Fire events at a local or landscape scale are fundamentally driven by three components: weather, fuel and local/landscape environmental controls (Whitlock et al. 2010). Changes in any single component can drive shifts in fire behavior or even fire regimes, depending on the scale. Changes in fuel in particular are directly related to subsequent changes in fire behavior across scales and regardless of system (Taylor and Fonda 1990, Schimmel and Grantsrom 1997, Hely et al. 2009). Fuel, therefore, serves as a link between vegetation type and combustion environment (Mitchell et al. 2009). Since the spatial distribution of fuel elements in a given stand shape both fire danger and initial surface fire behavior (Hely et al. 2009), shifts in community composition that alter the spatial distribution of fuels may influence subsequent fire behavior. Evaluating how ecological transitions alter the characteristics of fuel loads, connectivity and spatial distributions can provide insight into future landscape flammability and potential fire-vegetation feedbacks.

These results provide fine-scale characterizations of variation in fuel loads and structures within reburned areas in conjunction with , contributing to our understanding of the strength of the proposed deciduous negative feedback.

This chapter examines dynamics and distributions of fuel loads in reburned stands in boreal Alaska to evaluate subsequent modeled changes in potential fire danger and initial fire behavior. This chapter is an extension of the dissertation, funded with a Graduate Innovation Award from the Joint Fire Science Program (ID 19-1-01-43).

3) assess how modeled fire behavior differs across reburn sequence and between topographic position.

1. What is the effect of short interval reburns on modeled fire danger and initial surface fire behavior?
2. I further hypothesize that modeled fire danger and initial surface fire behavior will be greatest in once and twice-burned stands via the hypothesized increase in fuel loads but will differ according to site type.

We ask the following research questions: 1) What is the spatial distribution of fuel elements in areas experiencing 1, 2 or 3 short interval fires?, 2) How does the spatial distribution of fuel elements differ between uplands and lowlands in response to repeat burning? and 3) How does fire behavior differ across reburn sequence and between community types?

Method

Developed as an alternative to the more time- and resource-intensive terrestrial laser scanning approach, 3D sampling will be applied to each plot in both sites to record presence/absence occupied volume for each fuel type present in the plot. Fuel type categories are system-specific, and for Interior Alaska, may include 1-10-hour fuels, 100-1000-hour fuels, general spruce litter, deciduous litter, arctic grass and other sedges, shrubs, forbs and mosses.

An additional strength to this approach is that measurements will not be tied to specific plots, and instead will be stand-level metrics. This makes them more generalizable then stem maps, an alternative approach often used to evaluate fuel distributions.

#### Fire behavior modeling

This chapter takes advantage of existing collaboration with a team of fire modelers at Colorado State University. My specific role in this collaboration is to lead the field-based investigation of fuel characteristics, providing both data and insight into the ecological dynamics of fuel on the boreal landscape. Working with Dr. Chad Hoffman and others at the Western Forest Fire Research Center, we intend to apply these insights produced from this chapter into a physics-based computational modelling approach which will enable us to directly investigate the dynamics of fire-vegetation feedbacks in the boreal.

This chapter will use the HIGRAD/FIRETEC system, a combination of physics-based 3-D fuel models, to produce estimates of fire danger and initial surface fire behavior based on empirically estimated spatial fuel distributions. The combination of HIGRAD and FIRETEC models represents interactions between fire, fuel and atmosphere on a landscape scale, allowing specific investigation of how fire may respond to stand-level or even tree-level shifts in canopy arrangement or understory fuel loads (Koo et al. 2012).

Fire danger here is defined as the summed stand-level characteristics (both chemical and physical) of fuel elements that favor flame propagation if ignition occurs (Hely et al. 2009). High fire danger would indicate a stand containing an abundance of fuel elements made up of either flammable products or products with the ability to sustain combustion (Hely et al. 2009). Estimating potential fire danger allows for direct insight into management of reburned stands and provides specific guidance for managers making decisions about resource allocations.

The two approaches above represent more traditional methods of evaluating fuel loads and arrangements in forest stands and while meaningful, do not fully capture the range of variability or spatial non-uniformity often found in surface fuelbeds (Hardy et al. 2008).