

The Little Gabbro Fire 16 ½ Years Later; How Has The
Pattern of Fire Severity Influenced The Forest Today?

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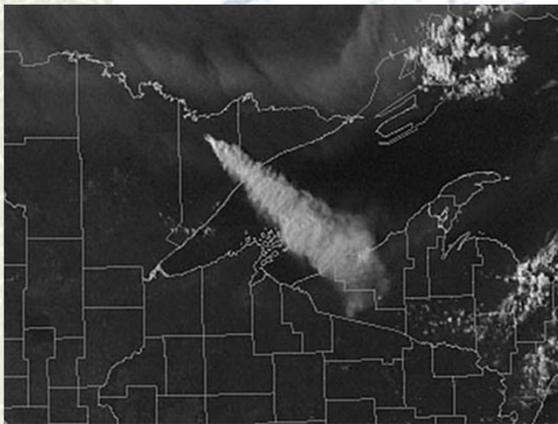
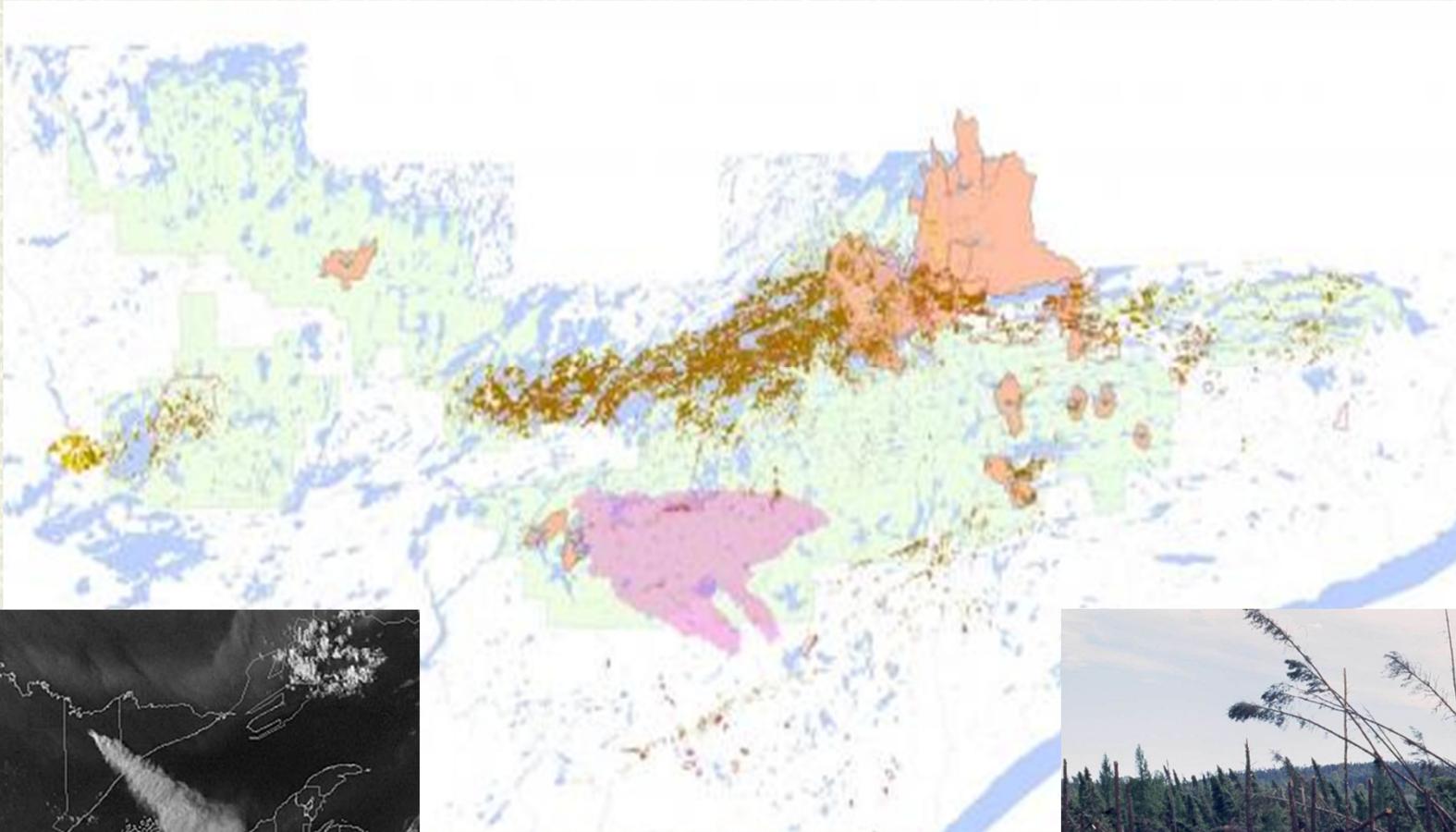
Little Gabbro Fire details:

- Following an extremely warm and dry late spring, it began on 6/6/1995 and ended on 6/22/1995
- Last 5 days were an intense crown fire
- Total size 1233 ha (3046 acres)
- Largest wildfire in the BWCAW since a Wildland Fire Use policy (WFU) was initiated by the US Forest Service in 1987



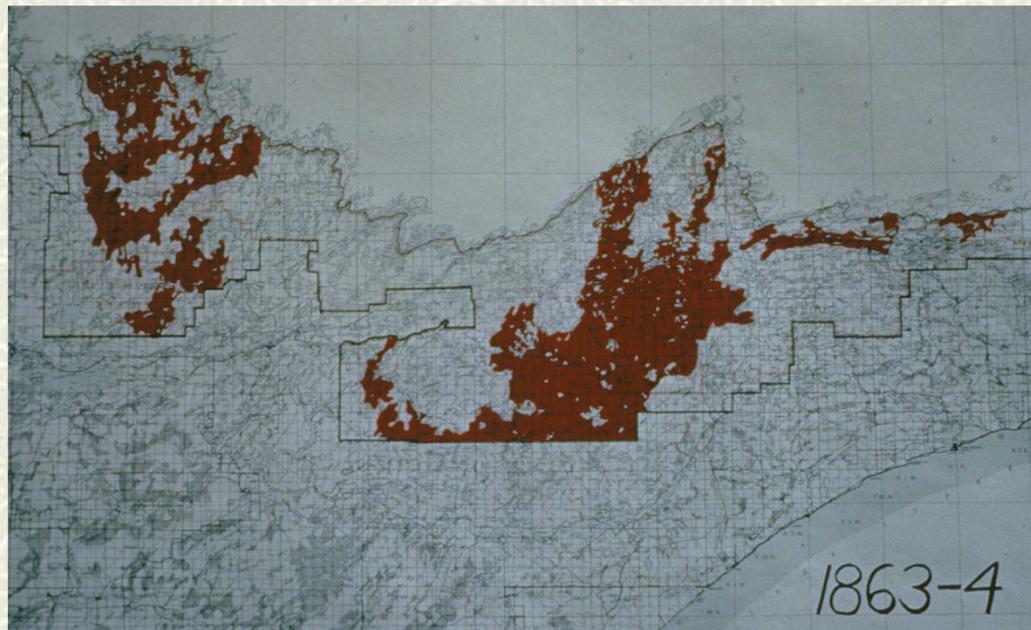
Major Disturbances of Last 16 Years Impacted Half of Land Area of BWW

(disturbance envy?)



Fire history in the Boundary Waters Canoe Area

Heinselman 1973



Mechanisms of vegetation recovery after fire

Resprouting



Canopy seed bank



Soil seed bank



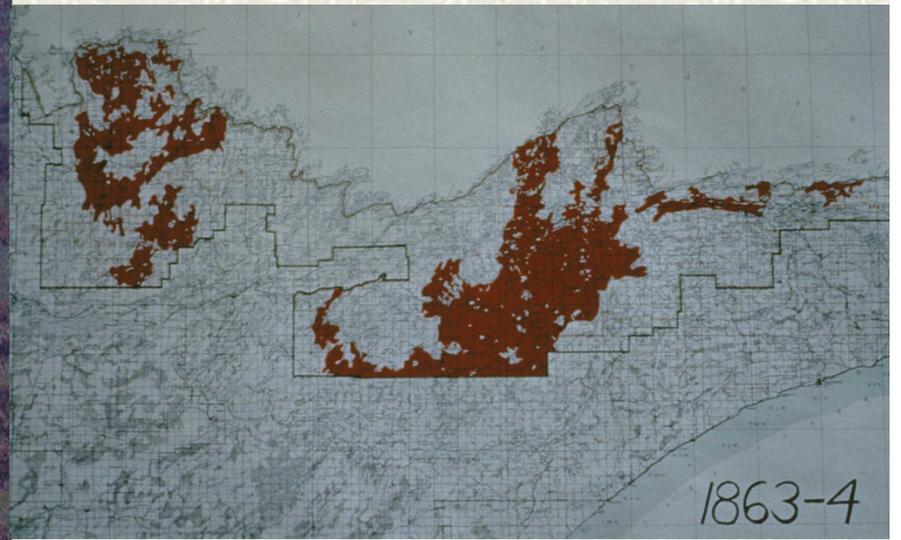
Dispersal



Geranium bicknelli

Dispersal

- Survivors outside fire extent
- Refuges within fire extent



Objectives/ road map

- **Measure heterogeneity of fire severity at 2 levels of scale: landscape-scale and stand-scale**
- **Identify some causes of fire severity heterogeneity at 2 levels of scale**
- **Examine how levels of fire severity affects vegetation up to 16 years post-fire**
- **Discuss management implications**



Crown severity class

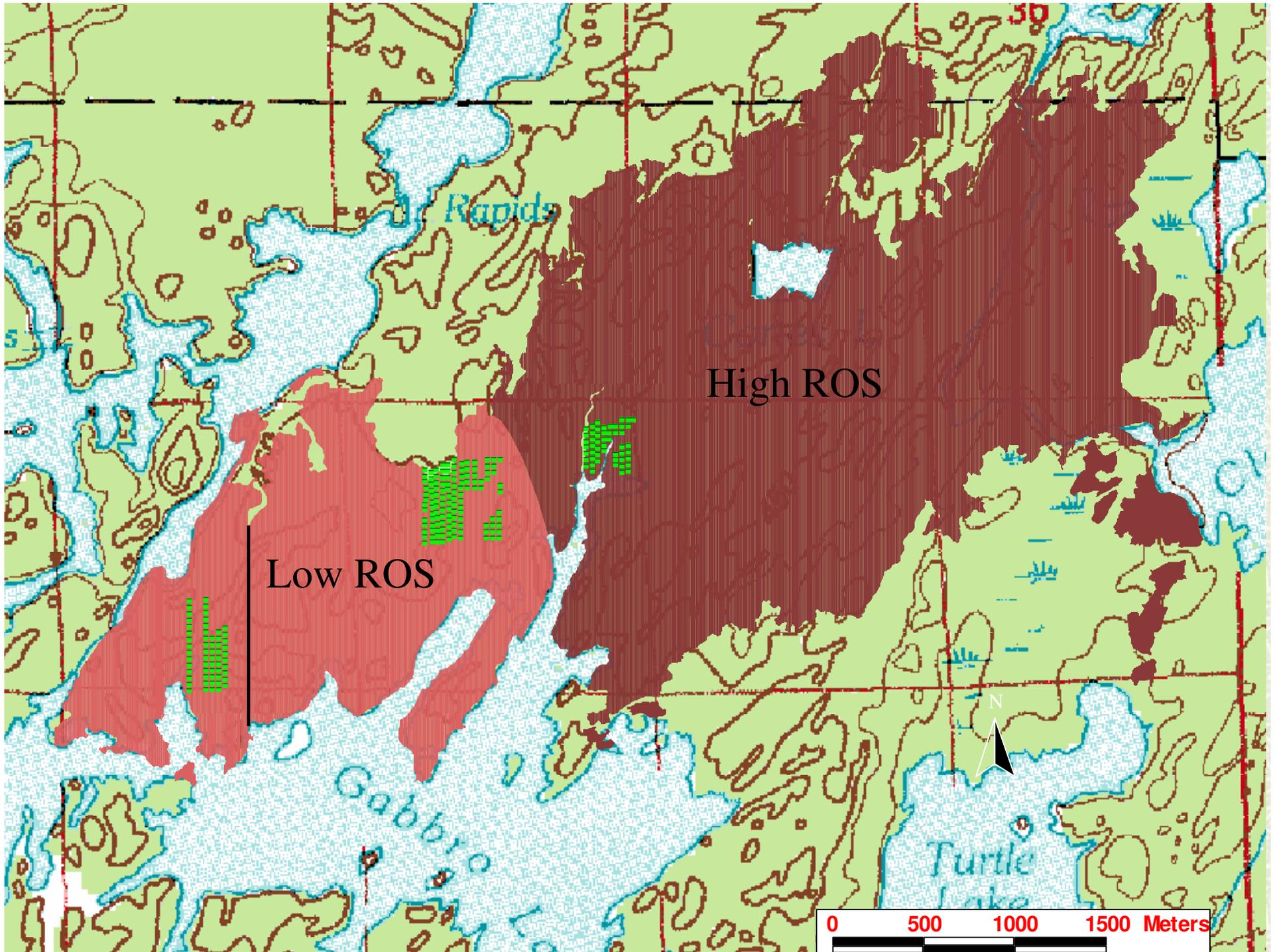
Severity class level	Crown severity class (CSC)		Severity class level
	<i>Canopy foliage consumed</i>		
	Stand-scale	Landscape-scale	
0	none	none	0
1	1-25%	1-5%	1
2	26-50%	6-25%	2
3	51-75%	26-50%	3
4	76-99%	51-75%	4
5	100%	76-94%	5
		95-99%	6
		100%	7



Ground severity class

	Ground severity class (GSC)
Severity class level (plot)	<i>Consumption of surface litter and duff layer</i>
0	Unburned
1	Light scorch of surface litter
2	1-50% of surface litter
3	50-99% of surface litter Some of duff layer
4	100% of surface litter Most of duff layer
5	Only mineral soil remaining





Landscape-scale – pre-fire cover type

Pre-fire cover type

- Lowland marsh
- Lowland black spruce
- Upland black spruce/ balsam fir
- Aspen-birch
- Aspen-birch/ spruce-fir
- Spruce-fir/ aspen birch
- Jack pine / spruce-fir
- Spruce-fir / jack pine
- Jack pine / aspen-birch
- Red – white pine / spruce-fir
- Red – white pine / aspen-birch
- Rock, shoreline
- Water

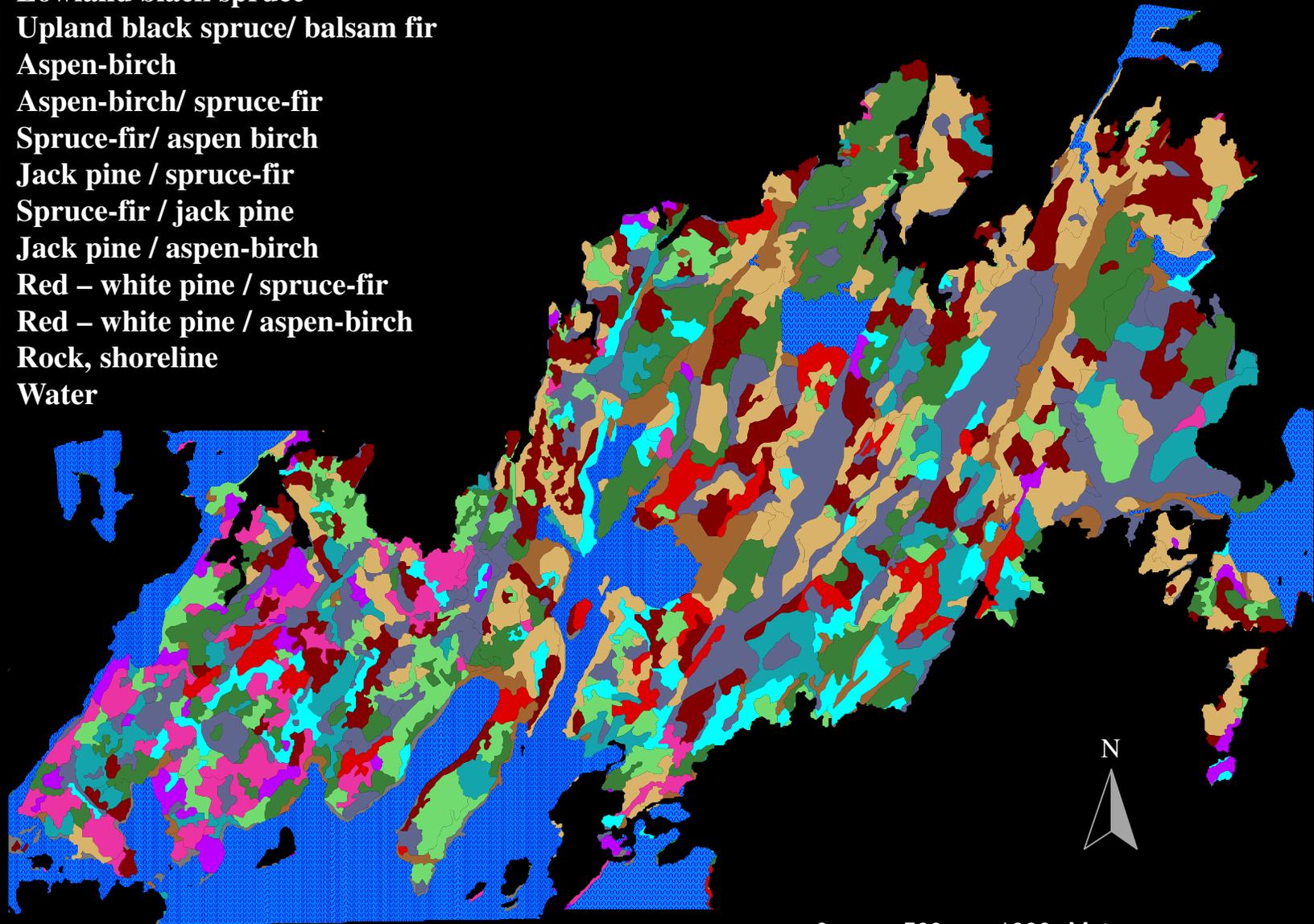


Photo source: 1993 & 1994 NAPP photos, 1:10,000

Landscape-scale fire severity

Fire severity

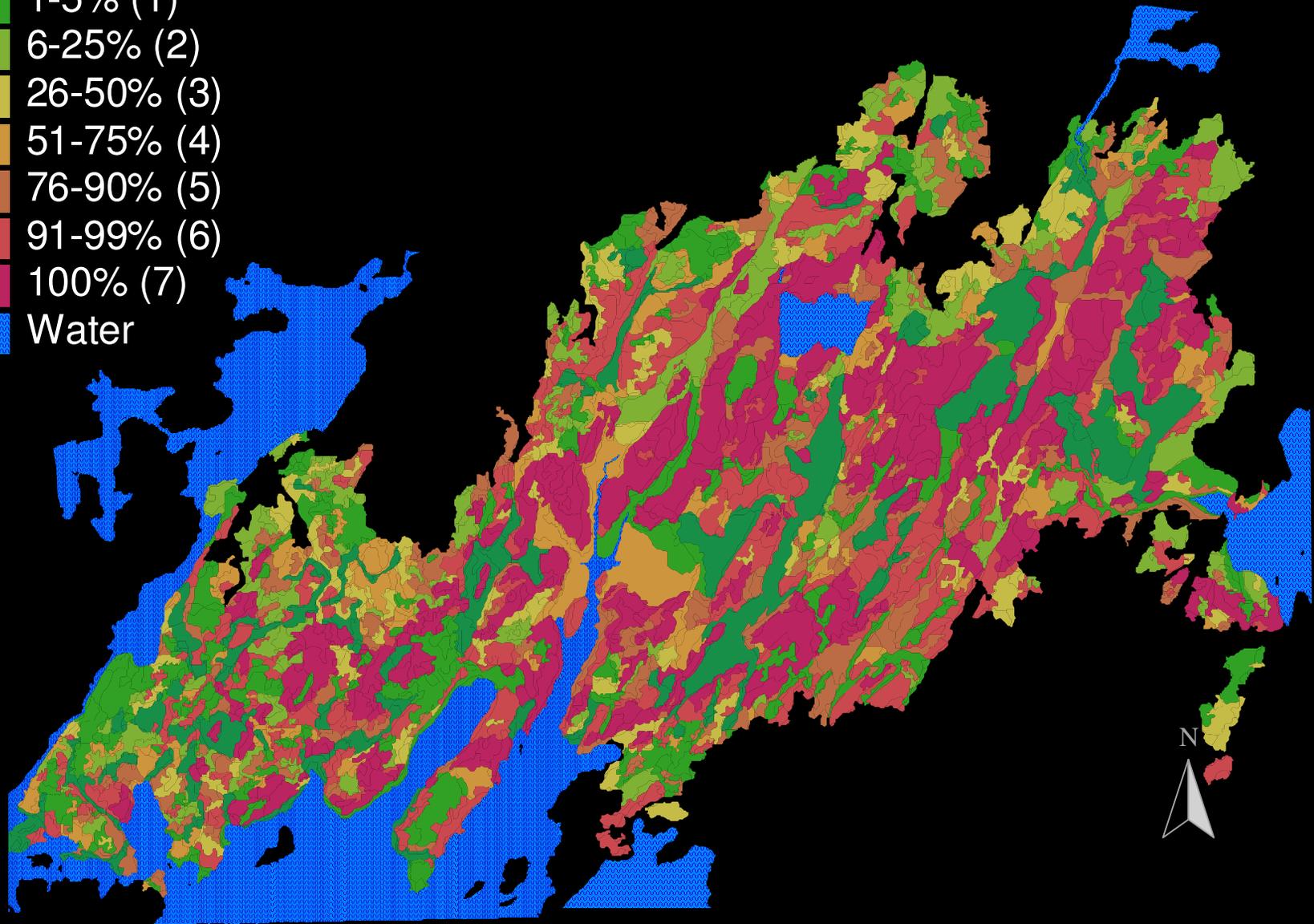
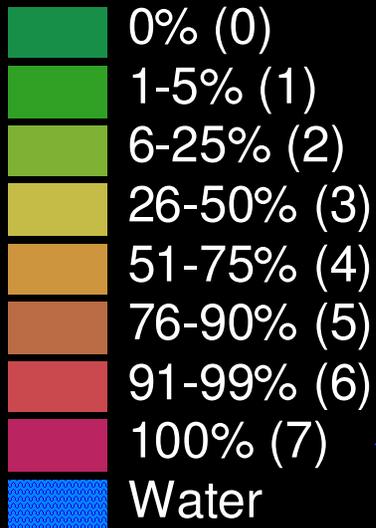
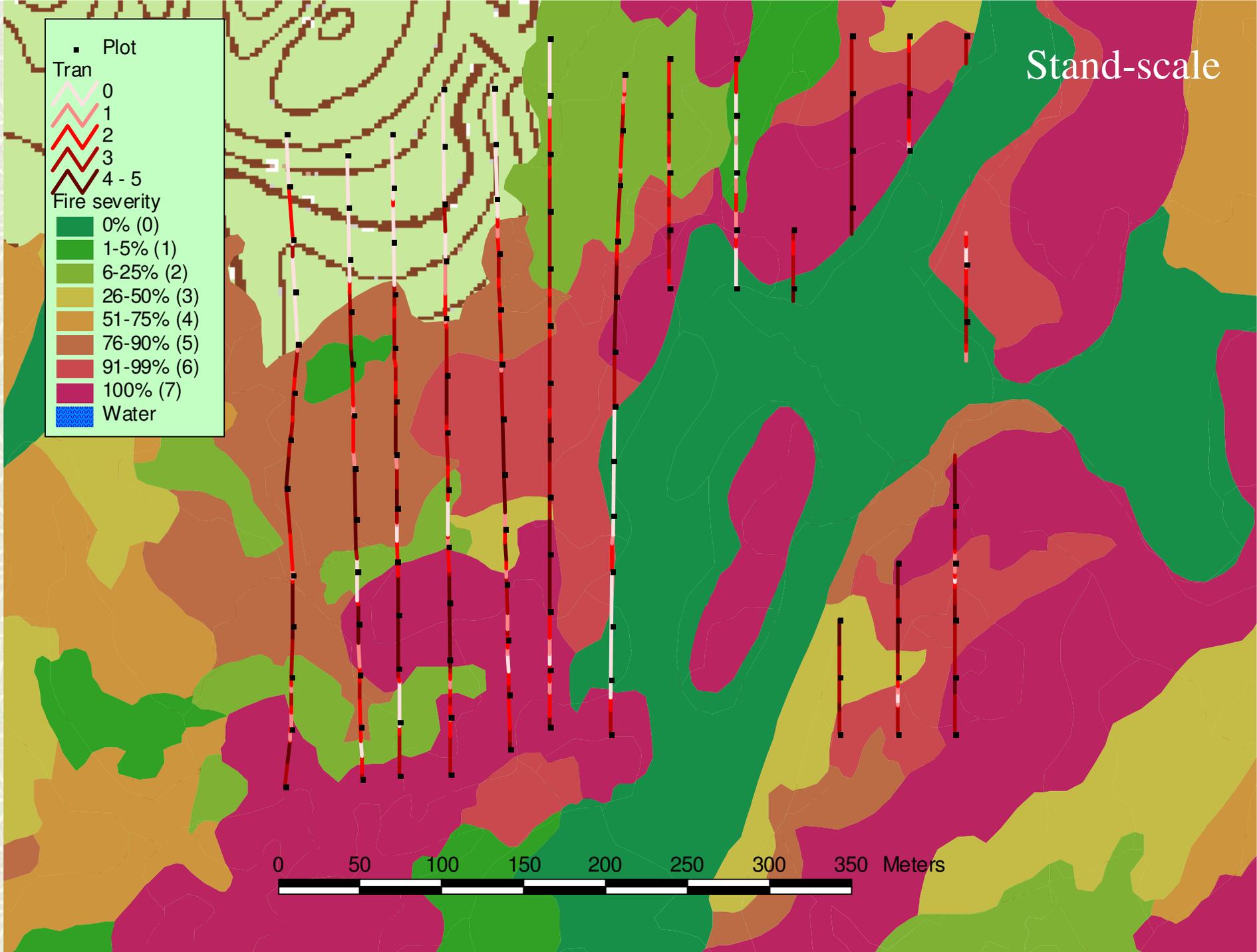
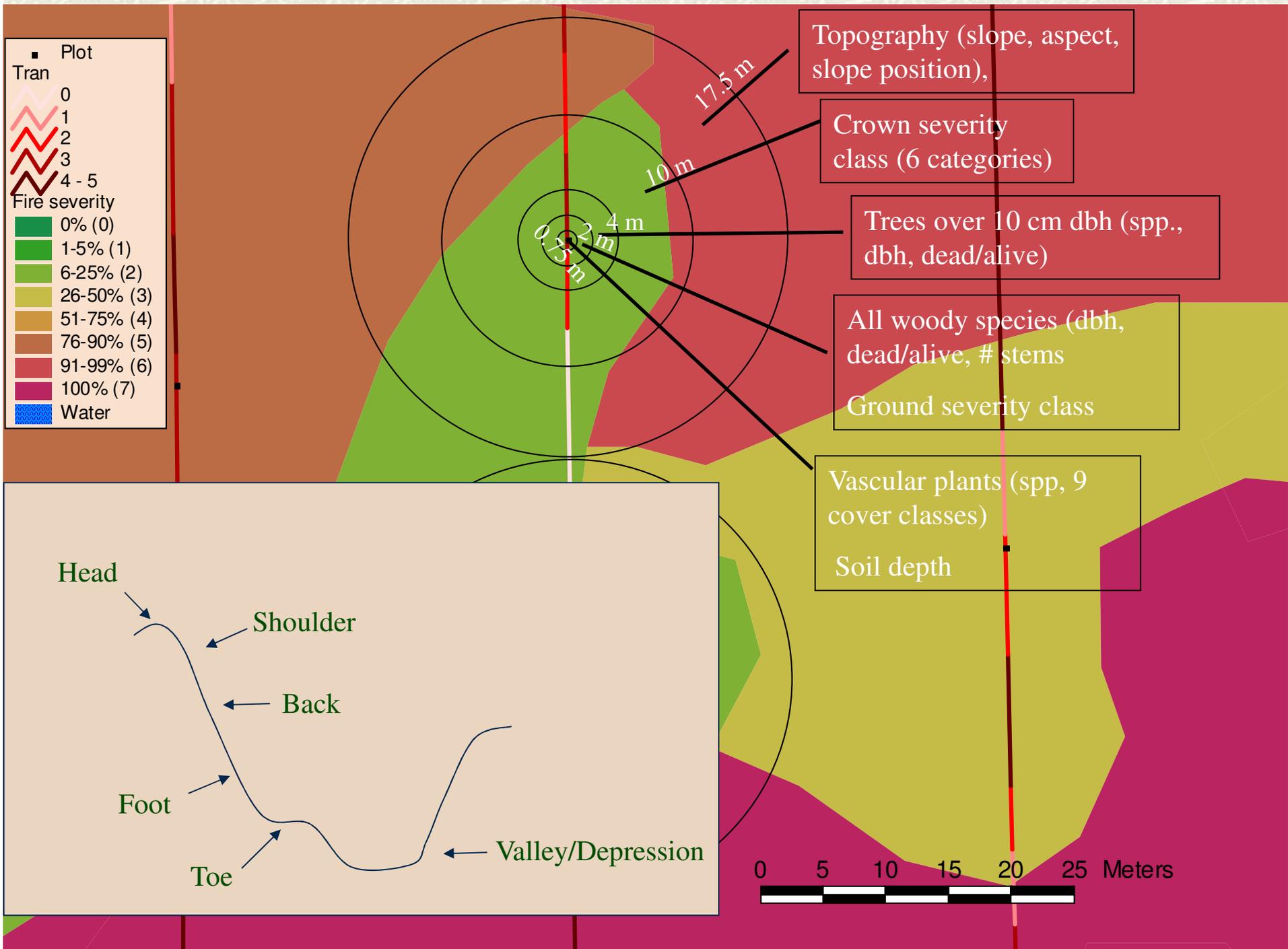


Photo source: Custom flown photos in August 1995, 1:7,500







Objectives/ road map

- **Measure heterogeneity of fire severity at 2 levels of scale: landscape-scale and stand-scale**
- **Identify some causes of fire severity heterogeneity at 2 levels of scale**
- **Examine how levels of fire severity affects vegetation**
- **Discuss management implications**



Landscape-scale fire severity

Fire severity

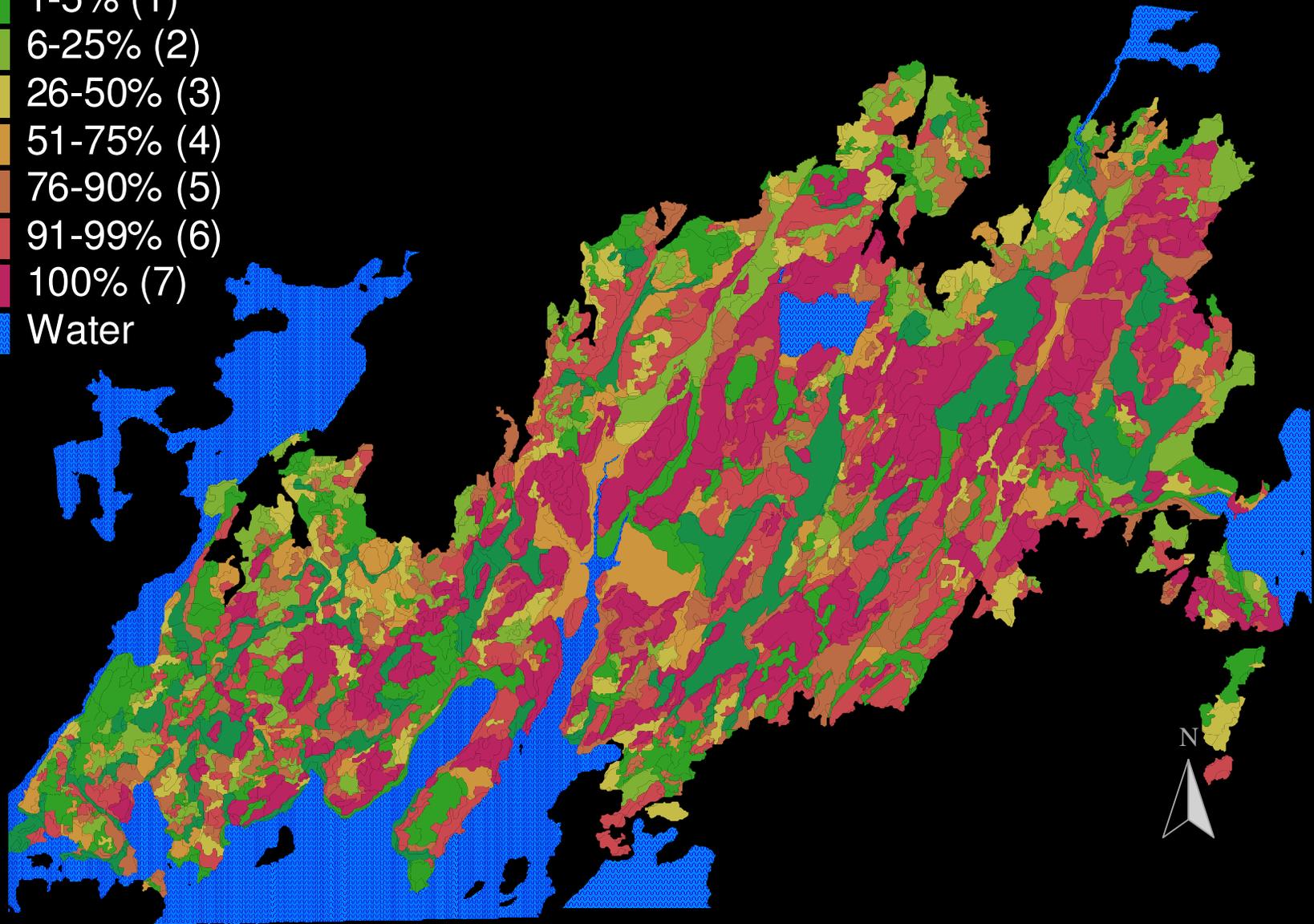
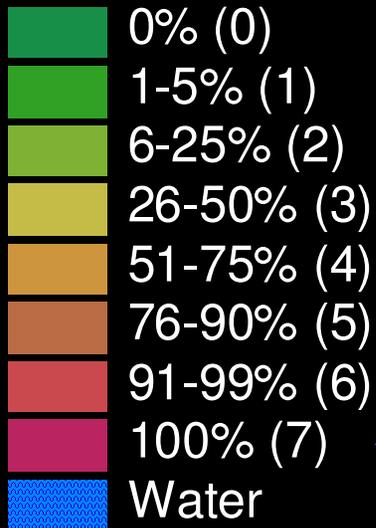


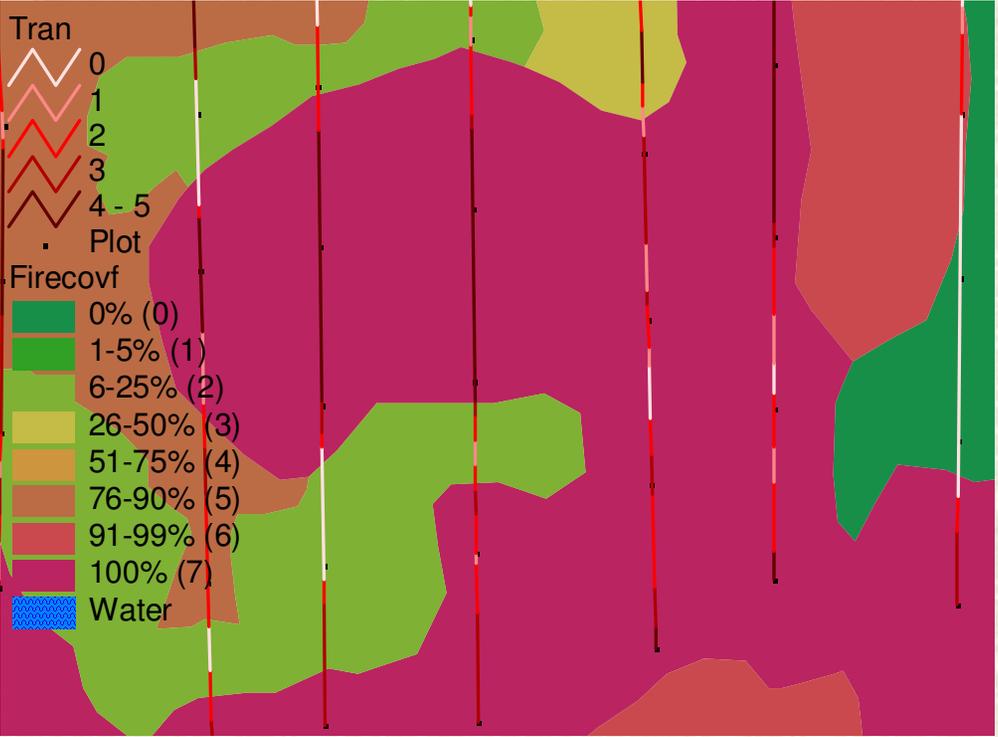
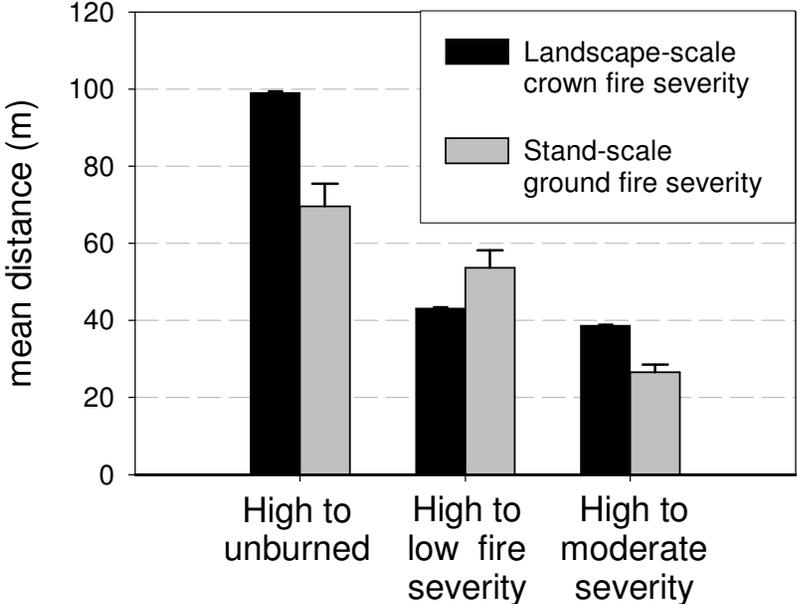
Photo source: Custom flown photos in August 1995, 1:7,500



Objectives/ road map

Crown fire severity class	Landscape-scale					Stand-scale				
	Upland and lowland			Upland only		Stand area	Crown fire severity	Ground fire severity	Stand-scale area (%)	Stand-scale area (%)
	No. of patches	Total area (ha)	Mean area (ha)	Mean Shape Index	Fire area (%)	Fire area (%)	Mean area (ha)	Stand-scale area (%)		
0	48	145	3.0	2.1	12.8	4.1	0.1	24.7	44.9	29.0
1	203	263	1.3	1.8	23.1	23.0	0.6	19.0	18.3	5.6
2	83	75	0.9	1.7	6.6	7.6	0.6	2.4	16.3	14.7
3	76	86	1.1	1.7	7.6	7.0	0.5	3.4	10.9	24.1
4	274	295	1.1	1.8	25.9	29.5	0.7	23.5	9.0	22.9
5	66	275	4.2	1.9	24.2	28.8	2.7	26.9	0.7	3.6
Total	750	1137	1.5	1.8	100	100	1.3	100	100.1	99.9

Patch isolation

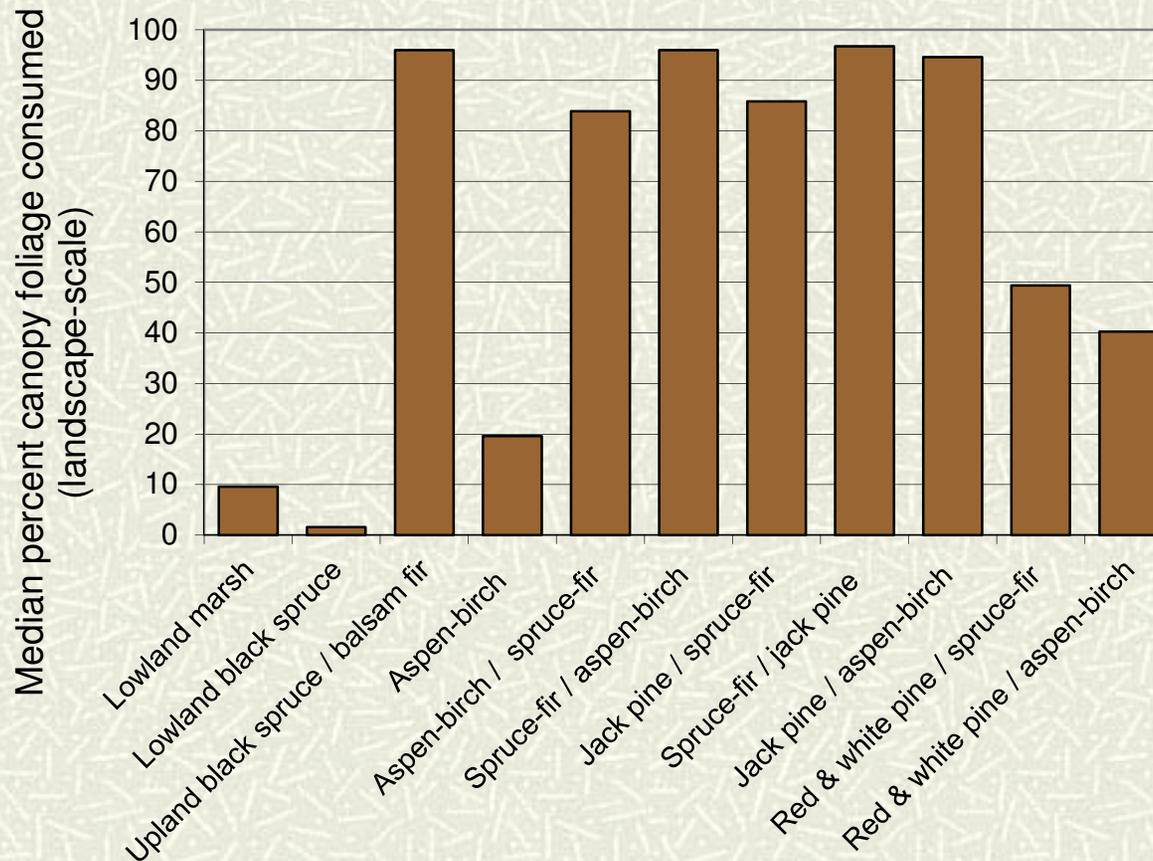


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Median percent canopy foliage consumed per cover type (landscape-scale)



Significant at $p < 0.5$: Lowland marsh, lowland black spruce, Spruce – fir, Aspen-birch, Spruce - Fir / Aspen – Birch, Jack Pine / Spruce – Fir, Spruce - Fir / Jack Pine, Jack Pine / Aspen – Birch, Red & White Pine / Aspen - Birch , patch area: Lowland black spruce, patch area: Aspen – Birch ($p = 0.068$)

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Vegetation resampling

year	# sample points	Ground severity class					
		0	1	2	3	4	5
1995	254	40	17	50	68	67	12
1996	230	35	15	43	59	66	12
2001	101	10	7	16	28	34	6
2005	84	4	6	14	21	32	7
2011	184	22	11	37	52	51	11

1995 Pre-fire tree species in 0-2m & 2-4m plots, all vascular plants in 0.75 m radius plot

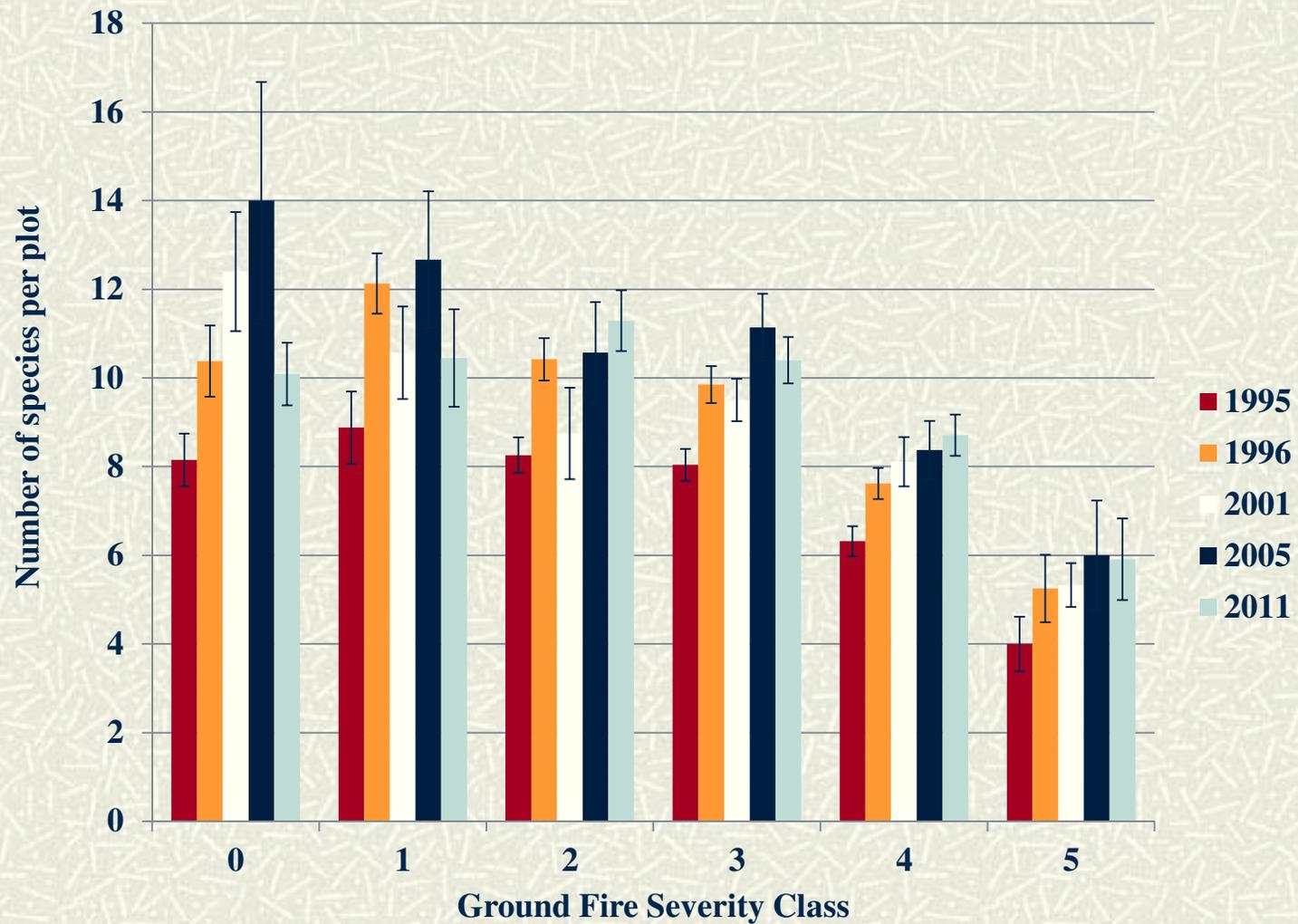
1996 Cover of all vascular plants in 0.75 m radius plot

2001 Cover of all vascular plants in 0.75 m radius plot

2005 Cover of all vascular plants in 0.75 m radius plot, count of trees/shrubs in 0-2 m plot

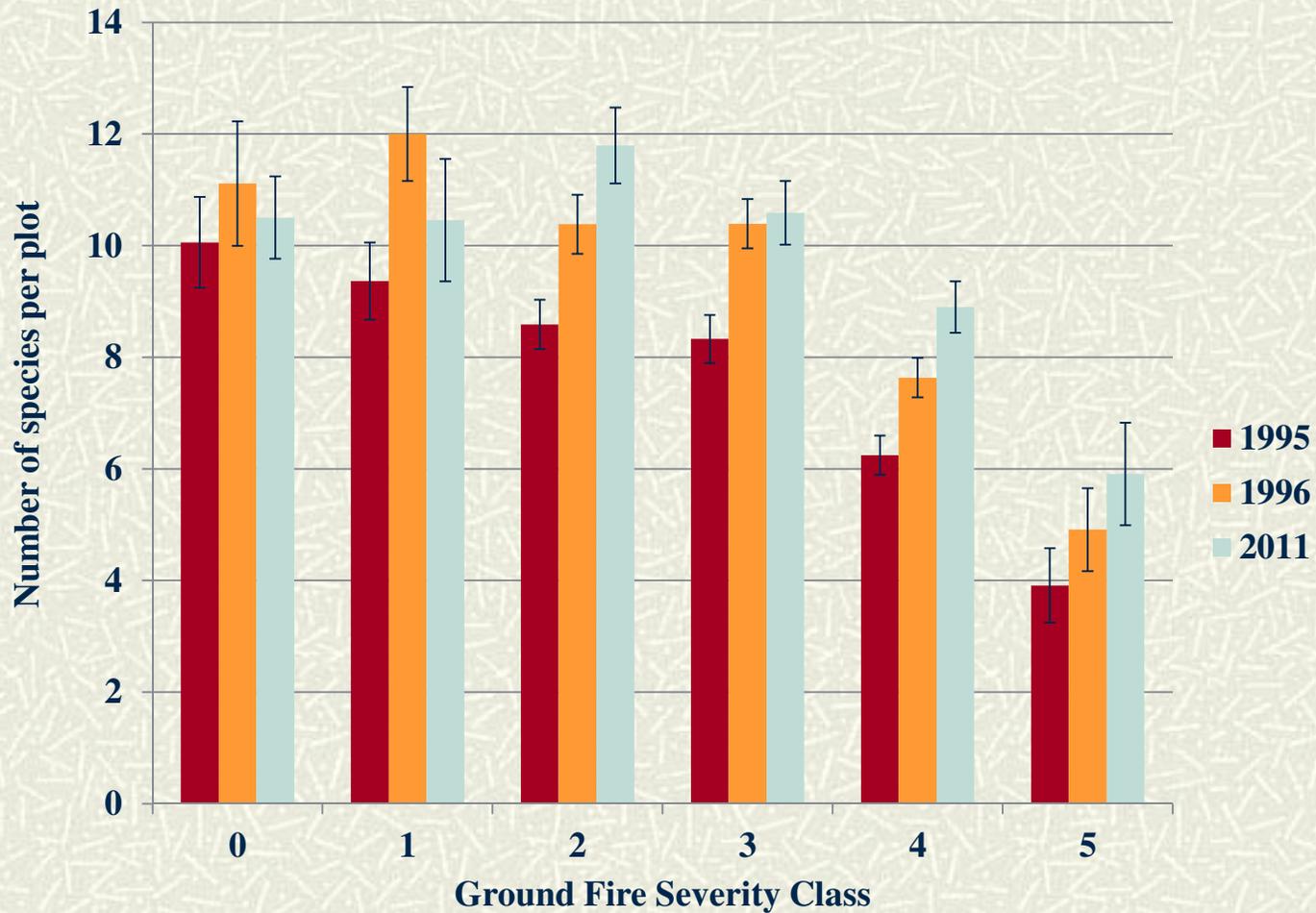
2011 Cover of all vascular plants in 0.75 m radius plot, count of all trees/shrubs in 0-2 m plot, count of trees in 2-4 m plot

Plant species richness per plot 1995 to 2011, all years



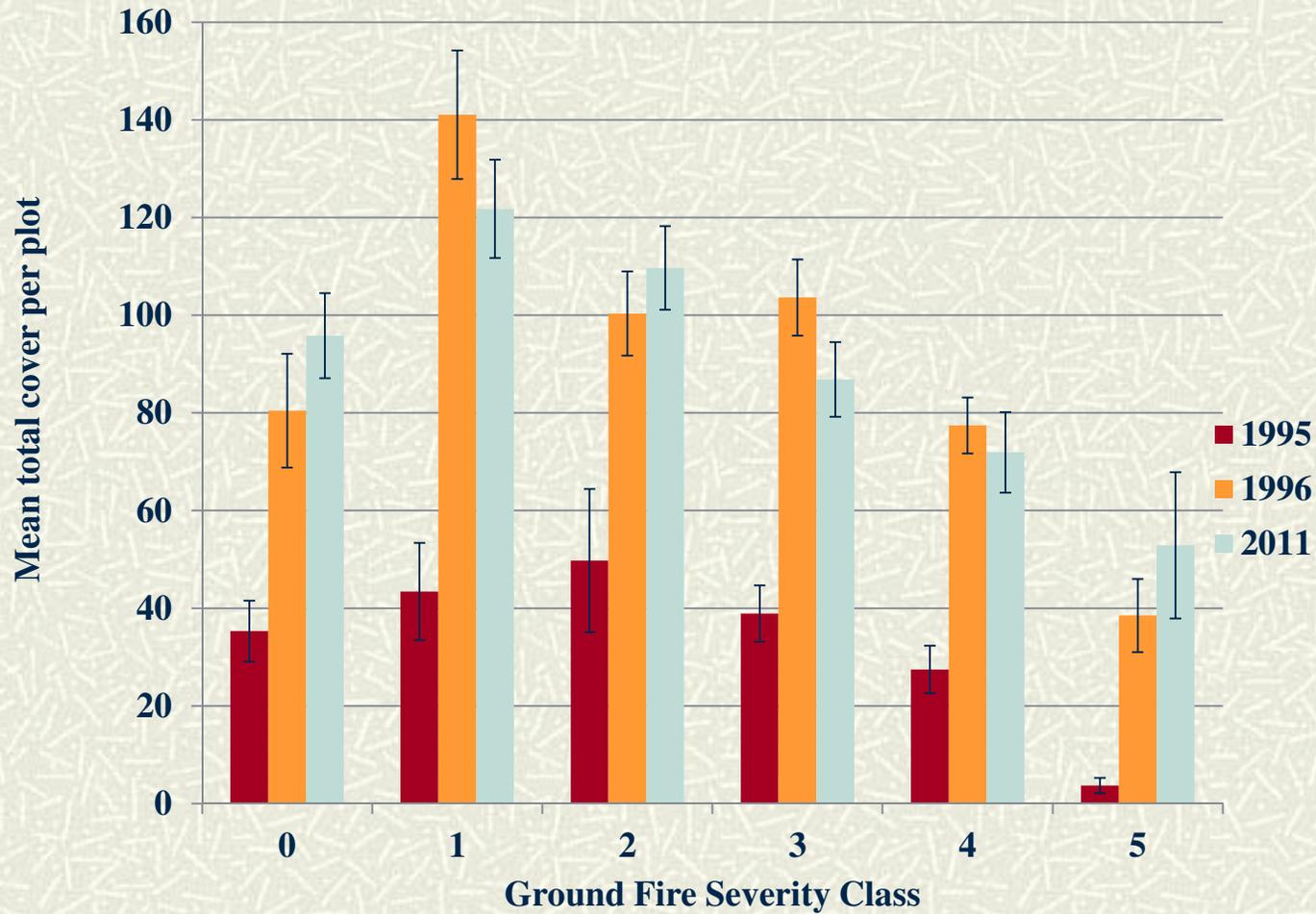
Plant species richness per plot

Plots sampled in 1995, 1996, 2011 (n=169)



Plant species total cover per plot

Plots sampled in 1995, 1996, 2011 (n=169)

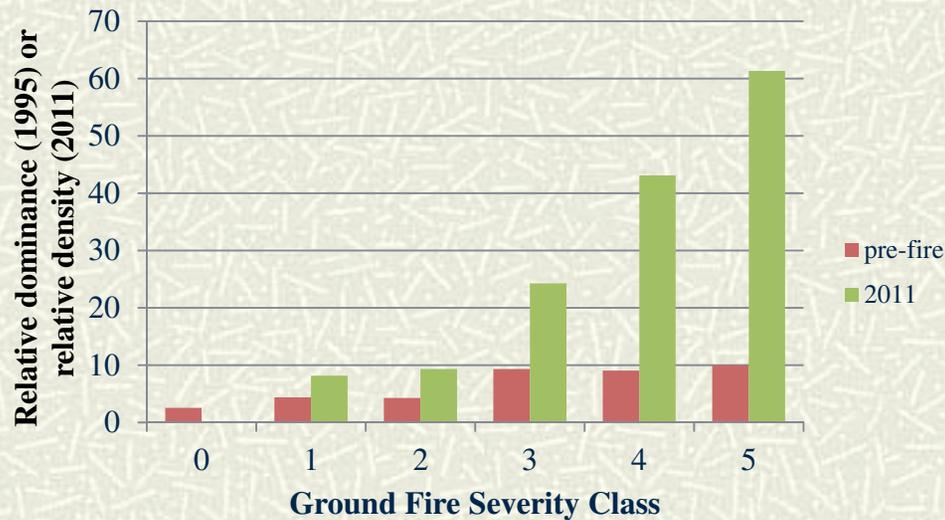


Forest trajectory – relative dominance (pre-fire) and relative density (2011) of tree species by Ground Fire Severity Class

Balsam Fir

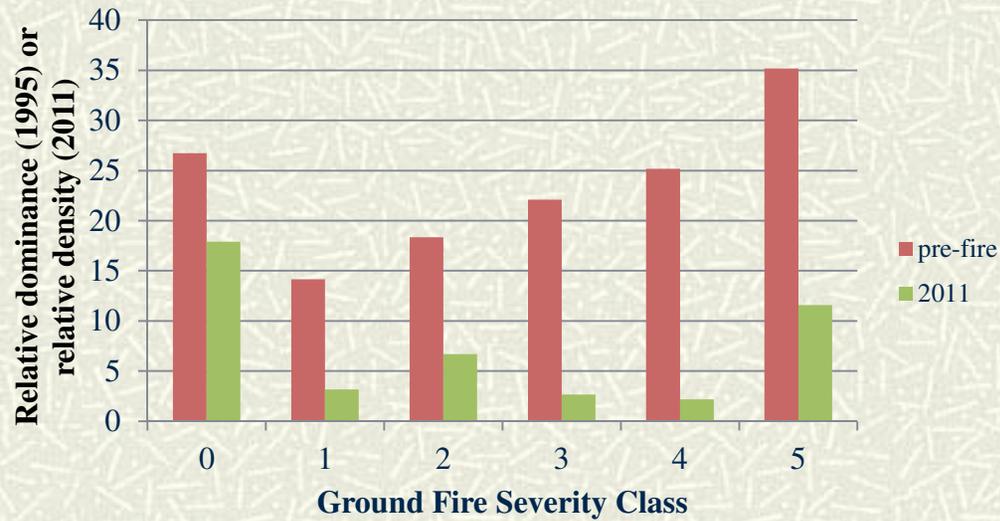


Jack pine

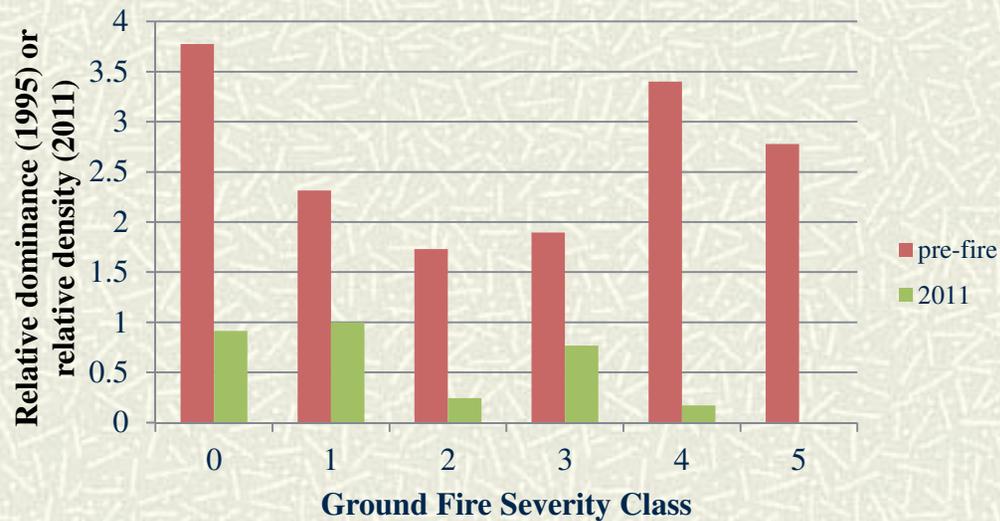


Forest trajectory – relative dominance (pre-fire) and relative density (2011) of tree species by Ground Fire Severity Class

Black spruce

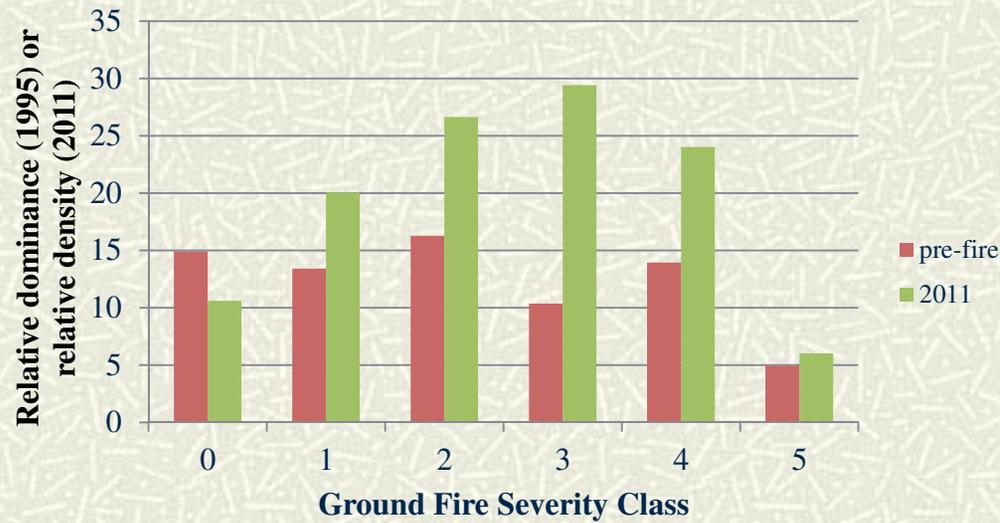


White spruce

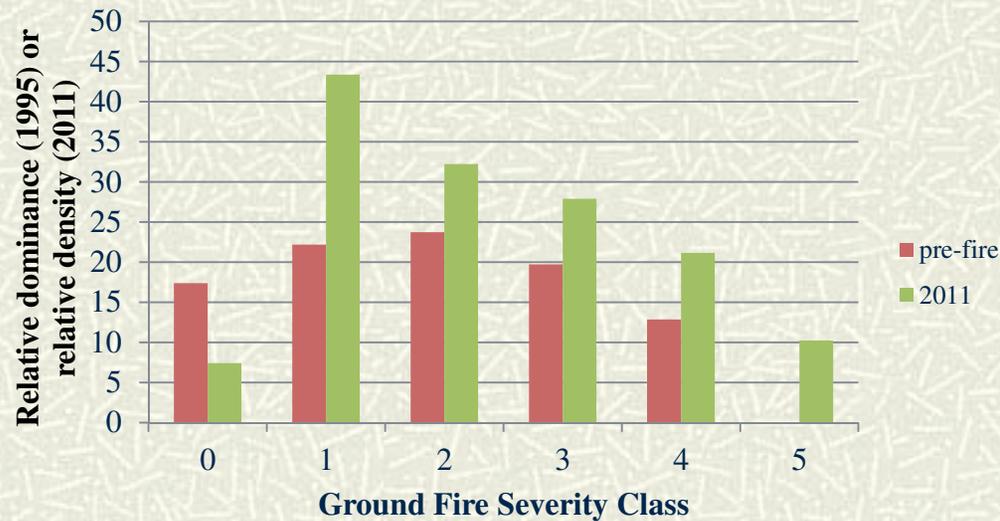


Forest trajectory – relative dominance (pre-fire) and relative density (2011) of tree species by Ground Fire Severity Class

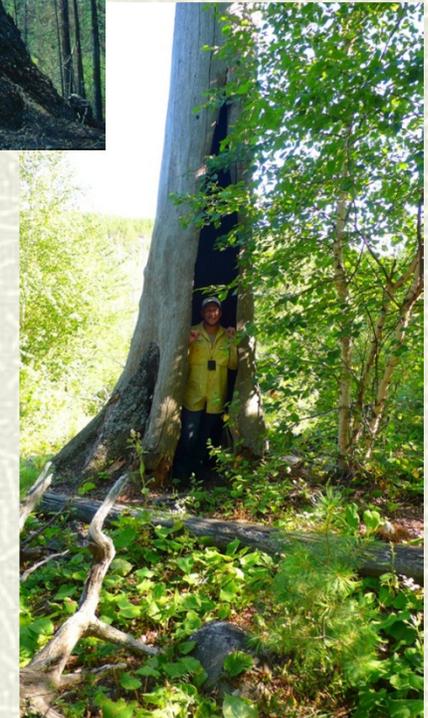
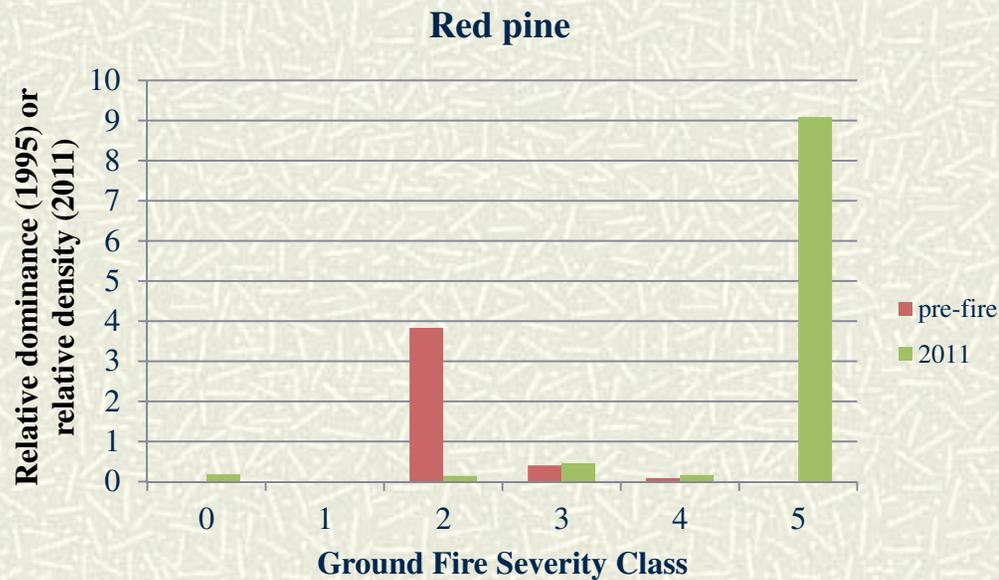
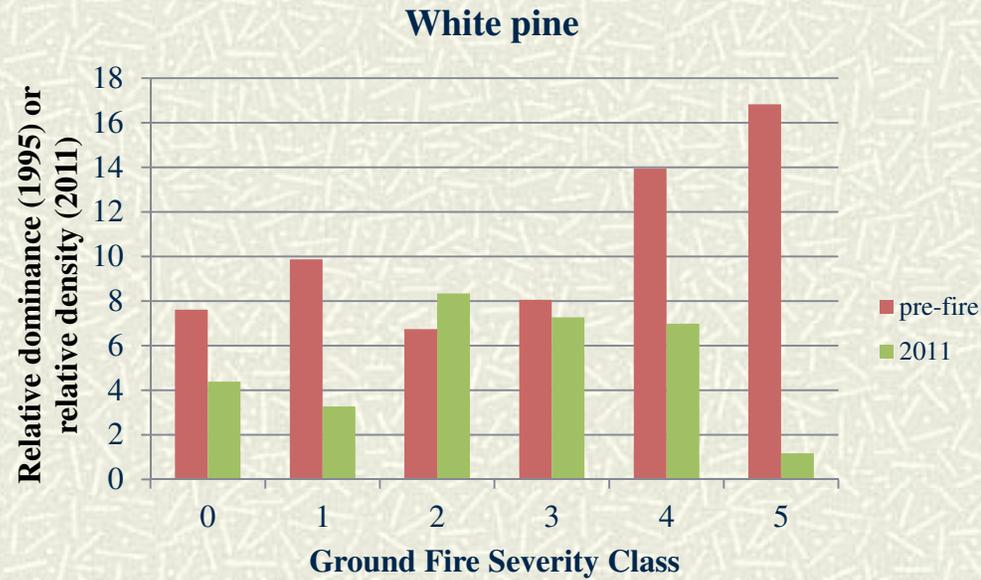
Paper birch



Quaking Aspen

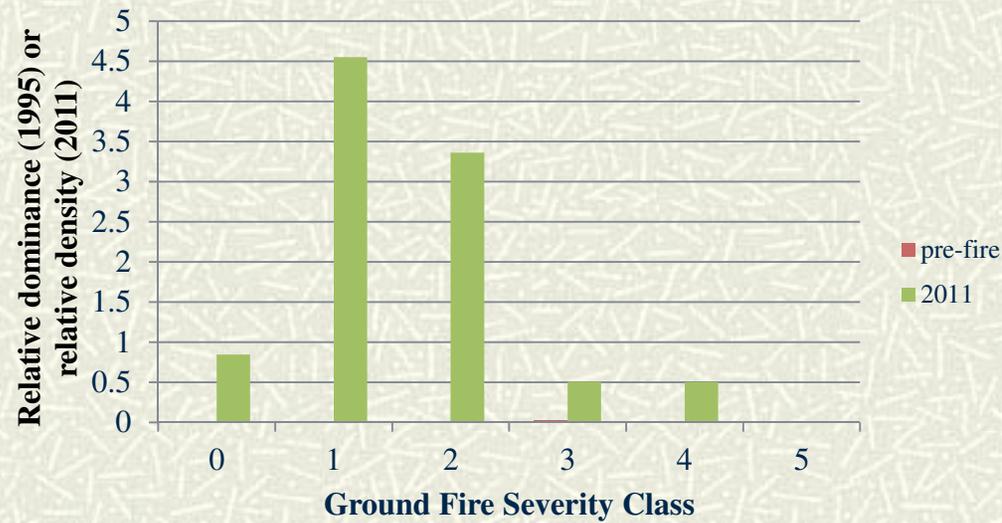


Forest trajectory – relative dominance (pre-fire) and relative density (2011) of tree species by Ground Fire Severity Class



Forest trajectory – relative dominance (pre-fire) and relative density (2011) of tree species by Ground Fire Severity Class

Red Maple



Tamarack



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Forest management implications

Managing for pattern guidelines – residual patches

MN Forest Resources Council (MFRC), Sustaining MN Forest Resources, voluntary site-level guidelines, 2005:

- 0.1 ha of residual patches for every 2 ha of clearcut (5% of landscape)

Results of this study:

Entire burn area (lowland & upland)

- 13% unburned, 23% lowest burn severity
- Size of residual patches was 1-3 ha

Upland areas

- 4% unburned, 23% lowest burn severity
- Size of residual patches averaged 0.43 ha, but varied from 0.09 ha to 25.2 ha



Forest management implications

Take home messages

- **16 years later, preliminary analyses suggest the patterns of fire severity still strongly influences the forest plant community.**
- **Mimicking forest harvest patterns after natural disturbance patterns can have important implications for forest biodiversity.**
- **Forest managers could make the most progress towards mimicking natural patterns caused by fire by:**
 - **Creating a larger range in ground and canopy disturbance severity from 0.1 to a few ha,**
 - **Increasing the recommended average size of residual patches**
 - **Increasing the range of sizes of residual patches.**

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Dr. Peter Reich, Dr. Lee Frelich,

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Dr. Paul Bolstad, Greg Olson

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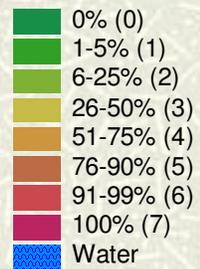
Miscellaneous support:

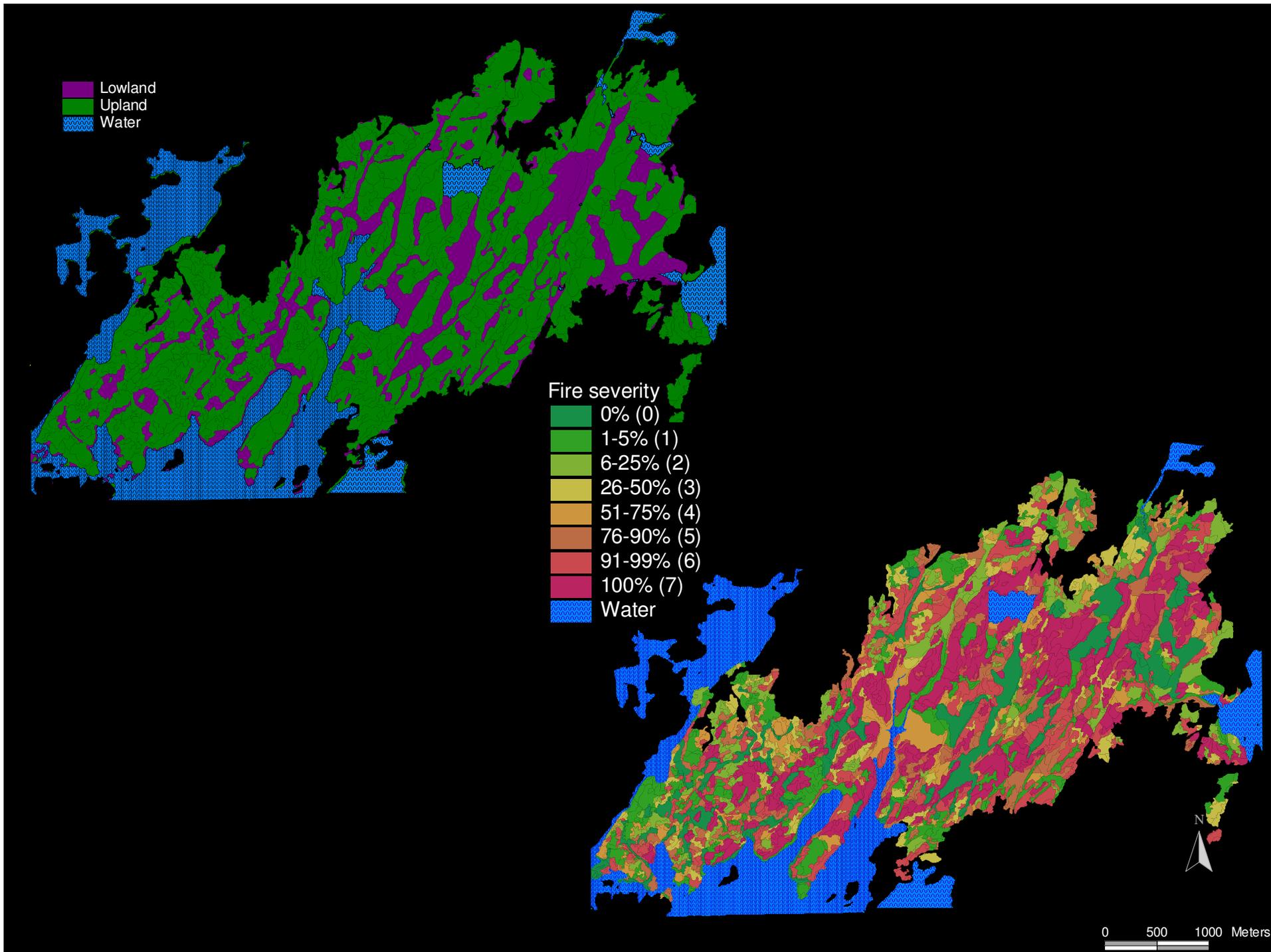
Reich lab group



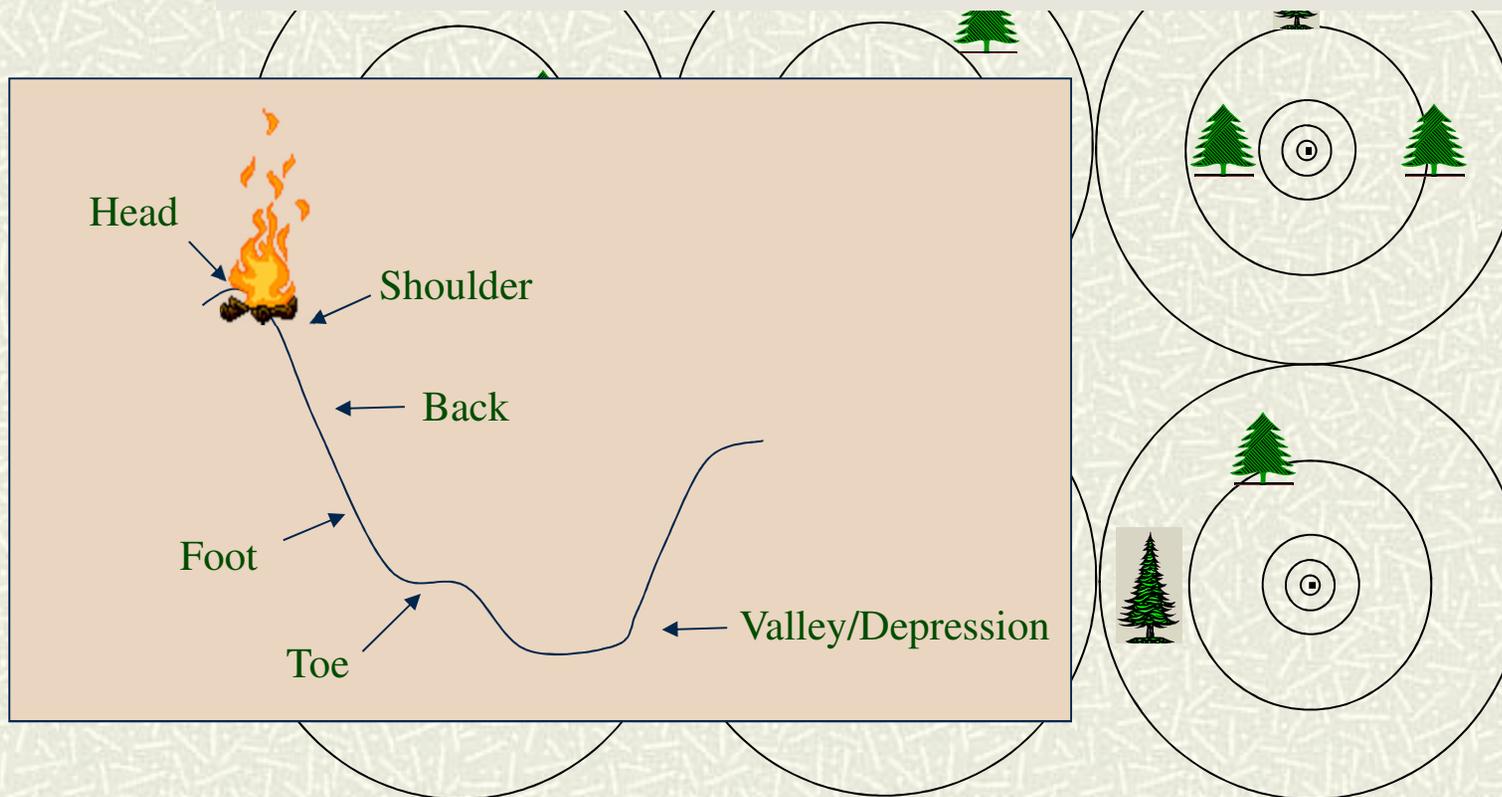
Patch size and shape

- **Lowest and highest severity classes were largest**
- **Larger patches more complex in shape**





a) Ground severity class			b) Crown severity class		
Variable	p	b	Variable	p	b
Position Class	0.003	0.641	Position Class	0.0079	0.389
Adjacent Density <i>Abies balsamea</i>	0.003	0.000266	Adjacent density <i>Abies balsamea</i>	0.0022	0.000272
Adjacent Density <i>Picea mariana</i>	0.0002	-0.00266	Adjacent density <i>Pinus banksiana</i>	0.0044	0.00715
Adjacent Density <i>Populus tremuloides</i>	<0.00001	0.00699	Adjacent density <i>Pinus strobus</i>	0.0019	0.014
			Adjacent density <i>Populus tremuloides</i>	<0.00001	0.00947



Crown severity class

Severity class level	Crown severity class (CSC)		Severity class level
	<i>Canopy foliage consumed</i>		
	Stand-scale	Landscape-scale	
0	none	none	0
1	1-25%	1-5%	1
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5	100%	76-94%	5
		95-99%	6
		100%	7



Ground severity class

	Ground severity class (GSC)
Severity class level (plot)	<i>Consumption of surface litter and duff layer</i>
0	Unburned
1	Light scorch of surface litter
2	1-50% of surface litter
3	50-99% of surface litter Some of duff layer
4	100% of surface litter Most of duff layer
5	Only mineral soil remaining

