THE ALASKA FIRE SCIENCE CONSORTIUM

What's new in fire science?

Advanced Search Results Detail

Project ID: 12-3-01-29

Year: 2012

Date Started: 04/01/2012

Ending Date: 09/01/2013

Title: Fire Effects on Seedling Establishment Success Across Treeline: Implications for Future Tree Migration and Flammability in a Changing Climate

Project Proposal Abstract: Understanding the complex mechanisms controlling treeline advance or retreat in the arctic and subarctic has important implications for projecting ecosystem response to changes in climate. Changes in landcover due to a treeline biome shift would alter climate feedbacks (carbon storage and energy exchange), ecosystem services such as wildlife and berry habitat, and landscape flammability Fire is the primary landscape-scale disturbance in the boreal forest, and in the last half-century fires have increased in severity and extent in the boreal forest and tundra. In the past fires at treeline have been rare with low fuel loads and cool/wet weather conditions. With increased warming and changing fuel loads at treeline and in tundra this may change. Treeline and tundra fire regimes and resulting successional trajectories are poorly understood. However, changes in fire regime are predicted to increase the extent of fires throughout the tundra and treeline ecosystems of Alaska potentially resulting in range expansion of species from the neighboring boreal forest. The indirect effects of climate warming, such as shifts in the fire regime, may be more critical to species migrations than the direct effects of warming. Invasion of tundra by trees may be facilitated by wildfire disturbance, which exposes new seedbeds, increases nutrient availability immediately post-fire, and creates opportunities for establishment in an ecosystem where tree recruitment is otherwise rare. The goal of this research proposal is to investigate abiotic controls over regional seedling establishment across the treeline ecotone after fire in order to predict tree migration under future scenarios of fire and warming. Specifically, I will investigate the following questions: 1. What are the regional abiotic factors governing seedling performance and establishment success across treeline after fire? 2. How will the hierarchy of post-fire abiotic and biotic factors influence tree migration into previously unforested sites under predicted scenarios of fire disturbance and climate change? At a variety of treeline and tundra sites, my dissertation research has focused on the biotic interaction between boreal tree seedling establishment, growth, and survival and belowground microbial dynamics. In this proposal, I will now examine abiotic factors driving regional seedling establishment success and performance and the potential for tree migration at arctic treeline using complementary field experiments and landscape modeling. Across a latitudinal gradient of fire scars in Alaska I will investigate the relative importance of drought stress and nutrient availability to seedling establishment using foliar C and N isotopic signatures from out-planted boreal tree seedlings. Contingent on the inclusion of this regional field investigation I will develop a heuristic model of abiotic and biotic factors influencing establishment success of boreal tree seedlings at treeline and tundra. Based on this heuristic model I will parameterize a regional frame-based model (ALFRESCO) of fire-climate-vegetation dynamics. I will model treeline movement as a function of fire regime, biotic factors, and abiotic factors. I will compare model scenarios to predict how wildfire-induced changes in tree establishment at treeline will drive landscape patterns of treeline movement. This project links mechanistic investigation of regional patterns of seedling establishment to model projects of continental biome shifts after fire using a novel suite of analytical tools in order to address fire effects on treeline successional trajectories and future flammability.

Principal Investigator: F. S. Chapin III

Agency/Organization: University of Alaska-Fairbanks

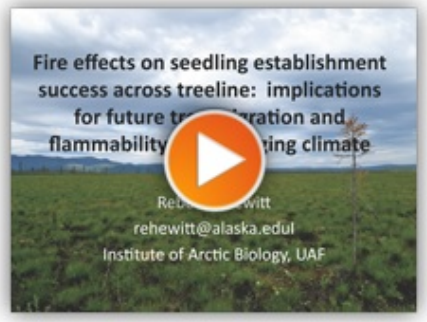
Branch or Dept: Institute of Arctic Biology

Other Project Collaborators

Type	Name	Agency/Organization	Branch or Dept
Budget Contact	Rachell R. Peterson	University of Alaska-Fairbanks	Institute of Arctic Biology
Co-Principal Investigator	Teresa N. Hollingsworth	Forest Service	PNW-Boreal Ecology Cooperative Research Unit
Grants and Agreements Contact	Gwendolen M. Griscavage	University of Alaska-Fairbanks	Grants & Contract Administration
Lead Reviewer	Rosemary L. Sherriff	Humboldt State University	Geography Department
Lead Reviewer	Andrea E. Thode	Northern Arizona University	School of Forestry
Student Investigator	Rebecca E. Hewitt	University of Alaska-Fairbanks	Institute of Arctic Biology

Project Locations

2012 Fire Science Workshop



Fire Effects on Seedling Establishment Success across Treeline: Implications for Future Tree Migration and Flammability in a Changing Climate

Presented By: Rebecca Hewitt (University of Alaska Fairbanks)

This newly funded project will build on previous research on biotic controls of seedling establishment to focus on abiotic controls and develop heuristic and lanscape models of tree establishment, migration, and landscape flammability.

Presentation (pdf) | Watch the Recording | Download the Video (wmv; 17 MB)

JFSP Project Proposal

- Alaska Fire Science Consortium > Events > Previous Events > Workshops > 2012 Fall Workshop

Advanced Search Results Detail

Project ID: 12-3-01-27

Year: 2012

Date Started: 08/01/2012

Ending Date: 12/31/2013

Title: Impacts of Past Warming Episodes on Fire Frequency, Carbon Fluxes and Soil Erosion in the Alaskan Boreal Forest: Lessons from the Past

Project Proposal Abstract: As part of my dissertation, I propose to study the interactions between climate change, wildland fires, and post-fire permafrost thaw over the last 1,000 years (permafrost; permanently frozen ground occurring in boreal regions). The last 1,000 years has seen sizable climate changes in Alaska including the Medieval Warm Period (MWP, AD 950-1250), the Little Ice Age (LIA, AD 1300-1900), and the dramatic warming trend that has occurred in Alaska since AD 1950 (1). My overall research question is: What effects have warming episodes in the recent past had on fire frequency, carbon fluxes, and soil erosion in black spruce forest in Interior Alaska? To study the these interactions I will use a unique time series provided by annually layered lake sediment records (varves). Through these varved records, I will be able to quantify the changing inputs of charcoal, and thaw-induced soil erosion from Interior Alaskan watersheds at annual time steps. Results of this study will be useful in forecasting how wildland fire regimes and boreal-forest landscapes could respond to further climatic warming over the coming century. This project is being proposed for the climate change and fire category of the GRIN fellowship.

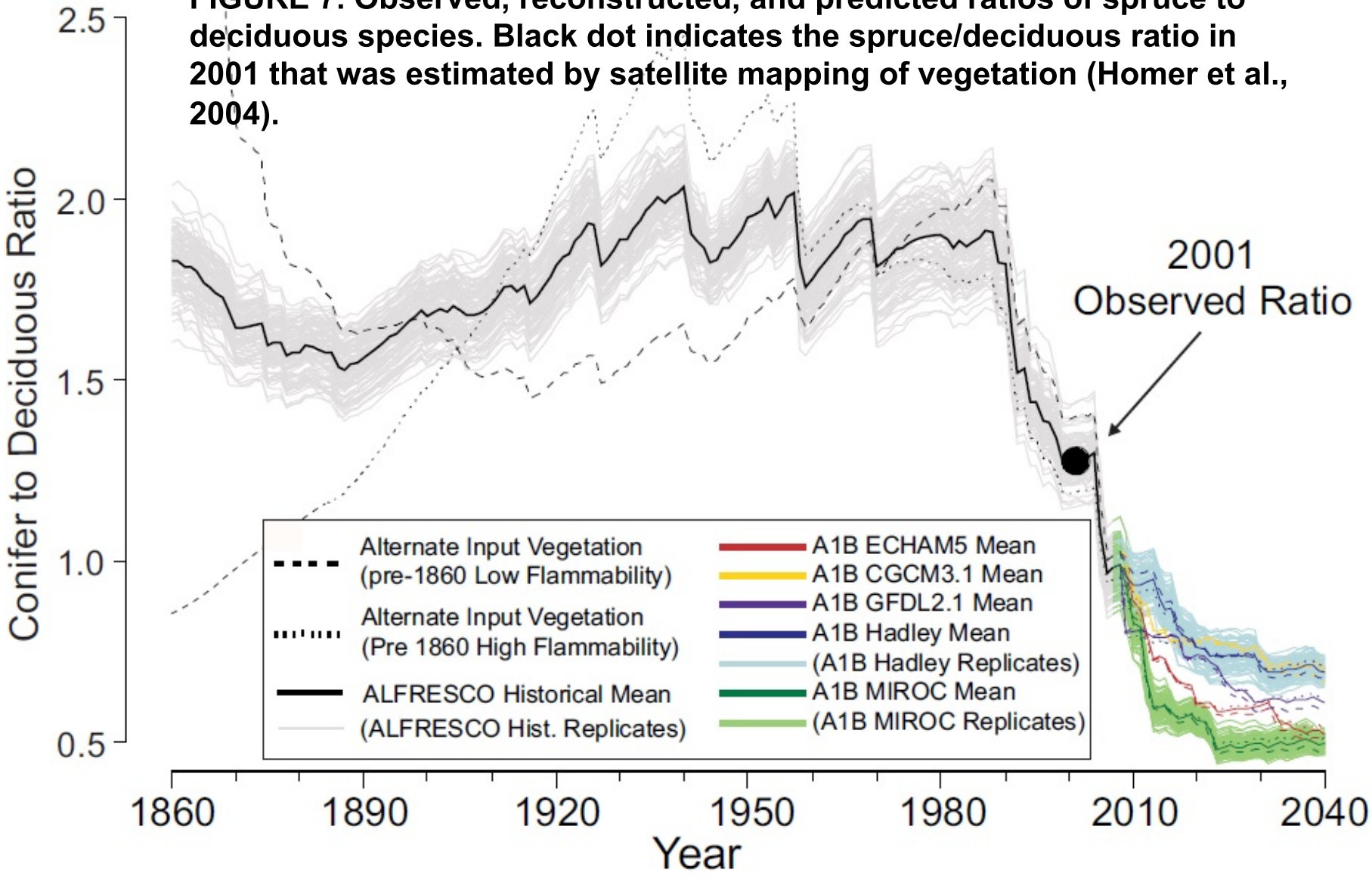
Principal Investigator: Daniel H. Mann Ph.D.

Agency/Organization: University of Alaska-Fairbanks

Branch or Dept: SNRAS-School of Natural Resources & Agricultural Sciences

Mann et al. 2012

FIGURE 7. Observed, reconstructed, and predicted ratios of spruce to deciduous species. Black dot indicates the spruce/deciduous ratio in 2001 that was estimated by satellite mapping of vegetation (Homer et al., 2004).

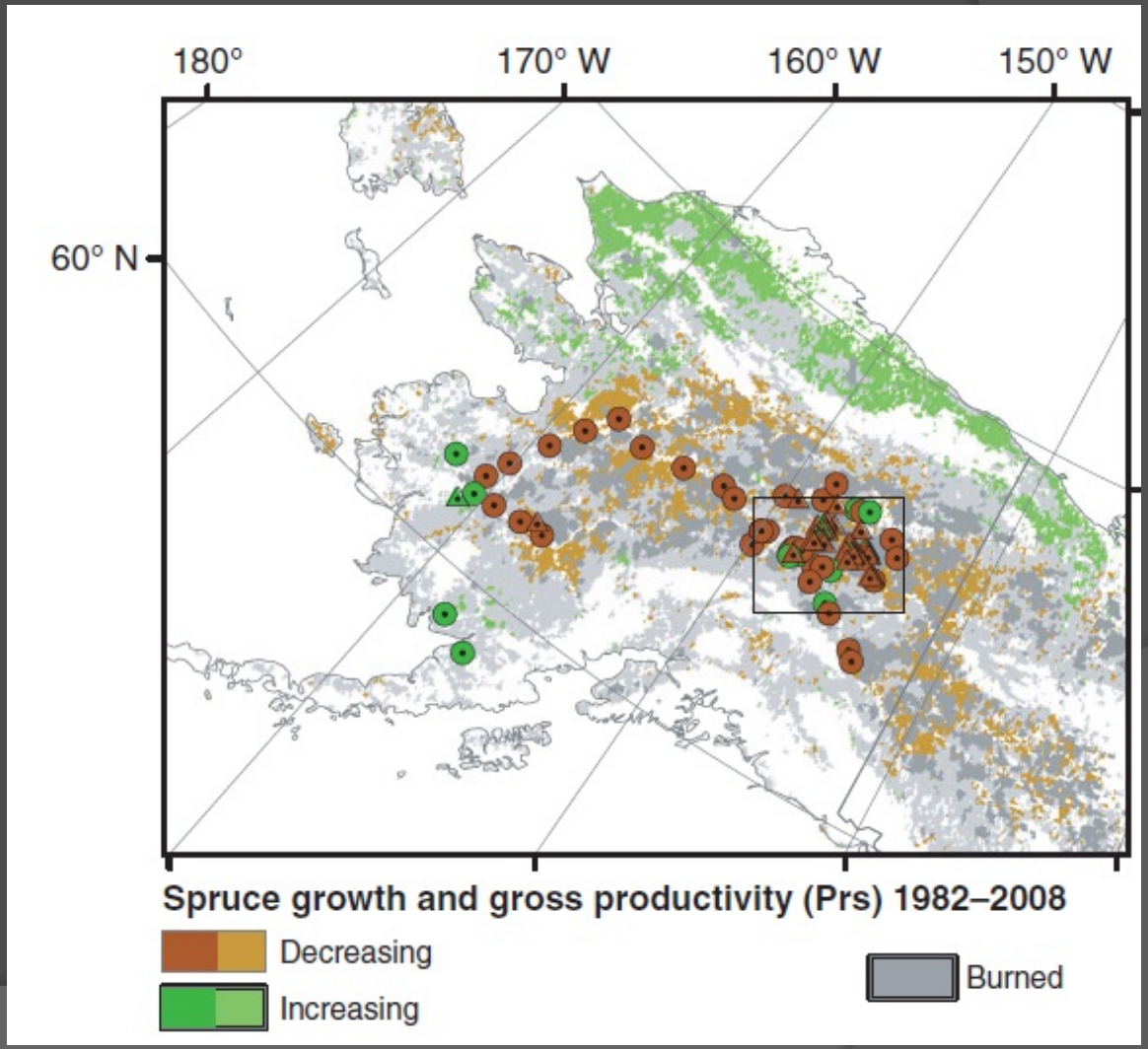


“Crossing the ecological threshold between conifer forest and boreal mixedwoods”

Changes in forest productivity across Alaska consistent with biome shift

Beck, Juday, et al. 2011: Ecological Research Letters

Green and brown shading in the symbols indicate increasing and decreasing ring widths, respectively, in unburned stands from 1982 to the year of sampling which ranged from 1994 to 2008.

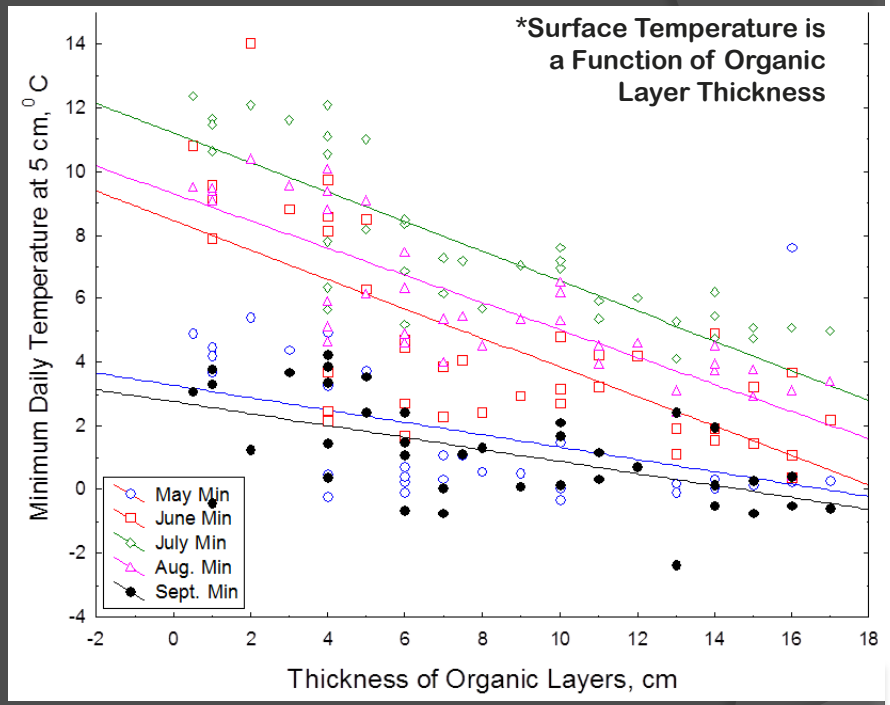


Fire Severity

- Hollingsworth, T.N., J.F. Johnstone, E.L. Bernhardt, F.S. Chapin III. 2013 Fire severity filters regeneration traits to shape community assembly in Alaska's boreal forest.

USGS: Harden & Manies

- Permafrost governs soil temperature and moisture regime
- Run-off and plant root growth limited to near the surface
- Without permafrost, AK soils have high infiltration, yielding dry surface



French, Loboda—NASA study

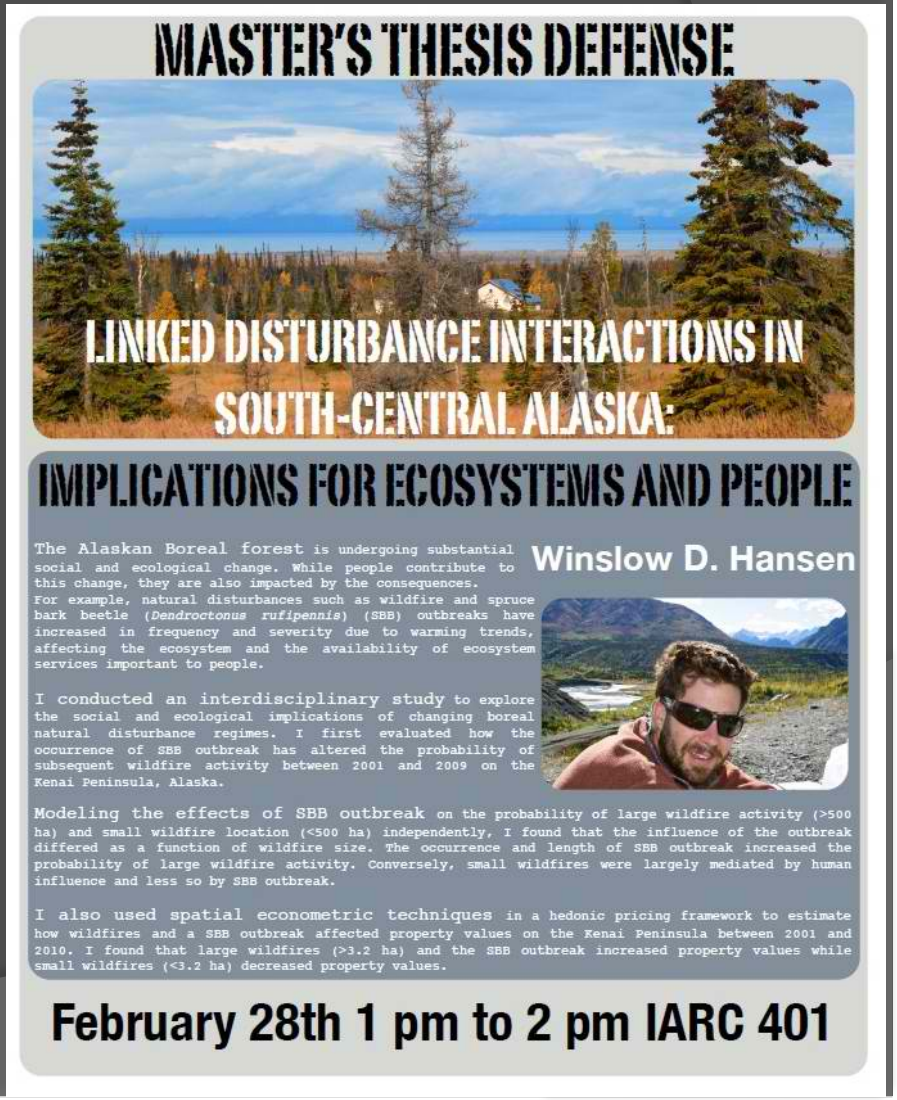
- Could SAR be used to remotely sense surface moisture as a monitoring tool for permafrost degradation?
- Fire in Alaska's tundra ecosystems is getting more attention as a potentially important factor in climate change. A 5-yr US Arctic Research Program Plan just released by the Interagency Arctic Research Policy Committee calls for investigating the frequency and severity of wildland fires in the Arctic.

Casey Brown, UAF-IAB

- Bull moose response in 1994 Hadjukovich fire by Gerstle River, using collared animals

Winslow Hansen, PhD student

- Fire on Kenai
- Bugs
- Property Values



www.akfireconsortium.uaf.edu