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

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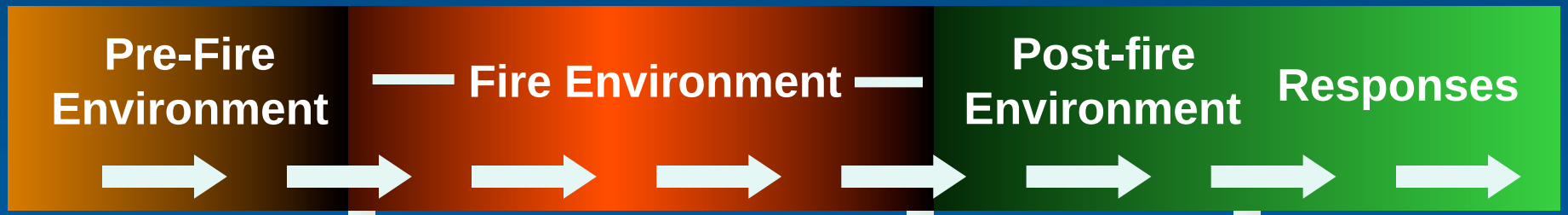
110+ Publications and Applications

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"



Environmental characteristics before the fire

Current Condition

Environmental characteristics during the fire

"Fire Intensity" (Fire characteristics)

"Fire Severity" (Direct effects from combustion process) Consumption

"First-order fire effects"

Disturbance

Environmental characteristics after the fire

"Burn Severity" What is left

Post-fire Condition

Desired Condition

The biological physical, social, economic response to the environment

"Second-order fire effects"

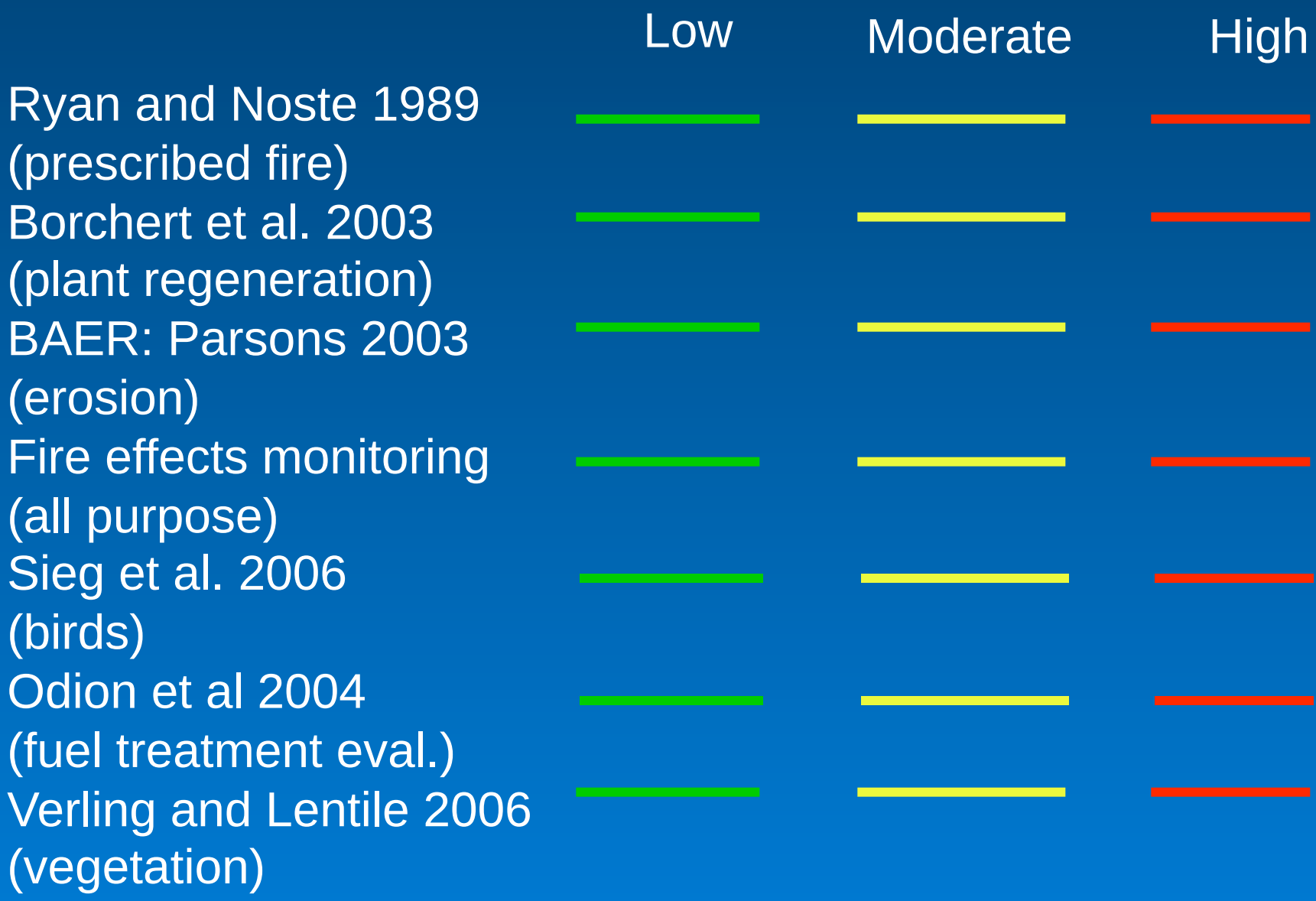
Response

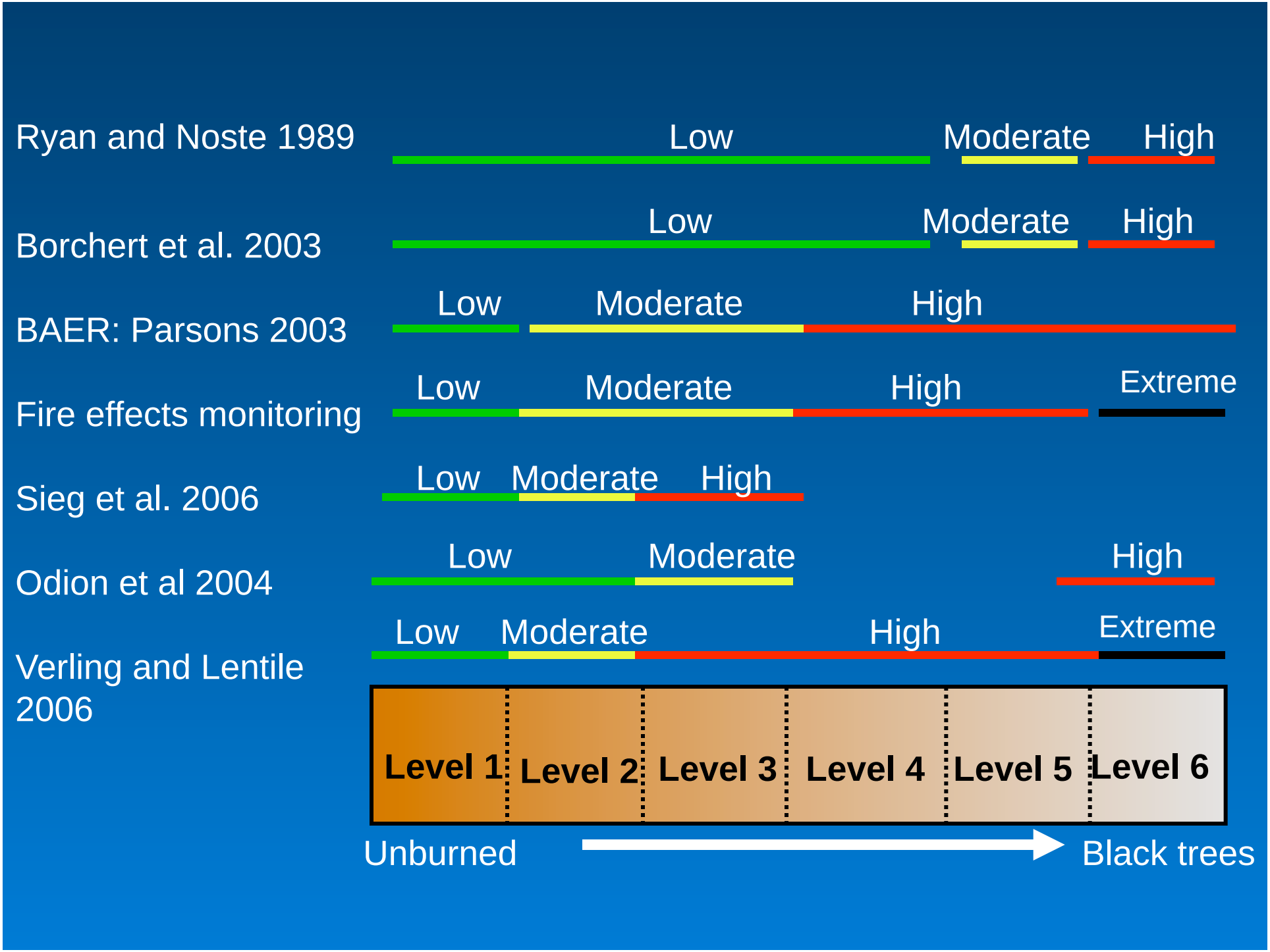
Tree Burn Severity is a Continuum

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




Ryan and Noste 1989
Low
Moderate
High
Borchert et al. 2003
Low
Moderate
High
BAER: Parsons 2003
Low
Moderate
High
Fire effects monitoring
Low
Moderate
High
Extreme
Sieg et al. 2006
Low
Moderate
High
Odion et al 2004
Low
Moderate
High
Verling and Lentile 2006
Low
Moderate
High
Extreme
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
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)

Pre-Fire Environment	Fire Environment	Post-Fire Environment	Response

Tree Species

Canopy base height

Surface fuels

Tree size

Ladder fuels

Flame Length

Feet

0 - 2

2 - 4

4 - 8

8 - 12

> 12

SCORCH

Crown

Bole dead

No fire

Green
≥ 60%

Mixed Green
≥ 30-60% green

Mixed Brown
< 30% green

Brown

Transition

Black

Harvest Mortality

Needle input

Habitat Hydrologic

Wood longevity

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

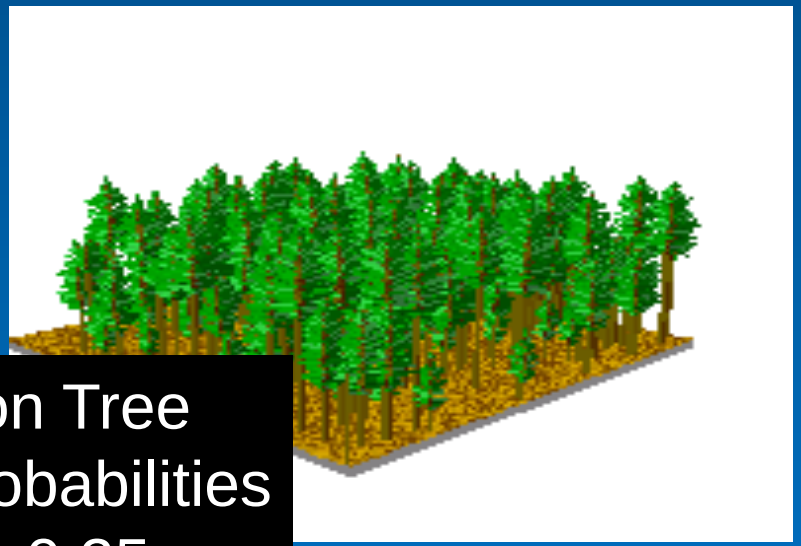
4b. Mixture of trees with brown needles/ leaves, trees with both brown and black, and trees with only black crowns (transition) — 200.2

4c. All trees contain only black crowns (black) — 200.3

Relation Between Forest Structure and Burn Severity Wildfires in Moist, Cold, and Dry Forests

Burn Severity

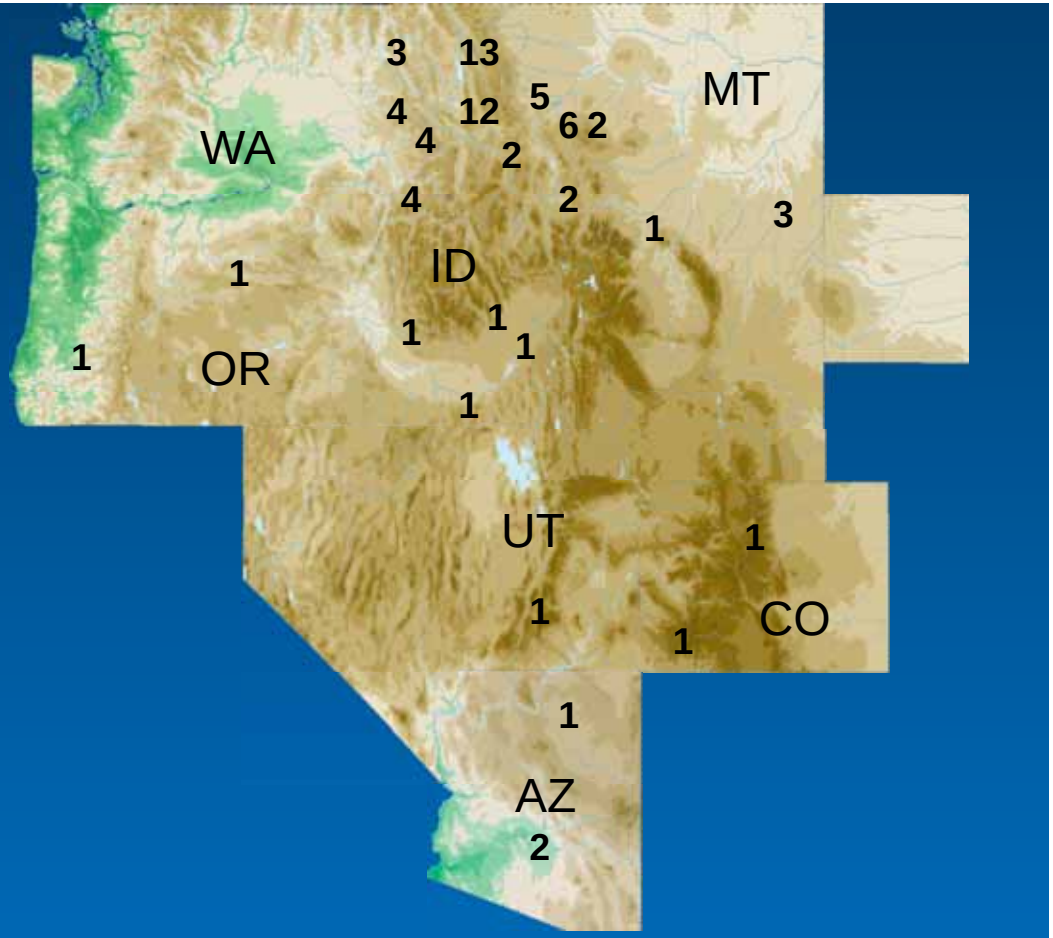
=



As a Function of Pre-Fire Forest Structure

Classification Tree
Conditional Probabilities
Random = 0.25

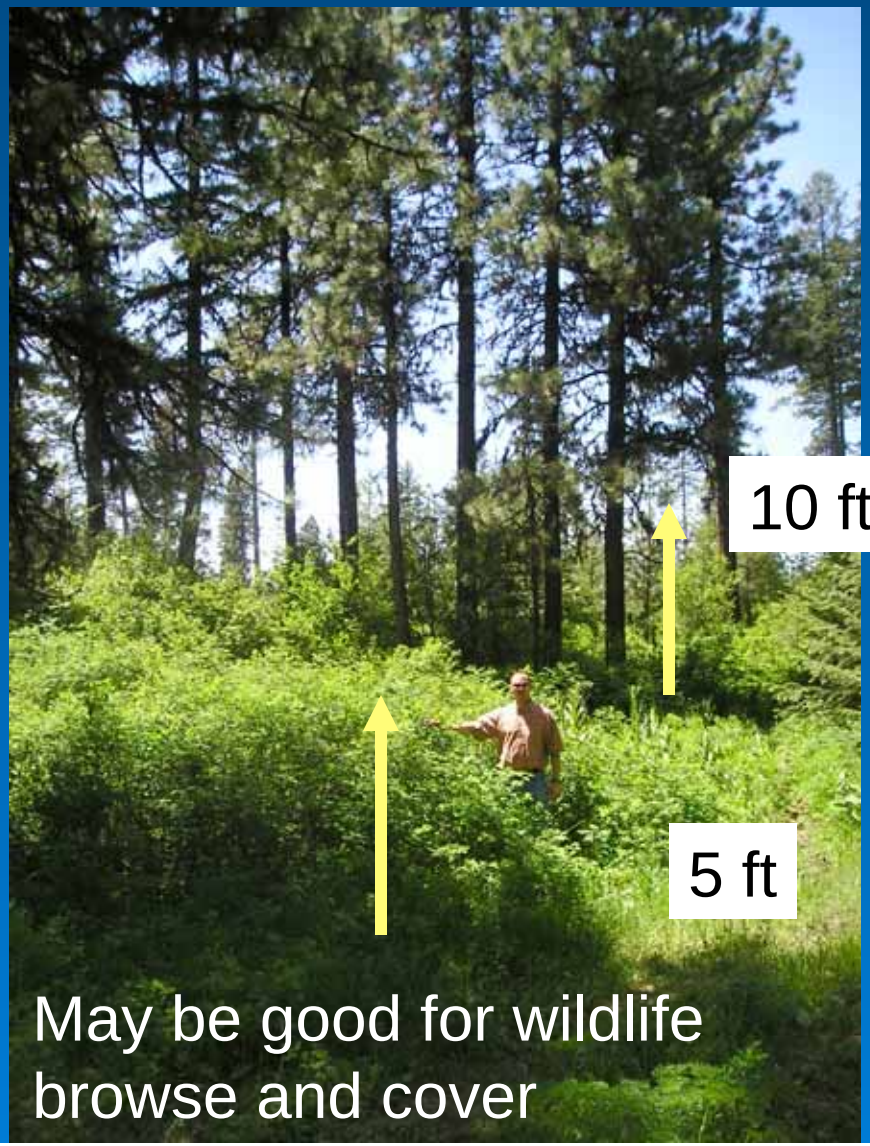
Visited 73 2001-2003 Wildfires



Dry Forests (PP/Mixed conifer)

Low Overstory Tree Density

Mixed Conifer Forests
Tree Burn Severity

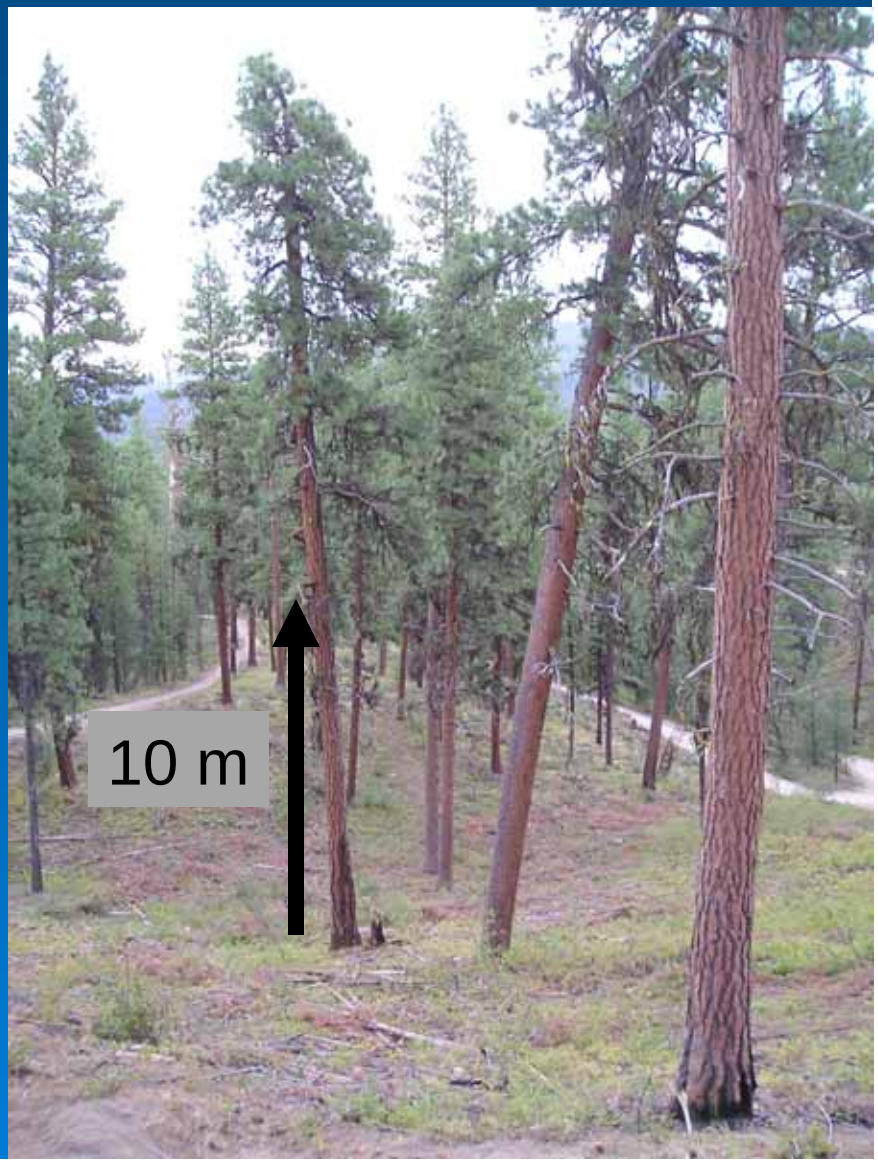


- 0.53 probability of brown trees (mixed brown, brown) from heat scorch
- 23 obs. – 10 mixed brown, 1 brown, 5 black
- Conditions:
- 1) Dry forest
- 2) Low canopy base height
- 3) Low cover (20%)
- 4) Surface fuels – produce high heat?

PP/Mixed Conifer Forests
Tree Burn Severity

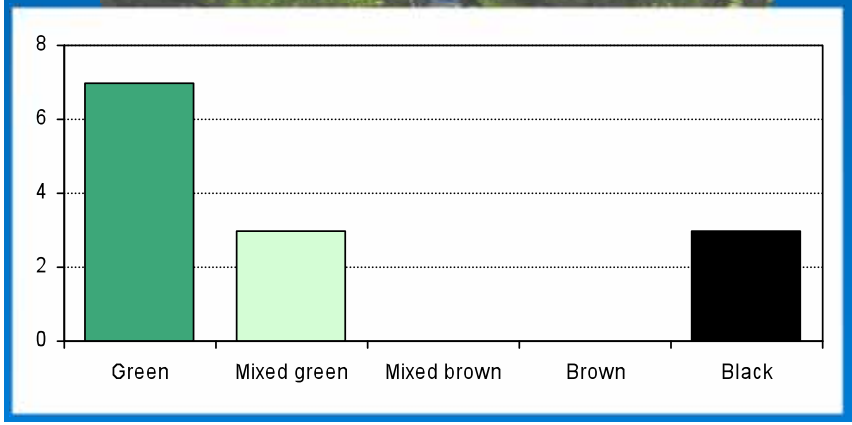
Tree size > 50 cm diameter
0.70 probability of green trees
Surface fuels < 7 Tonnes/ha
0.57 probability of green trees

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

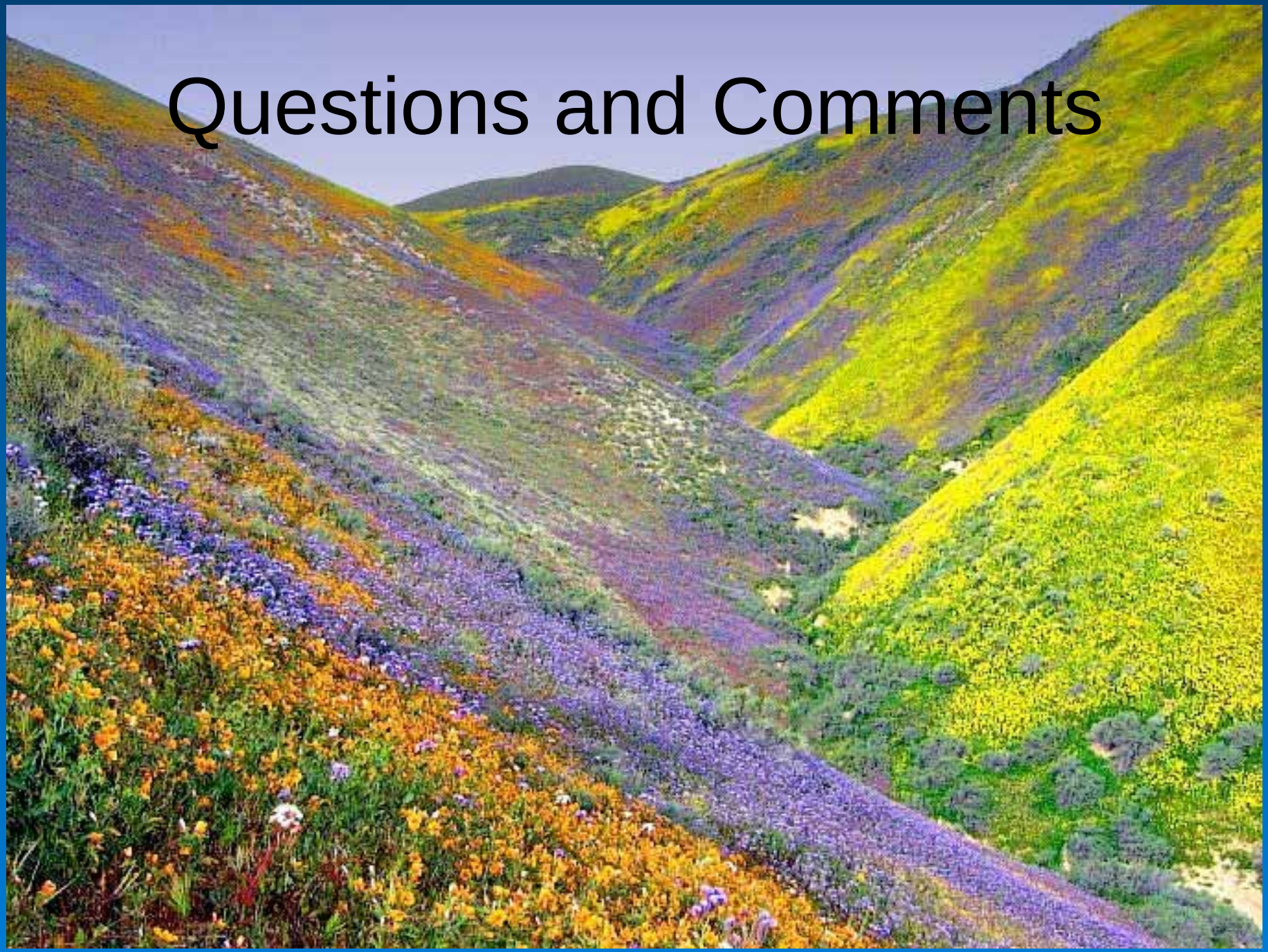
0.41 probability of brown trees

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?