Effects of spatial heterogeneity on boreal successional trajectories following repeat disturbances

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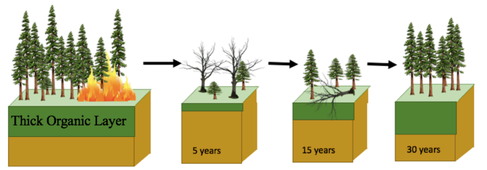
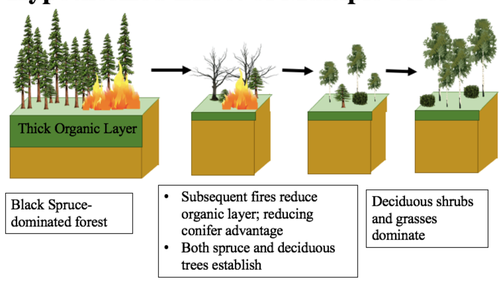
Background:
Warming temperatures in the boreal have increased the frequency and severity of wildfires, causing time intervals between fires in some areas to decrease to 10-15 years within the last several decades. Shortening fire intervals drive changes in successional pathways in boreal forests, but the extent of those changes and the interaction between topography and fire remains unclear.

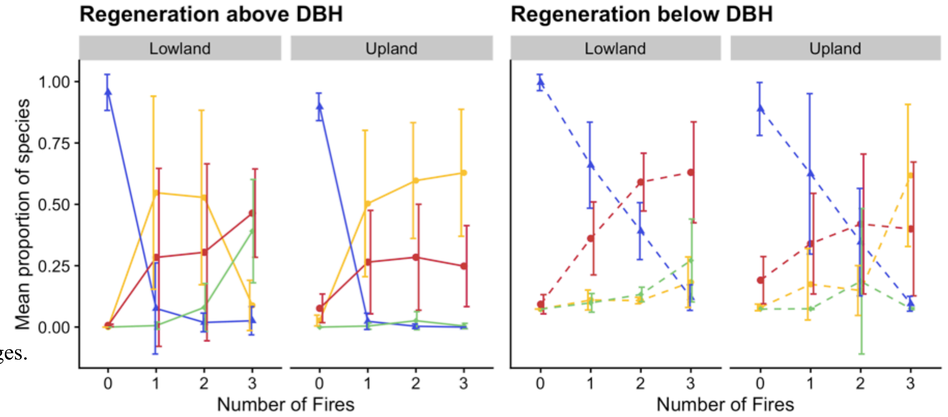
Hypotheses:
- Repeat short-interval fires will reduce conifer abundance via consumption of seedbank and substrate.
- Lowland sites will be more resistant to a transition in community composition via local soil moisture.
- Emerging deciduous communities will differ in forest structure and composition characteristics than existing boreal community assemblages.

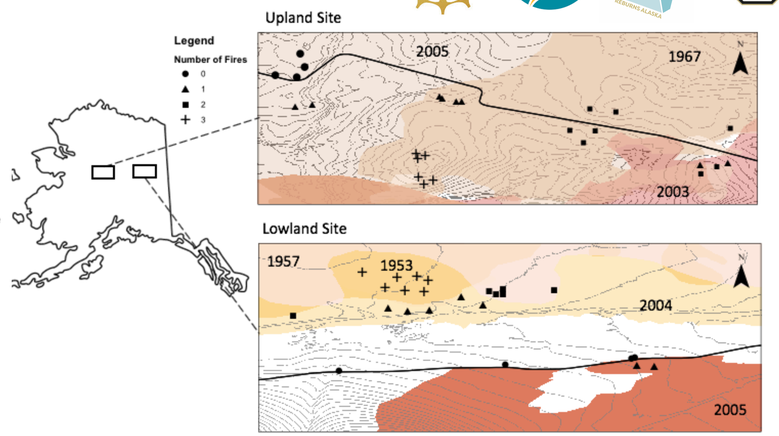
Boreal Forest Successional Trajectories

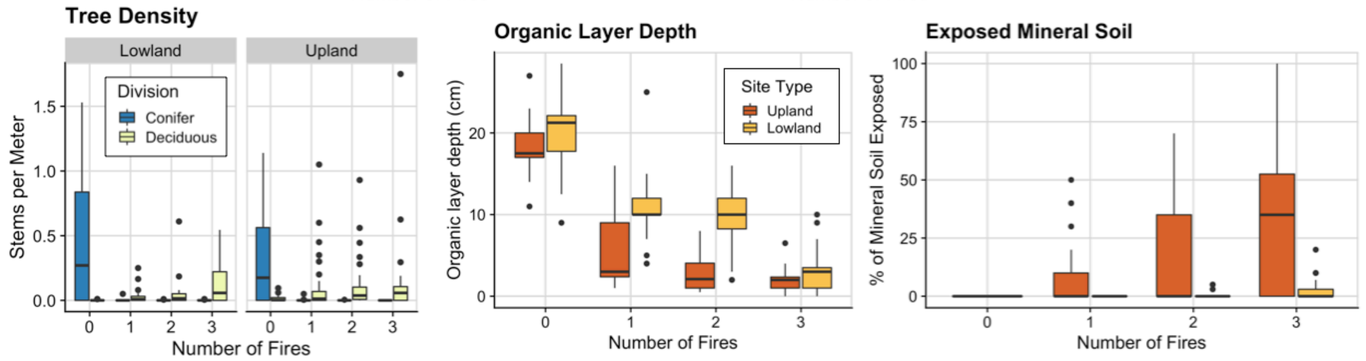


Hypothesized Effect of Multiple Fires









Regeneration patterns
- Abundance (basal area), proportion and density (stem per ha) of deciduous species increased significantly with number of fires.
- Conifer presence, abundance and density decreased significantly after one fire, and abundance of seedlings/saplings suggest further decline.

Results of Linear Mixed Effect Models
- Effect of fire on basal area of deciduous regeneration varies as a function of site type (upland or lowland).
- Fire history reduced basal area of conifer regeneration significantly regardless of site type.

Field Methods:
- 50 20x20m plots established in an upland and lowland location in summers of 2018 and 2019 across gradient of fire histories (as identified by remote sensing).
- Species, DBH, condition, canopy health and understory recorded for each individual tree above 1.37 meters.
- Seedling and saplings below 1.37 m recorded within subsection of plot.

Analysis:
- Effect of organic layer, local topography and site on cumulative basal area of deciduous and coniferous species assessed by linear mixed effect model. .

Conclusions:
- Repeat short-interval fires lead to the emergence of boreal communities dominated by novel assemblages of deciduous species at the site-level.
- Lowland tree communities undergo transition at a slightly slower pace, but converge with upland conditions by third fire, implying site-level thresholds of fire history may exist.

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