Assessing climate-growth relationships and resilience in northern black spruce forests: proposed research

Xanthe Walker and Jill Johnstone
Department of Biology, University of Saskatchewan, Saskatoon. Email: xanthe.walker@gmail.com

INTRODUCTION
Successional processes within the black spruce forest of Interior Alaska have been historically observed as a simple cycle of stand self-replacement, with forests burning and recovering to pre-fire vegetation composition at approximately 100 year intervals. As climate changes, successional trajectories may alter in direct response to increasing temperatures and indirectly through alterations in the fire regime. Forest stands experiencing drought stress may be more vulnerable to a change in successional trajectory following fire than stands that are not experiencing drought stress.

OBJECTIVE
Determine if it is possible to use the climate-growth relationship of pre-fire black spruce trees to predict post-fire successional trajectories in the boreal forests of Interior Alaska.

RESEARCH QUESTIONS
1. How do landscape position of lowland, upland, and north versus south aspects, and gradients in soil drainage affect the climate growth relationship?
2. How do changes in pre-fire vs. post-fire stand structure relate to climate-growth relationships, and landscape position and gradients?
3. Does the reproductive potential differ between trees of different climate-growth responses?

STUDY AREA
This research will take place in Interior Alaska, USA at sites established by the Bonanza Creek long-term ecological research project (BNZ LTER) and the joint fire science program (JFSP).

SITE SELECTION
- sites will be established in both burned and unburned areas
- sites within three separate burns, covering a range of soil burn severities and site moisture will be examined
- sites will vary in topographic location: south/southwest facing slopes, lowlands, and north/northeast facing slopes
- at least 3 plots will be established within each site
  - each plot will consist of two nested circular sub-plots around a central point
    - outer subplot = 4 m radius
    - inner subplot = 2 m radius

METHODS

Climate-Growth Relationship
- correlate yearly radial growth to monthly climate data of temperature and precipitation, obtained from Fairbanks climate station
- determine growth response (positive, negative, or neutral) to variations in climatic conditions

Pre-fire vs. Post-fire Vegetation
- examine in outer 4 m radius subplot
  - find fallen deadwood or snags, identify species, measure basal area, and calculate density

Cones and Seed Production:
- count and collect cones from live trees where cores were obtained
- compare cone and seed production to climate-growth response

Germination Trials:
- conduct germination trials on a per tree basis
- compare germination rates to climate-growth response

Reproductive Capacity
- transplant seedlings from different responder types in greenhouse
- assess growth and survival in relation to climate-growth response

Growth and Survival:

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