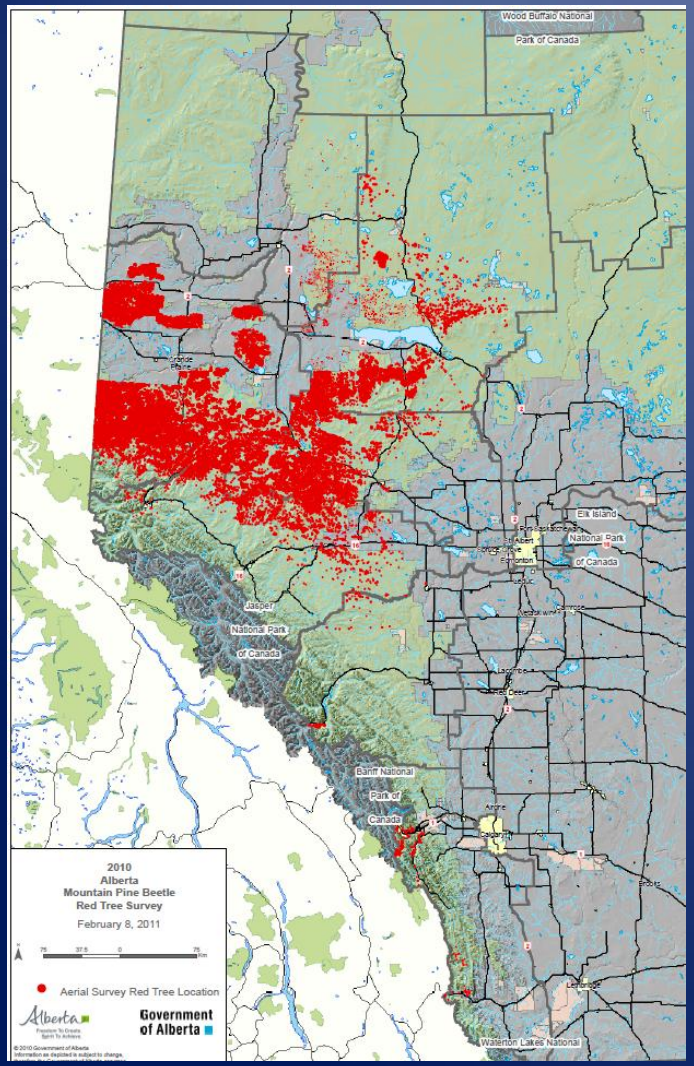
Comparison of Understory Burning and Mechanical Site Preparation to Regenerate Lodgepole Pine Stands Killed by Mountain Pine Beetle

Soung Ryu, and Victor Lieffers

University of Alberta

Background Information



Current mountain beetle attack area
(2011 Feb Survey)
(http://www.mpb.alberta.ca/Resources/maps.aspx)

- MPB attack area ↑
  - > Salvage logging
  - Tree fall danger
- Lodgepole pine regeneration
  - OL removal required
  - Mechanical treatment
  - Prescribed burning

Site Preparations

- Mechanical treatment
  - Effectiveness proven
  - Expensive / Labor intensive
  - Time restriction
- Prescribed burning
  - Can be cost effective
  - Unproven applicability
  - Danger of fire escape

Fire Behavior after MPB attack

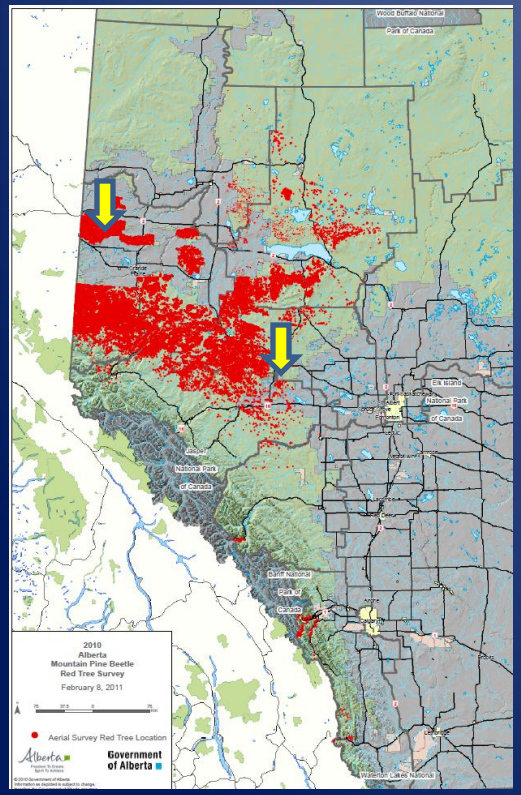
- Influence on
  - Available fuel
  - Fuel arrangement
  - Fuel moisture
  - Crown fire possibility?

- Increased risk in intense forest fire?
- Prescribed burning on surface fuel reduction ?

Two Main Questions

- Effectiveness on regeneration
  - Seed source
  - Seed germination
  - Seedling growth
- Fire behaviour
  - Fuel consumption, fire residence time, etc.
  - Fuel moisture dynamics

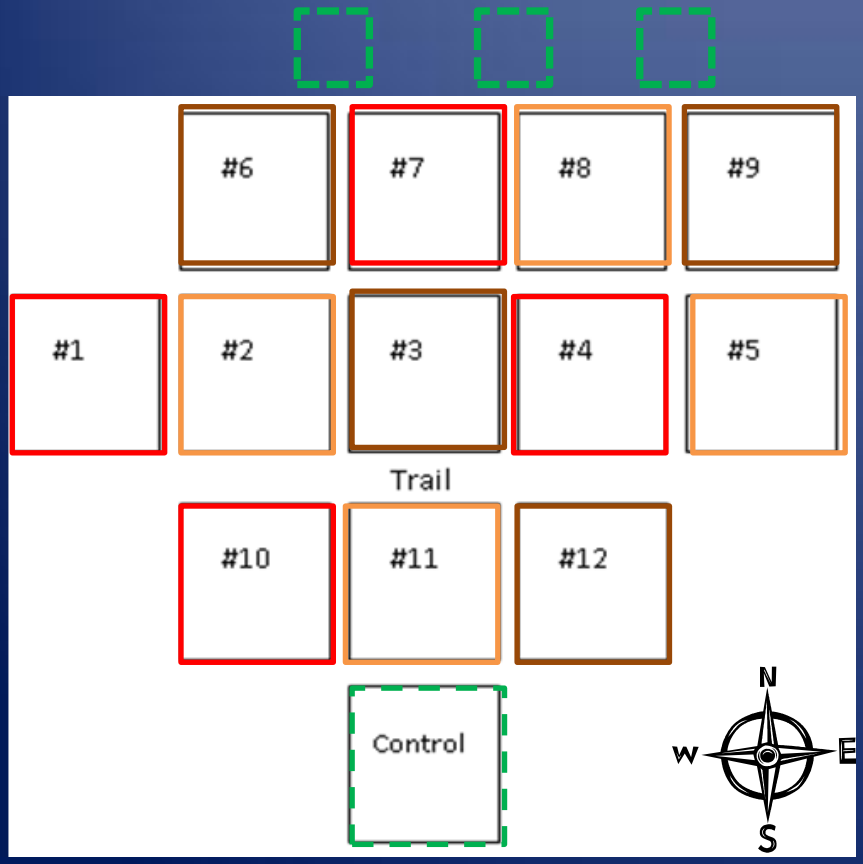
Study Sites



Jackfish Lake (JF)

Horse Creek (HC)

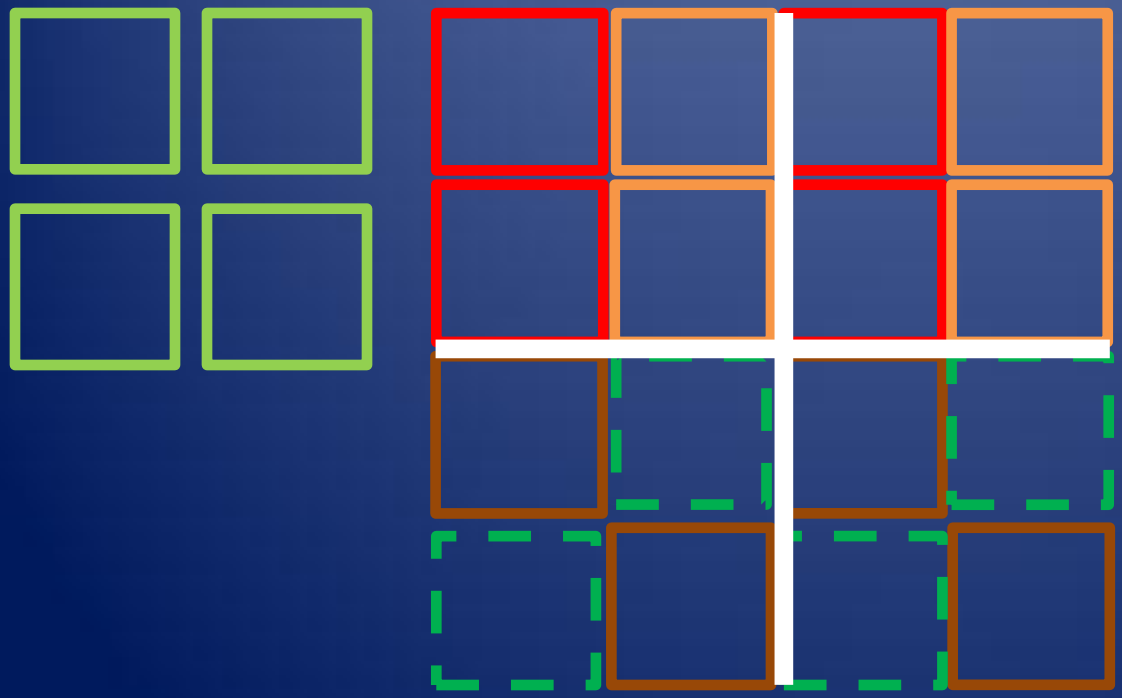
Experimental design – Jack Fish



13 (50*50m²) plots + Controls

- Mechanical Trt
- High intensity burning
- Low intensity burning
- Control

Experimental design – Horse Creek



Mechanical treatment

High intensity burning

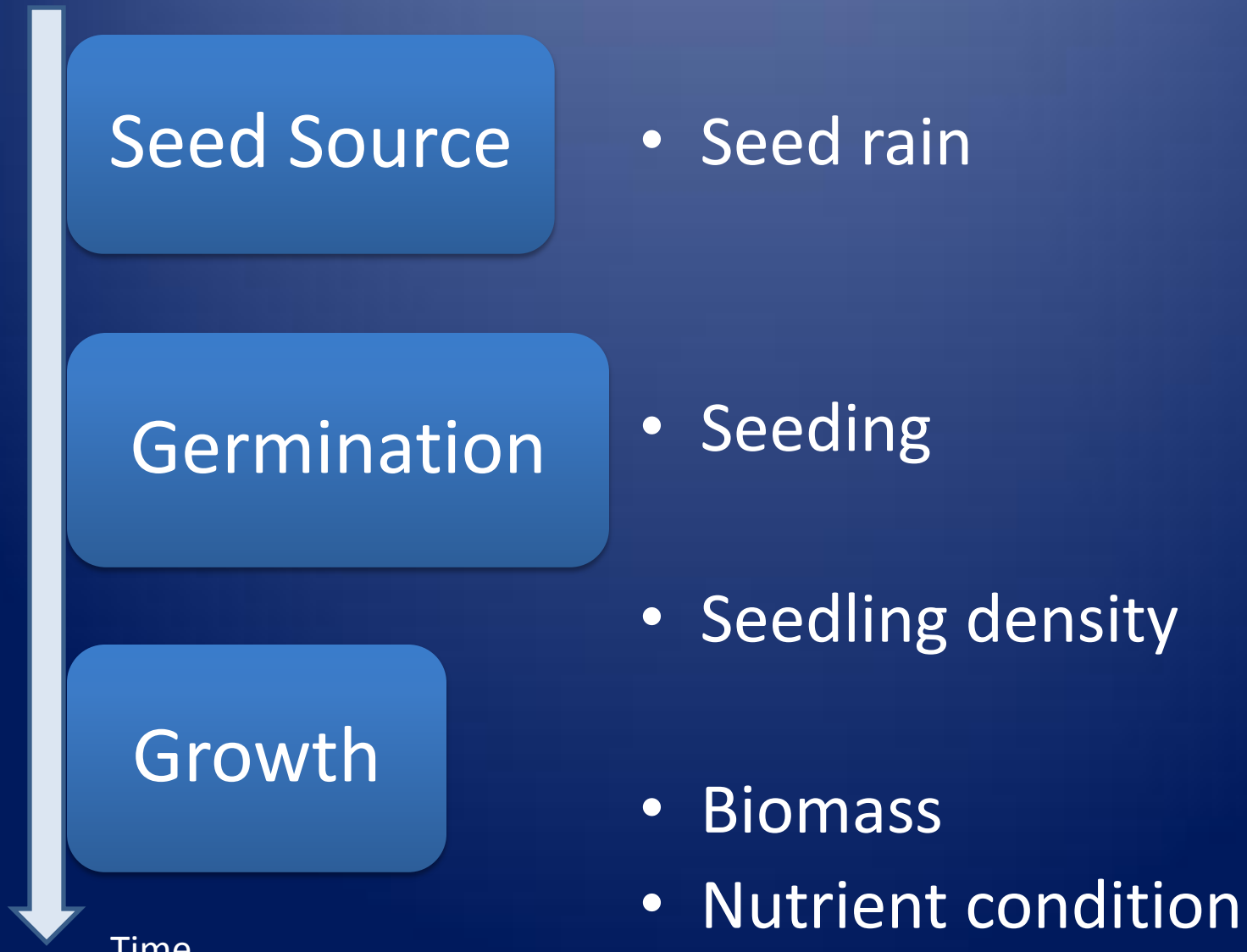
Low intensity burning

Disturbed Control

Control

16 (50*50m²) plots + 4 controls

Q1. Regeneration

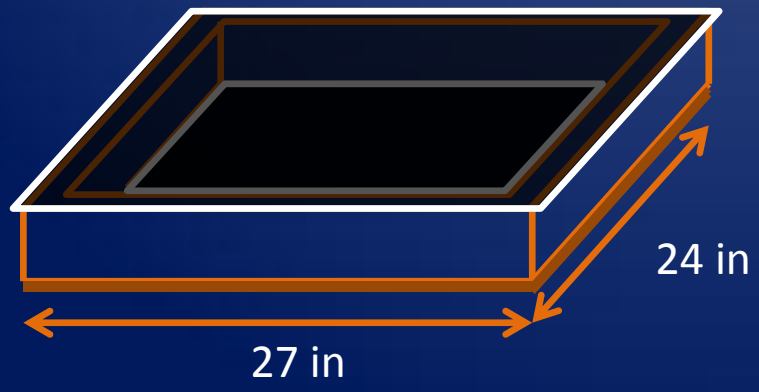


- Seed rain
- Seeding
- Seedling density
- Biomass
- Nutrient condition

Seed Source

Study Site: HC + JF

Equipment: 5 seed traps (systematic) *
28 plots (2 sites) = 140 traps



Collected in 2012:
-1 week after fire
-1 month intervals

Germination

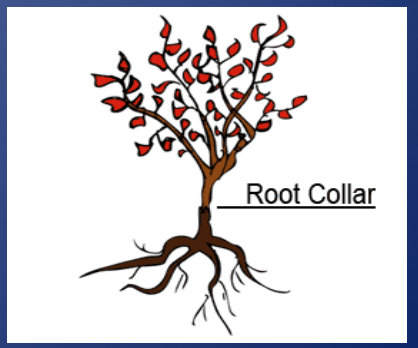
- Natural germination
  - Transects (NE-SW & SE-NW)
  - 5m interval, 1.78m radius circular plot
  - 1 week and 1 month after treatment
- Seeding
  - 12 “ideal” sub-plots per plot
  - 10 seeds per sub-plot (w/ control)
  - Count germination (monthly)

Growth

- Seedling growth
  - Seedling density
  - Aboveground net primary production
- Nutrient dynamics

Seedling Growth

- Seedling density
  - At the end of growing season (2012 & 2013)
  - Transects (NE-SW & SE-NW)



ANPP

- Trees will be harvested to measure above ground biomass.
- At the end of second growing season (2013)
- Foliar nutrient (N & P) will be analyzed.

Nutrient Dynamics

- Soil Nutrient
  - Soil samples (top 15cm) will be sampled (pre-treatment & end of 2nd growing season)
  - Target: pH, exchangeable N, P, Ca, Mg, K)
- N mineralization
  - Resin capsule (6 reps per plot)
  - Pre-treatment, 1 month after trt, 2-3 month interval
- Litter decomposition
  - Litter bag will be placed after treatment
  - 1st year: 3 bags (monthly during growing season)
  - 2nd year: 3 bags at the beginning and end of G.S.
  - Biomass, N & P content, lignin

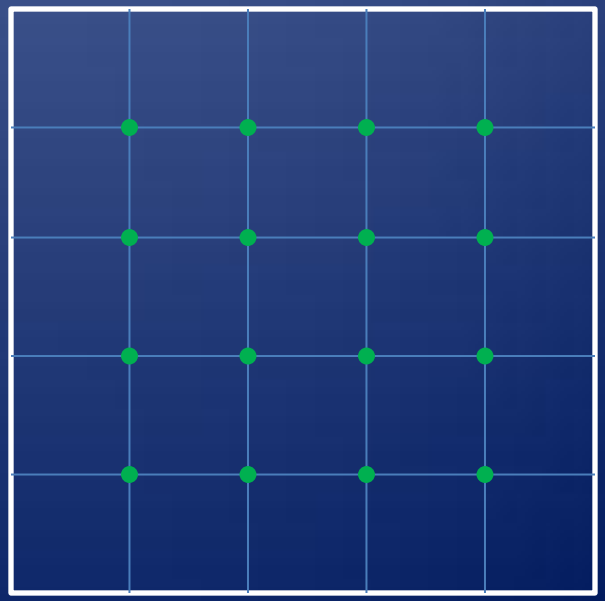
Q2. Fire Behaviour

- Evaluate the effectiveness of burn treatment
- Find the prescribed burning window
- Crown fire initiation (FMC)

Burn Effectiveness

- Depth of burn, rate of spread, and fire residence time will be measured
- 16 points per plot

(http://www.wildfirewiki.org/mediawiki/index.php/Category:Fuel_Consumption)

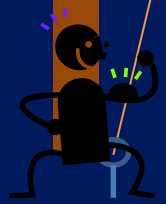


Crown Temp

- Insights on the serotinous cone opening and heat transfer during fire.

Data logger with thermal blanket (prepared)

Fishing line



Fishing line

knot

wire

Fuel Moisture Dynamics

Transpiration ↓ / Evaporation = / Interception = or ↓

Fuel moisture? = Available Fuel Loading?

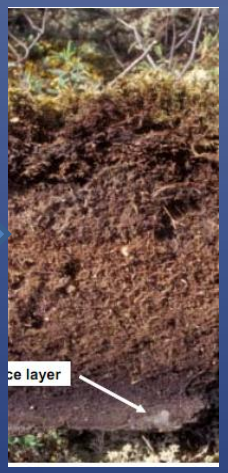
Canadian Fire Weather Index

- Widely used and very effective
- Used to prescribing a fire (e.g., FFMC, DMC, DC)
- Developed for closed canopy / alive forest

Methods

Separate each layer visually by degree of decomposition (Norum and Miller 1984)

thick feathermoss!



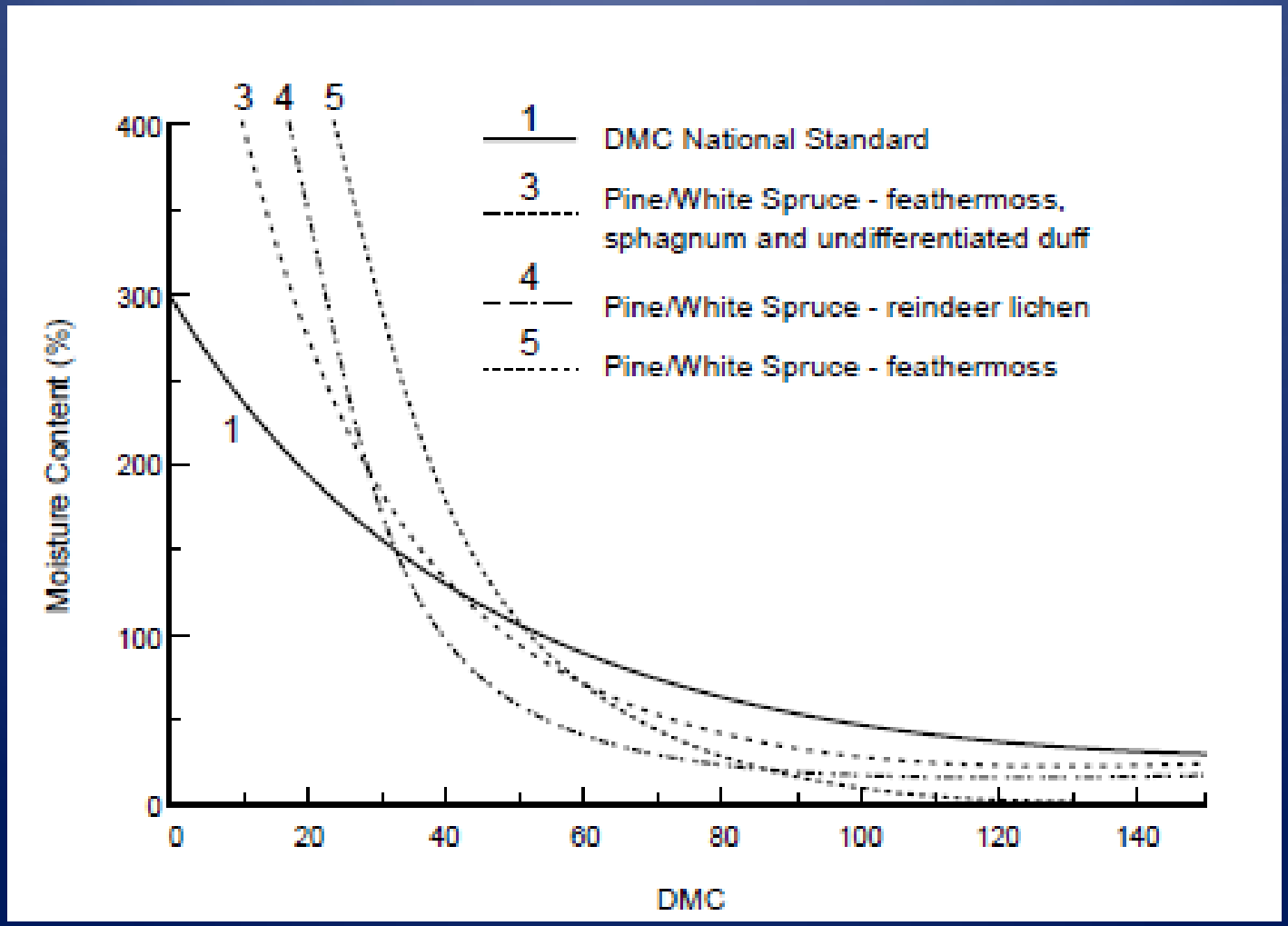
Litter layer (L)
Live feathermoss (LF)
Fermentation layer (F)
Humus layer (H)
Soil (top 5cm)
Fuel moisture sticks (at 2 locations

Ottmar, R. D., and Baker, S. P. 2007.

Methods

- 8 plots (4 control + 4 disturbed-control) * 4 reps per plot (random sampling)
- Sample periods: Apr – Sep
- # of sample: 20 (minimum) are planned with varying FWI indices
- Moisture sticks

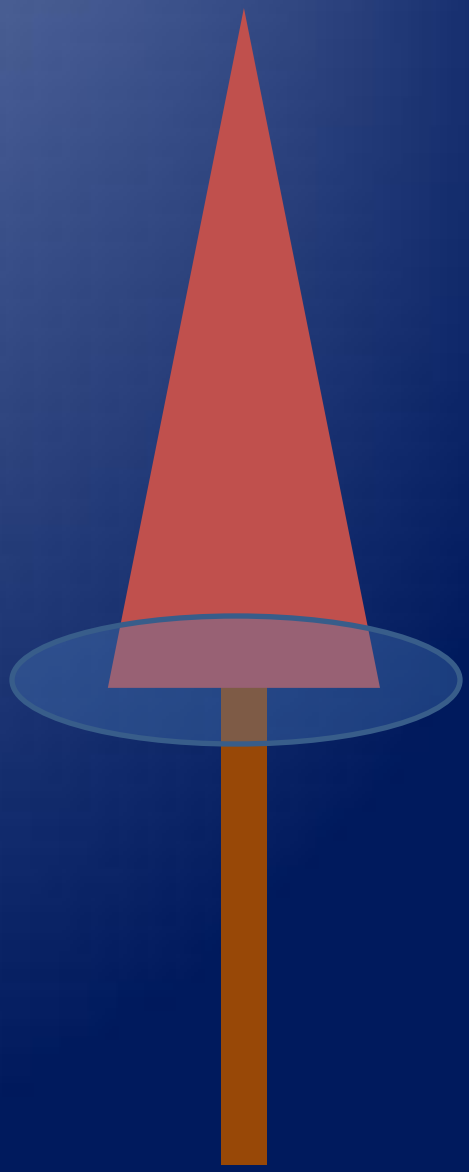
Expected results



The standard FWI ≠ every fuel type.
Different DMCs w/ or w/o feathermoss

Crown Fire Initiation

- Four Main Components
  - Canopy base height
  - Canopy bulk density
  - Surface fire intensity
  - Foliar moisture content
    - 5 dominant trees/plot
    - Monthly



Expected Management Implications

- Evaluate if controlled burns can be an effective and inexpensive regeneration tool.
- Compare the effectiveness of burn and mechanical treatment on regeneration
- Evaluate the seed bed preparation by burn
- Understand the 'burn window'
  - Modified fuel moisture prediction
  - Possible to apply large scale prescribed burn
- Improve our understand on the fire hazard reduction (e.g., crowning possibility)
  - FMC
  - Fuel reduction

Goldilocks syndrome

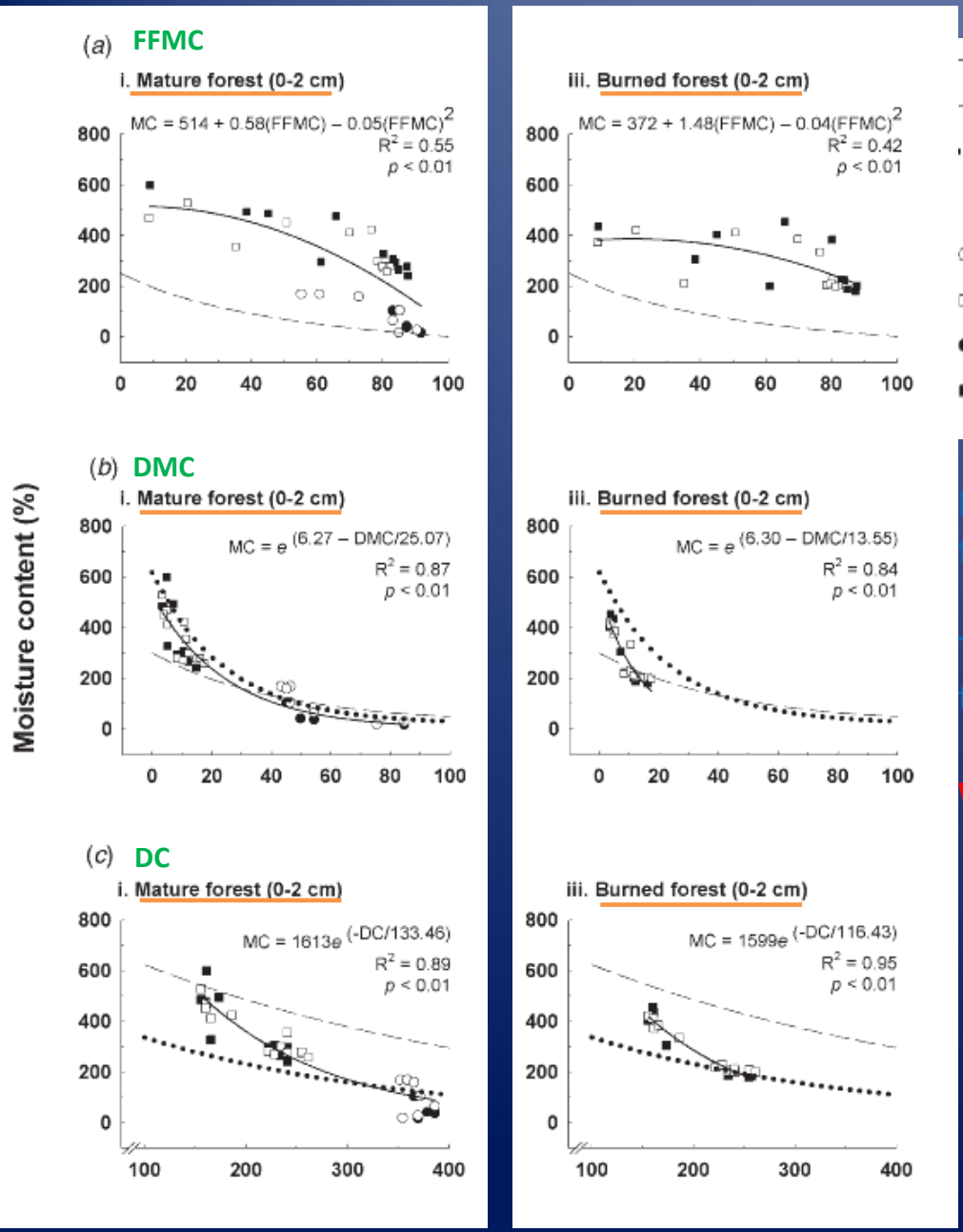
Project Members

- Victor Lieffers, University of Alberta
- Soung Ryu, University of Alberta
- Derek MacKenzie, University of Alberta
- Dennis Quintilio
- Dave Schroeder, ASRD
- Jin Hwang, MSc student
- Maria Sharpe, MSc student
- Stephanie Koroscil, MSc student

- FPInnovations
- Weyerhaeuser

Thank you

Expected results - continued



Present study, Northwest Territories relationships

Standard relationships (from Van Wagner and Pickett 1985)

Southern Yukon relationships for the DMC (from Lawson *et al.* 1997*a*) and DC (from Lawson and Dalrymple 1996)

- Morning fuel moisture data, June 2000
- Morning fuel moisture data, August 2002
- Evening fuel moisture data, June 2000
- Evening fuel moisture data, August 2002

Pre- and post-burning,
the curve of each FWI component was changed.

This study compared alive/mature forest
to burned forest,

What about FWI of stand killed and burned?