Future Forest Conditions

Claudia Regan
Regional Vegetation Ecologist
USFS Rocky Mountain Region
cregan@fs.fed.us

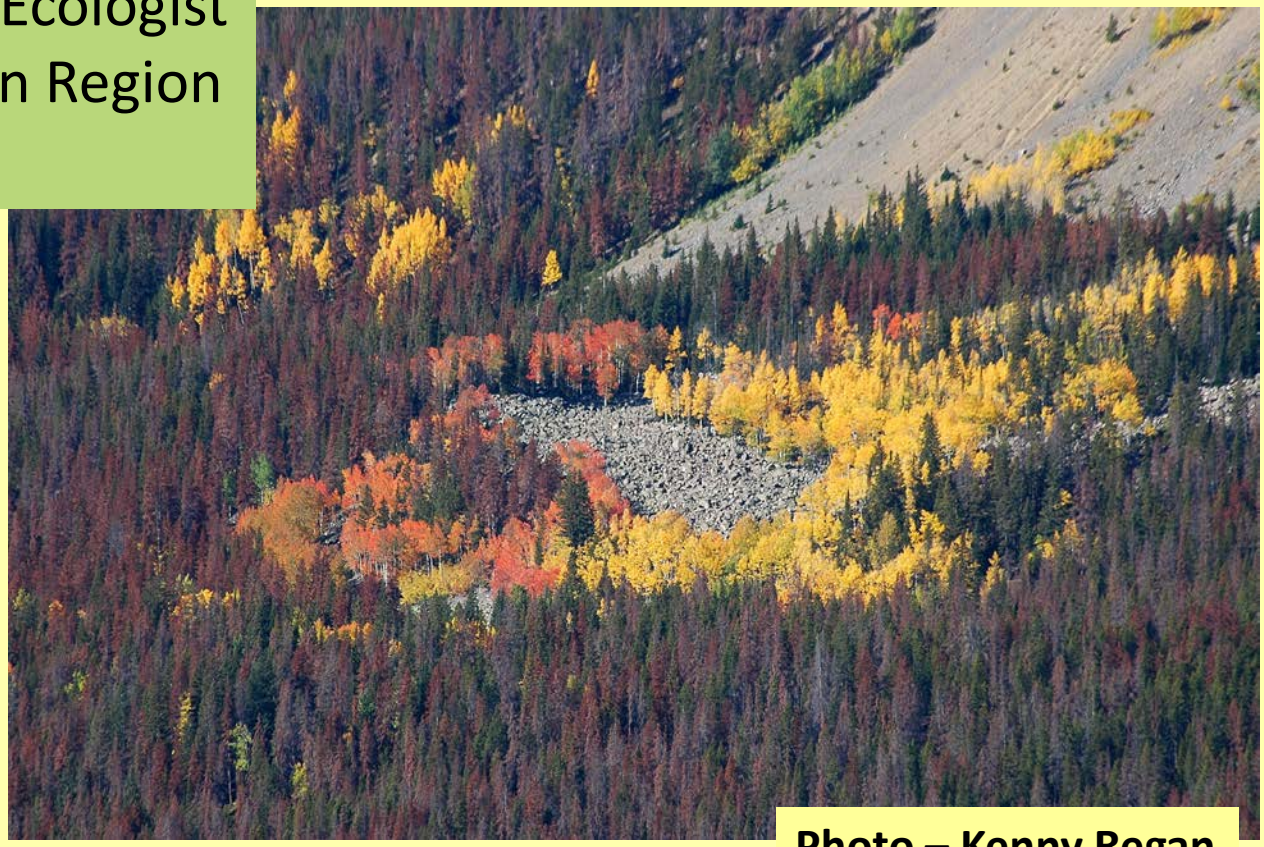


Photo – Kenny Regan

Acknowledgements

Missy Dressen, Polly Hays, Greg Hayward, Don Vandendriesche, Kristen Pelz, Chuck Rhoades, Rob Hubbard, Kelly Elder, Byron Collins, Mike Battaglia

Future Forest Conditions
Key Messages

- Forests are resilient
- Future variability is expected
- Ecosystem services may be affected
- Uncertainty can be addressed by monitoring and research

Photo -Kristen Pelz, Colorado State University

Forests are Resilient

Lodgepole pine forests are adapted to respond to severe disturbance.

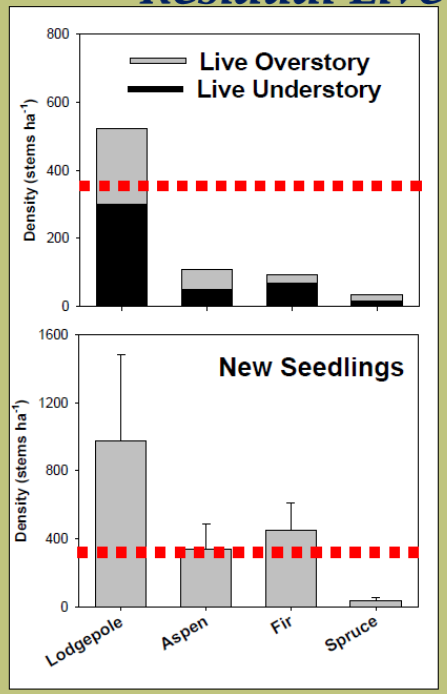
- **Lodgepole pine will regenerate on some sites**
- **Shade tolerant advanced regeneration will become dominant on other sites**
- **Understory species, including shrubs, grasses, and forbs will respond positively**
- **Some wildlife species will be winners in the near term**

Forests are Resilient

Recovery is already underway with understory species responses, release of advanced regeneration, and tree seedling recruitment.

Growing Stock in MPB Forests

Residual Live & New Trees



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

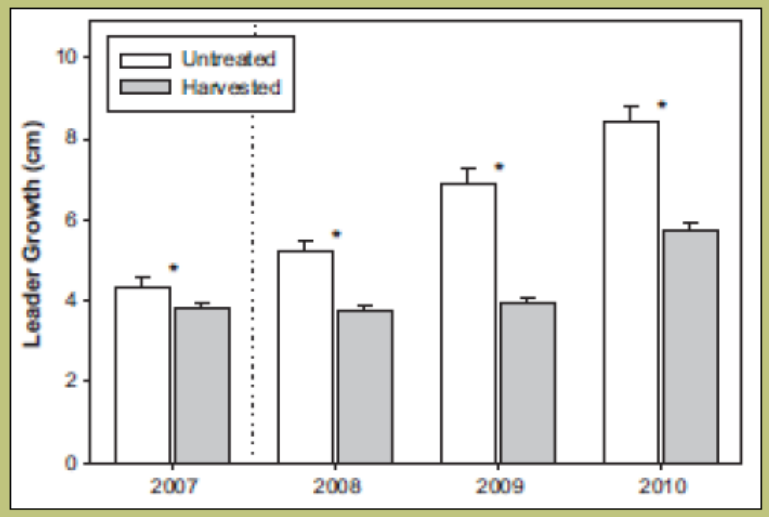
Understory Trees
445 t/ha (180 t/Ac)
68% LPP; 12% AS; 15% SF

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

*Stocking Levels
370 t/ha (150 t/Ac)

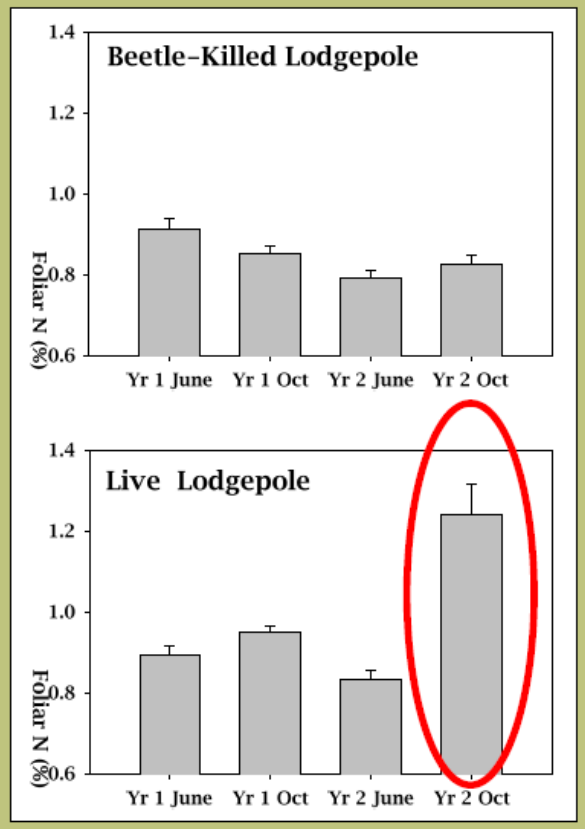
Rhoades et al. 2011, RMRS

Height Growth & Foliar Responses



Advanced regeneration has begun to respond to the increased light and soil resources beneath the dead canopy.

Nearly 40% of understory trees added > 2X as much height in 2010 as in 2007.



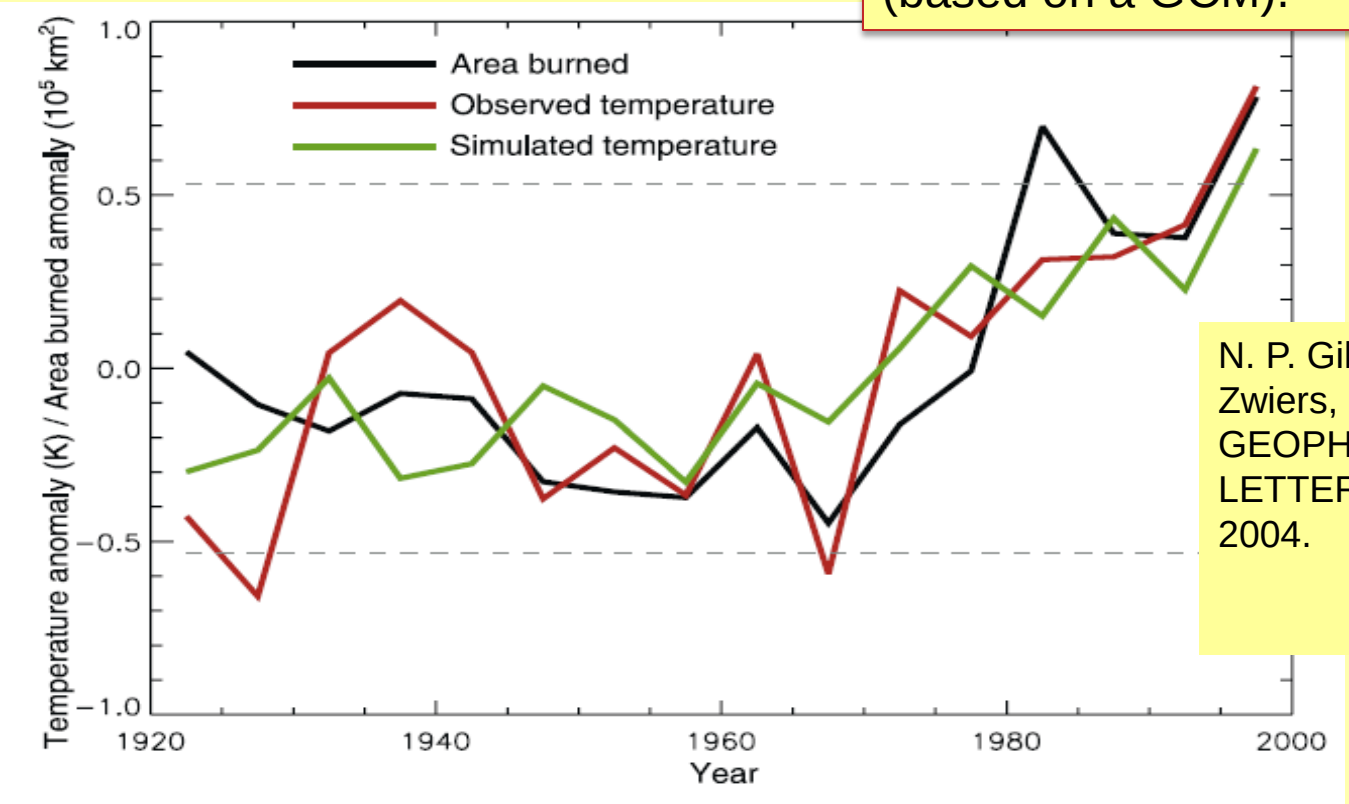
Foliar N more than doubled following loss of neighboring trees.

Rhoades et al. 2011, RMRS

Uncertainty About Future Resilience

Current and future climates may result in additional stress

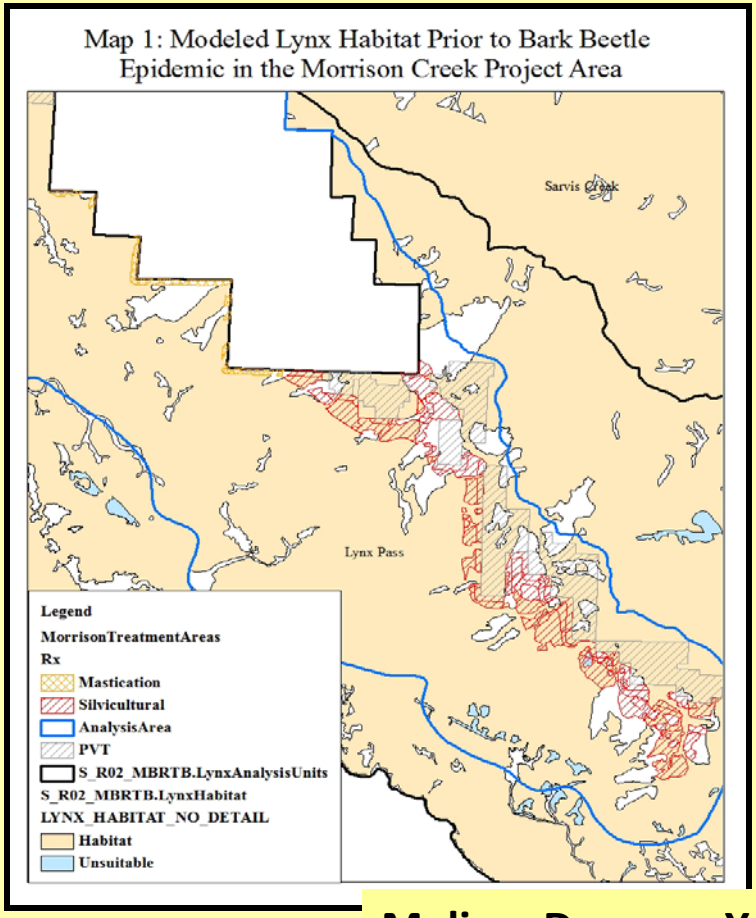
Increasing trend in area burned in Canada is correlated to observed and simulated summer temperatures (based on a GCM).

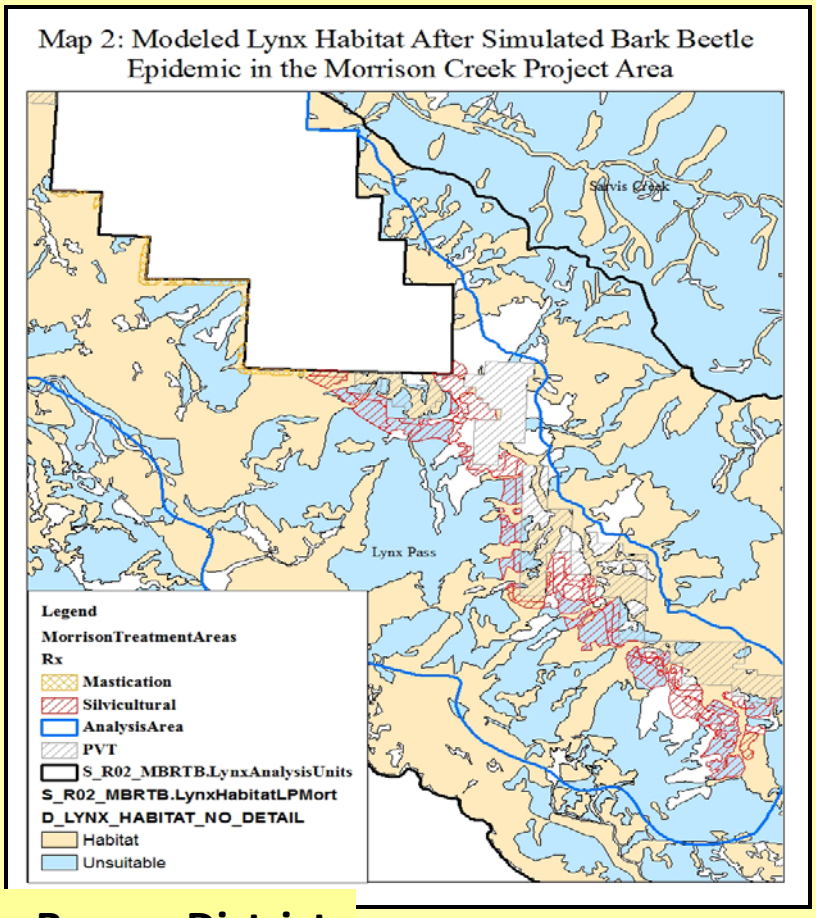


N. P. Gillett, A. J. Weaver, F. W. Zwiers, and M. D. Flannigan. GEOPHYSICAL RESEARCH LETTERS, VOL. 31, September 2004.

Uncertainty About Future Resilience

Some ecosystem elements may be vulnerable





Melissa Dressen, Yampa Ranger District

Future Variability is Expected

Future stand conditions will be influenced by:

- **Past stand conditions**
- **Site potential**
- **Future disturbance interactions**
- **Management influences**

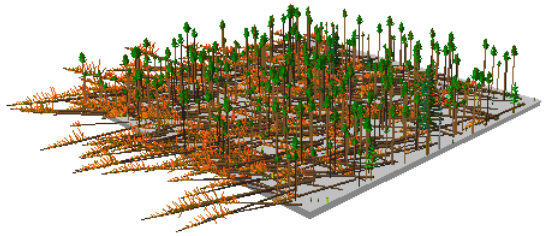
Photos -Kristen Pelz, Colorado State University

Dry or "Climax" Lodgepole Pine

- Drier sites or frost pockets
- Grouse huckleberry typically in understory
- Sparse understory vegetation
- Other tree species unlikely to grow on site or slow to become established

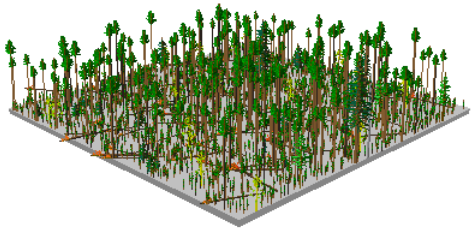
Climax lodgepole pine, >120 years
MPB mortality trees > 5 inches dbh

initial density = 906 trees/acre
initial BA/acre = 153



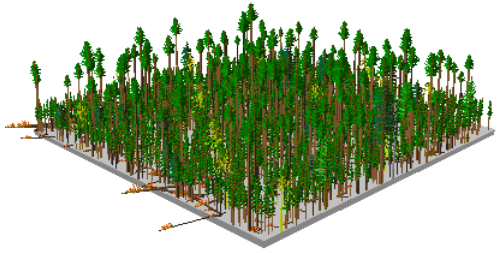
Climax lodgepole pine, >120 years
Stand recovery – 20 years

density = 2434 trees/acre
BA/acre = 31



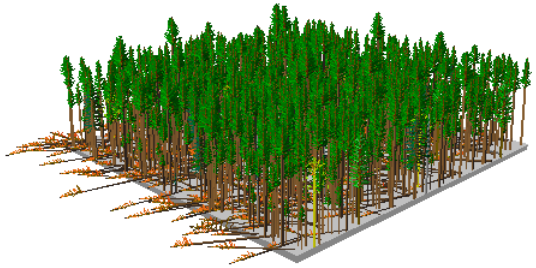
Climax lodgepole pine, >120 years
Stand recovery – 40 years

density = 2044 trees/acre
BA/acre = 71



Climax lodgepole pine, >120 years
Stand recovery – 80 years

density = 1126 trees/acre
BA/acre = 150

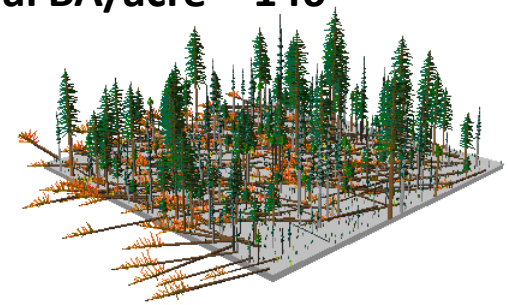


Seral or Transitional Lodgepole Pine

- Moist sites
- Spruce or subalpine fir are usually climax
- Often dense understory vegetation
- Understory typically has spruce and/or fir
- LP tends to be serotinous

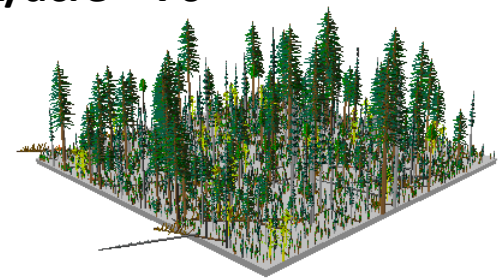
Spruce-Fir and lodgepole, >120 years
MPB mortality trees > 5 inches dbh

initial density = 1707 trees/acre
initial BA/acre = 146



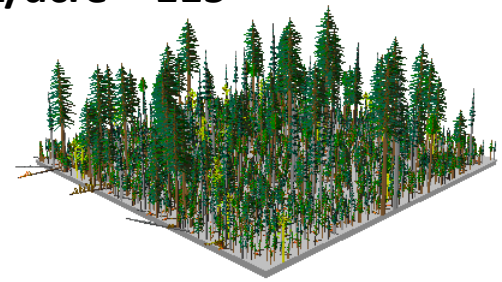
Spruce-Fir and lodgepole, >120 years
Stand Recovery – 20 years

density = 3374 trees/acre
BA/acre = 76



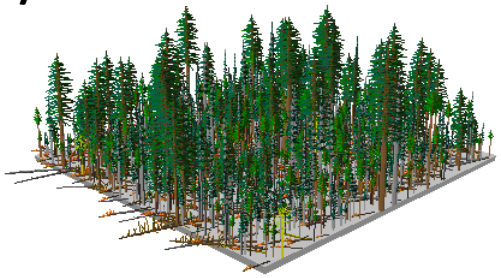
Spruce-Fir and lodgepole, >120 years
Stand Recovery – 40 years

density = 2598 trees/acre
BA/acre = 115



Spruce-Fir and lodgepole, >120 years
Stand Recovery – 80 years

density = 1215 trees/acre
BA/acre = 175

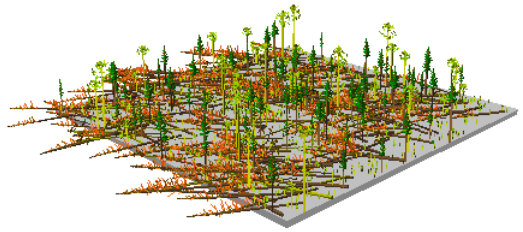


Mesic Lodgepole Pine with Aspen

Where aspen occurs, it will likely sprout after overstory pine mortality and dominate the site for some period, depending on herbivory pressures

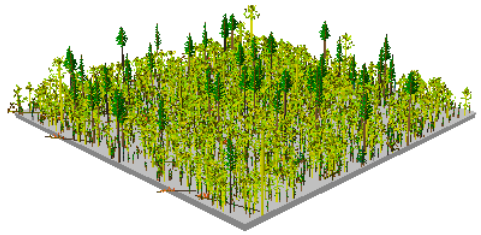
Lodgepole with aspen
MPB mortality trees > 5 inches dbh

initial density = 1171 trees/acre
initial BA/acre = 99



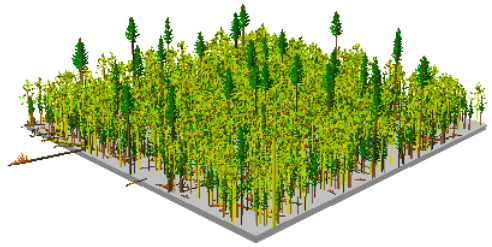
Lodgepole with aspen
Stand recovery – 20 years

density = 1974 trees/acre
BA/acre = 34



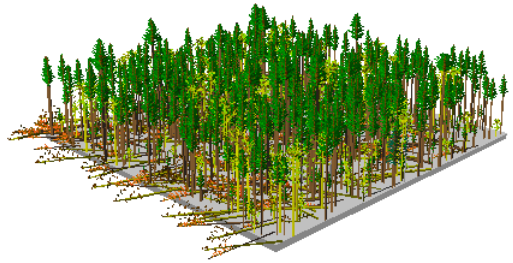
Lodgepole with aspen
Stand recovery – 40 years

density = 1499 trees/acre
BA/acre = 84



Lodgepole with aspen
Stand recovery – 80 years

density = 822 trees/acre
BA/acre = 89

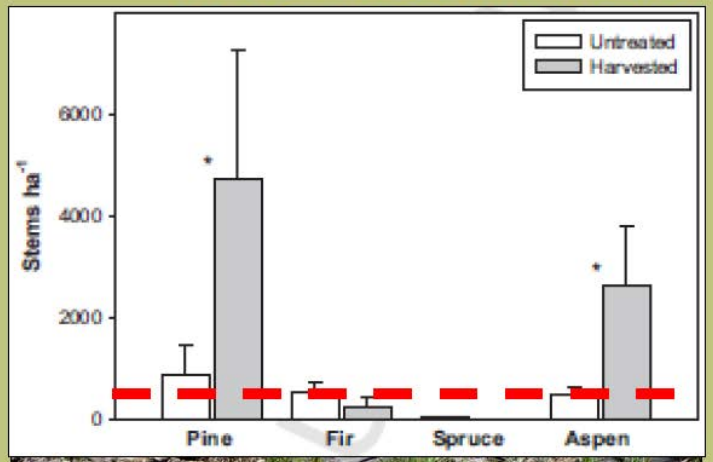


Future Variability is Expected

Post beetle management will influence future conditions

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

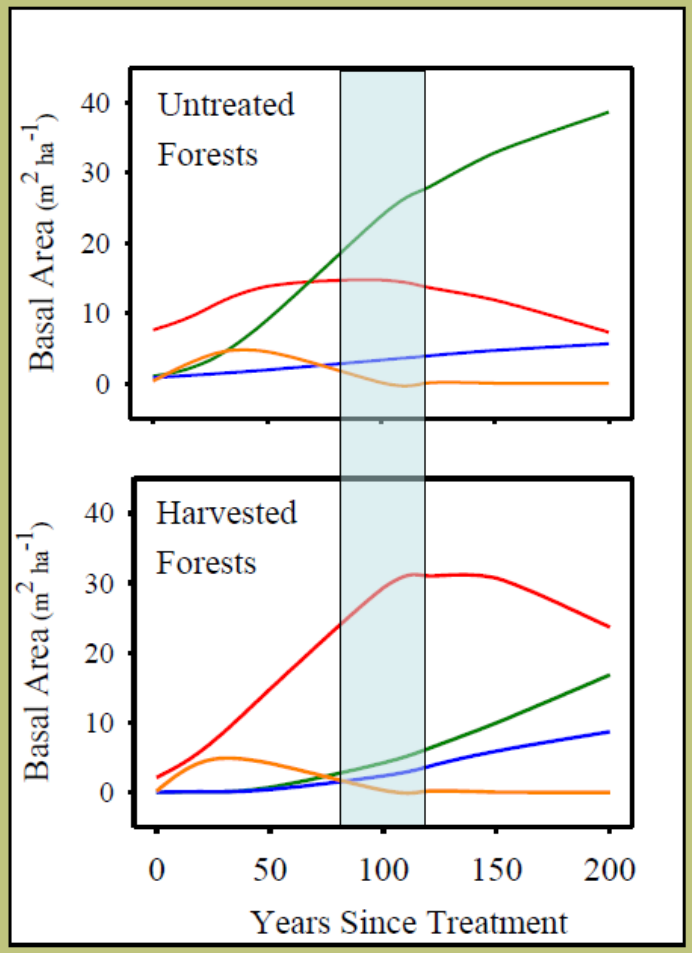
*Cut stands meet minimum stocking requirements (i.e., > 150 t/acre)

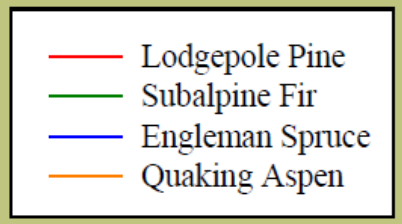
*8 paired sites at Fraser

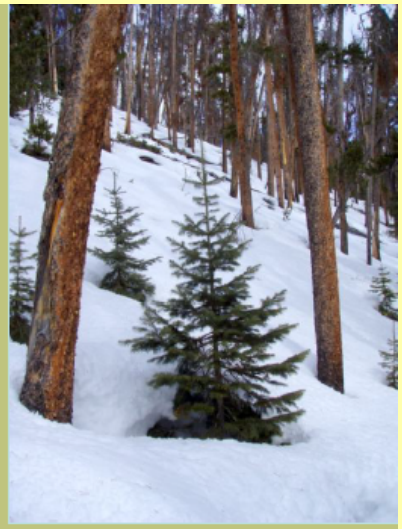
(Collins et al. 2010b)

Rhoades et al. 2011, RMRS

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)

Rhoades et al. 2011, RMRS

Future Forest Conditions Will Influence Ecosystem Services

Photo – Tanya Shenk

Wildlife Habitat

Watershed Function

Photo – Melissa Dressen

Watershed Condition in the Current and Future Forest

From Lukas 2010 / USGS photo

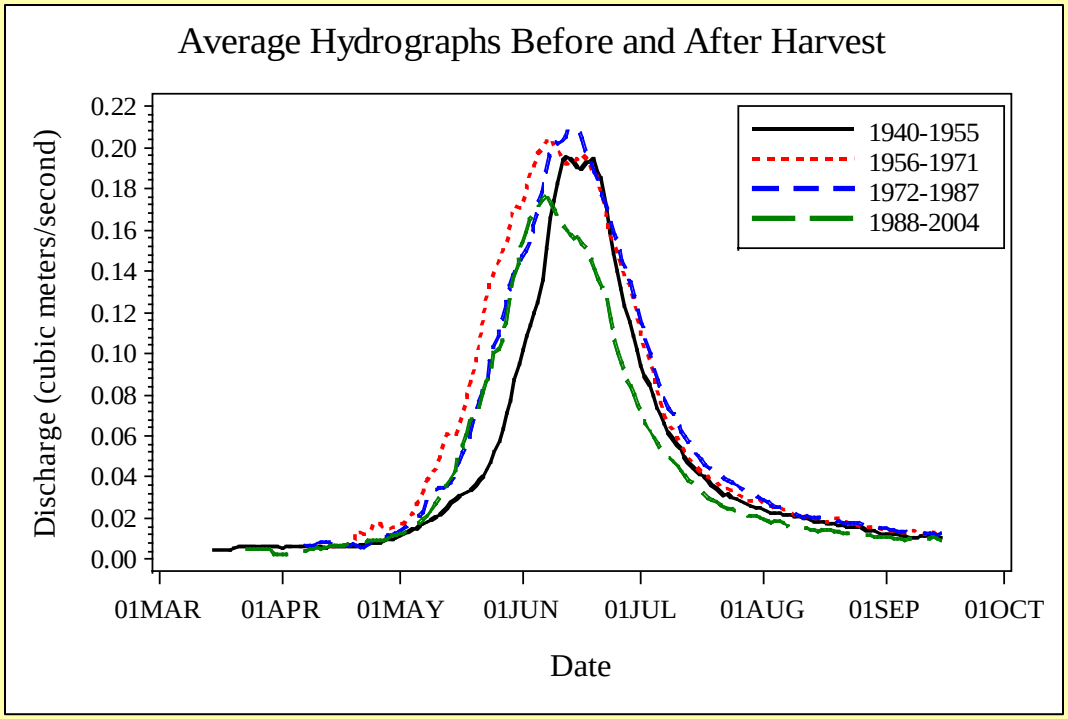
Questions About Watershed Function

Water Yield and Peak Flows
Water Quality
Groundwater
Channel Morphology
Riparian Areas

What is the spatial scale of effects?
Local or basin-wide?

What is the temporal scale of effects?
How long will effects last?

Effect on timing of runoff



Not yet seeing this signal in any USGS gages.
And, even if we were, it's the same shift in the hydrograph we would expect with dust on snow, and climate change.

And, when infested basins were compared with uninfested basins, results indicated no apparent increase in stream discharge with mpb mortality. Positive understory plant species and overstory tree responses are important factors.

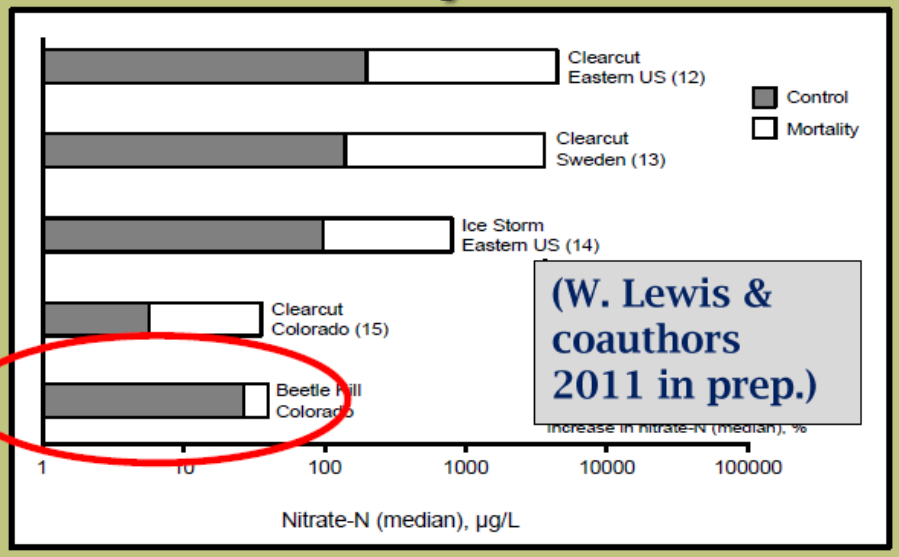
Watershed Function – Water Yield and Timing

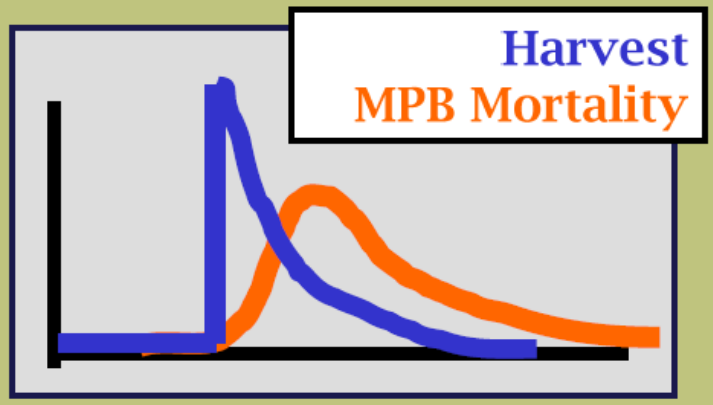
"Based on experimental studies of tree harvesting and observational studies following previous infestations in Colorado and elsewhere, there has been a general expectation that the widespread tree mortality will significantly increase water yield at the basin scale and lead to earlier runoff peaks. ***However, there is no compelling evidence yet for runoff changes caused by the current MPB infestation, and there is increasing evidence that the story is much more complex than the simple "fewer live trees = more runoff" formulation.*** *"*

Impacts of the mountain pine beetle infestation on the hydrologic cycle and water quality: A symposium report and summary of the latest science . Jeff Lukas and Eric Gordon, Western Water Assessment, May 2010

Initial Watershed Responses are Relatively Minor

Western Water Assessment
MPB – Water Science Workshop
(Lukas & Gordon 2010)





Decline in stand transpiration and nutrient use depends on extent of mortality, species composition, understory response

Magnitude and timing of changes in water differ from harvest response

In general, studies do not indicate nutrient loading or other water chemistry changes of the magnitude that would present problems for either human water use or aquatic ecosystems.

Rhoades et al. 2011, RMRS

Watershed Function – Water Quality

"As with water yield, there has been an expectation of significant changes in some parameters of water quality in watersheds with high tree mortality from MPB. ***But initial results from recent field studies, in general, do not indicate nutrient loading or other water chemistry changes of the magnitude that would present problems for either human water use or aquatic ecosystems. "***

Impacts of the mountain pine beetle infestation on the hydrologic cycle and water quality: A symposium report and summary of the latest science . Jeff Lukas and Eric Gordon, Western Water Assessment , May 2010

Future Forests and Wildlife Habitat

Regional Sensitive Species in Lodgepole pine

American marten
Pygmy shrew
Northern goshawk
Boreal owl
Olive-sided flycatcher
Lewis's woodpecker
Three-toed woodpecker
Black-backed woodpecker
Boreal toad

Other Species

Elk
Snowshoe hare
Pine squirrel
Other woodpeckers
Ruby-crowned kinglet
Golden-crown kinglet
Red-breasted nuthatch
Mountain Bluebird
Swainson's thrush

There will be winners and losers

Variable responses in the first 5 years

INCREASE:

- **Elk**
- **3-toed woodpecker**
- **Hairy woodpecker**
- **Northern Flicker**
- **Red-breasted nuthatch**
- **Stellar's Jay**
- **Mountain Bluebird**
- **Swallows**
- **Olive-sided flycatcher**
- **Chickadees**

DECREASE:

- Pine squirrel
- Red-backed vole
- American marten
- Boreal owl
- Golden-crowned kinglet
- Ruby-crowned kinglet
- Brown creeper
- Hermit thrush
- Swainson's thrush
- Yellow-rumped warbler
- Hammond's flycatcher

Photo – Greg Hayward

Forest carnivore using lodgepole pine as secondary habitat will see a decline but residual spruce-fir forest will buffer the effects

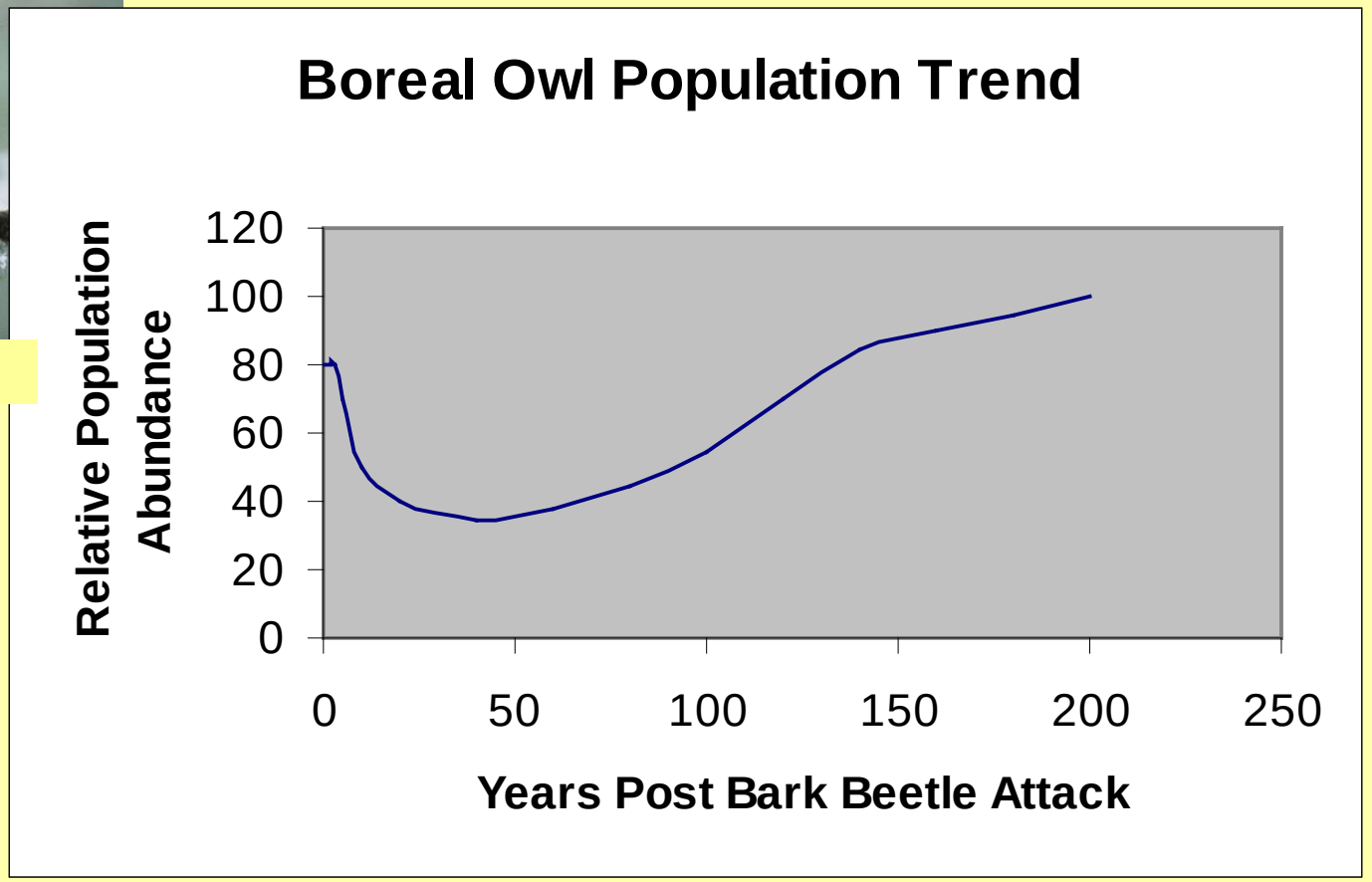


Photo – Greg Hayward

Initially rapid and long term decline due to dependence on pine seed for winter diet – broad ecosystem implications

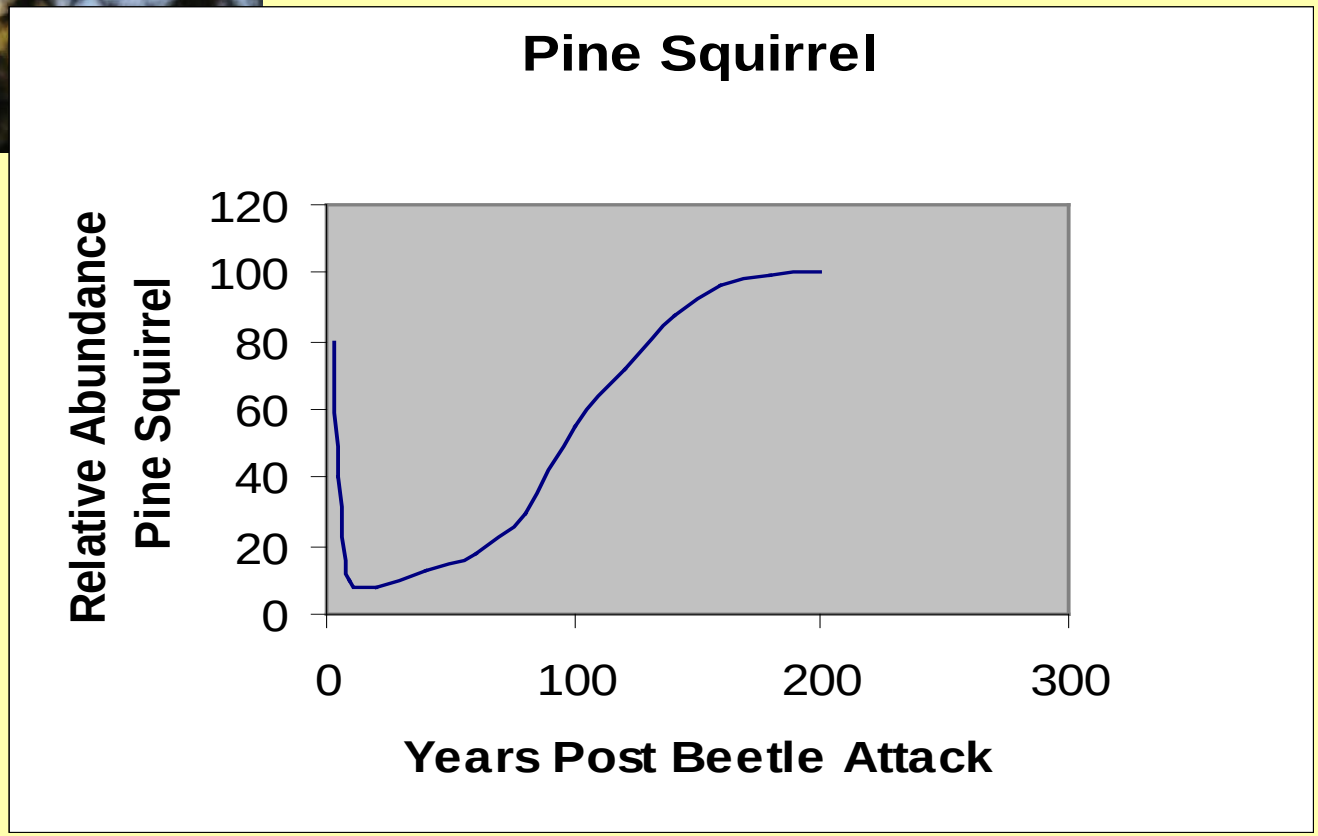
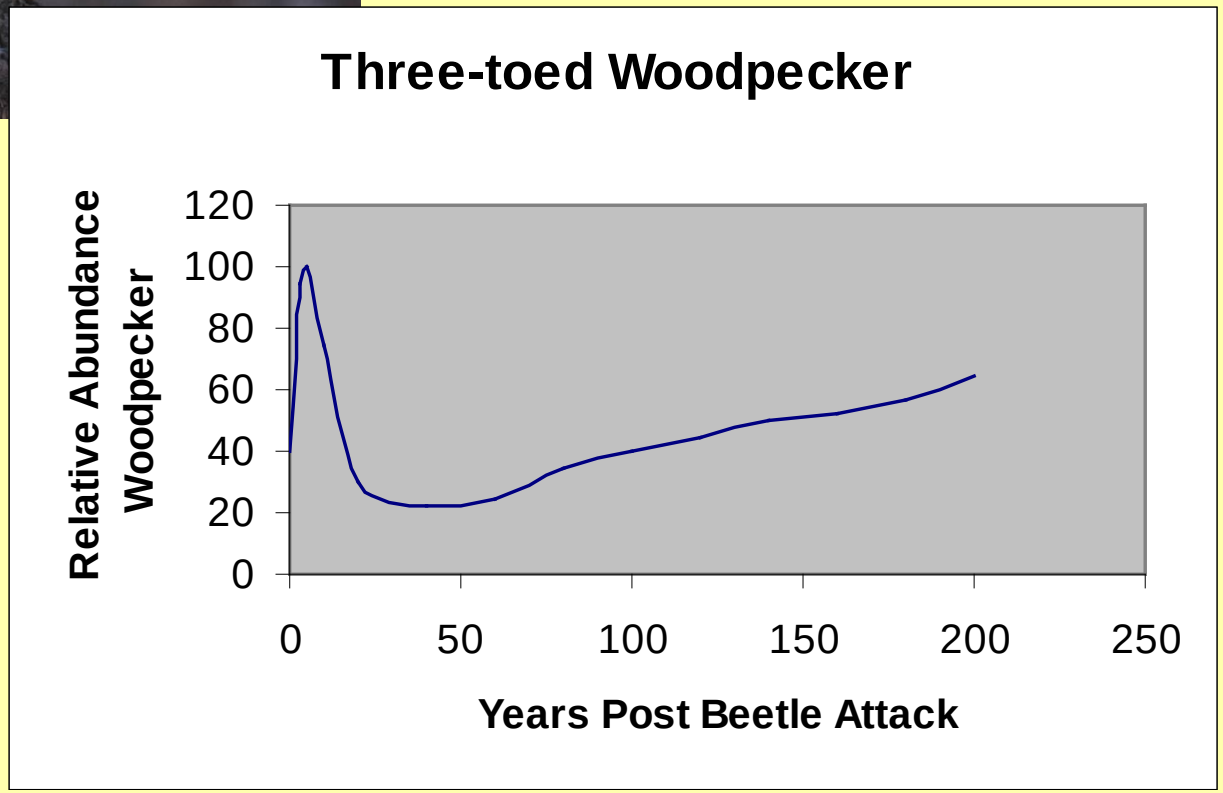


Photo – Greg Hayward

Initial eruption of woodpeckers with high abundance for a few years followed by a rapid drop in abundance to levels below pre-epdemic



Major Areas of Uncertainty

Monitoring Needs and Research Opportunities

- Tree species responses over full range of site conditions
- Understory species responses over full range of site conditions
- Future landscape patterns
- Empirical evidence of interactions with future disturbances, including fire
- Role of changing climate
- Effects on riparian and aquatic habitat
- Terrestrial and aquatic species vulnerabilities and responses
- Effectiveness of management treatments

Photo -Kristen Pelz, Colorado State University