

# A Post-Fire Index for Describing Mixed severity Outcomes after Wildfire for Trees and Soils



Theresa “Terrie”  
Jain

David Pilliod

Russell Graham

Leigh Lentile

110+ Publications and  
Applications



# The Past and Current Use of Severity Classification

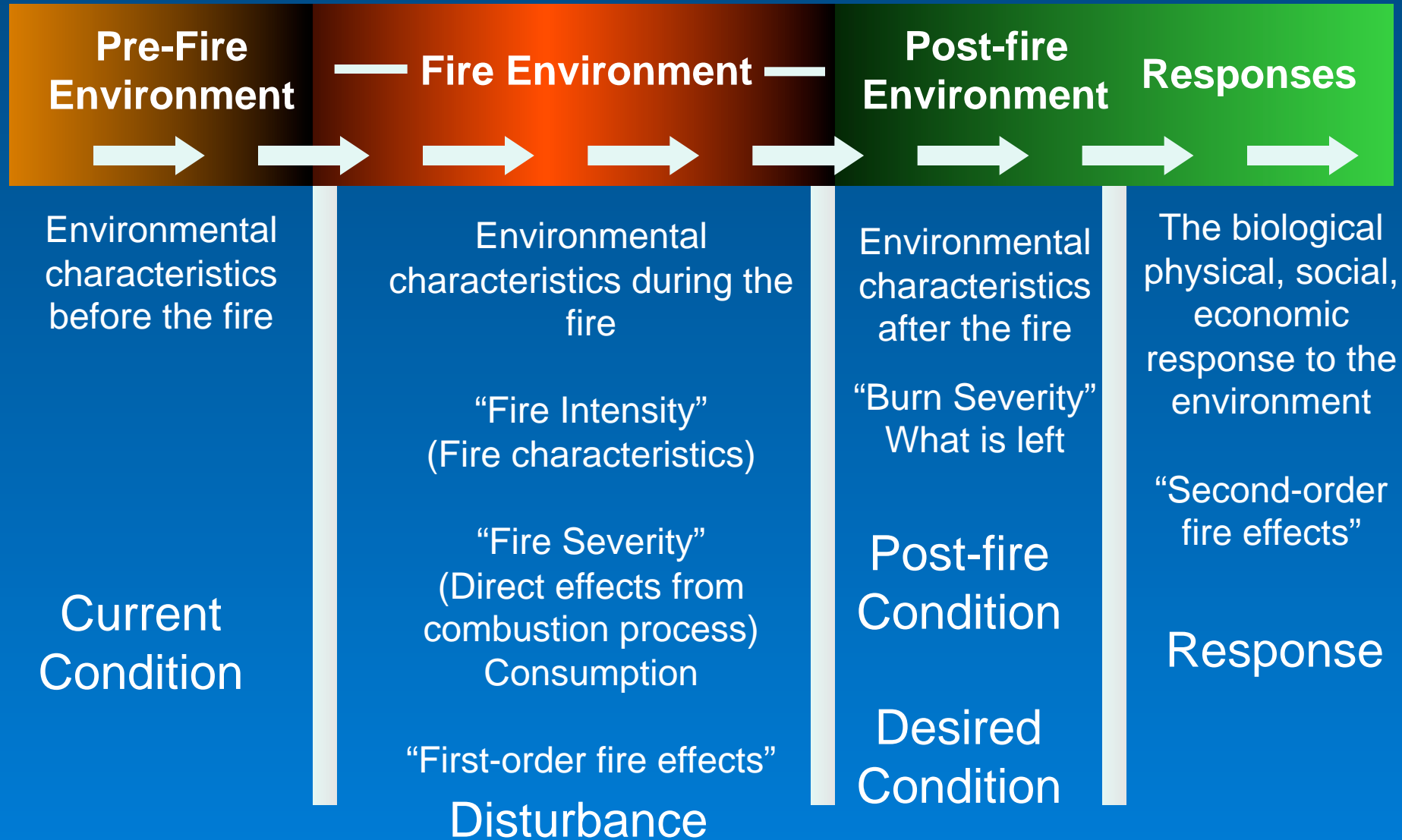
## Issues:

- Fire intensity, fire severity, and burn severity definitions are inconsistently used leading to confusion and misinterpretation
- No consistent way to communicate severity
- Past rationale for a severity classification: prescribed fire with activity fuels
- Lumpers, splitters, selectors
- No integrated severity classification



# Fire Disturbance Continuum

## Clarification of Terminology: "A Work in Progress"



# Tree Burn Severity is a Continuum



Unburned  Black trees

Classification can be Levels of this continuum






















Measurement of Interest – Indicator Variables?

Where are the breaks (thresholds) between the levels?

Enough levels so they can be selected or grouped

“Low”, “Moderate”, or “High” are values placed on the levels which is a combination of the pre-fire condition, burn severity of other vegetation, and response

# This might be how a person perceives tree burn severity

	Low	Moderate	High
Ryan and Noste 1989 (prescribed fire)			
Borchert et al. 2003 (plant regeneration)			
BAER: Parsons 2003 (erosion)			
Fire effects monitoring (all purpose)			
Sieg et al. 2006 (birds)			
Odion et al 2004 (fuel treatment eval.)			
Verling and Lentile 2006 (vegetation)			

Ryan and Noste 1989



Borchert et al. 2003



BAER: Parsons 2003



Fire effects monitoring



Sieg et al. 2006



Odion et al 2004



Verling and Lentile 2006



Unburned



Black trees

# Revisiting and Revising Severity Definitions

To develop an integrated severity classification:

- Management application for multiple purposes and integration among disciplines
- Integrates scientific information
  - Fire Behavior and Effects
- Can be combined, split, or selected
- Simple to quantify and describe
- Visualize severity
- Provide a rationale

# Two Views of Tree Burn Severity



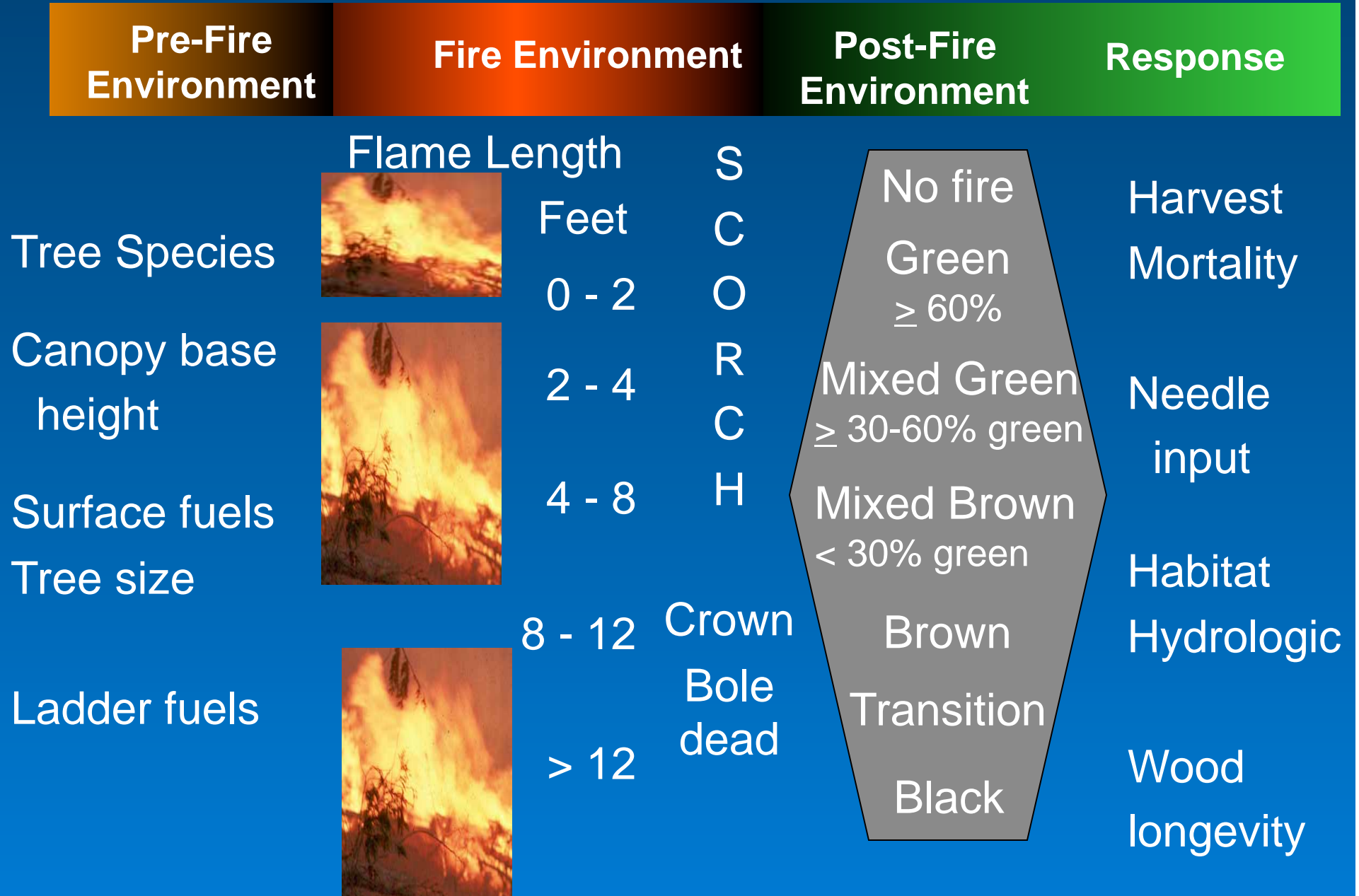
Vertical (mortality prediction)

Plot or patch  
(wildlife, erosion)





# Tree Burn Severity (Individual Tree)



# Tree Post-Fire Index Key Patch

1a. No evidence of fire	0
1b. Evidence of fire	
2a. Presence of residual green crown “Alive”	100.0
3a. All trees have > 60% (green)	100.1
3b. Plurality of trees contain green crowns, brown trees may be present, no black trees present (mixed green)	100.2
3c. Trees with green crowns present, brown trees maybe present, black trees present (mixed brown)	100.3

# Tree Post-Fire Index Key Patch

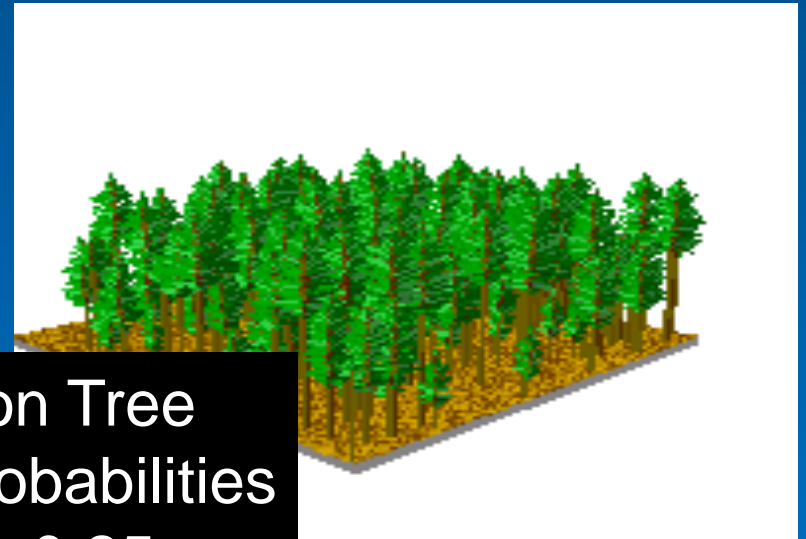
1a. No evidence of fire	0
1b. Evidence of fire	
2b. No evidence of residual green crown “dead”	200.0
4a. All trees contain only brown needles/ leaves (brown)	200.1
4b. Mixture of trees with brown needles/ leaves, trees with both brown and black, and trees with only black crowns (transition)	200.2
4c. All trees contain only black crowns (black)	200.3

# Relation Between Forest Structure and Burn Severity

## Wildfires in Moist, Cold, and Dry Forests



=



Classification Tree  
Conditional Probabilities  
Random = 0.25

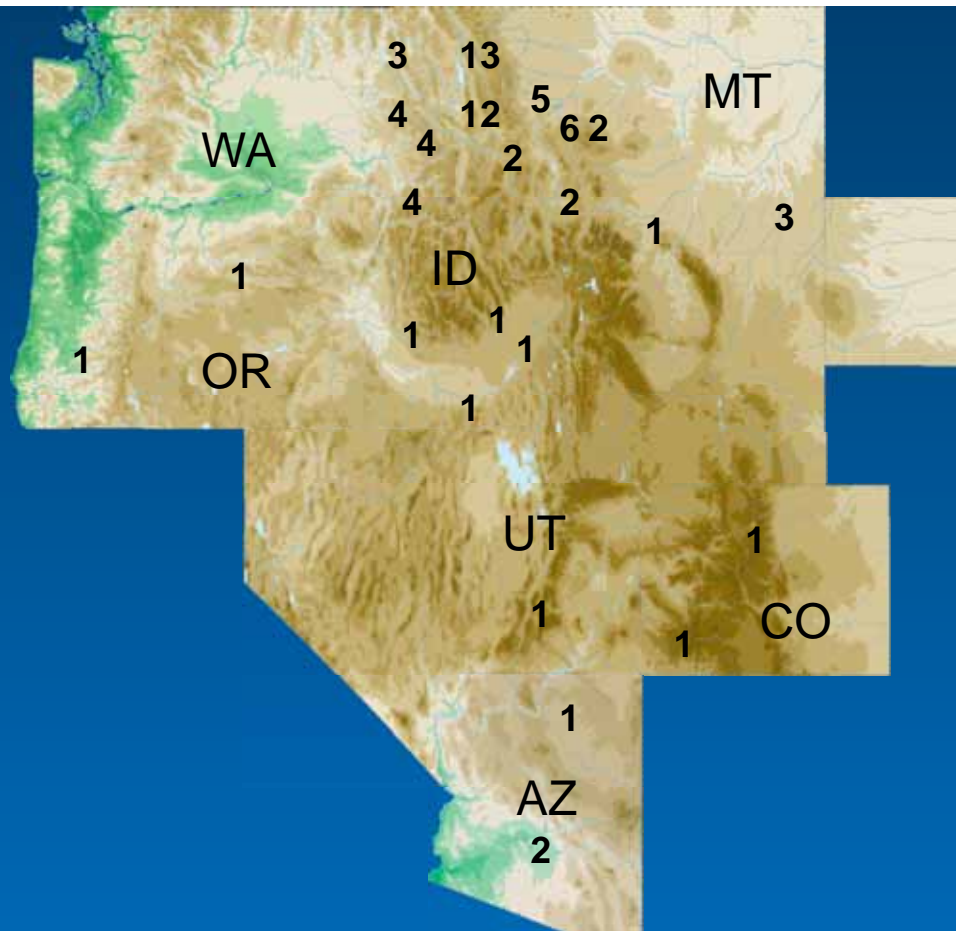
As a Function of  
Pre-Fire Forest  
Structure



Burn Severity

# Visited 73 2001-2003 Wildfires

Moist Forest (Hemlock/Cedar)



Dry Forests (PP/Mixed conifer)



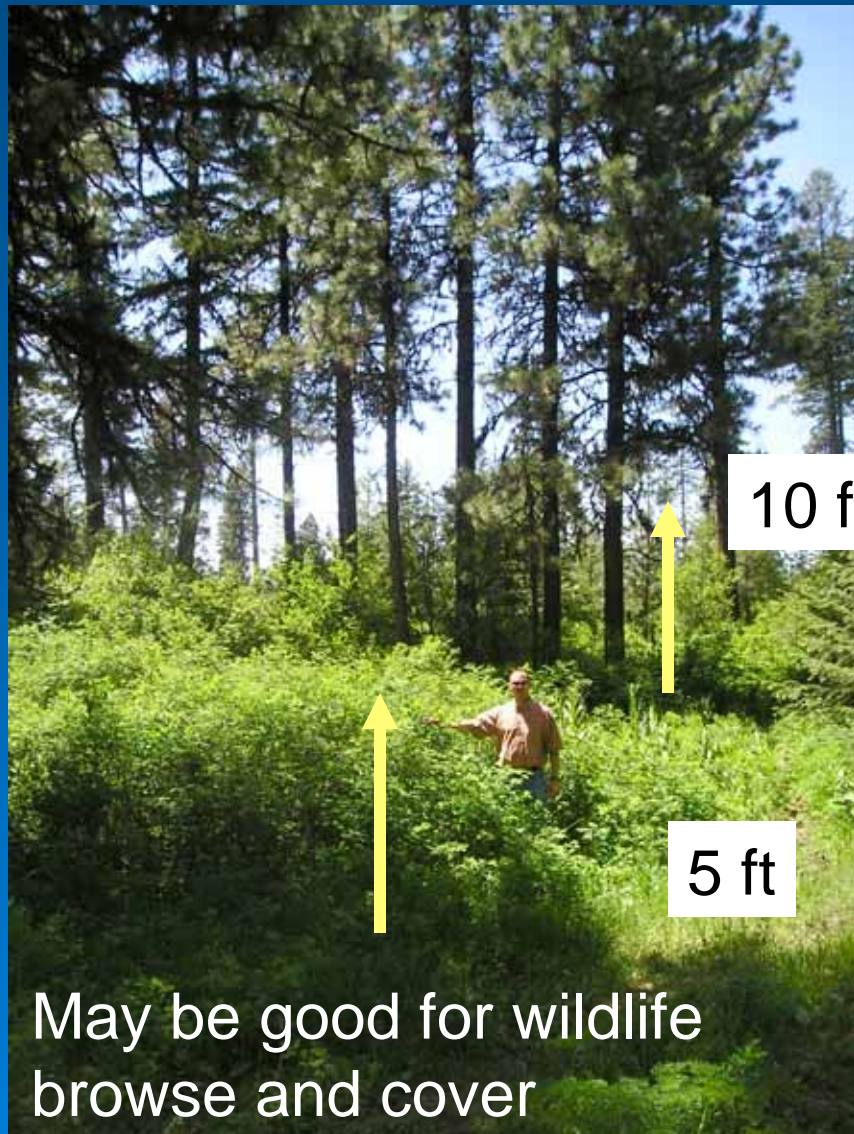
Cold Forests (spruce/fir)

# Low Overstory Tree Density



# Mixed Conifer Forests

## Tree Burn Severity



0.53 probability of brown trees (mixed brown, brown) from heat scorch

23 obs. – 10 mixed brown, 1 brown, 5 black

Conditions:

- 1) Dry forest
- 2) Low canopy base height
- 3) Low cover (20%)
- 4) Surface fuels – produce high heat?

# PP/Mixed Conifer Forests

## Tree Burn Severity

Tree size > 50 cm diameter

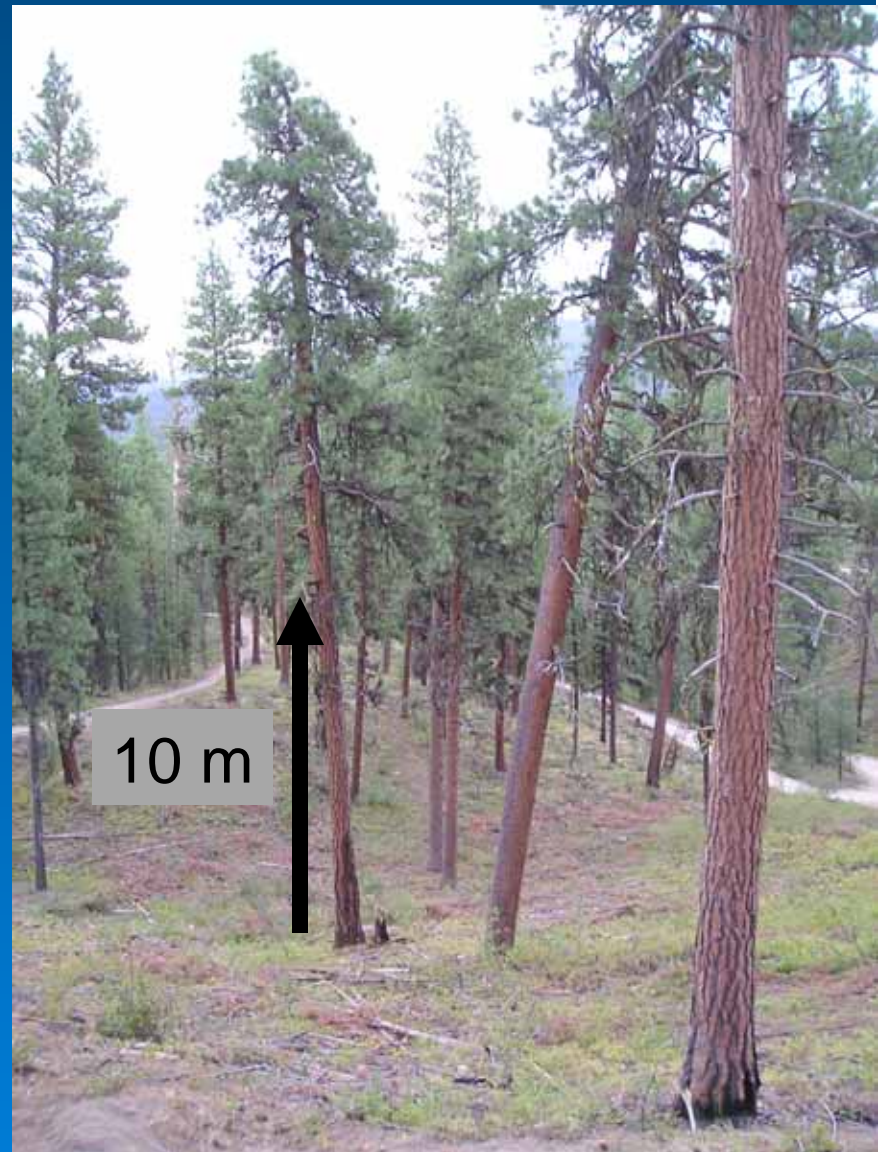
0.70 probability of green trees

Surface fuels < 7 Tonnes/ha

0.57 probability of green trees

Conditions:

- 1) Dry forest
- 2) Canopy base height (high)
- 3) Low surface fuels





# High Overstory Tree Density



# PP/Mixed Conifer to Moist Conifer Forests

## Tree Burn Severity



0.67 probability of green trees

Conditions: 13 observations

Top height: Dry=18 m; Moist=19

Canopy cover: 60 to 70%

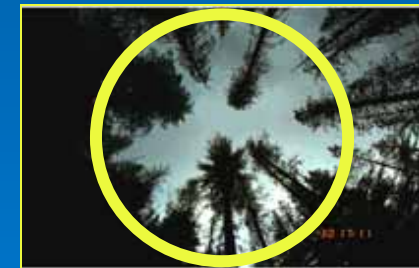
High canopy base heights:

Dry = 9 m; Moist = 4

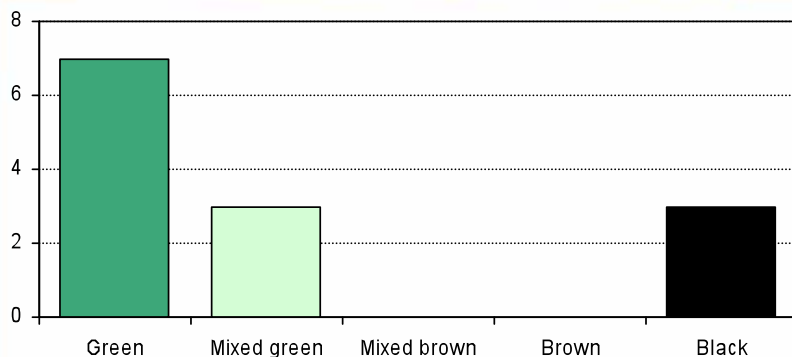
Crown ratio: Dry=38; Moist=39



75 % cover



45 % cover



# All forest types Tree Burn Severity



Conditions:  
High overstory density  
Needle understory  
Higher canopy base height

0.52 prob. of  
mixed green

0.41  
probability of  
brown trees

Conditions:  
Low overstory density  
Grass understory  
Low canopy base height



# Application

- Describes the post-fire environment
- Integrates past and current science
- Placed within the context of the fire disturbance continuum – provides a rationale
- Relates to fire behavior and fire effects
- It is a hypothesis that can be changed, added to, and critically evaluated
- Elements can be combined and/or selected
- There is a soil burn severity developed using the same technique

# Questions and Comments



# Example on how response influences a value



Low or High Severity?

