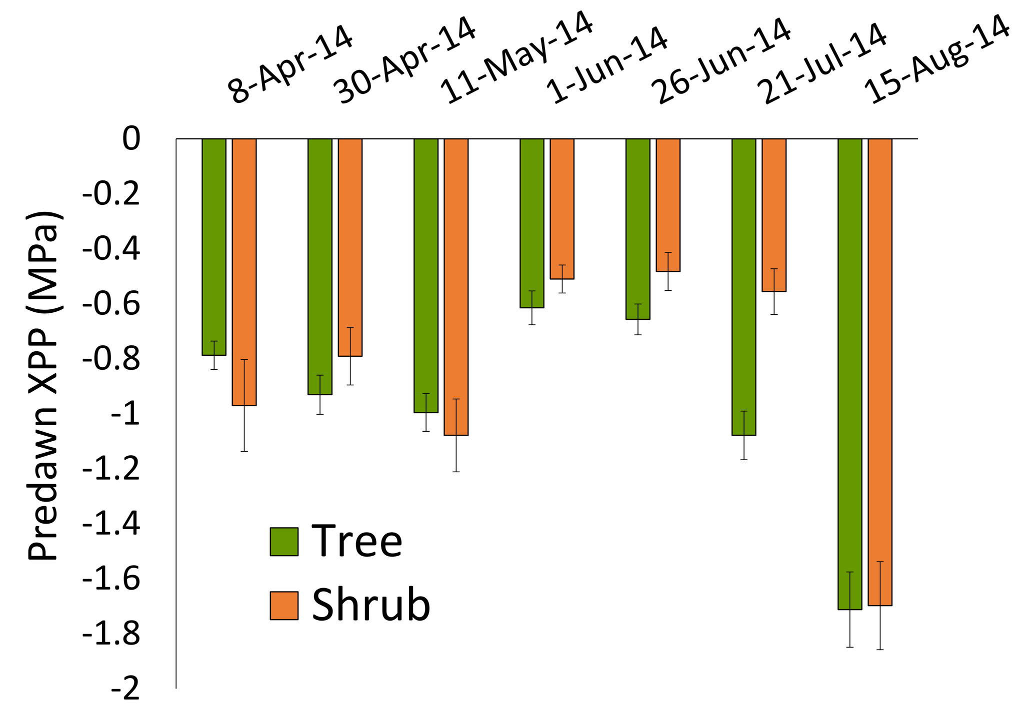
Steps for developing new "shrublands"

Currently implemented: (1), (2)

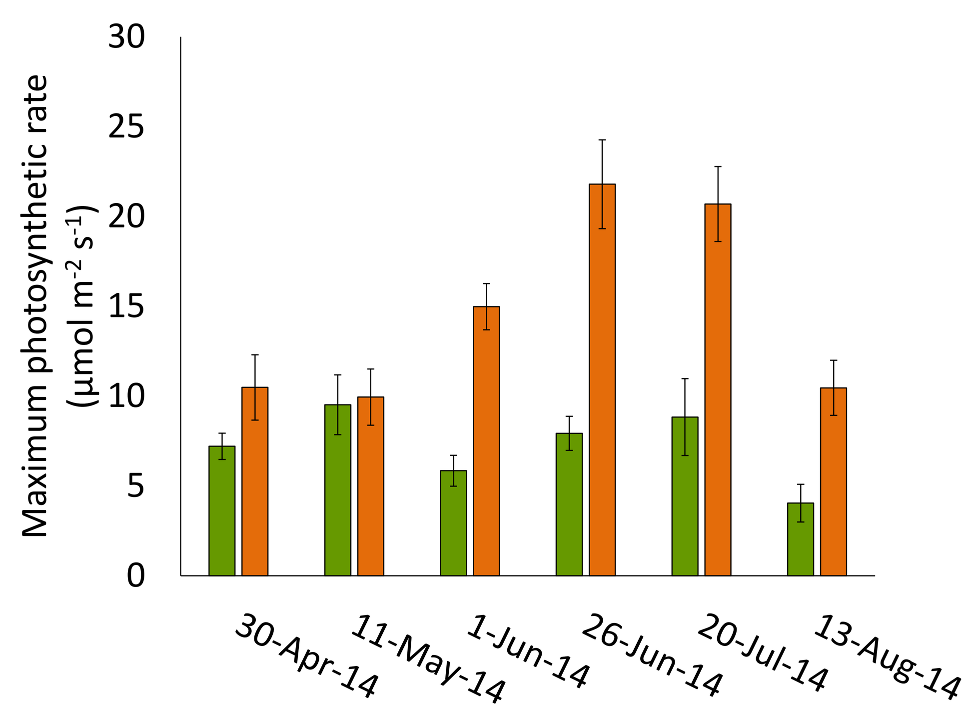
Step	Development	Source
(1)	Reduce Above-Ground Biomass by 3/4ths	Remote Sensing
(2)	Shallower Rooting Depth (5m -> 3m)	Project field data
(3)	Refine Stomatal Responses	Project field data
(4)	Dynamic Eco-physiological Properties (e.g. leaf-turnover under drought)	Literature

Field Results (from Site #1)

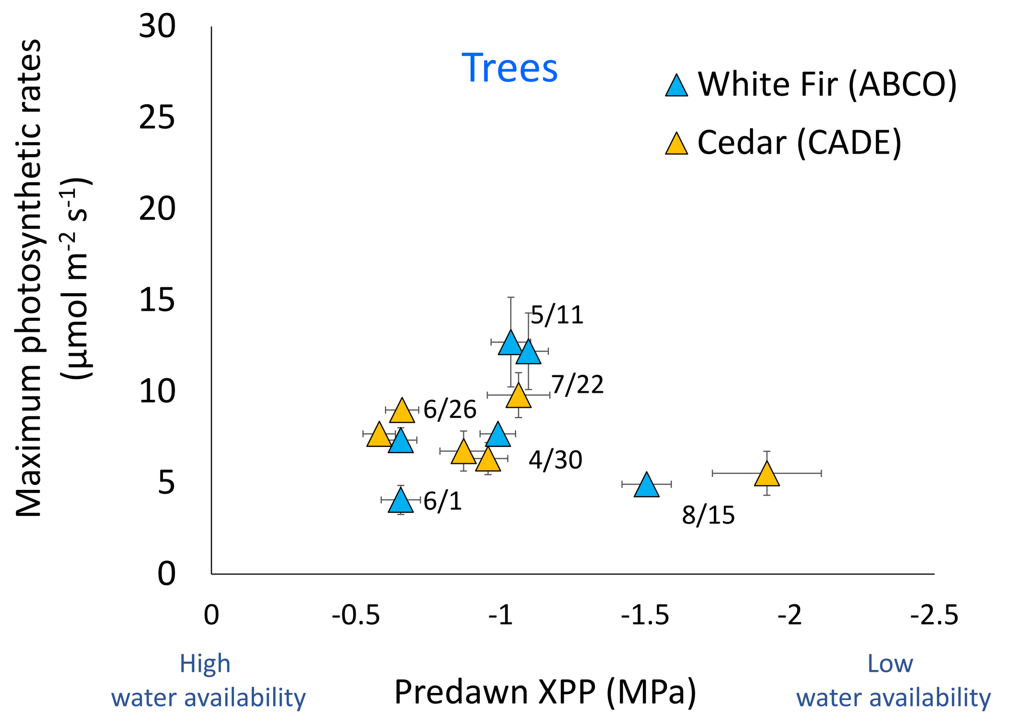
1 Water availability during the dry-down is similar for trees and shrubs.



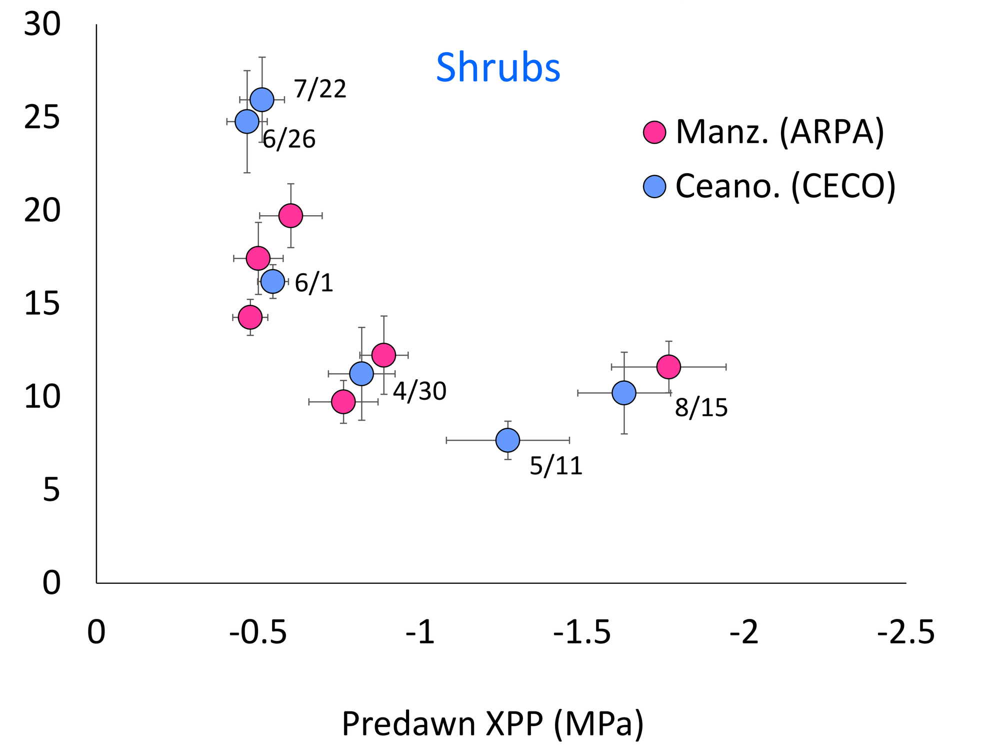
2 Carbon assimilation is higher per unit leaf area in shrubs than in trees.



3 No clear relationship between photosynthetic rates and water availability in trees.



4 Photosynthesis rates of shrubs track water availability through season

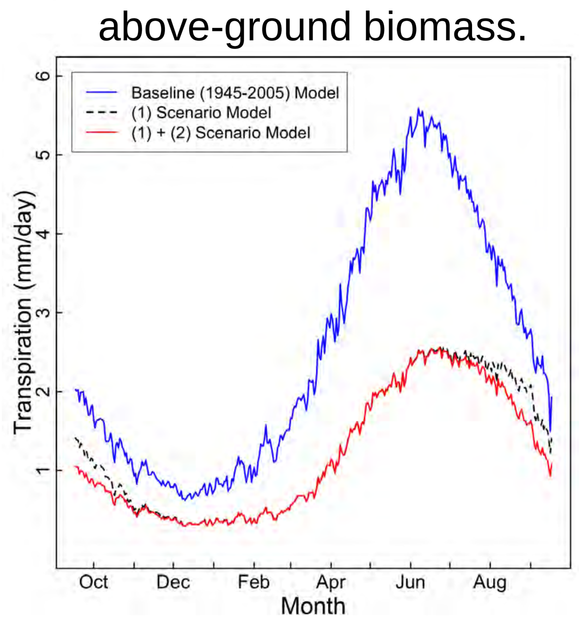


Preliminary Modeling Results

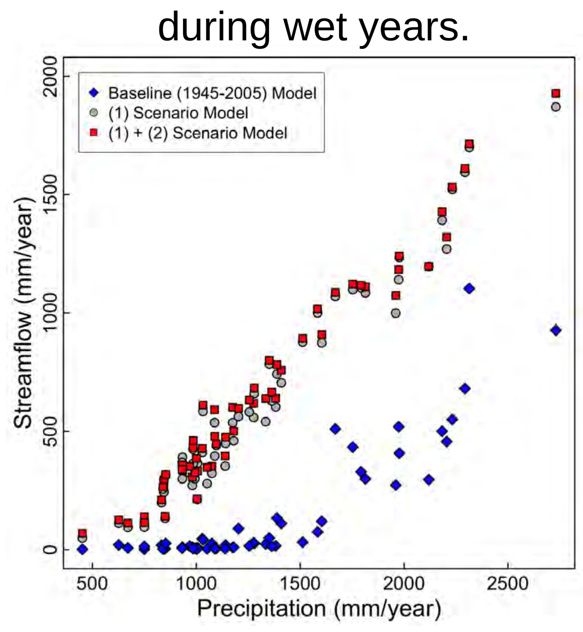
Scenario: Full watershed conversion from conifer to shrub (P301)

What is the effect of (Step 1) changing biomass only and (Step 2) changing biomass and rooting depth?

Transpiration decreases primarily due to reductions in above-ground biomass.



Streamflow increases at all wetness levels, but is greatest during wet years.



Future Model Refinements

- Vegetation steps (Step 3) & (Step 4)
- Vegetation distribution scenarios
- Climate change scenarios
- Explicit representation of uncertainty

Discussion

- Maximum photosynthesis declined with soil water availability for shrubs, yet this pattern was not evident for trees. These results suggest that shrubs are more sensitive than trees to changes in available soil moisture between April and August.
- We expect to see reduced gas exchange rates in trees as soil moisture conditions continue to decline in September and October.
- Preliminary modeling results indicate that streamflow greatly increases following tree-to-shrub type conversion over an entire watershed. More realistic scenarios (e.g. partial watershed conversion) are needed to substantiate these results.

Acknowledgments

Funding support for this research is provided by the California Energy Commission with help from the Southern Sierra CZO. We would like to thank Rodney Feddema and Josie Lesage their excellent assistance in the field and post-processing of samples in laboratory.