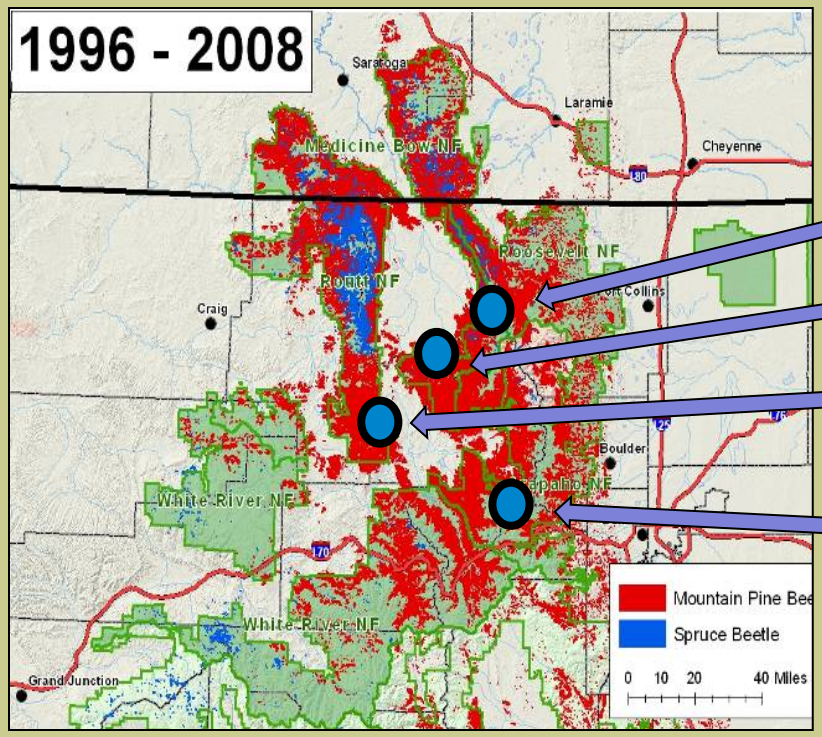
Initial Forest Responses to Colorado's Bark Beetle Outbreak

Chuck Rhoades
Kelly Elder, Rob Hubbard
Byron Collins, Mike Battaglia, Jeff Lukas

Western Water Assessment Science Symposium
25 April 2011, Boulder

Colorado's Bark Beetle Outbreak



CO State Forest

Willow Ck, Parks RD

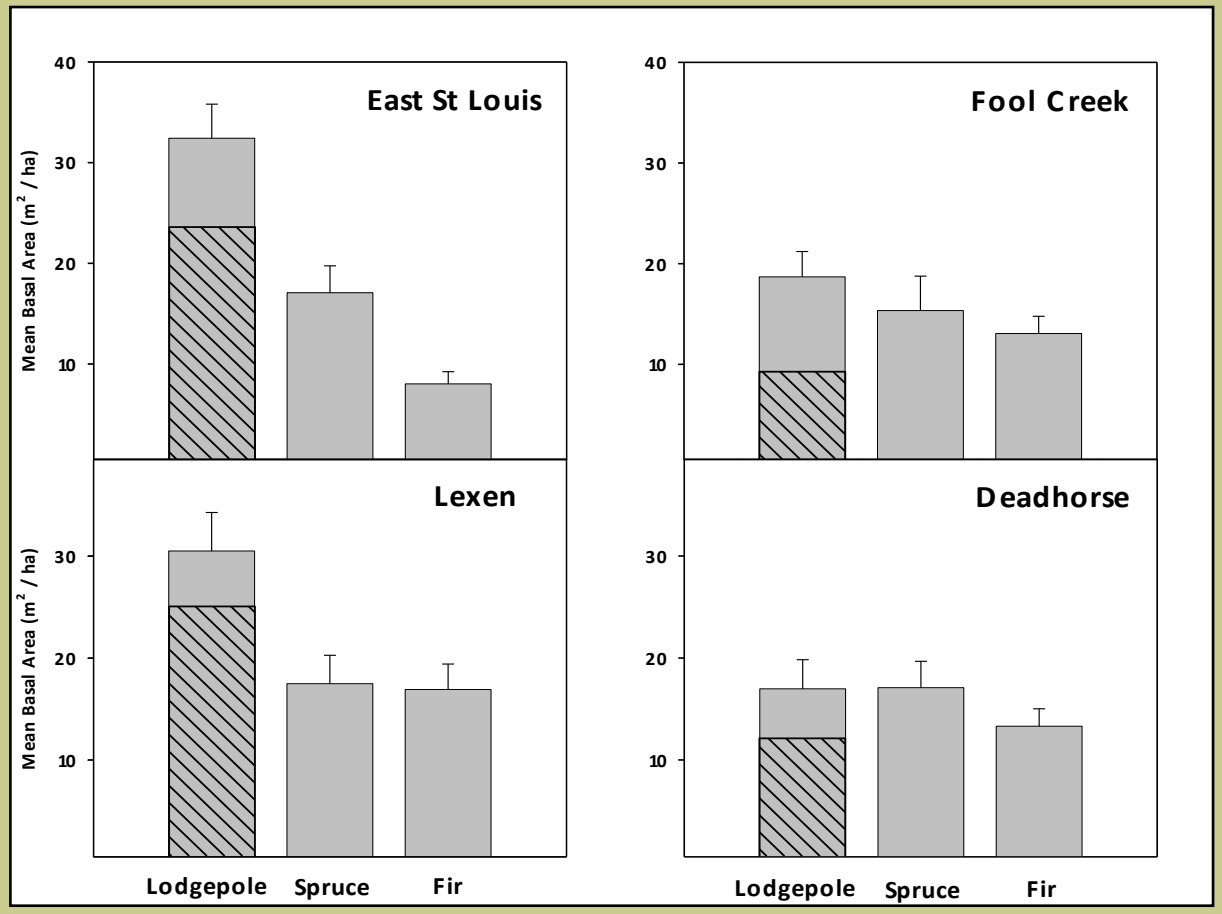
Gore Pass, Yampa RD

Fraser Expt Forest

Last Year – Tree Water Use, Stream Nutrients

This Year - Forest Structure Change,
Growth Responses, Fuels and Fire

Amount of Mortality - Depends on Forest Composition & Structure



Basal Area Loss

Old Growth

73- 83% LPP loss

39 - 41% total loss

Mixed Age/Managed

50-70% of LPP

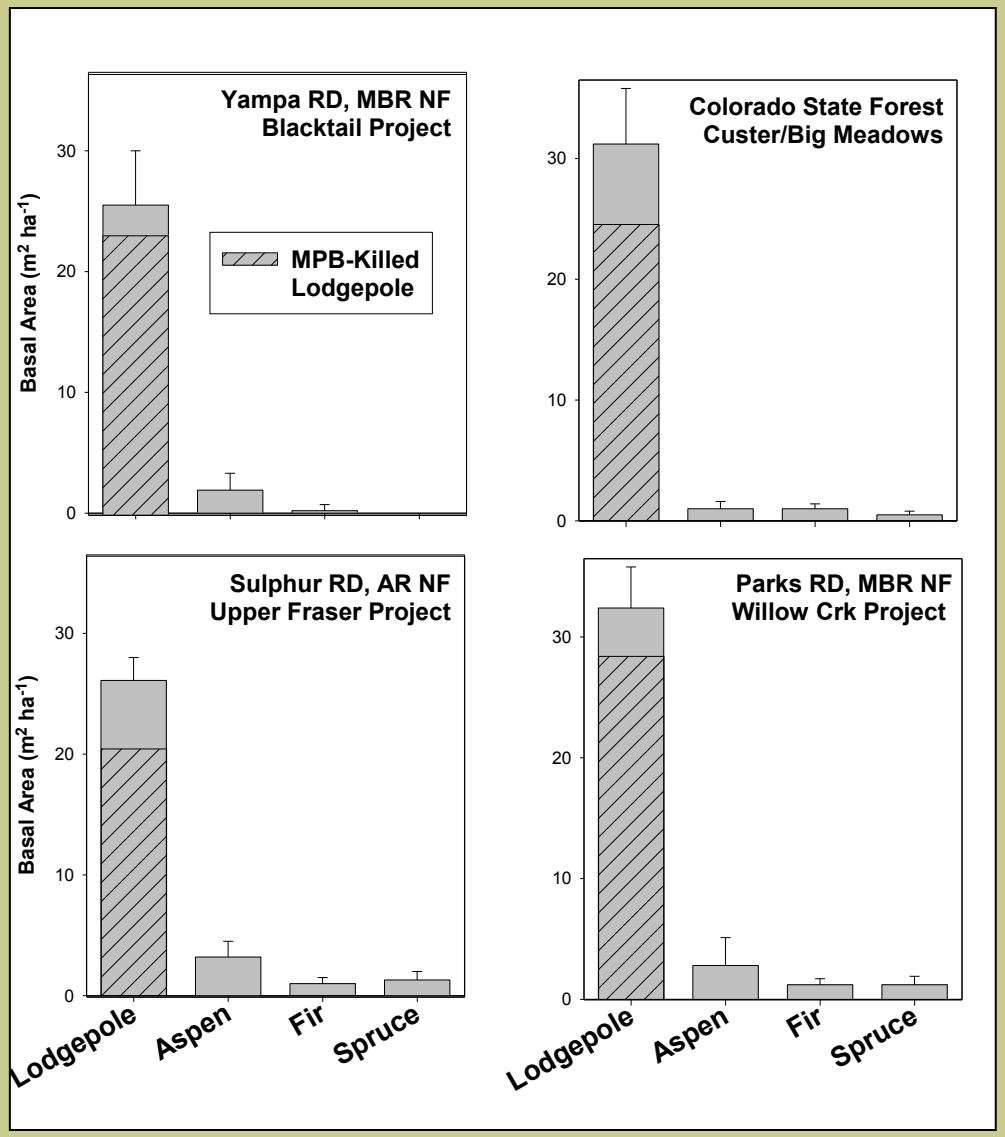
20-25% of total

Old Growth

Mixed Young/Old

Amount of Mortality

Pine dominated stands



Loss of lodgepole

pine basal area = 80-90%

Residual live

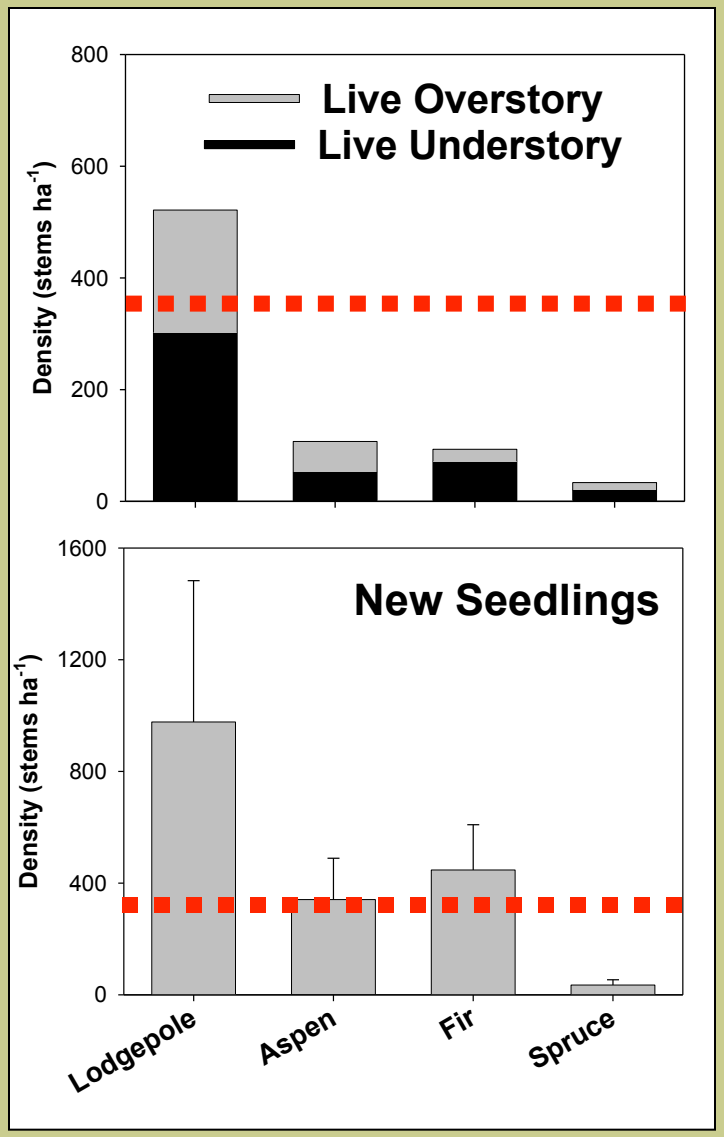
15-35% of total stand BA.

*24 pine-dominated stands at 4 MPB projects

* Trees >10 cm (4”) DBH

Growing Stock in MPB Forests

Residual Live & New Trees



Overstory

310 t/ha (126 t/acre)
71% LPP; 17% AS; 7% SF

Understory Trees

445 t/ha (180 t/Ac)
68% LPP; 12% AS; 15% SF

New Recruits

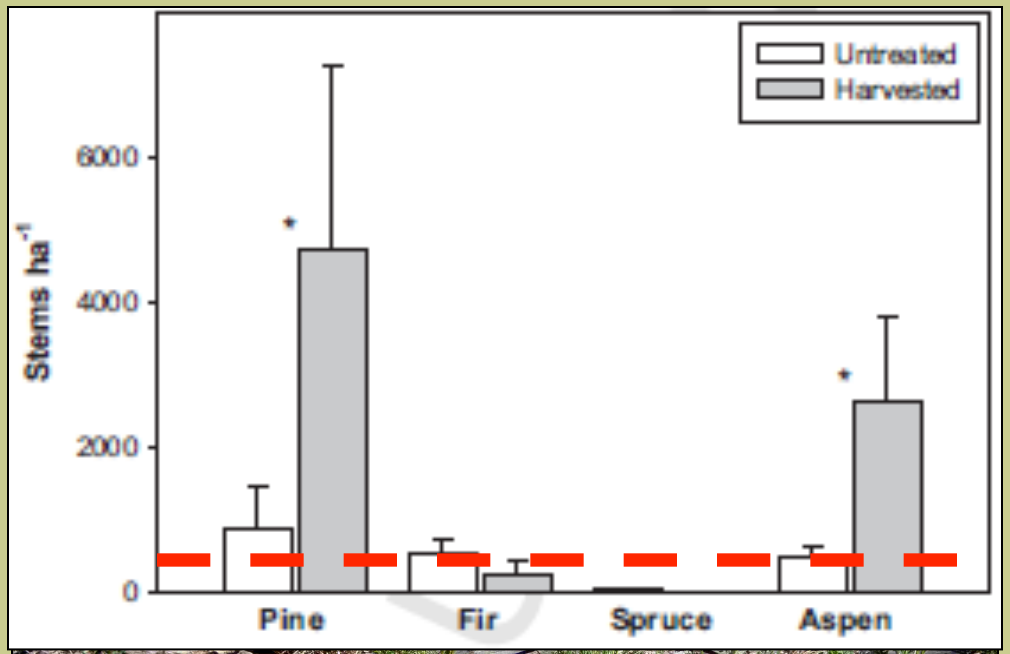
1820 t/ha (736 t/Ac)
54% LPP; 19% AS; 25% SF

*Stocking Levels

370 t/ha (150 t/Ac)

Response to Management

Tree Recruitment



Harvesting stimulates new pine seedlings and aspen sprouts.

5 times more pine, aspen compared to uncut stands

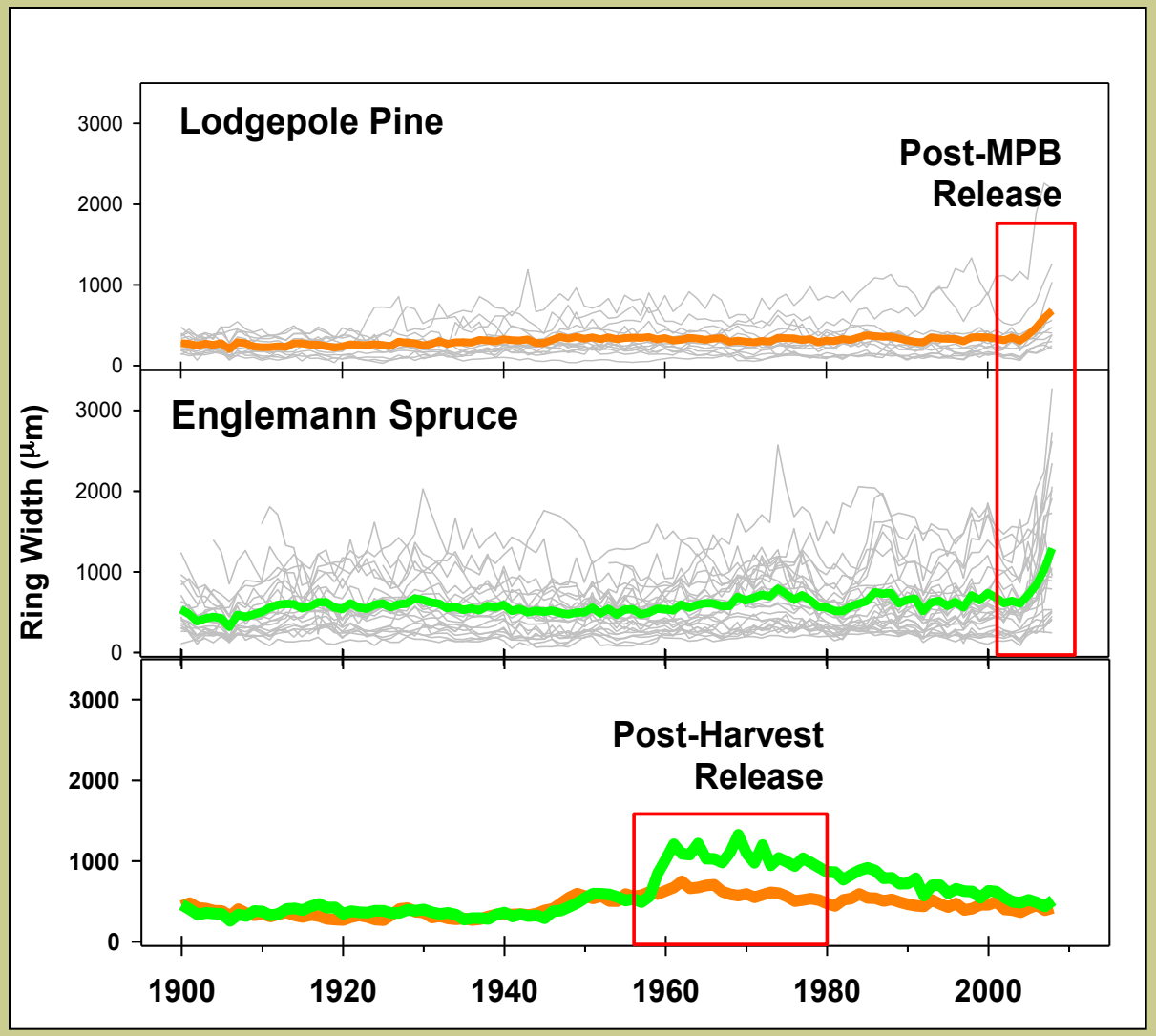
Fir recruitment is promoted in uncut stands

*Cut stands meet minimum stocking requirements
(i.e., > 150 t/acre)

*8 paired sites at Fraser

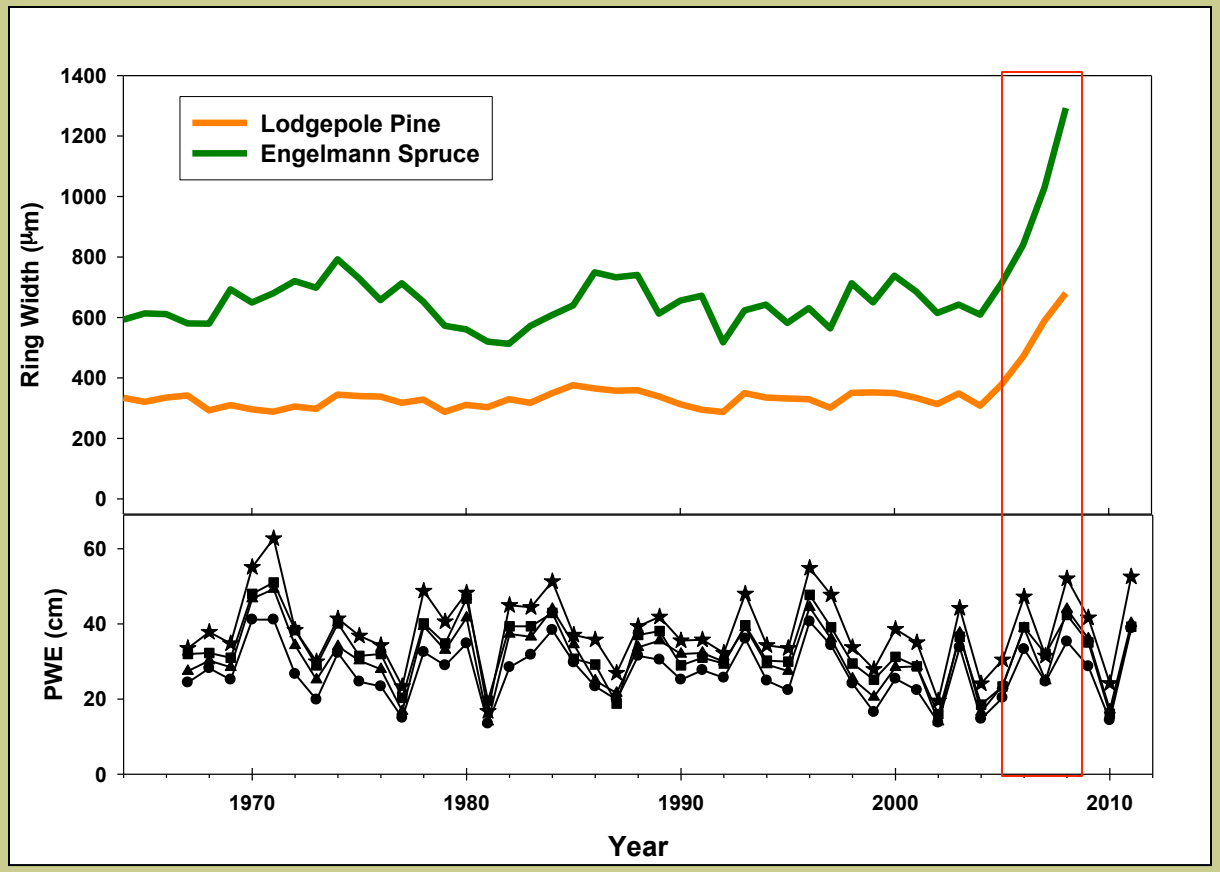
(Collins et al. 2010b)

Overstory Growth Response



- Assessed 123 cores in 4 basins
- 35% of trees grew > 25% faster since the infestation than the previous decade
- 16% of trees grew faster than ever before.
- LPP more likely to respond that ES

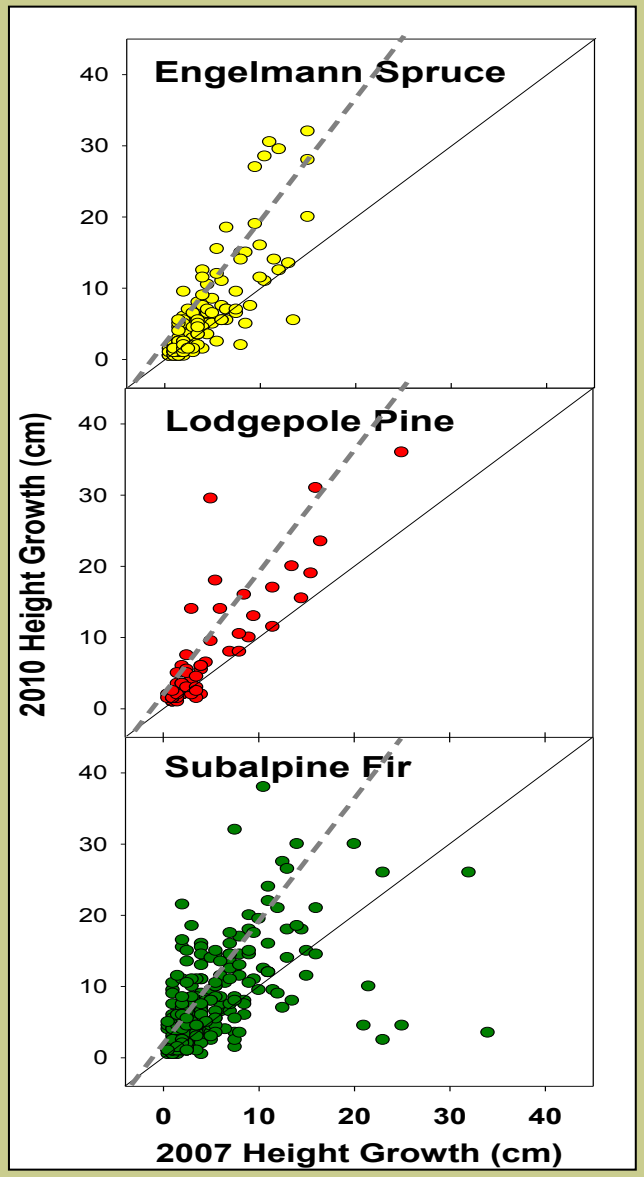
Radial Growth Response

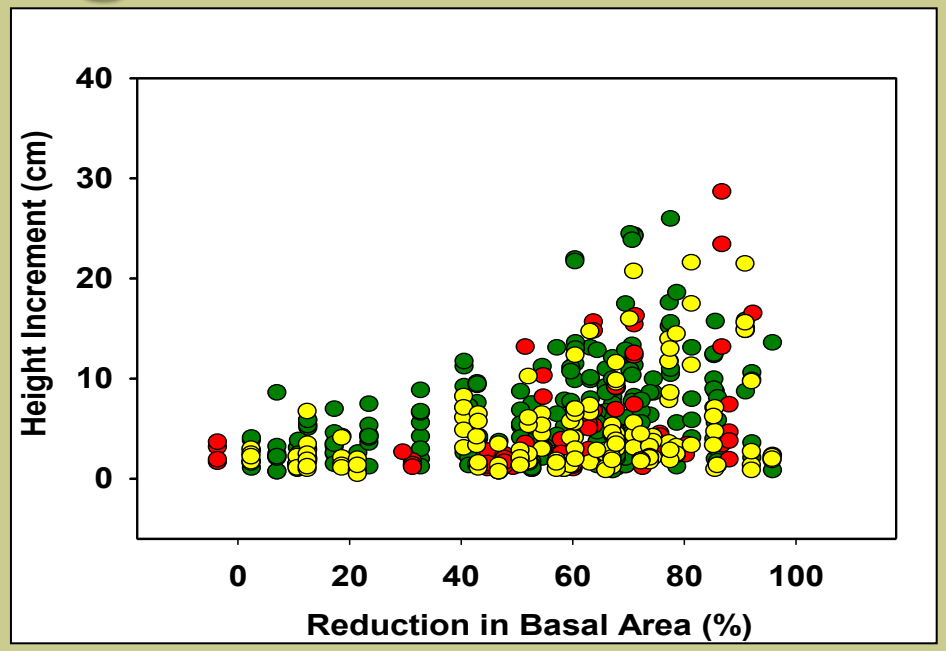


Change in ring width was unrelated to winter precipitation during the post-MPB period.

Decline in overstory basal area explained 10-20% of variability in radial release.

Understory Height Growth

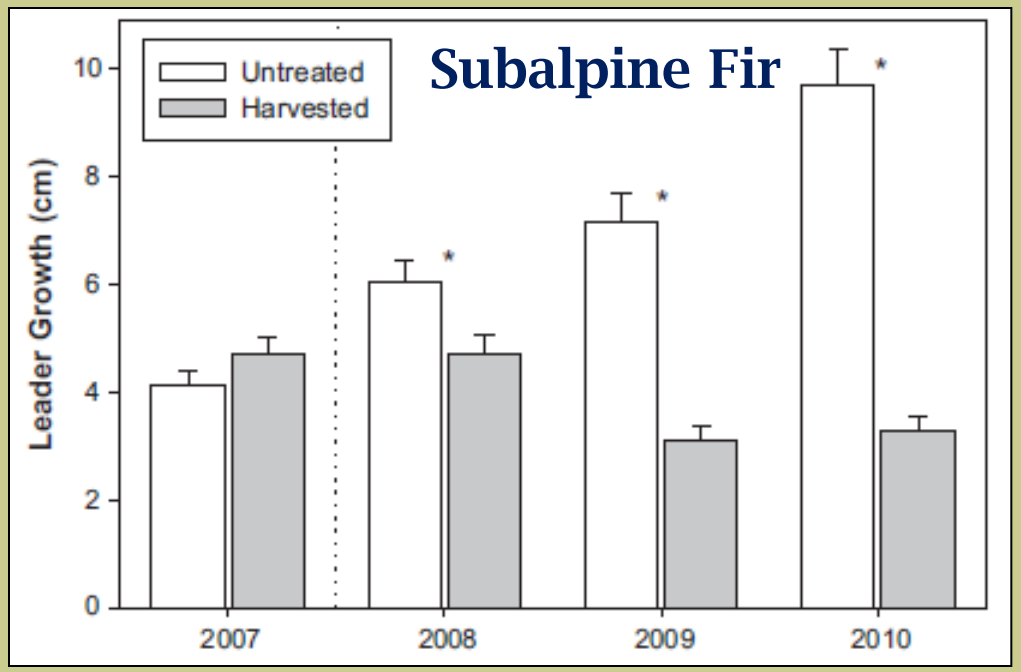


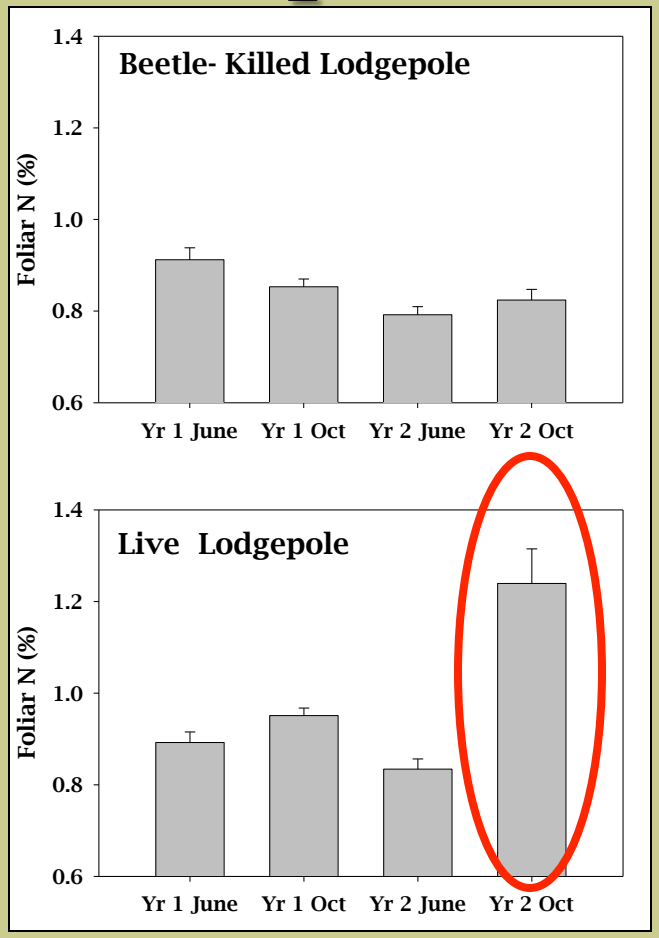


40% of trees added > 2X more height in '01 as in '07. Proportionally, fir was most likely to double height; spruce was least likely.

Loss of basal area explains 13 - 23% of height increment. Pine most sensitive to BA; spruce least sensitive.

Height Growth & Foliar Responses

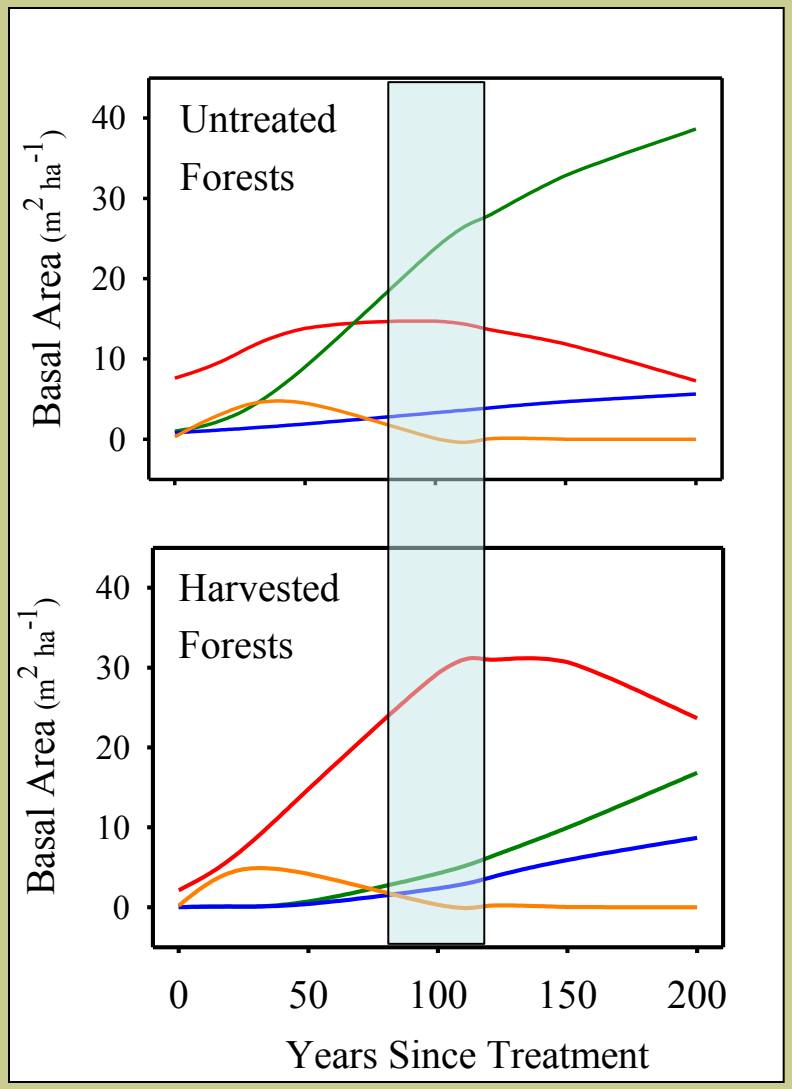




Annual height growth of Fir & Pine has doubled since infestation beneath the dead overstory, but neither has responded in cuts.

Foliar N more than doubled following loss of neighboring trees.

Stand Species Composition
Varies with Management



Forest Recovery
Projections based on stand-level measurements

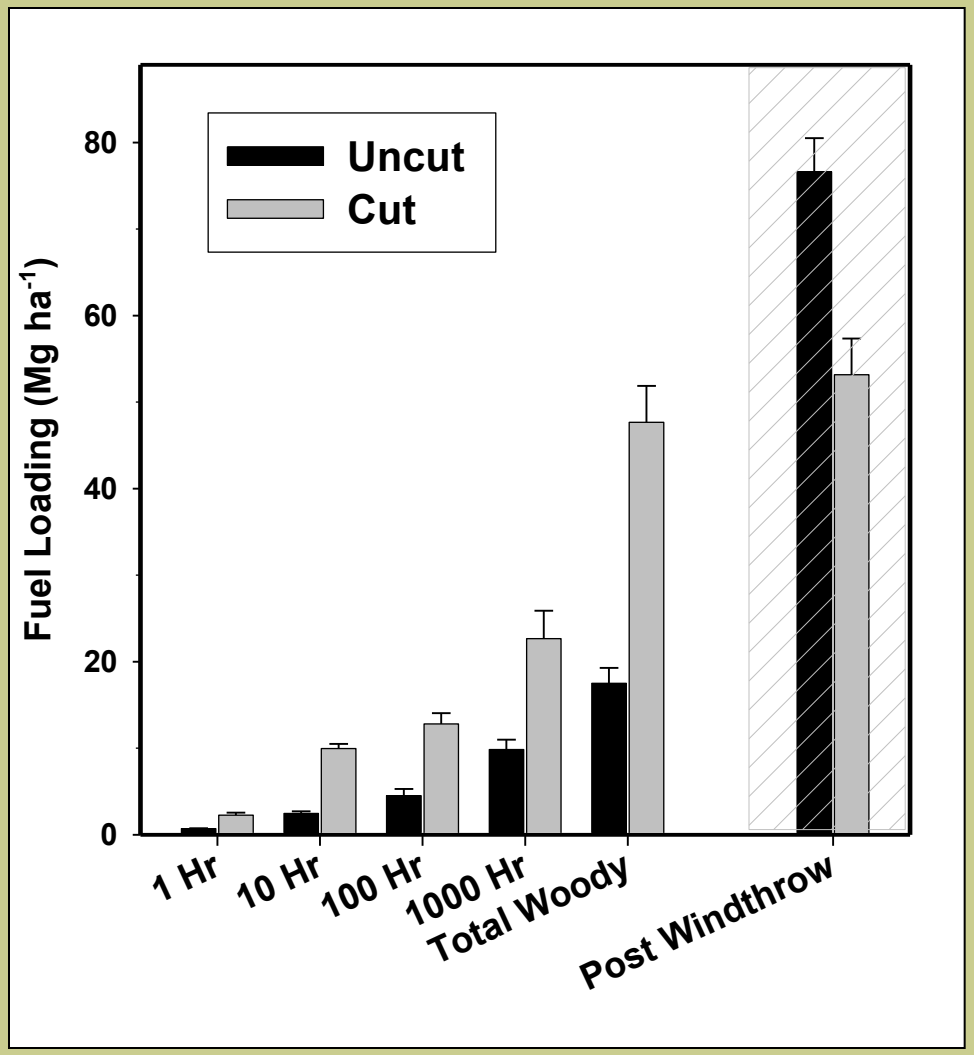
MPB-killed stands recover to pre-MPB basal area in 80 - 105 yr

Uncut & Partial Cut Stands
Dominated by fir

Clear Cut Stands
Similar to pre-MPB stands
Dominated by pine

(Collins et al. 2010b)

Post-Treatment Surface Fuels



Harvesting adds

~4X fine fuels (1 + 10 hr)

~3X total surface fuels

The increase in surface fuels may result in greater flame lengths (i.e., under extreme weather conditions: 2.3 vs 1.7 m compared to 5m).

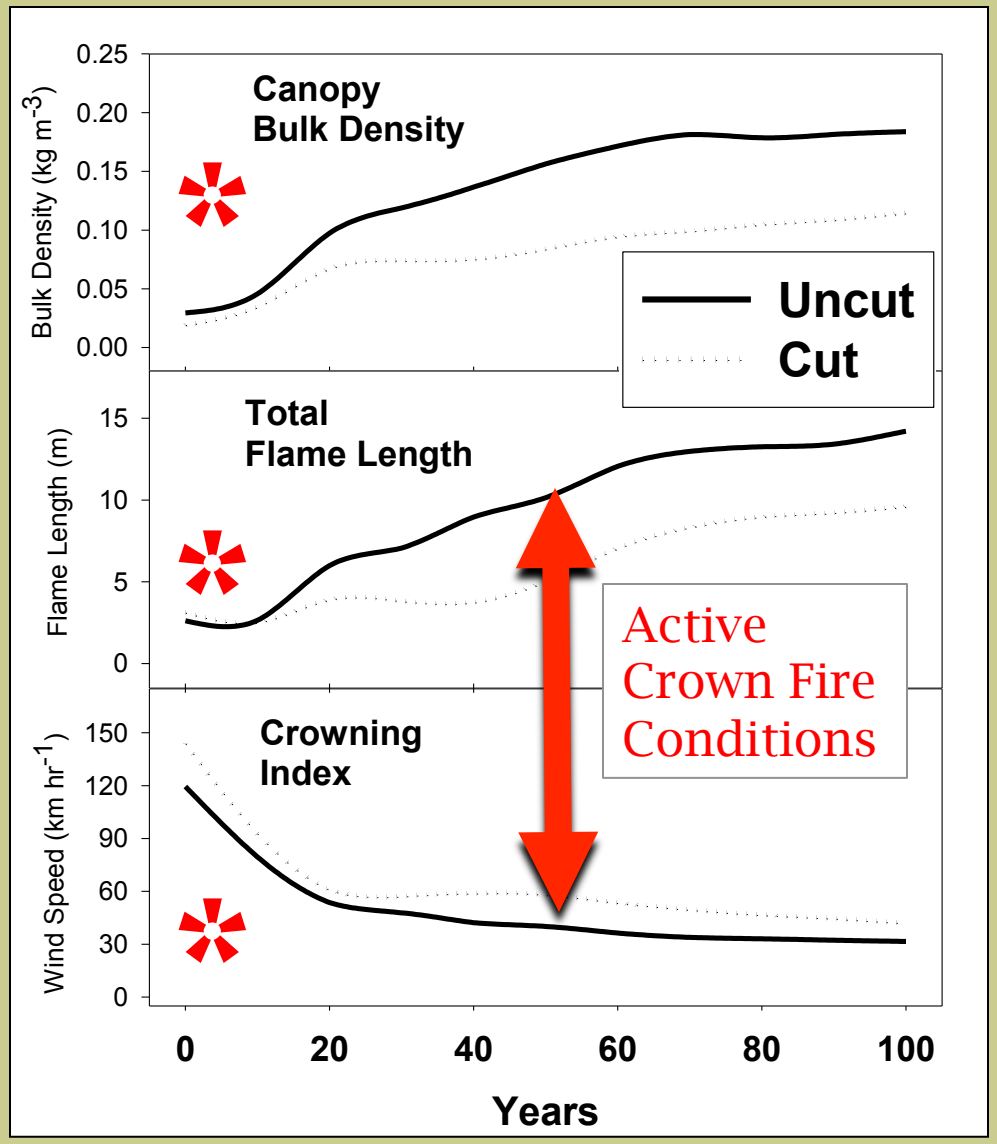
1.2 m - halt direct-attack

2.5 m - halt dozers

Windthrow will increase the surface load in uncut areas

~1.4x higher than cut areas

Post Treatment Fire Behavior



Recovery of the forest canopy determines fire behavior in future stands

Risk of crown fire is low and will differ little between treated & uncut stands until new stands develop (~20 yrs).

More fir in uncut stands increases canopy BD, crown base height and flame length.

Green Stands - Risk, intensity of crown fire is greater:

*6m total flame length

*Crowing Index 55 km/hr (34 mph – moderate risk)

Take Home Messages

Tree regeneration is abundant in beetle-infested stands

Growth of residual overstory & understory trees are responding to loss of lodgepole

Harvesting leads to development of different stand types - with likely implications on future fire potential and effects

Many Thanks!

PROJECT SUPPORT

USFS Chief's Emergency Funds

USFS R2 - Bark Beetle Initiative

USFS AR, MBR, WR National Forests

USFS Sulphur Ranger District – Upper Fraser Project ID team

Colorado State Forest Service

Colorado Water Conservation Board

Joint Fire Science Program

Colorado Forest Restoration Institute

Denver Water

On-the-Ground

CSFS

Brook Lee
Hunter Townsend
John Twitchell

USFS

Kevin Bridges
Andy Cadenhead
Chris Oliver
Jeff Underhill

Contact Information
Chuck Rhoades
crhoades@fs.fed.us
US Forest Service
Rocky Mountain Research Station