Hyperspectral Reflectance as a Proxy for Stable Isotope Composition to Assess Drought-Resiliency Associated Traits

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Objective

Determine the relationship between stable carbon isotope composition and hyperspectral reflectance of tree rings to assess drought-resiliency associated traits and growth variations of Douglas-fir trees.

Background

• McDonald Research Forest experienced hot-drought induced Douglas-fir (*Pseudotsuga menziesii)* mortality in 2015. Some impacted stands were thinned (Figure 1).

• Plant tissue and atmospheric stable carbon isotope composition can estimate intrinsic water use efficiency (iWUE), coupled to the ratio of photo-synthesis and stomatal conductance.

• Hyperspectral (HS) reflectance splits spectrum into many bands to extend beyond visible light. HS Reflectance will be measured from 900-1700nm to assess varied wood properties between this and earlier droughts.

Figure 1. Trees continue to die in thinned stand impacted by hot-drought.

Methods

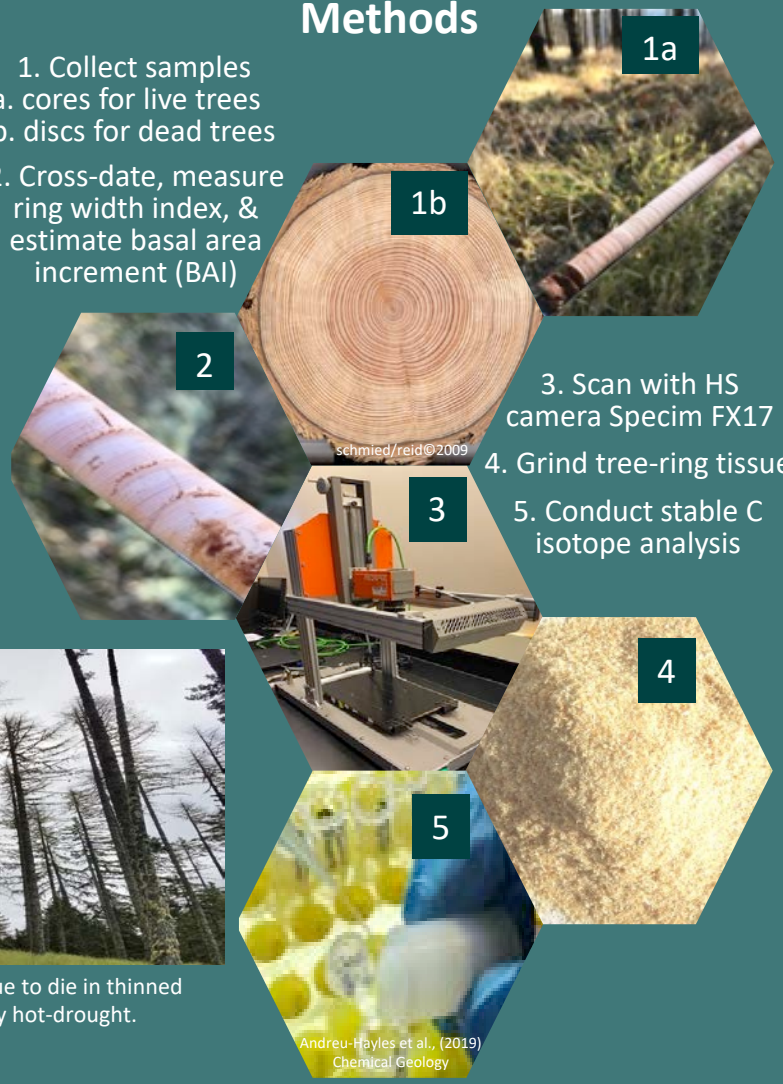
1. Collect samples
a. cores for live trees
b. discs for dead trees

2. Cross-date, measure ring width index, & estimate basal area increment (BAI)

3. Scan with HS camera Specim FX17

4. Grind tree-ring tissue

5. Conduct stable C isotope analysis



Interpretation

If there is a strong relationship between stable carbon isotope composition and HS reflectance, then hyperspectral reflectance can be used as a proxy to assess drought-resiliency associated traits and growth variations of Douglas-fir individuals.

Significance

• PNW summers are projected to become increasingly hotter and longer with a 10% decrease in rainfall [1].

• Biotic drivers of mortality such as pathogens and insects are highly correlated with water stressed trees.

• It is important to understand the drivers of drought induced tree mortality and implement effective ways to detect physiological status of individuals to manage forests proactively with climate change in mind.

• Determining the correlation between HS reflectance and BAI or iWUE would be a highly novel approach to global-change-type drought.

[1] Law and Waring (2015) *Forest Ecology & Management* **355**:4-14.