Dealing with Drought: Do forest thinning treatments increase forest drought resistance in Redwood National Park?

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Introduction

Coast redwood forests are vital and unique ecosystems that provide essential habitat for endemic and threatened species, enhance stream and watershed health, and contribute to carbon sequestration and storage. Today, the vast majority of existing redwood forests are comprised of dense second or third growth stands. Recently, there has been growing interest in developing management practices that will create and support coast redwood forests that persist during changing climatic conditions and predicted drought stress conditions (Cook et al., 2015).

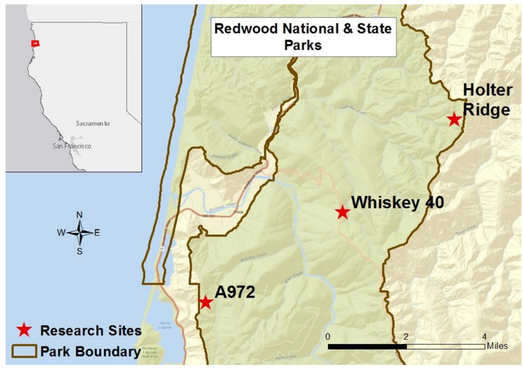
Researchers have documented substantial tree-growth responses to thinning treatments in coast redwood-Douglas-fir forests in northern California and specifically in Redwood National Park (Plummer et al., 2012). However, the response of these treated forests to extreme drought events has not been evaluated.

Control site (left) and low thinning site (right) 14 years after treatment.

Research Questions

1. Do tree growth responses differ thru time in different competitive environments and while under drought stress?
2. Do growth-climate relationships change across different competitive environments?
3. How does tree resiliency to drought change across environments and species and which tree factors are most important?

Study Area



Redwood National Park (RNP) is located in northern coastal California's Humboldt and Del Norte Counties. The park was established in 1968 and expanded to include a large parcel of timber land in the Redwood Creek watershed in 1978. Restoration thinning treatments have since been an important component of forest management in RNP with the **aim to accelerate forest maturation towards old-growth forest conditions,** including decreased stand densities, altered species composition favoring redwood, development of multistoried canopies, and promoting growth of remaining trees and understory (National Park Service, 2008; Teraoka & Keyes, 2011).

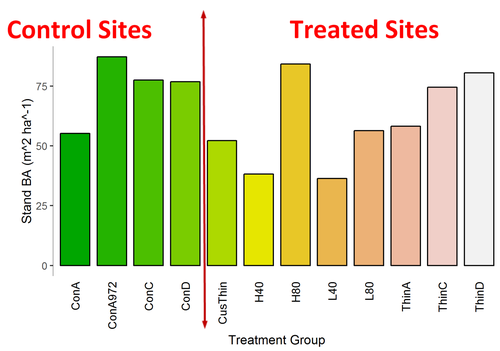
Methods

In the fall and winter of 2014 and 2015 over 400 coast redwood and Douglas-fir tree cores were collected from three ridgetop study sites in the park, representing 7 different thinning treatments (crown thin and low thin with varied reductions in stand basal area (BA)). Tree cores were processed in the lab using standard dendroecology methodology (Speer, 2010) and growth rings measured using WinDendro (Regent Instruments, 2012). All cores were then visually crossdated. Local competition metrics were calculated within a 10 m radius for each sampled tree and site climate data obtained from the California Basin Characterization Model (BCM). Linear regression and mixed effects models will be used to address research questions.

Table 1. Number of sampled trees per each restoration thinning treatment in Redwood National Park. SESE = *Sequoia sempervirens;* PSME = *Pseudotsuga menziesii.*

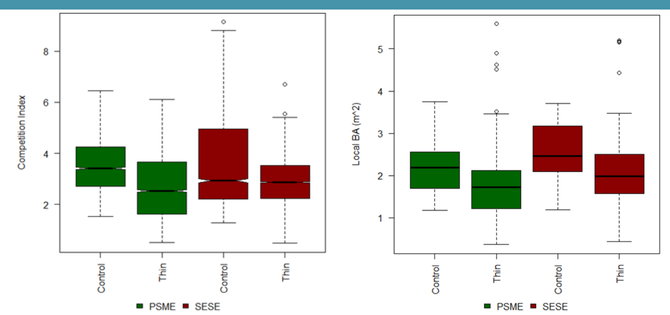
Site	Thinning Treatment	Thinning Method	# Sampled Trees SESE	PSME	Total
A972	20% reduction in BA	low	9	12	21
A972	55% reduction in BA	low	5	10	15
A972	20% reduction in BA	crown	12	8	20
A972	55% reduction in BA	crown	5	9	14
A972	Control	NA	9	12	21
W40	2x- 30% reduction in BA	low	28	48	76
W40	30% reduction in BA	low	25	22	47
W40	Control	NA	24	20	44
HR	20-25% reduction in BA	low	42	32	74
HR	Control	NA	38	72	110

Preliminary Results



Stand basal area (BA) of all trees ≥ 20cm DBH varied greatly across control and treated sites in Redwood National Park in 2014.

Primary analysis will focus on variables at the individual tree level (e.g. local competition, tree species, etc.) in order to better understand the influences on tree growth response to climate and the current drought.



Hegyi competition index and local basal area (BA) for all coast redwood (SESE) and Douglas-fir (PSME) trees sampled in control and treated sites in RNP.

Literature Cited

1) Cook, B.I, Ault, T.R., Smerdon, J.E., 2015. Unprecedented 21st century drought risk in the American Southwest and Central Plains. Science Advances 1.1 (2015): e1400082. **2)** Noss, Reed F., 2000. The Redwood Forest: History, Ecology, and Conservation of the Coast Redwoods. Island Press, Covelo, California. **3)** Plummer, J.F., Keyes, C.R., Varner, J.M., 2012. Early-stage thinning for the restoration of young redwood-Douglas-fir forests in northern coastal California, USA. International Scholarly Research Notices 2012, e725827. doi:10.5402/2012/725827 **4)** Regent Instruments Canada Inc., 2009. WUBDEBDRI fir tree-ring analysis, Quebec, Canada. **5)** Speer, J.H., 2010. Fundamentals of Tree-Ring Research, first ed. The University of Arizona Press, Tucson, Arizona. **6)** Teraoka, J.R., Keyes, C.R., 2011. Field Note: Low Thinning as a Forest Restoration Tool at Redwood National Park. Western Journal of Applied Forestry 26, 91–93.

Acknowledgements

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