Evaluating fire effects and forest regeneration following prescribed- and wild-fires in the Boundary Waters Canoe Area Wilderness

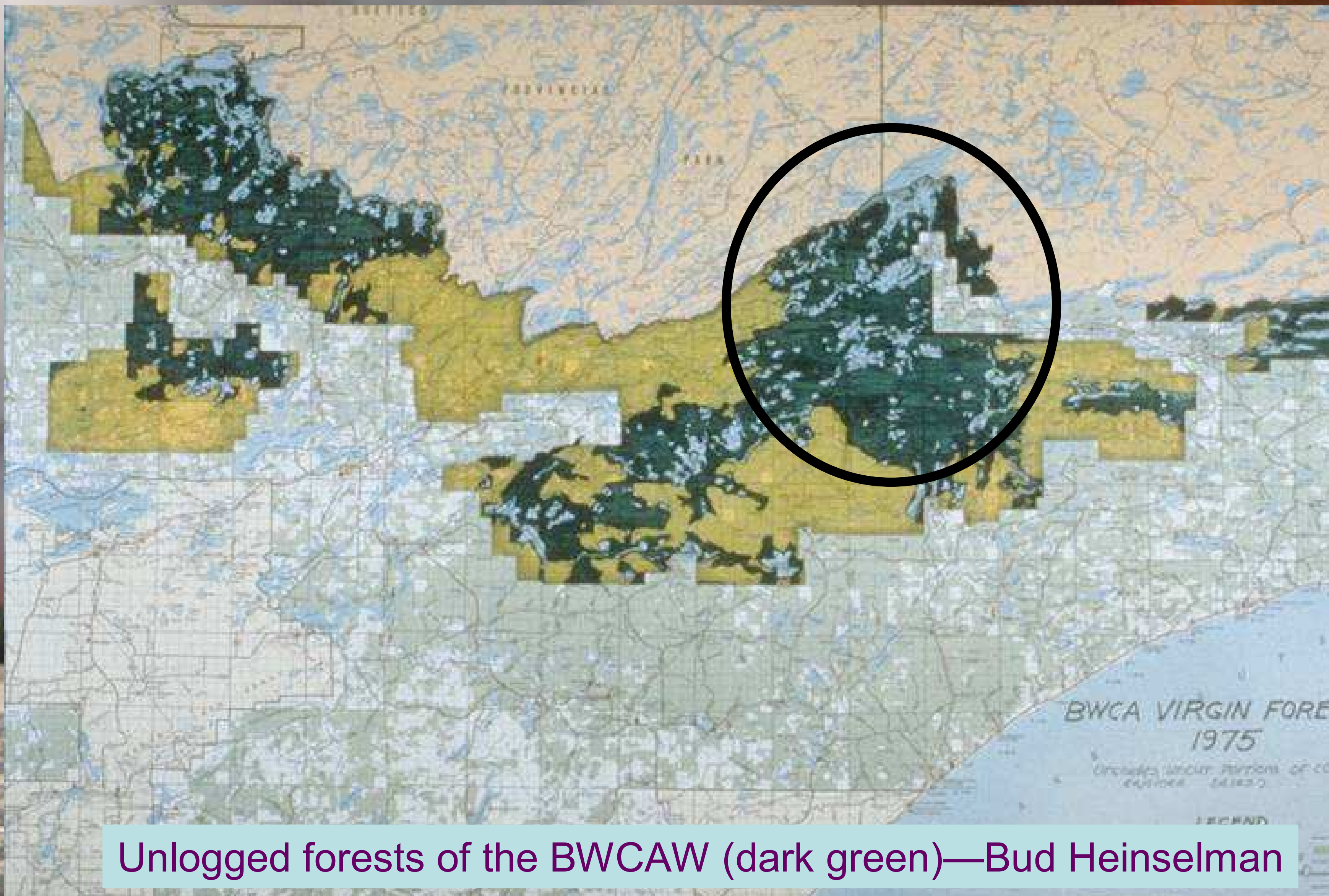
Roy L. Rich

Department of FOREST RESOURCES
UNIVERSITY OF MINNESOTA

Talk outline

1. Disturbance and Regeneration in BWCAW
2. TMI prescribed fire results
3. Cavity Lake Fire Germination

Boundary Waters Canoes Area Wilderness



Unlogged forests of the BWCAW (dark green)—Bud Heinselman

<u>Disturbance</u>: **"any relatively discrete event in time that disrupts ecosystem, community, or population structure, and changes resources, substrate availability, or the physical environment" (Pickett and White, 1985).**

Type → Intensity→ Severity → Residuals ← Extent

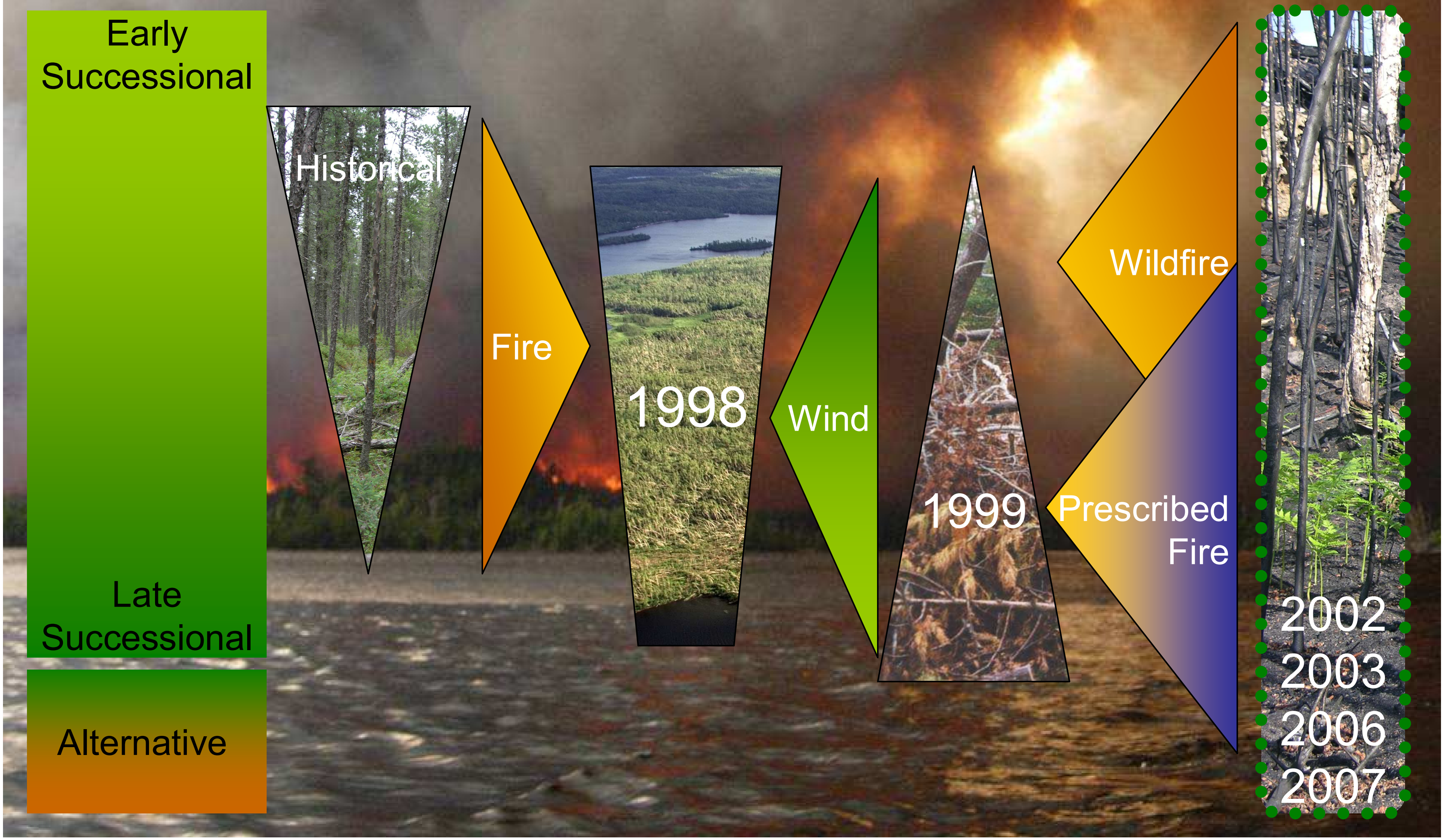
Issues of concern:
∆ Diversity, ∆ Composition or ∆ Structure
∆ Heterogeneity
∆ Stability or Resilience

Various ecological scales… microsite → local → community →landscape → regional landscape

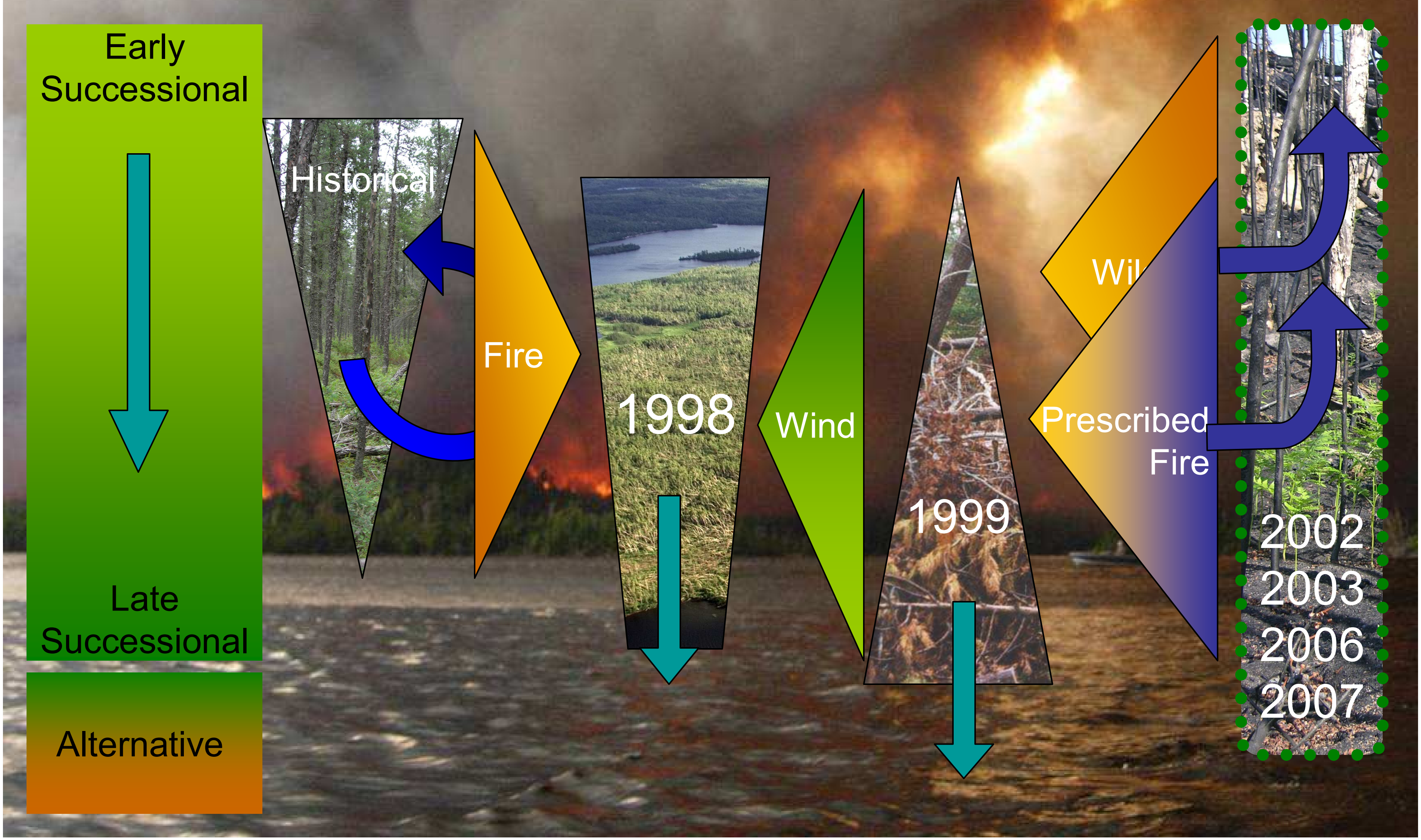
Large-scale disturbances influence a larger domain of ecological scales

	Crown Fire	Surface Fire	Downbursts
Severity: effect of disturbance on environment	Kills canopy and understory trees	Kills understory vegetation and susceptible trees	Kills canopy and susceptible trees
Intensity: force of the disturbance on environment	High intensity by heat	Lower intensity by heat	Low to moderate by mechanical force
Residuals: the organisms that survive	resprouting, serotinous cones buried seeds	mature trees, resprouting	understory trees and shrubs

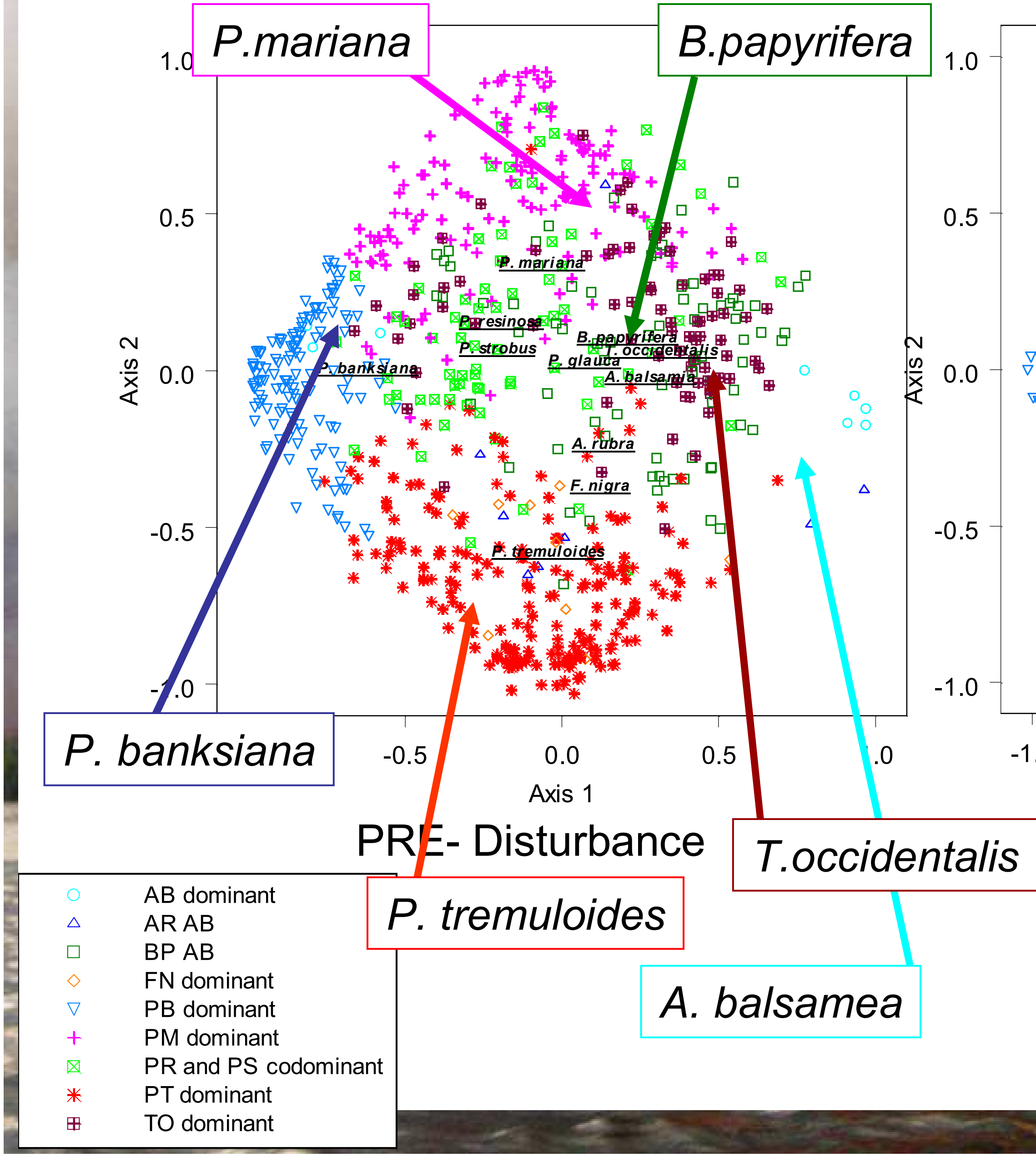
Disturbance as filter and agent of reorganization



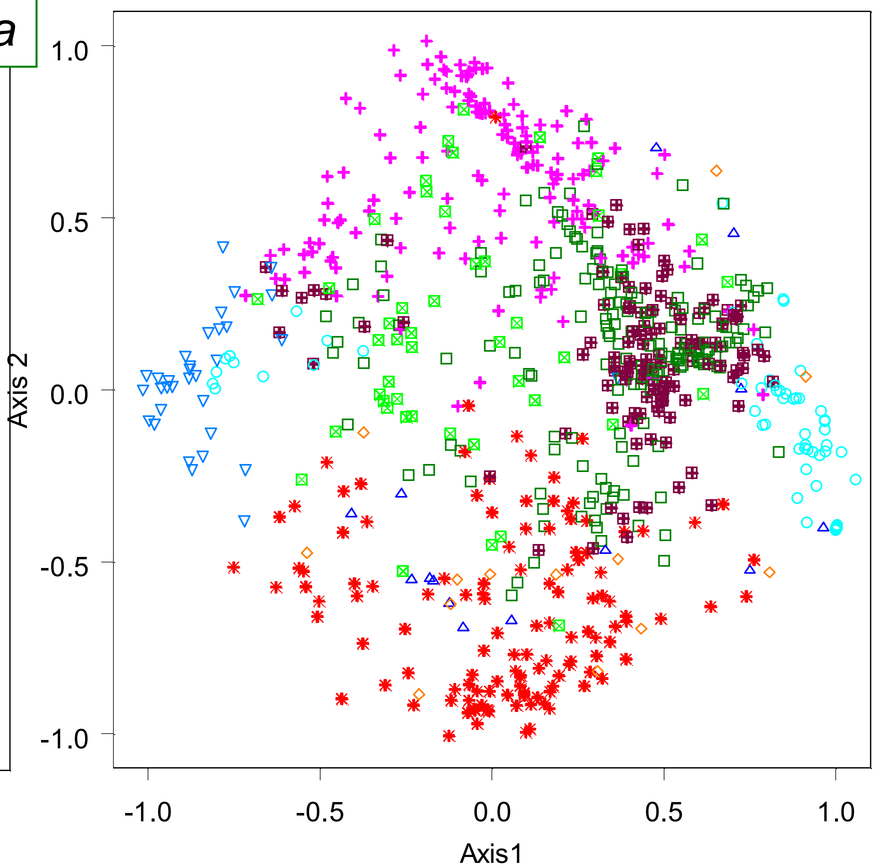
Patterns of Succession



Composition NMS derived from relative basal area



PRE- Disturbance



POST- Disturbance

Axis	Increment R^2	Cumulative R^2
1	0.172	0.172
2	0.175	0.346
3	0.253	0.600

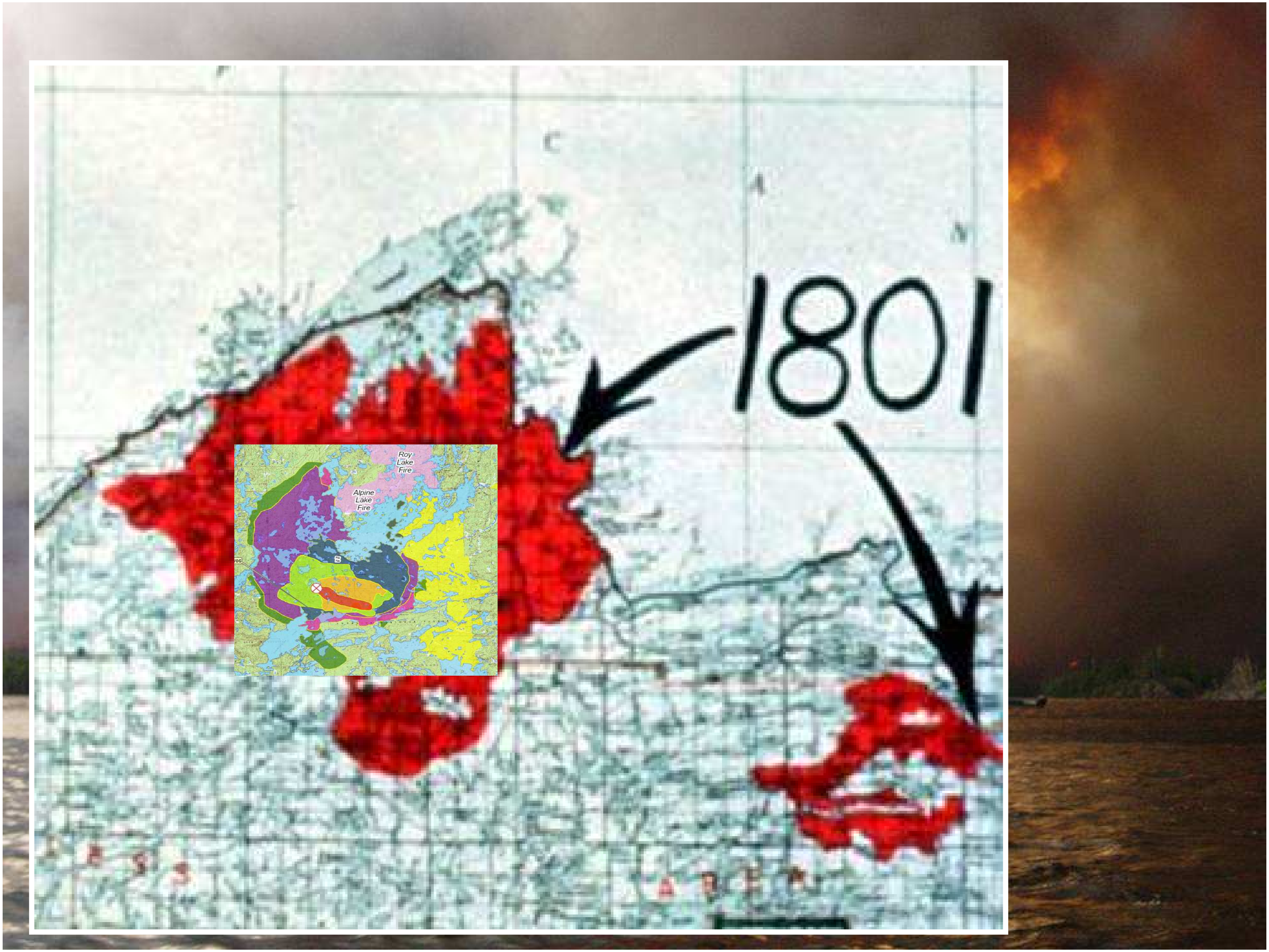
Final Stress ~ 22

Composition transitions (overall)

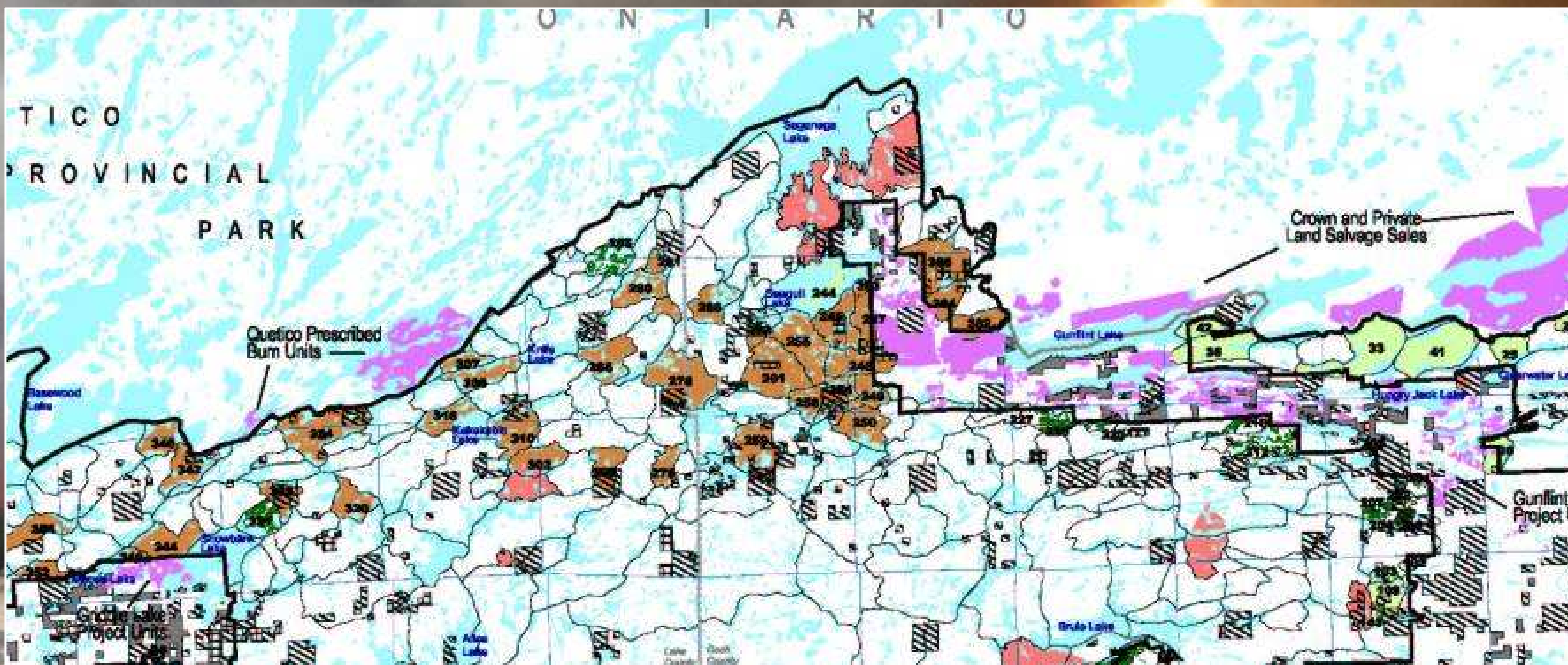
Transition from	n	Transition to: Black Ash	Jack Pine	Aspen	Red Pine	Black Spruce	Balsam Fir	Red Maple-Fir	Paper Birch-Fir	White Cedar
Black Ash	9	100.0								
Jack Pine	130		23.9	10.0	0.8	22.3	10.0		20.0	13.1
Aspen	200	2.0	0.5	48.5		7.5	11.5	3.0	19.5	7.5
Red Pine	75				57.3	12.0	10.7		6.7	13.3
Black Spruce	147		0.7	7.5	1.4	67.4	1.4		18.4	3.4
Balsam Fir	8					12.5	75.0		12.5	
Red Maple-Fir	8							100.0		
Paper Birch-Fir	78			2.6	1.3		6.4		89.7	
White Cedar	80								3.8	96.3
(n=735)										

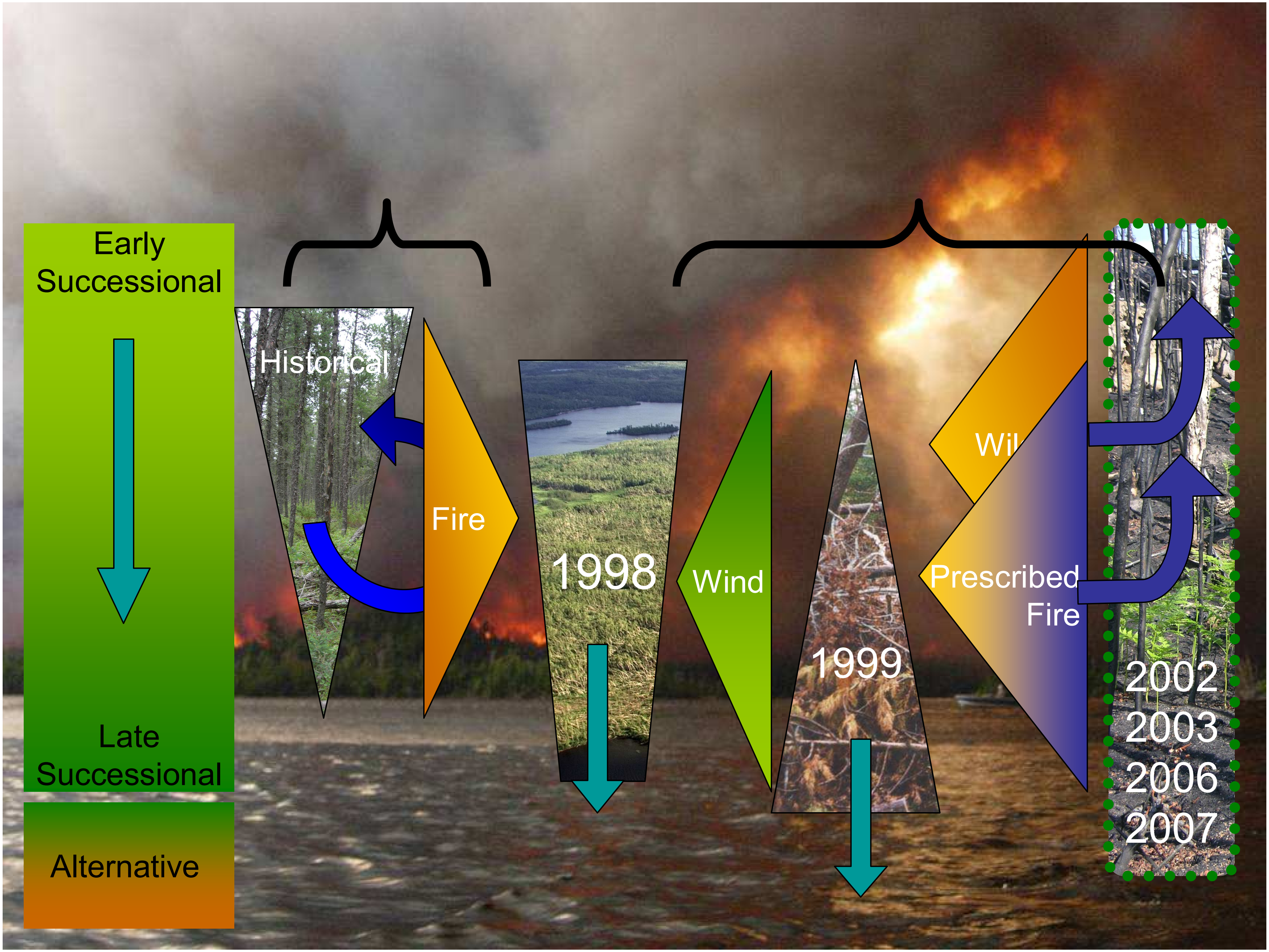
Community	n	Pre-storm landscape prevelance	Post-storm landscape prevelance	Change	Total Pre	Total Post
Black Ash	9	1.2	1.8	0.5		
Jack Pine	130	17.7	4.5	-13.2		
Aspen	200	27.2	16.7	-10.5		
Red Pine	75	10.2	6.4	-3.8	55.1	27.6
Black Spruce	147	20.0	20.8	0.8		
Balsam Fir	8	1.1	7.8	6.7		
Red Maple-Fir	8	1.1	1.9	0.8		
Paper Birch-Fir	78	10.6	23.3	12.7		
White Cedar	80	10.9	16.9	6.0	43.7	70.6

Late-successional
No change
Early successional

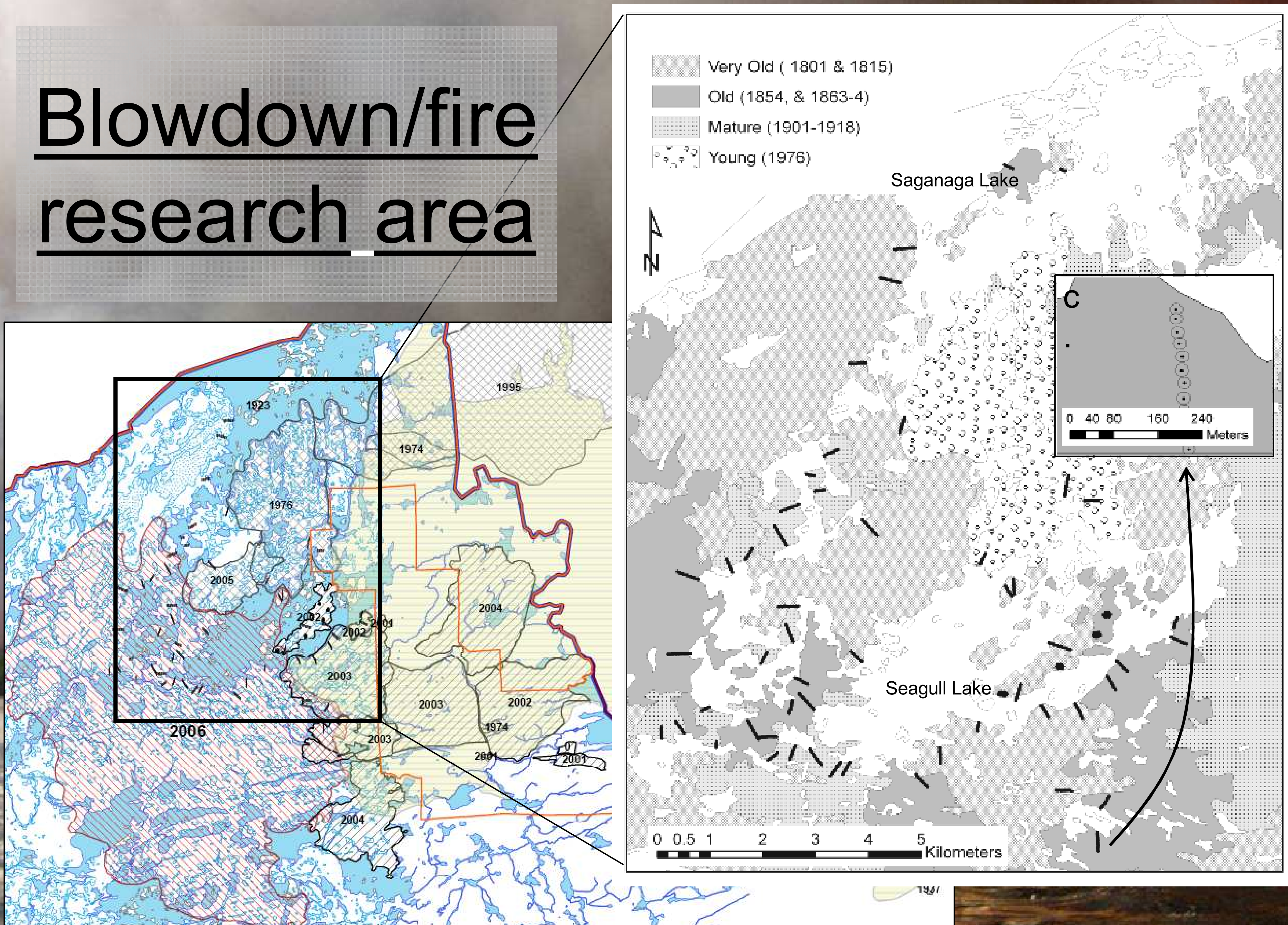

1801
Roy Lake Fire
Alpine Lake Fire

BWCAW prescribed burn plan




Early
Successional
Late
Successional
Alternative
Historical
Fire
1998
Wind
1999
Wil
Prescribed
Fire
2002
2003
2006
2007

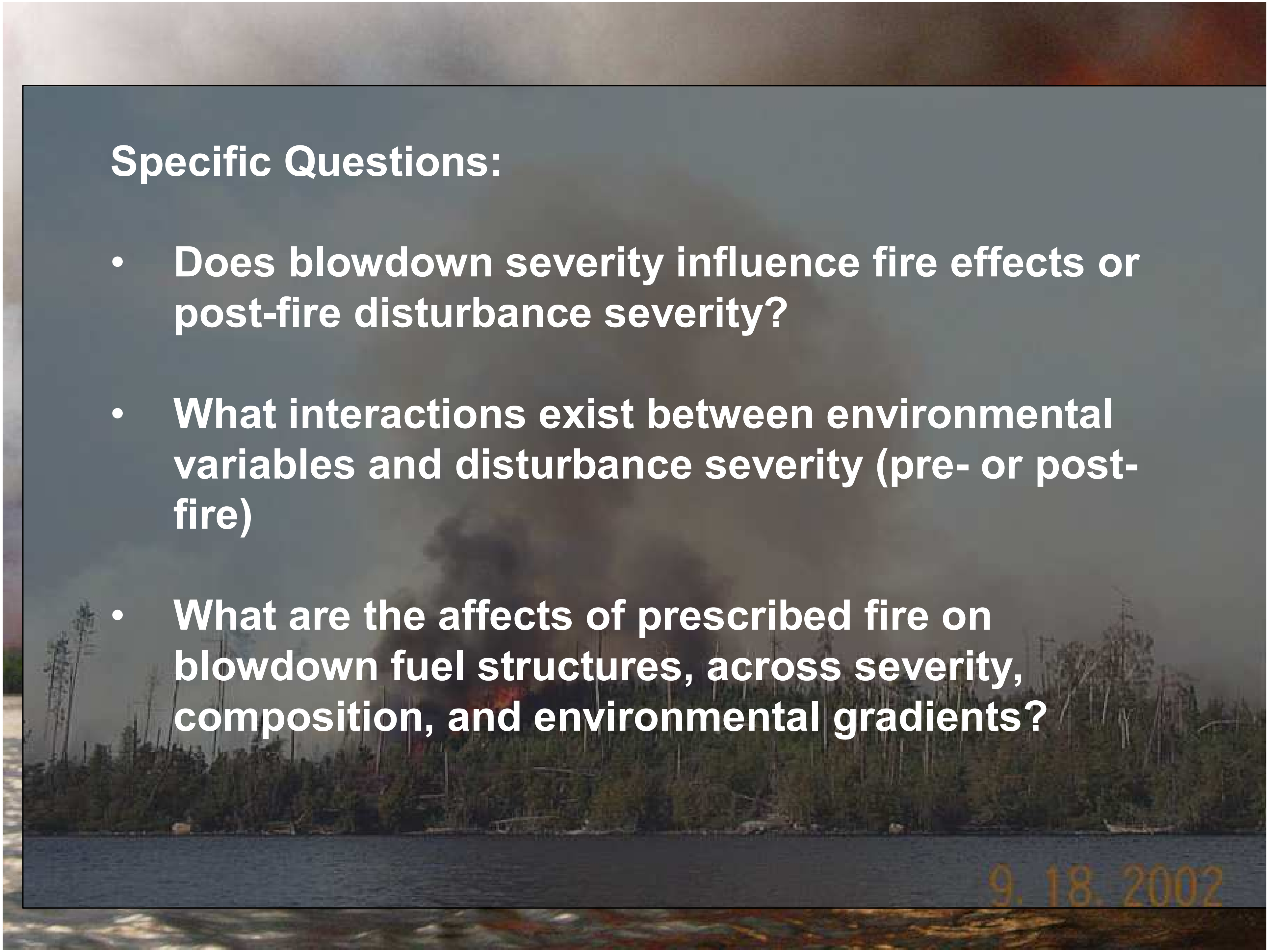
Blowdown/fire research area



Three Mile Island Prescribed Fire Experiment

Specific Questions:

- Does blowdown severity influence fire effects or post-fire disturbance severity?
- What interactions exist between environmental variables and disturbance severity (pre- or post-fire)
- What are the affects of prescribed fire on blowdown fuel structures, across severity, composition, and environmental gradients?



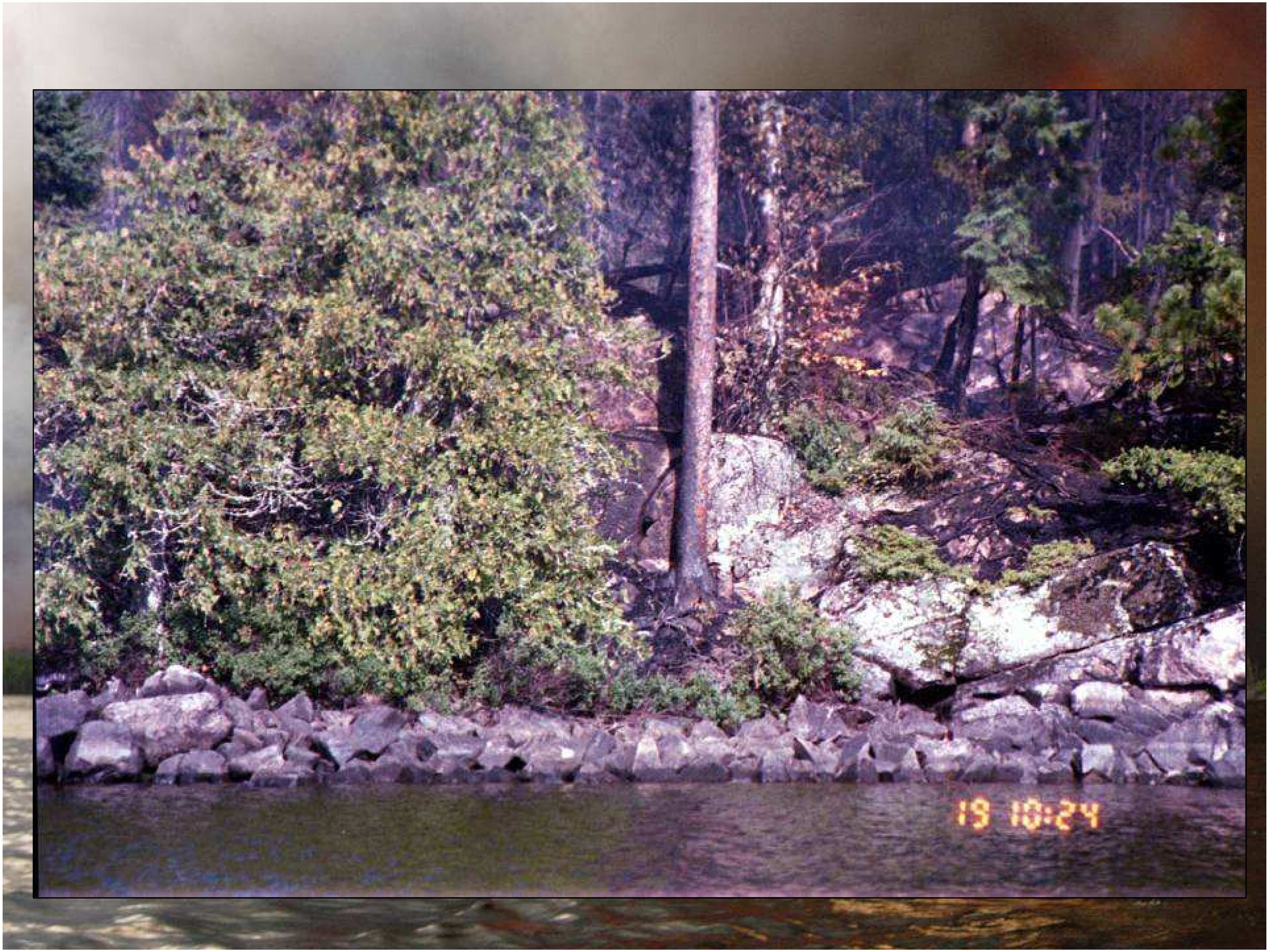
TMI Experiment Overview

- 4 SW facing sites, 24 plots on each in 2 age classes (1801, 1864)
- Summer 2001 sampled blowdown damage
- Fall 2001 surveyed pre-burn fuels
- Fall 2002 fire and post-burn fuels, other surrogates for fire severity.
- Other data including duff consumption

9. 18. 2002


18 18:21


18 16:42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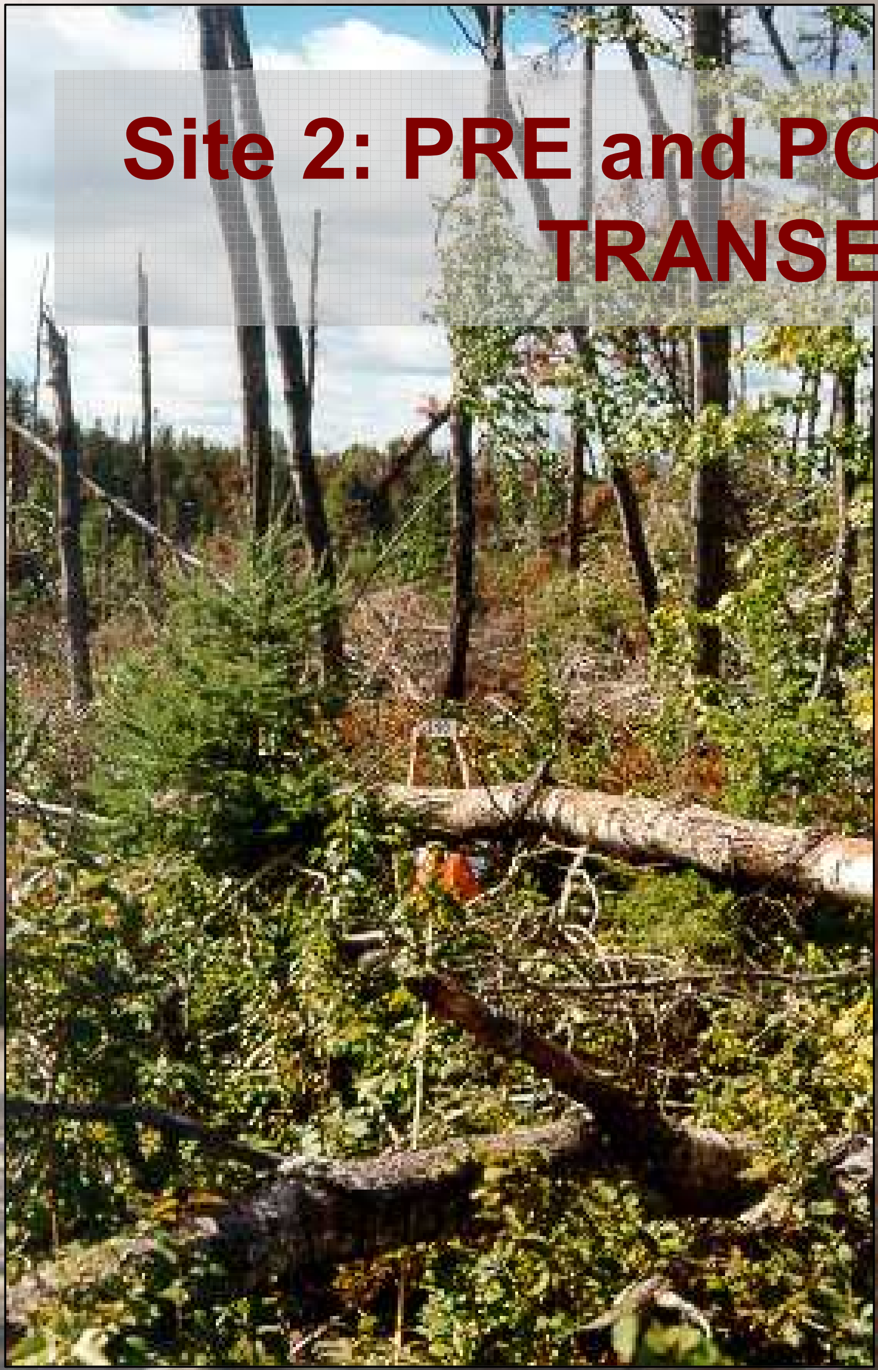
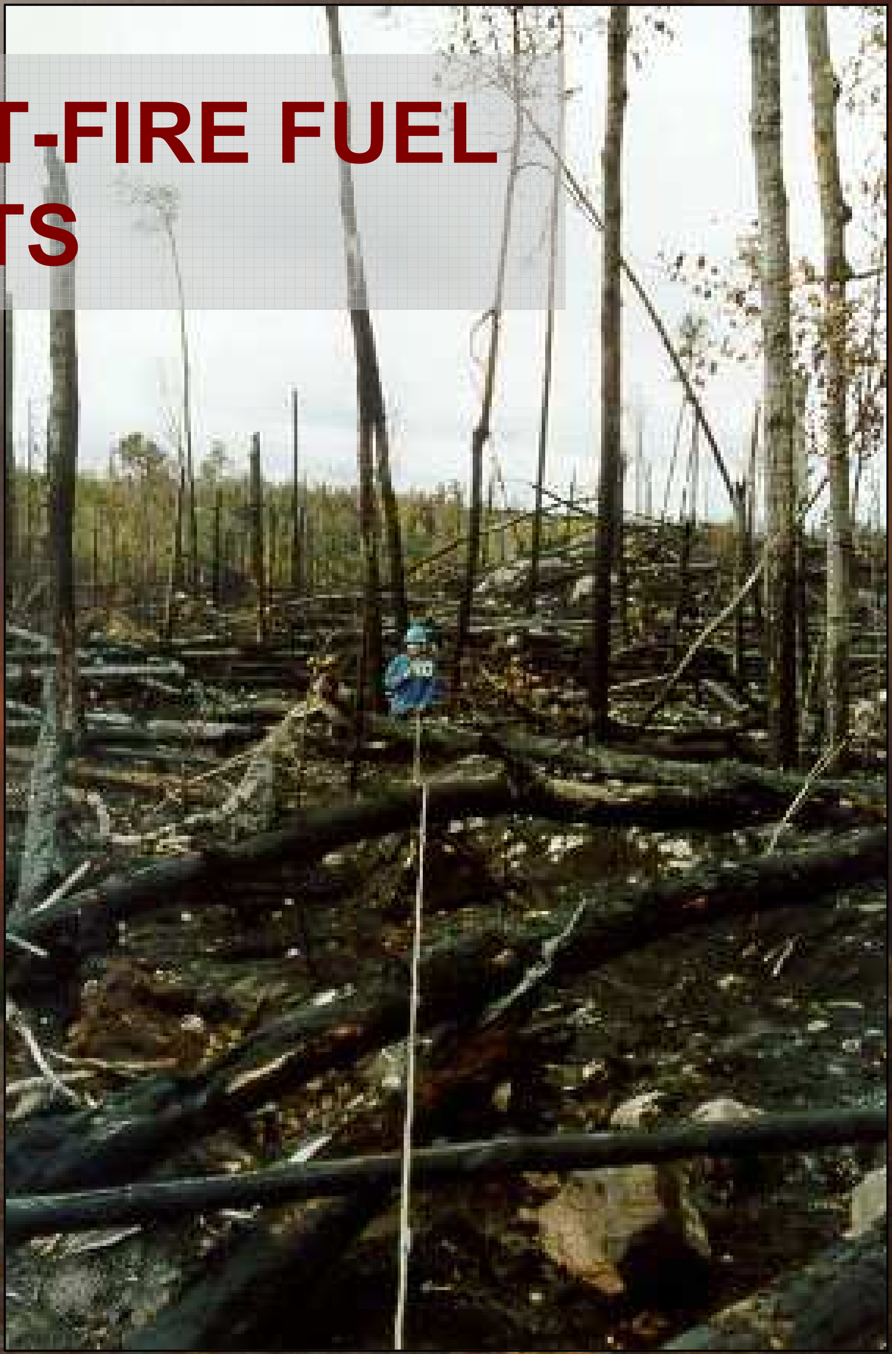
Spruce Layering
Paper Birch saplings colonize old woody debris
Shrub Layers remain largely intact and may provide refugia for some species


Site 4, south end TMI


Site 2

Site 2: PRE and POST-FIRE FUEL TRANSECTS





Plot 69 Pre-burn

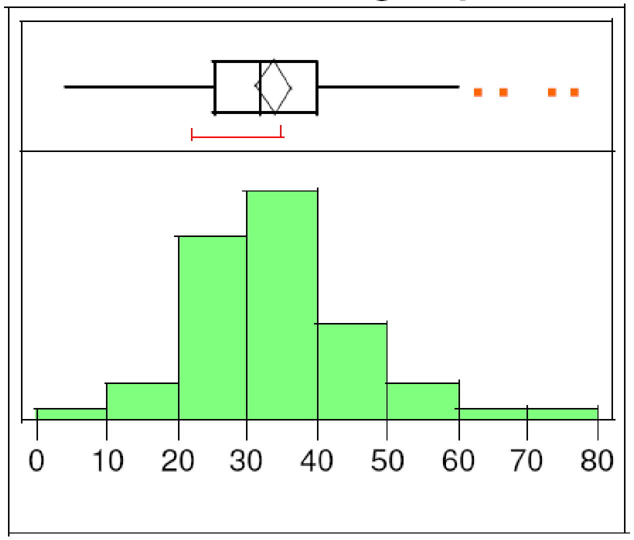
Plot 69 Post-burn

Fuel Consumption:

What were the pre-fire fuel loadings? Did they vary by community, slope position or blowdown severity.

What factors influenced fuel consumption?

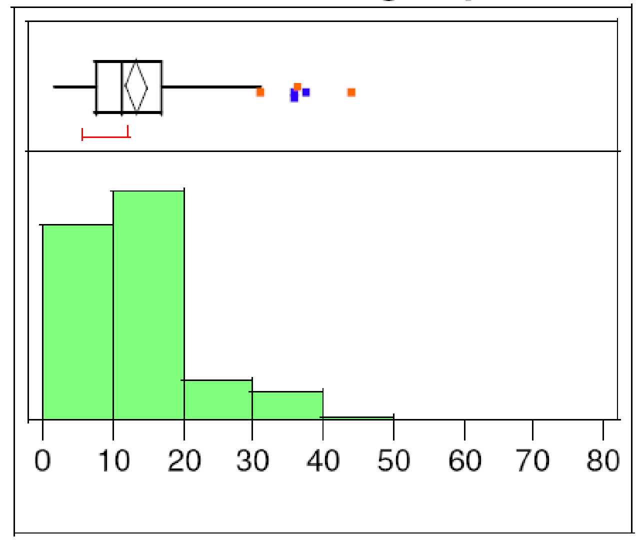
Cumulative Pile Height (pre-burn) (m)



Moments

Mean	33.865306
Std Dev	12.805458
Std Err Mean	1.2935466
upper 95% Mean	36.432638
lower 95% Mean	31.297974
N	98

Cumulative Pile Height (post-burn) (m)

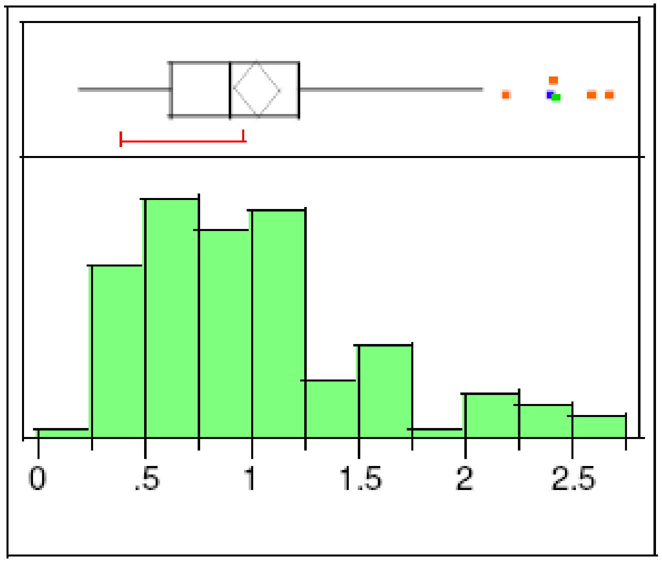


Moments

Mean	13.494592
Std Dev	8.1663592
Std Err Mean	0.8249269
upper 95% Mean	15.131843
lower 95% Mean	11.85734
N	98

Cumulative line intercept height of 36 subplots ~ stacking

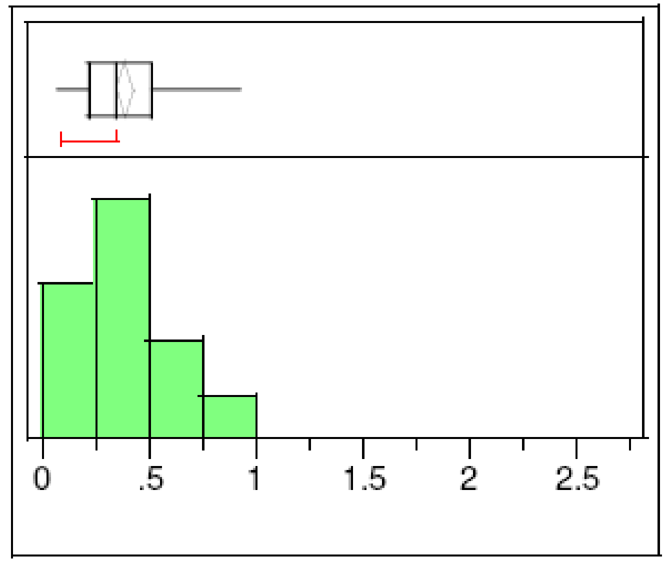
Mean pre-fire Fuels by plot (kg/m2)
Class IV-V (5-7 cm)



Moments

Mean	1.0275495
Std Dev	0.5530783
Std Err Mean	0.0558693
upper 95% Mean	1.1384347
lower 95% Mean	0.9166643
N	98

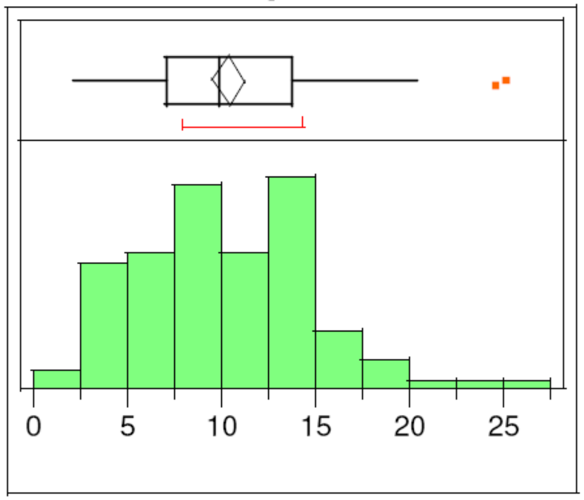
Mean post-fire Fuels by plot (kg/m2)
Class IV-V (5-7cm)



Moments

Mean	0.3843254
Std Dev	0.2071161
Std Err Mean	0.0209219
upper 95% Mean	0.4258495
lower 95% Mean	0.3428012
N	98

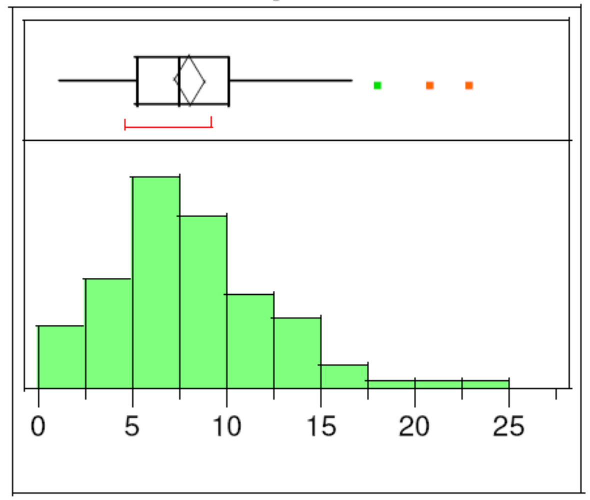
Fuels > 7 cm pre-fire



Moments

Mean	10.359939
Std Dev	4.762152
Std Err Mean	0.48105
upper 95% Mean	11.31469
lower 95% Mean	9.4051877
N	98

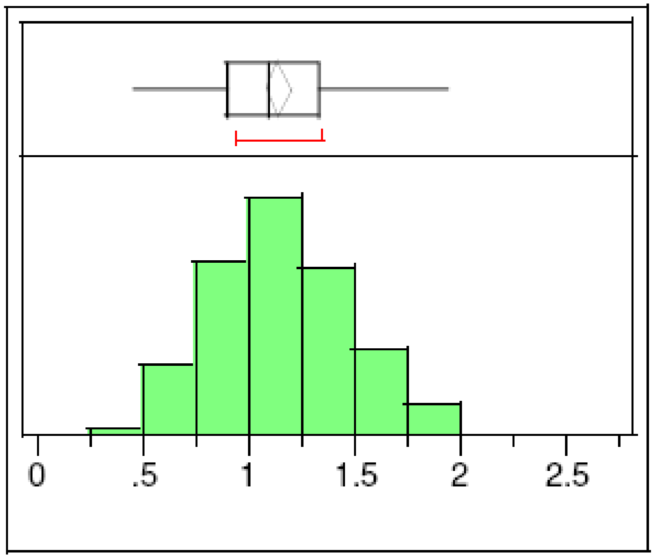
Distributions
Fuels > 7 cm post-fire



Moments

Mean	8.0554053
Std Dev	4.2083094
Std Err Mean	0.4251034
upper 95% Mean	8.899118
lower 95% Mean	7.2116927
N	98

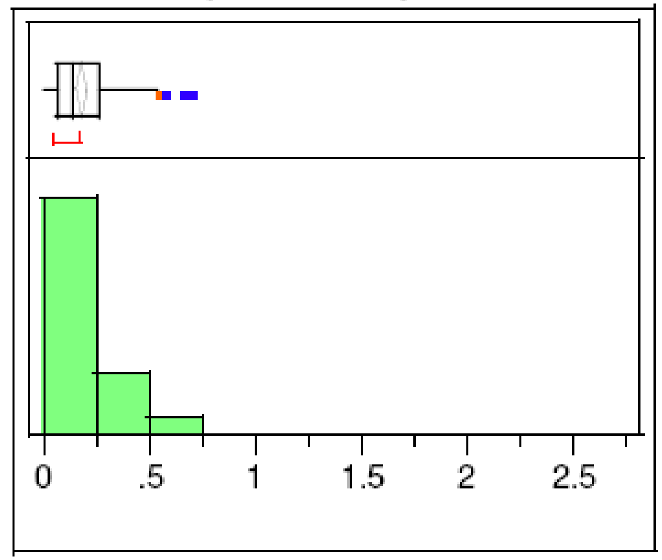
Mean pre-fire Fuels by plot (kg/m2)
Class I-III (0.5 - 3 cm)



Moments

Mean	1.1443813
Std Dev	0.3256354
Std Err Mean	0.0328941
upper 95% Mean	1.209667
lower 95% Mean	1.0790955
N	98

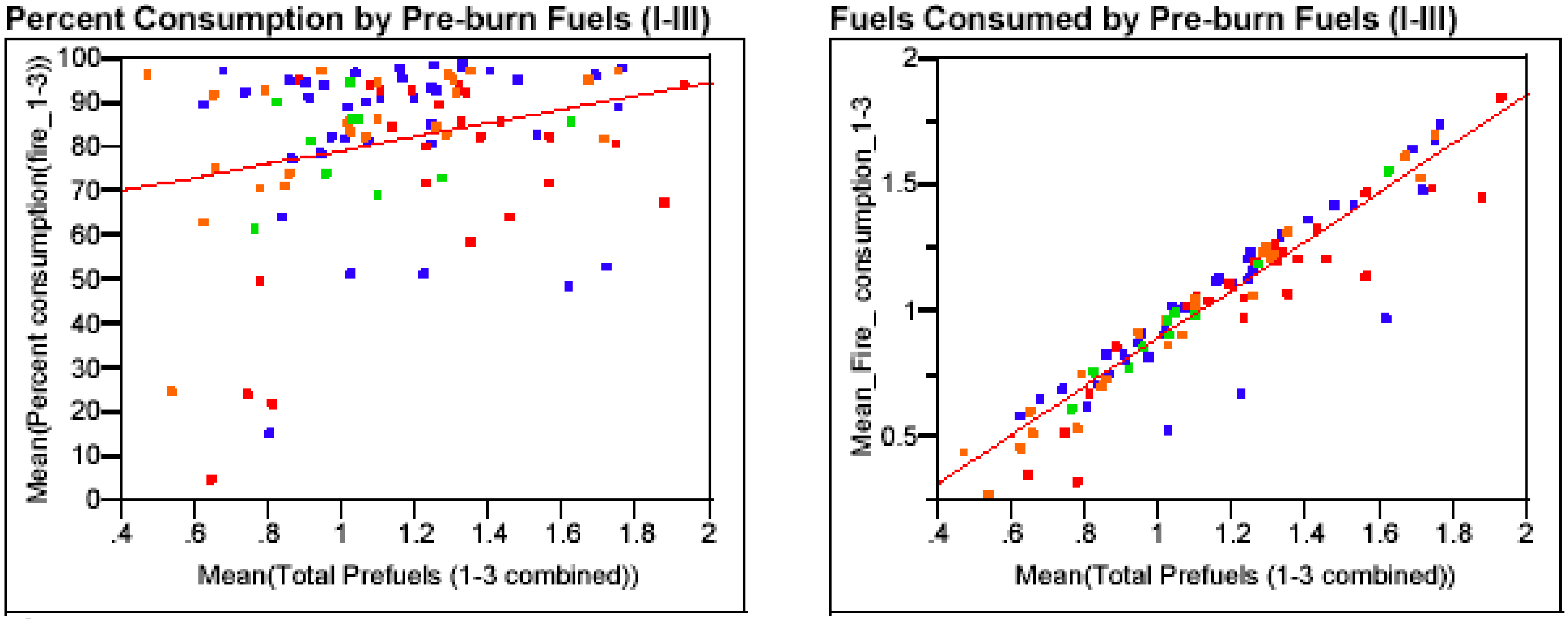
Mean post-fire Fuels by plot (kg/m2)
Class I-III (0.5 - 3 cm)



Moments

Mean	0.1819056
Std Dev	0.1526828
Std Err Mean	0.0154233
upper 95% Mean	0.2125166
lower 95% Mean	0.1512947
N	98

Figure 2. Example relationships between pre-burn fuels and fuel consumption



$R^2 = 0.66$, $p = 0.011$

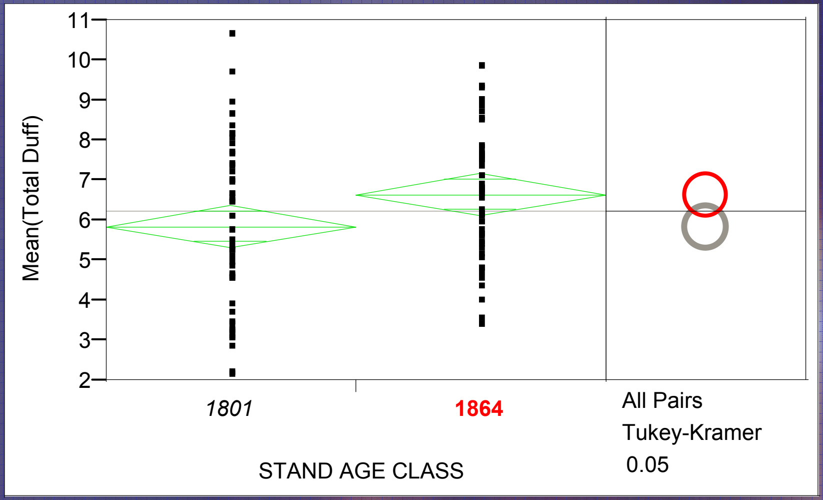
$R2 = 0.87$, $p < 0.0001$

Duff Consumption:

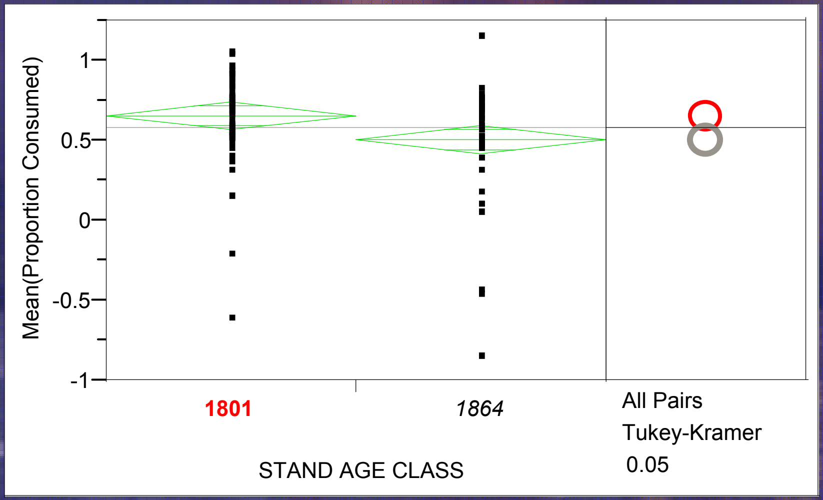
Duff measurement hoops were used to establish the total duff depth, duff consumed, and proportion duff consumed at ~ 900 subplots across sites.

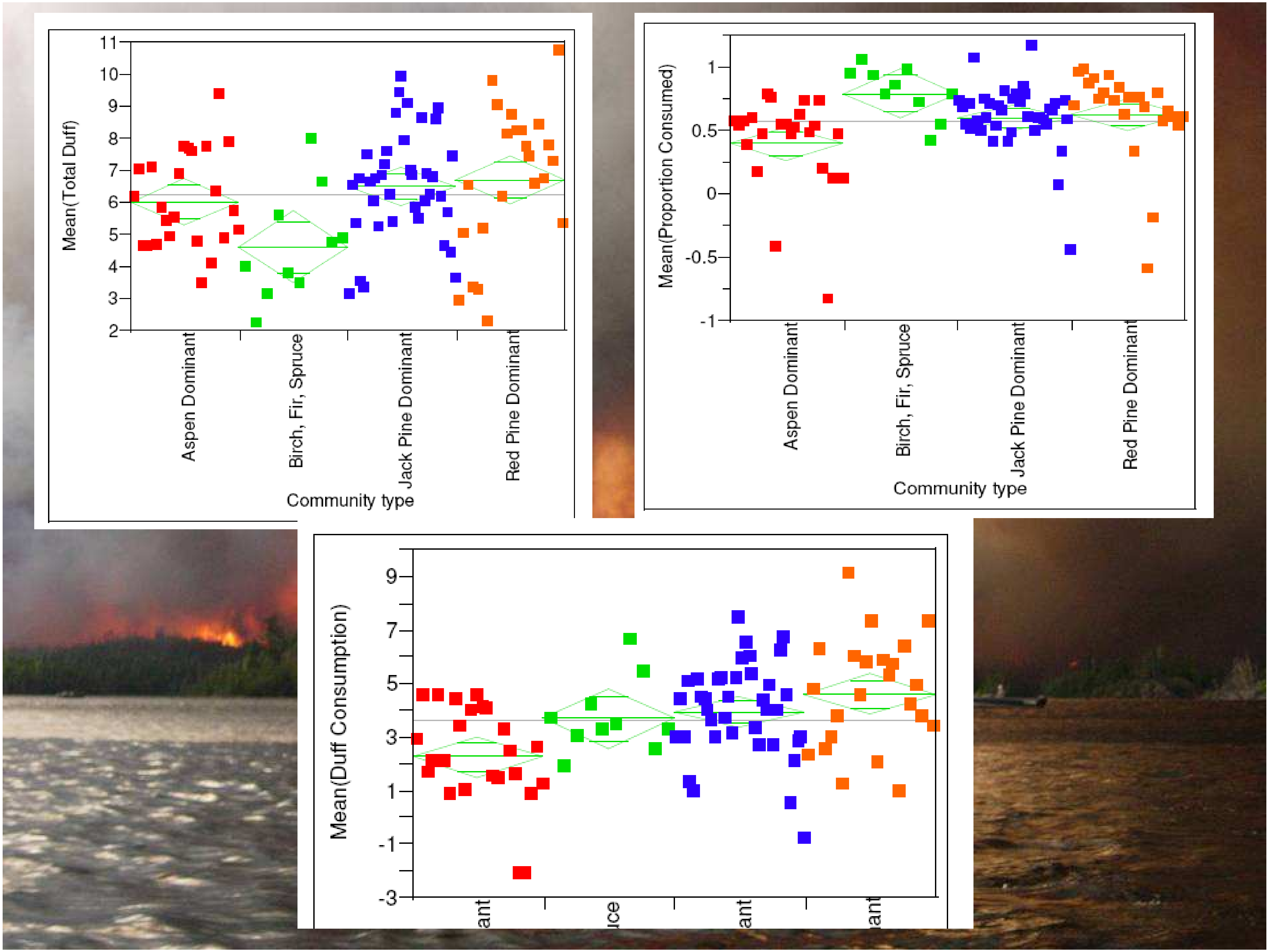
How does duff consumption vary with stand age, blowdown severity, slope position, fuel composition?

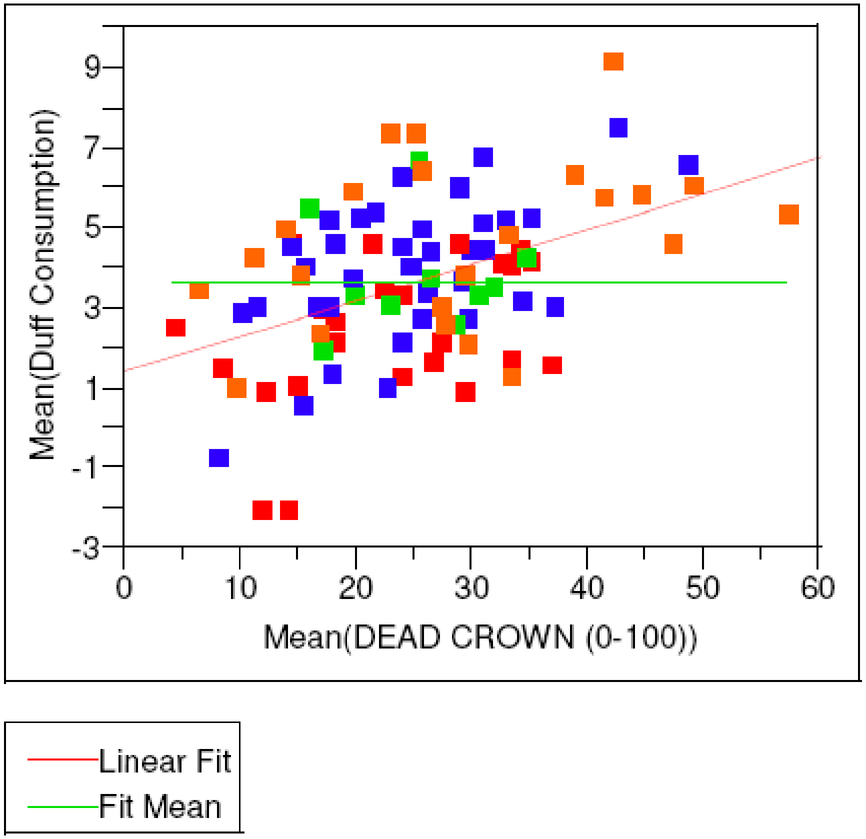
Mean(Total Duff) By STAND AGE CLASS



Mean(Proportion Consumed) By STAND AGE CLASS




Mean(Total Duff)
Aspen Dominant
Birch, Fir, Spruce
Jack Pine Dominant
Red Pine Dominant
Community type
Mean(Proportion Consumed)
Aspen Dominant
Birch, Fir, Spruce
Jack Pine Dominant
Red Pine Dominant
Community type
Mean(Duff Consumption)



Linear Fit

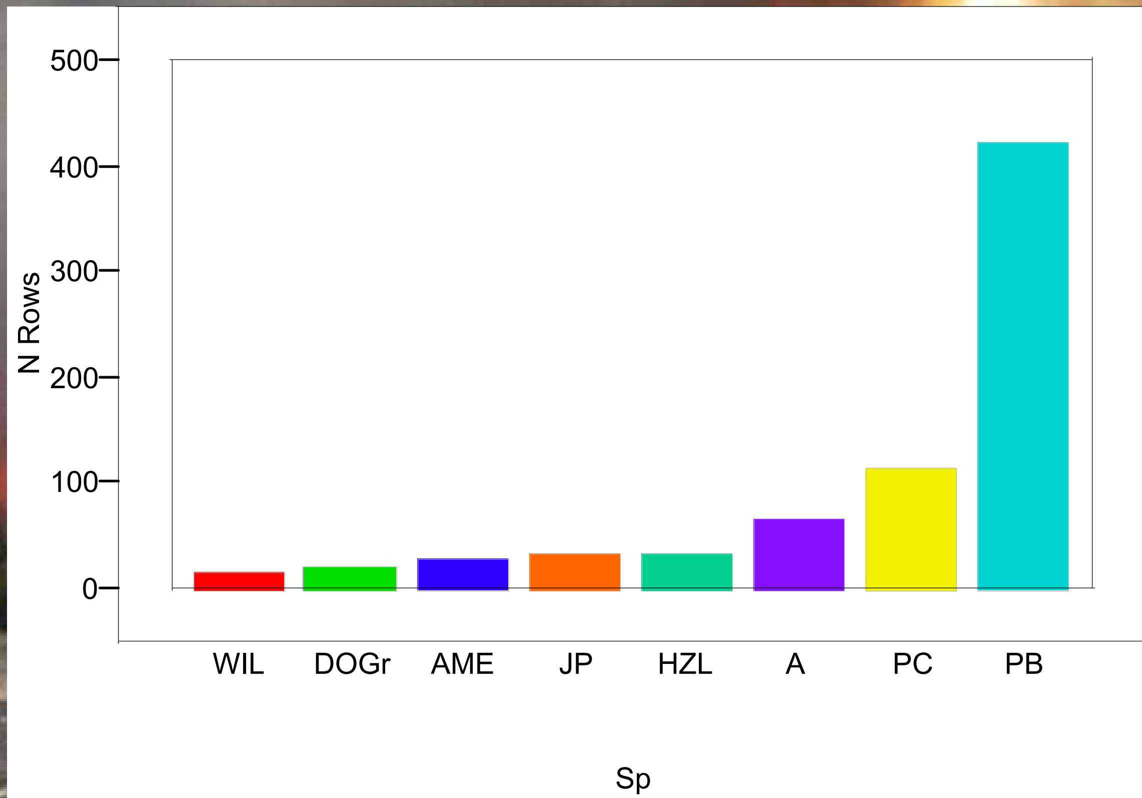
Mean(Duff Consumption) = 1.423453 + 0.0891519 Mean(DEAD CROWN (0-100))

Summary of Fit

RSquare	0.208759
RSquare Adj	0.200251
Root Mean Square Error	1.787715
Mean of Response	3.680503
Observations (or Sum Wgts)	95

Site 4, south end TMI

TMI 2007 Resurvey



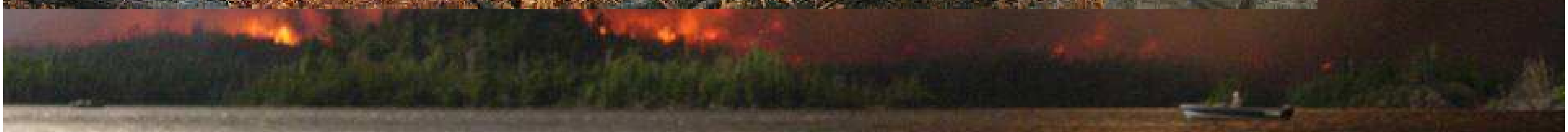
Cavity Lake Fire: July 14, 2006 3 pm

July 15th afternoon

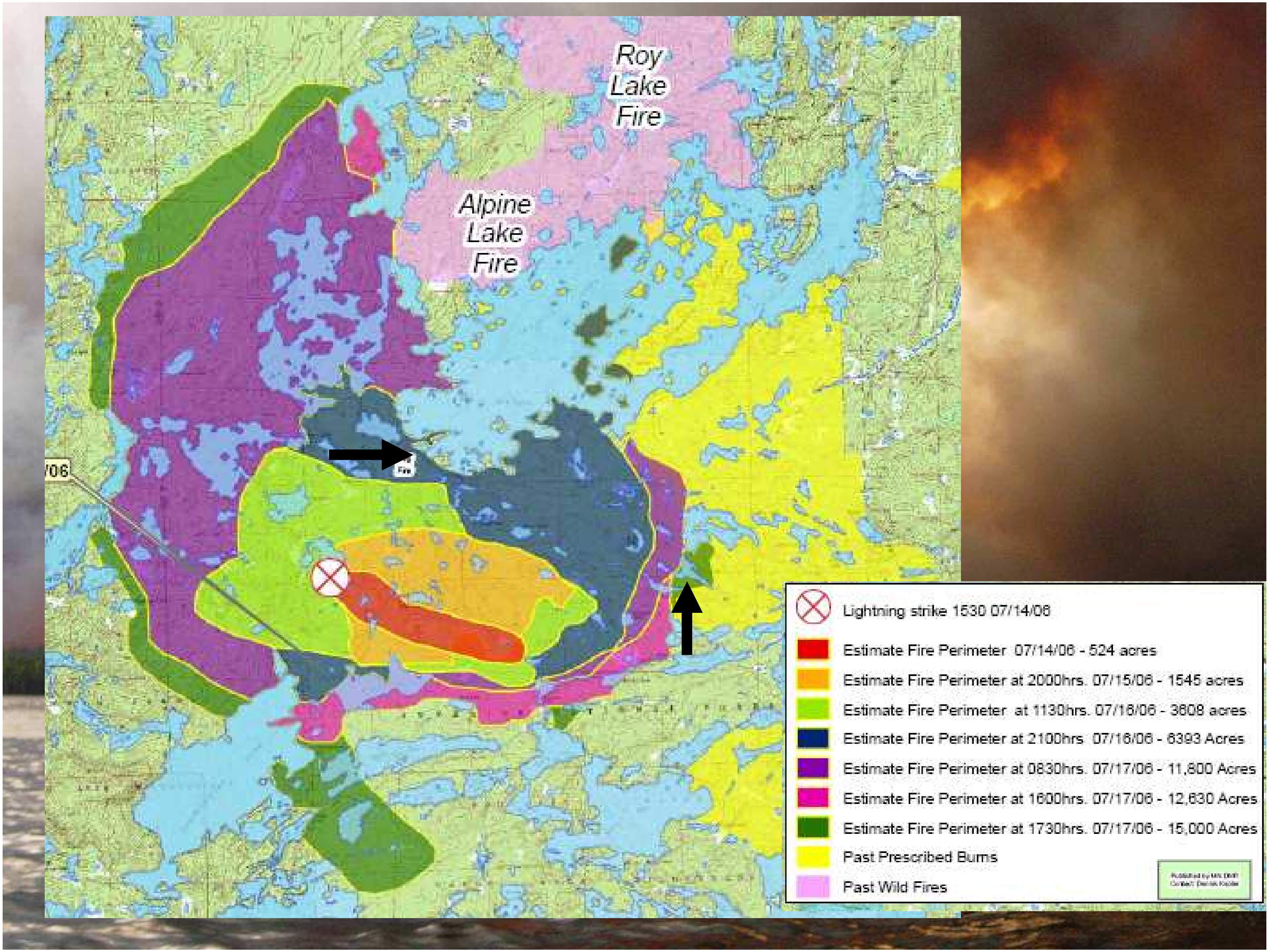
July 16th morning


July 16th afternoon


July 16th late afternoon



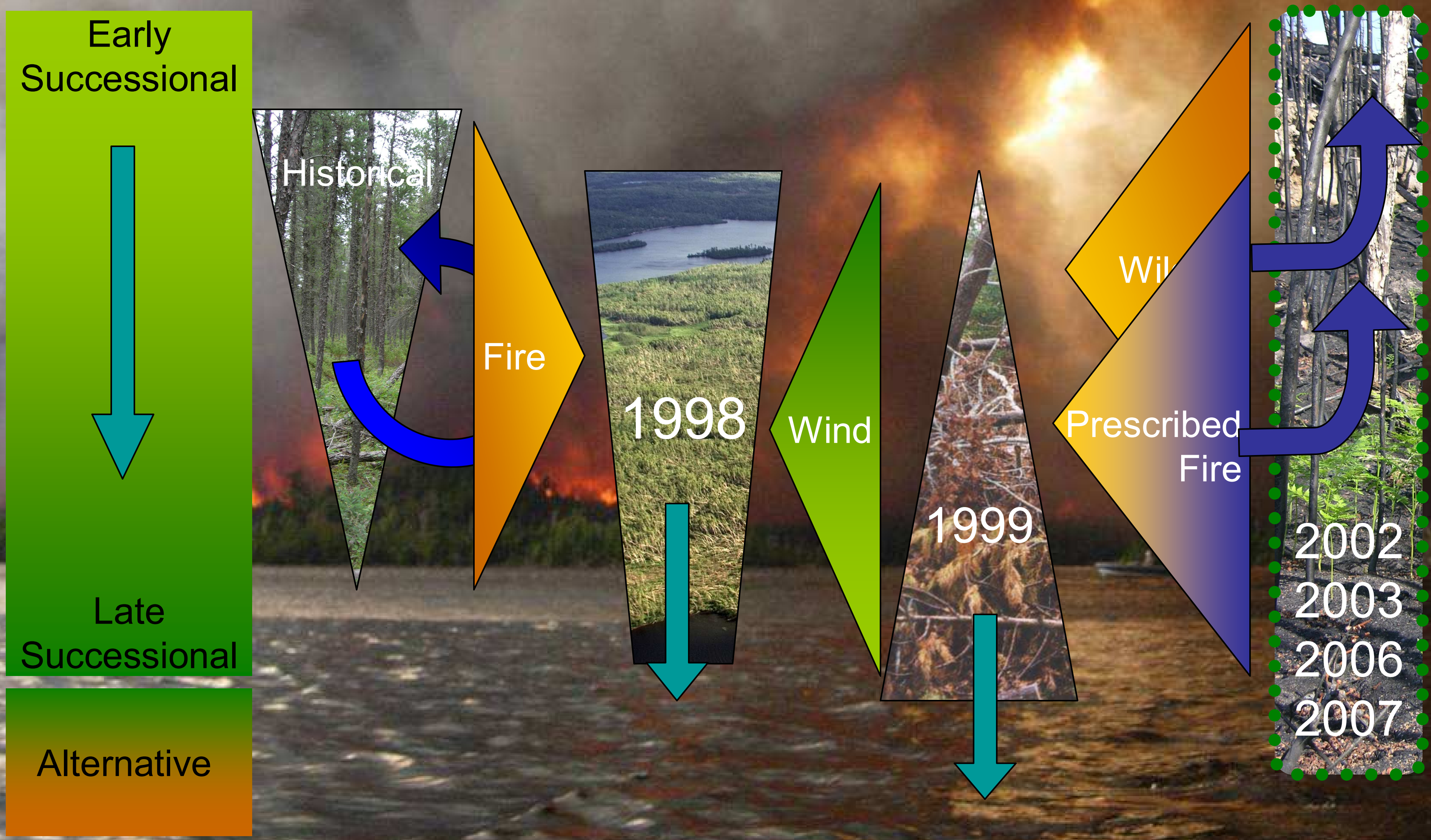
J. A. Paulson Lake looking NE



Roy Lake Fire
Alpine Lake Fire
/06
Lightning strike 1530 07/14/06
Estimate Fire Perimeter 07/14/06 - 524 acres
Estimate Fire Perimeter at 2000hrs. 07/15/06 - 1545 acres
Estimate Fire Perimeter at 1130hrs. 07/16/06 - 3608 acres
Estimate Fire Perimeter at 2100hrs 07/16/06 - 6393 Acres
Estimate Fire Perimeter at 0830hrs. 07/17/06 - 11,800 Acres
Estimate Fire Perimeter at 1600hrs. 07/17/06 - 12,630 Acres
Estimate Fire Perimeter at 1730hrs. 07/17/06 - 15,000 Acres
Past Prescribed Burns
Past Wild Fires

Rog Lake Panoramic

Patterns of Succession



Patrick Nelson & Kyle Gill
2007
UROP STUDENTS

Germination and seedbed diversity in boreal forests following wildfire

Methods (lab)

Measured pH

Planted 100ml of soil

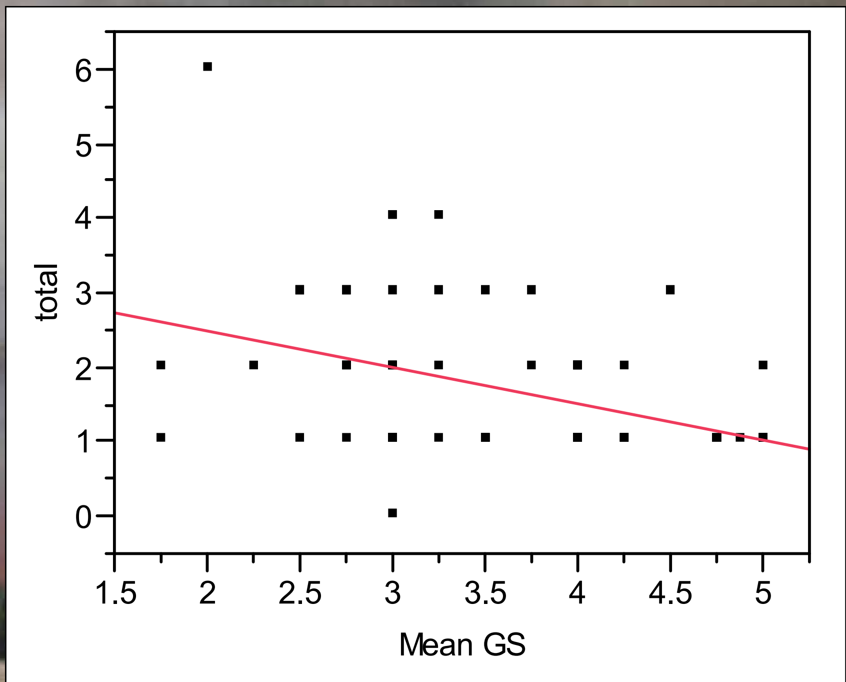
Sifted out all organic materials and rocks

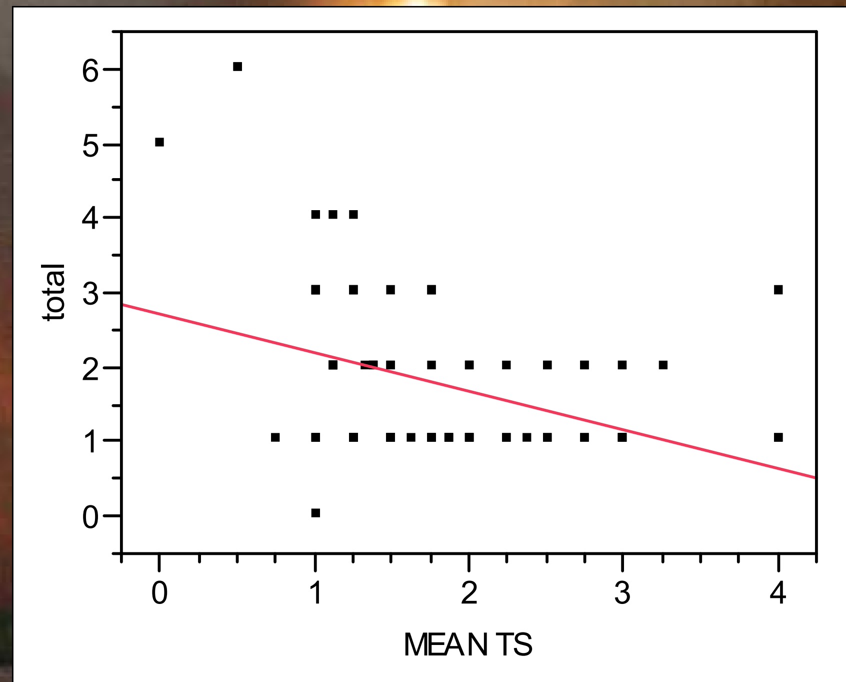
Defining Ground Severity (GS) and Tree Severity (TS)

Ground severity:
- 0 = unburned
- 1 = light scorch
- 2 = 1-50% surface litter
- 3 = 50-99% surface litter
- 4 = 100% surface some duff
- 5 = only mineral soil
- 6 = >50% ash

Tree Severity:
- 0 = no damage
- 1 = needles scorched
- 1a = needles burned
- 2 = most fine branches burned (<1 cm)
- 3 = only nubs remain
- 4 = main stem or stubs remain

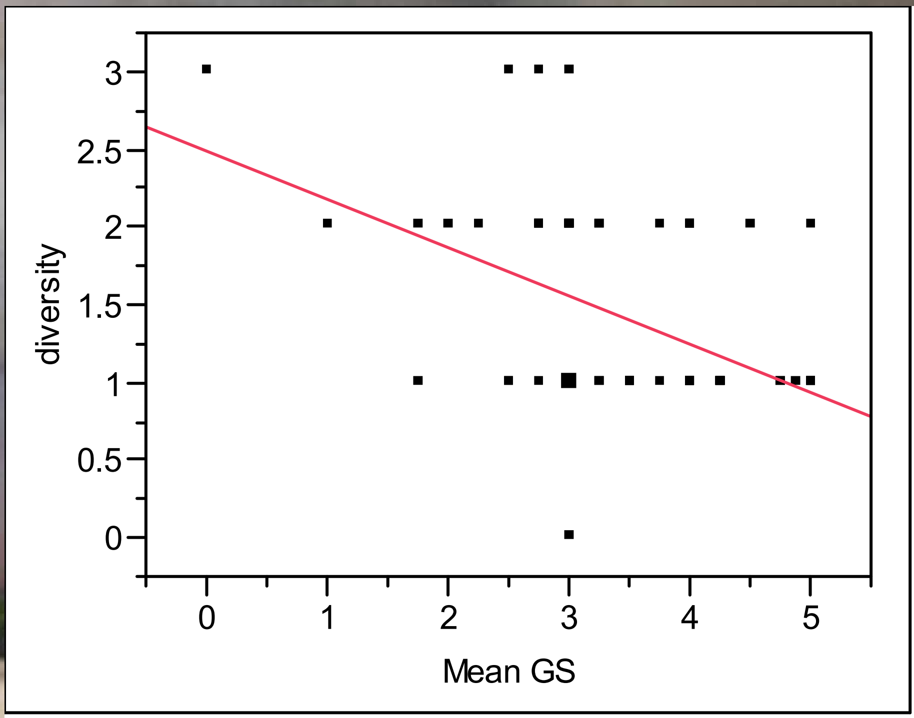
Results of GS and TS on abundance

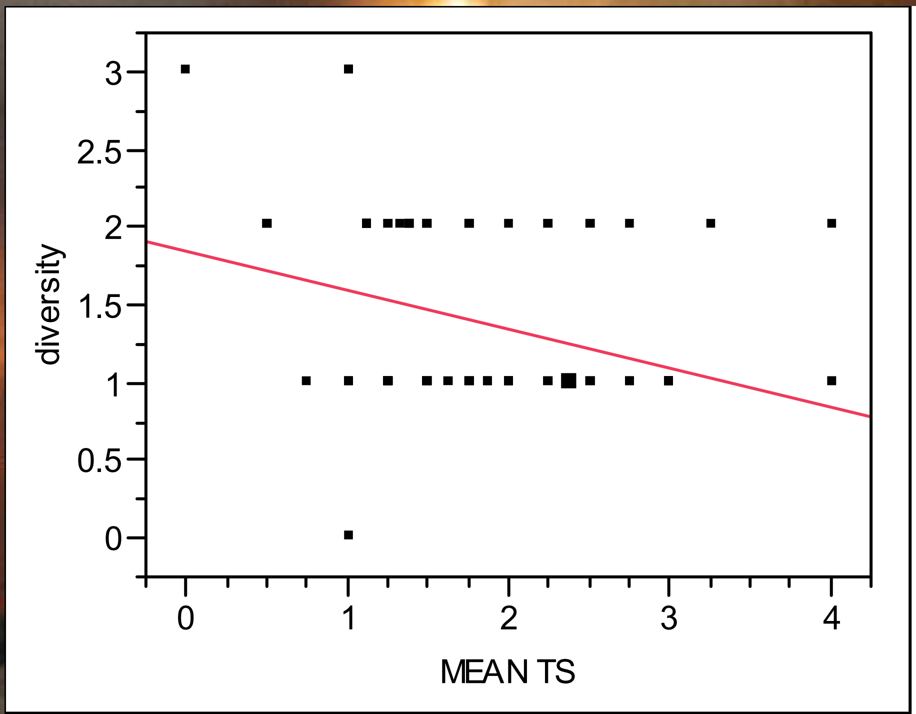




Total germination decreases as TS and GS increase

Results of GS and TS on diversity





Diversity also decreases as GS and TS increase

Results: Field Data

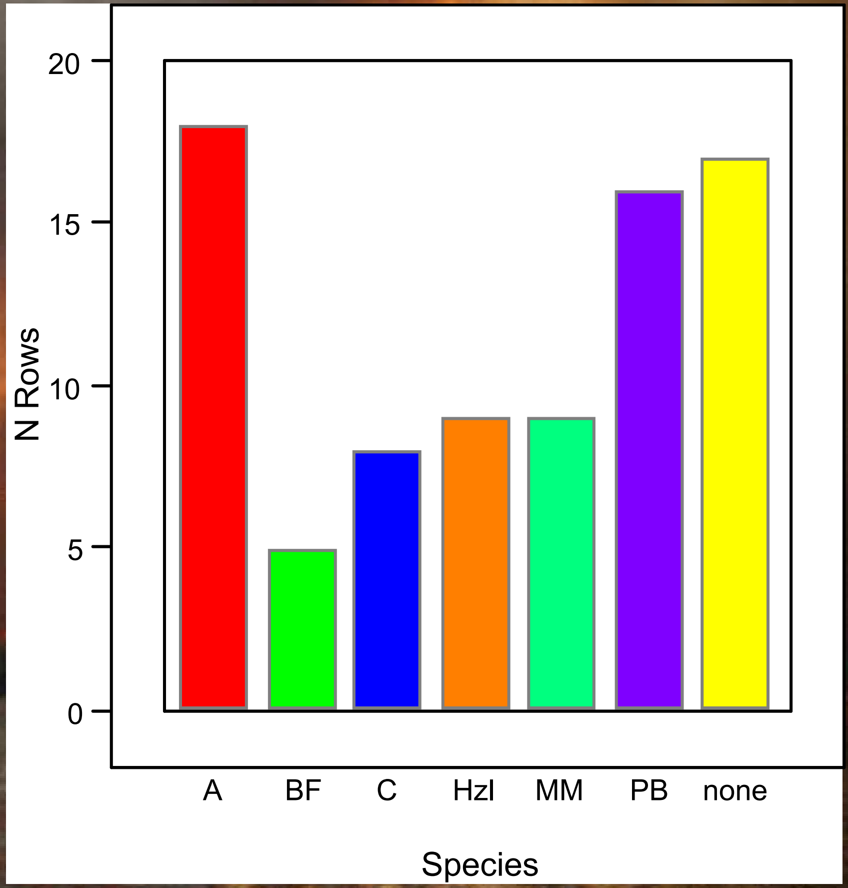
Results: #CS by Species

N=19 CS plots

N=171 1m^2 plots

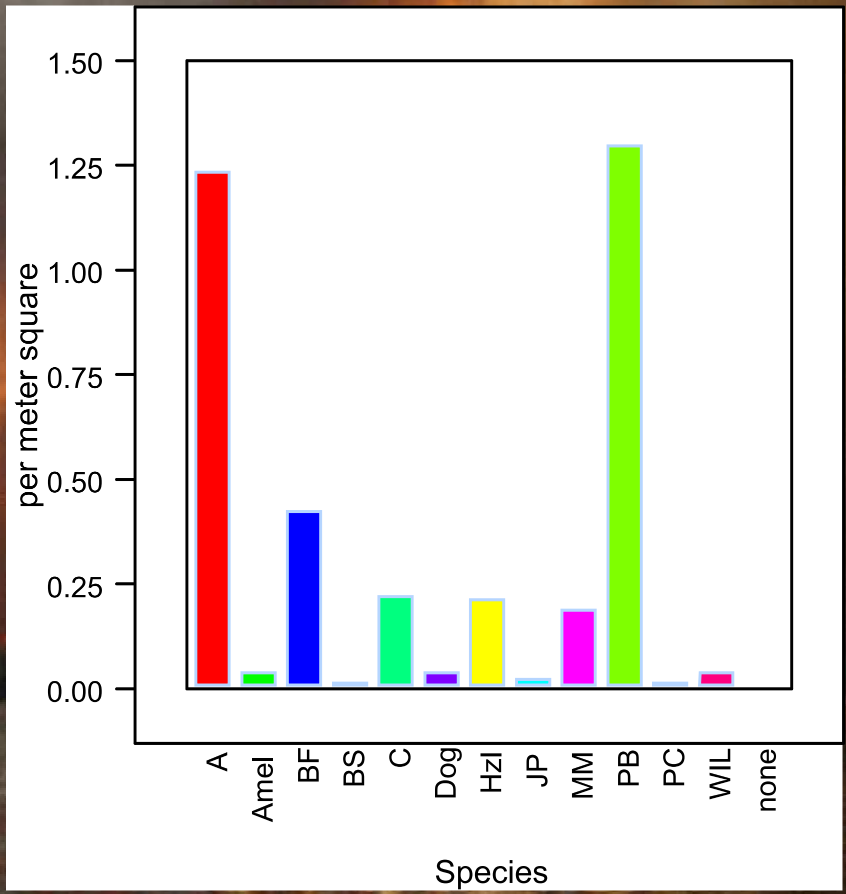
26% had at least one BF

95% had at least one A



Results: Germs/m^2

- BF~.5/m^2
- PB/A~1.25/m^2
- Total=3.74/m^2



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Jesse Griffith
Robyn Yechout
Derek Olsen
Jason McGovern
Steve Markey
Scott James
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Ben Otto
Heather Hendrixson
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