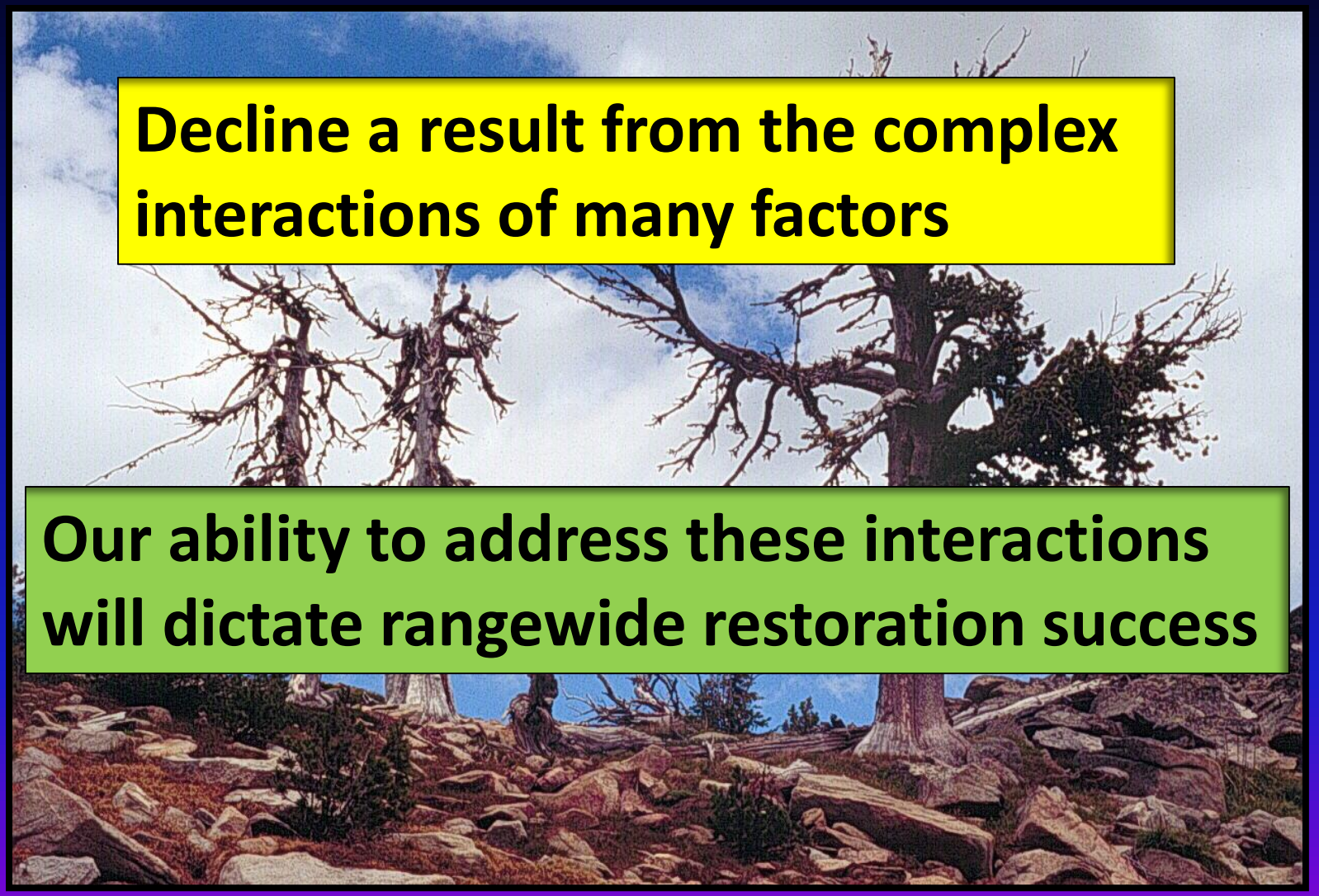
Restoring whitebark forests in the Crown of the Continent under climate change

Bob Keane,
USDA Forest Service
Rocky Mountain Research Station
Fire Sciences Laboratory

Whitebark Pine Decline



Great Burn Roadless Area, Idaho

Whitebark Pine Ecosystem

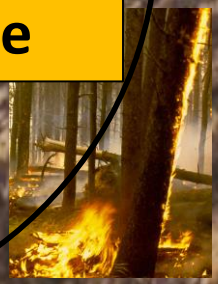
White Pine Blister Rust

Mountain Pine Beetle

Whitebark Pine

Clark's Nutcracker

Wildland Fire

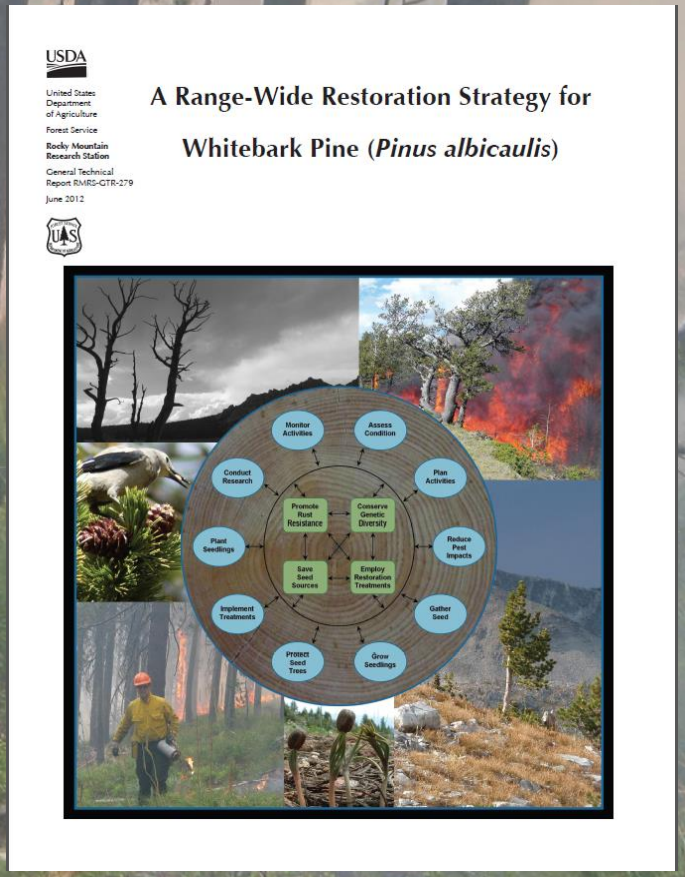


Climate

Land Management "Restoration"

Whitebark pine range-wide restoration strategy

Possible Actions



USDA

United States Department of Agriculture

Forest Service

Rocky Mountain Research Station

General Technical Report RMRS-GTR-279

June 2012

A Range-Wide Restoration Strategy for Whitebark Pine (*Pinus albicaulis*)

Whitebark Pine Restoration

What about climate change?

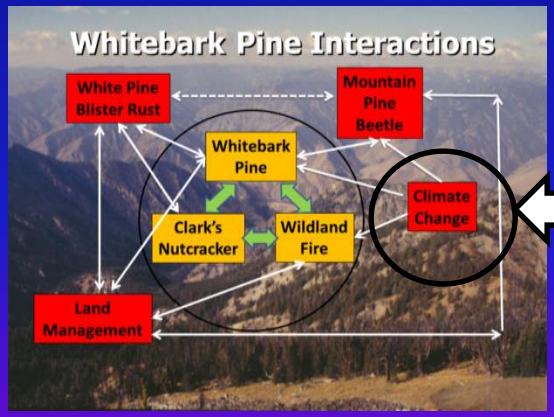
Why treat whitebark pine when:

- it might decline anyway?
- future climates may render costly treatments ineffective?

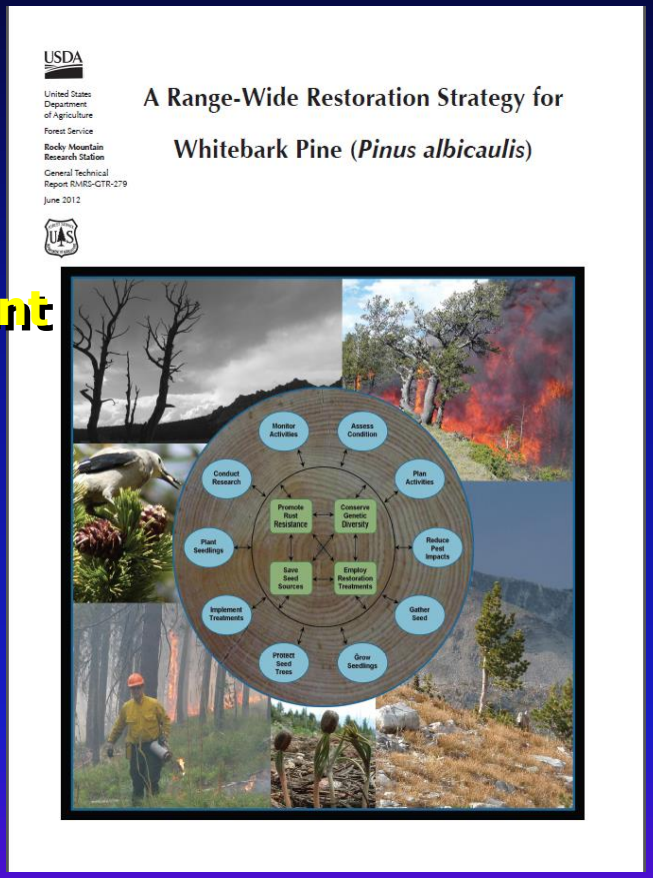
GNLCC Project:

Restoring whitebark pine in the face of climate change

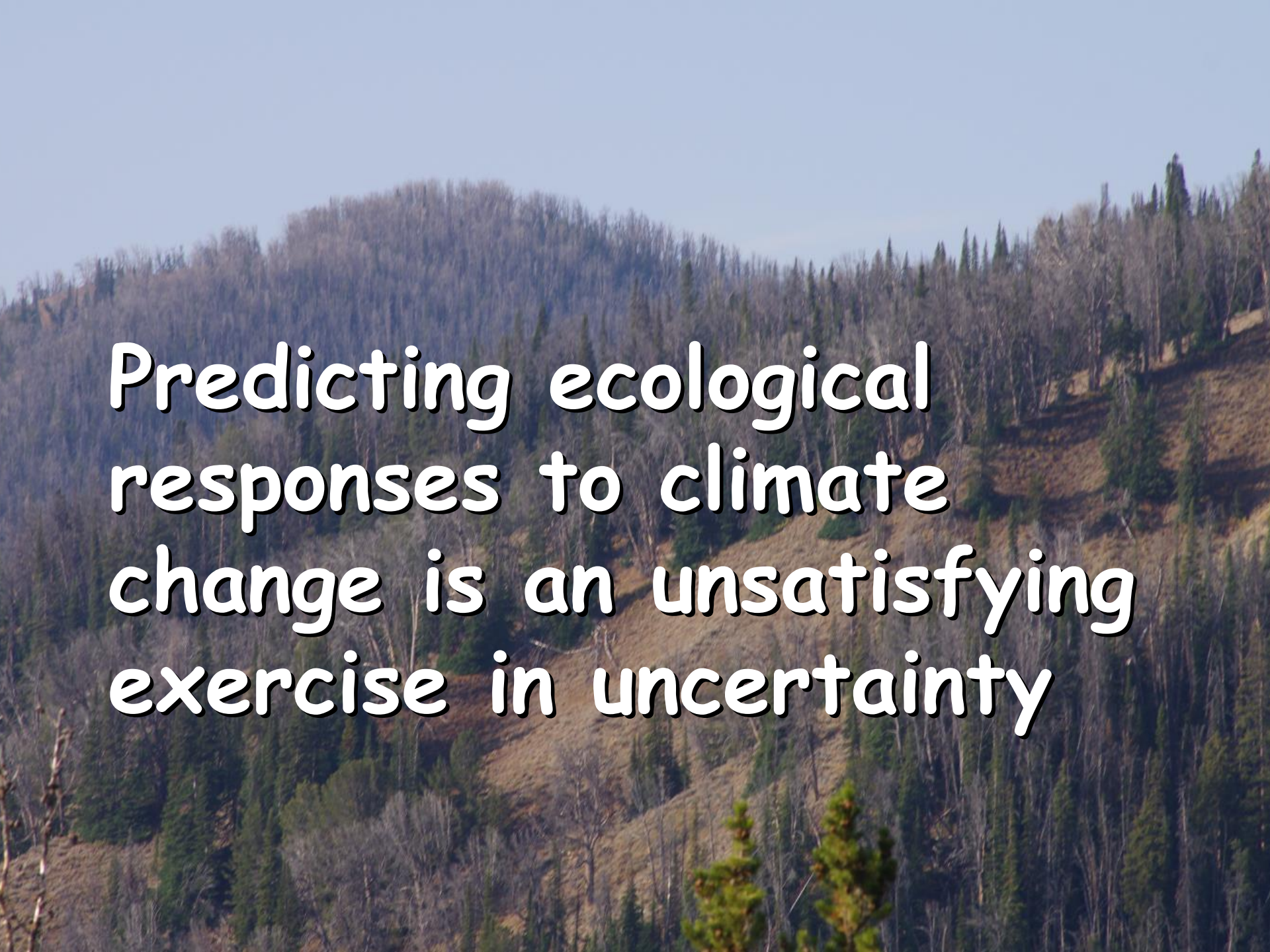
- Develop companion guide to the Rangewide strategy that incorporates climate change
- Used a comprehensive literature search
- Conducted an extensive simulation experiment
- Compiled results and made a whitebark pine restoration climate change adaptation plan



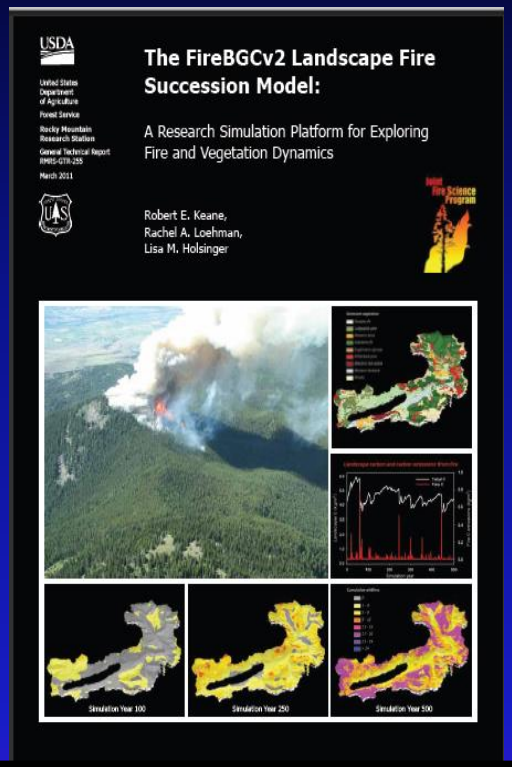
Addressed this box

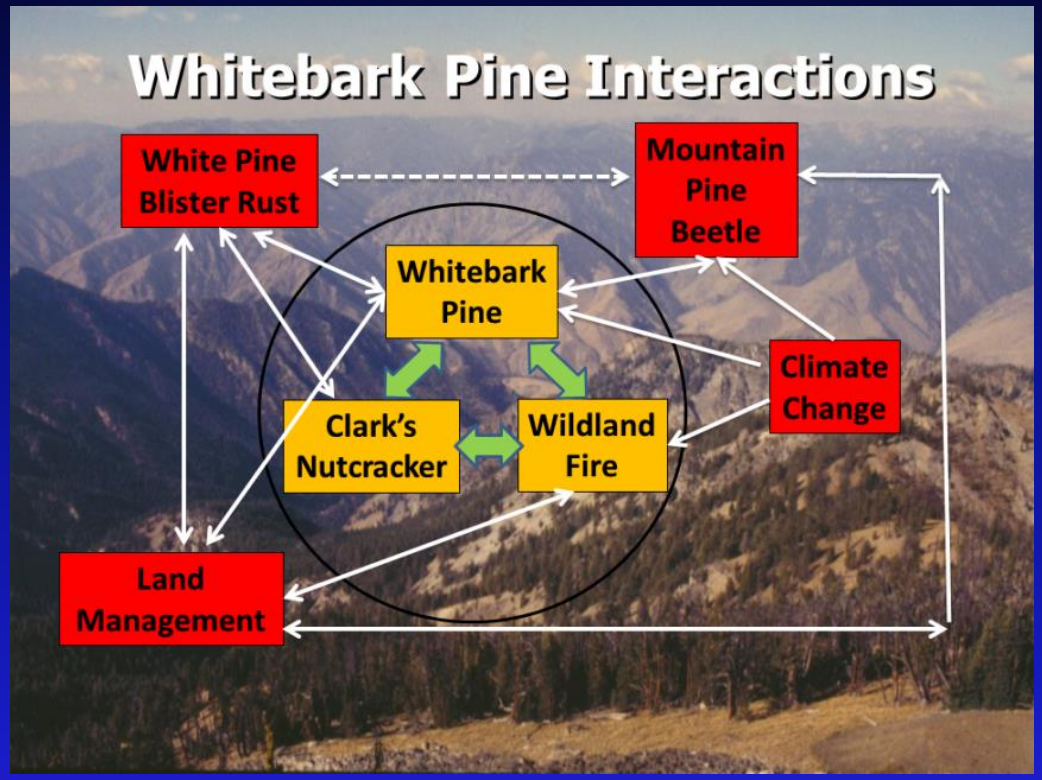


Keane, Robert E.; Holsinger, Lisa M.; Mahalovich, Mary F.; Tomback, Diana F. 2016[in press]. Restoring whitebark pine ecosystems in the face of climate change. Gen. Tech. Rep. RMRS-GTR-XXX. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station XXX p


Predicting ecological responses to climate change is an unsatisfying exercise in uncertainty

FireBGCv2: A research simulation platform for exploring fire, vegetation, and climate dynamics





Keane, Robert E.; Loehman, Rachel A.; Holsinger, Lisa M. 2011. The FireBGCv2 – a landscape fire and succession model: a research simulation platform for exploring fire and vegetation dynamics. Gen. Tech. Rep. RMRS-GTR-255. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 137 p.

FireLab
MISSOULA, MONTANA

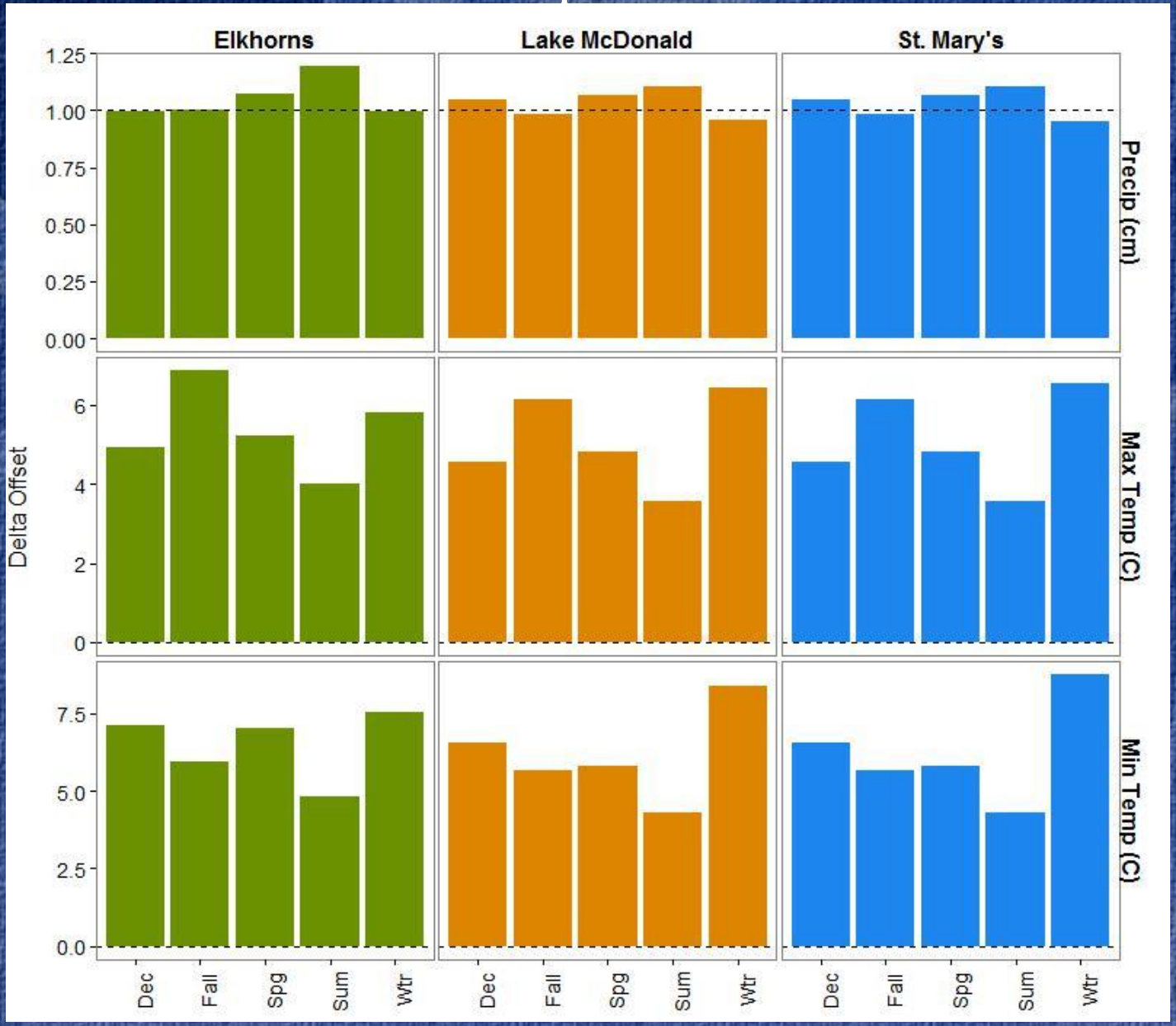
Climate change in the Crown

2 Climate Scenarios (Hadley synthesis of 7 GCMs)

- **H-Historical climate (recorded weather)**
- **RCP8.5: HOT AND DRY (+5.5ºC; 95% ppt)**

Based on IPCC (2011) projections

Extrapolation to fine scales – CMIP5 800 m daily RCP8.5– Whitebark pine zone for three Crown landscapes

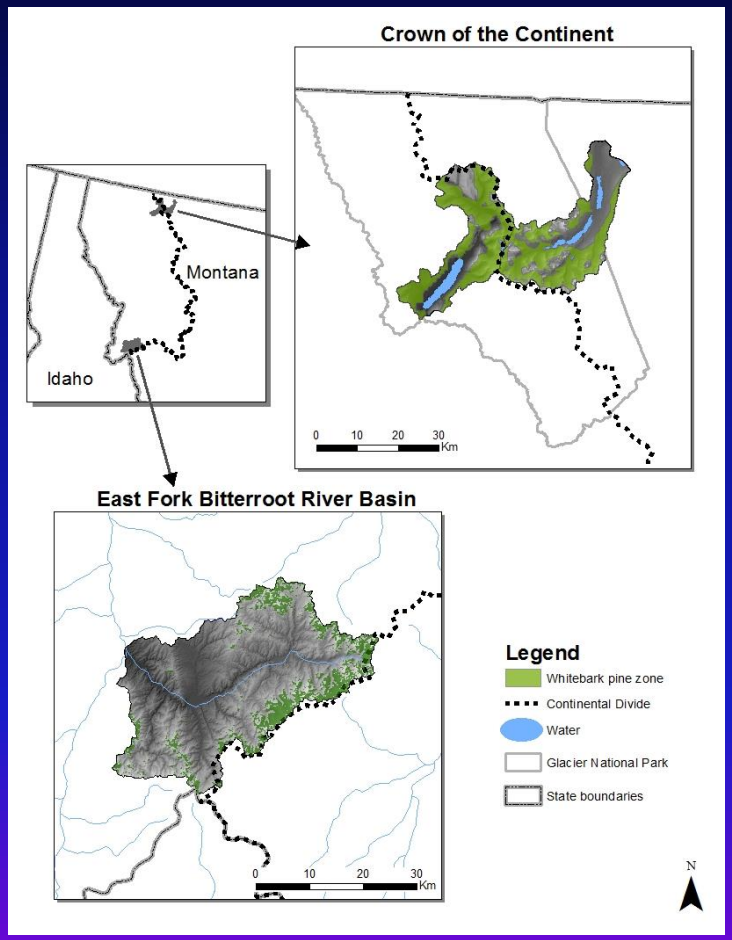


CNRM GCM

Peters and others 2013

FireBGCv2 Simulation Experiment

Lisa Holsinger simulated levels of four important factors on two landscapes

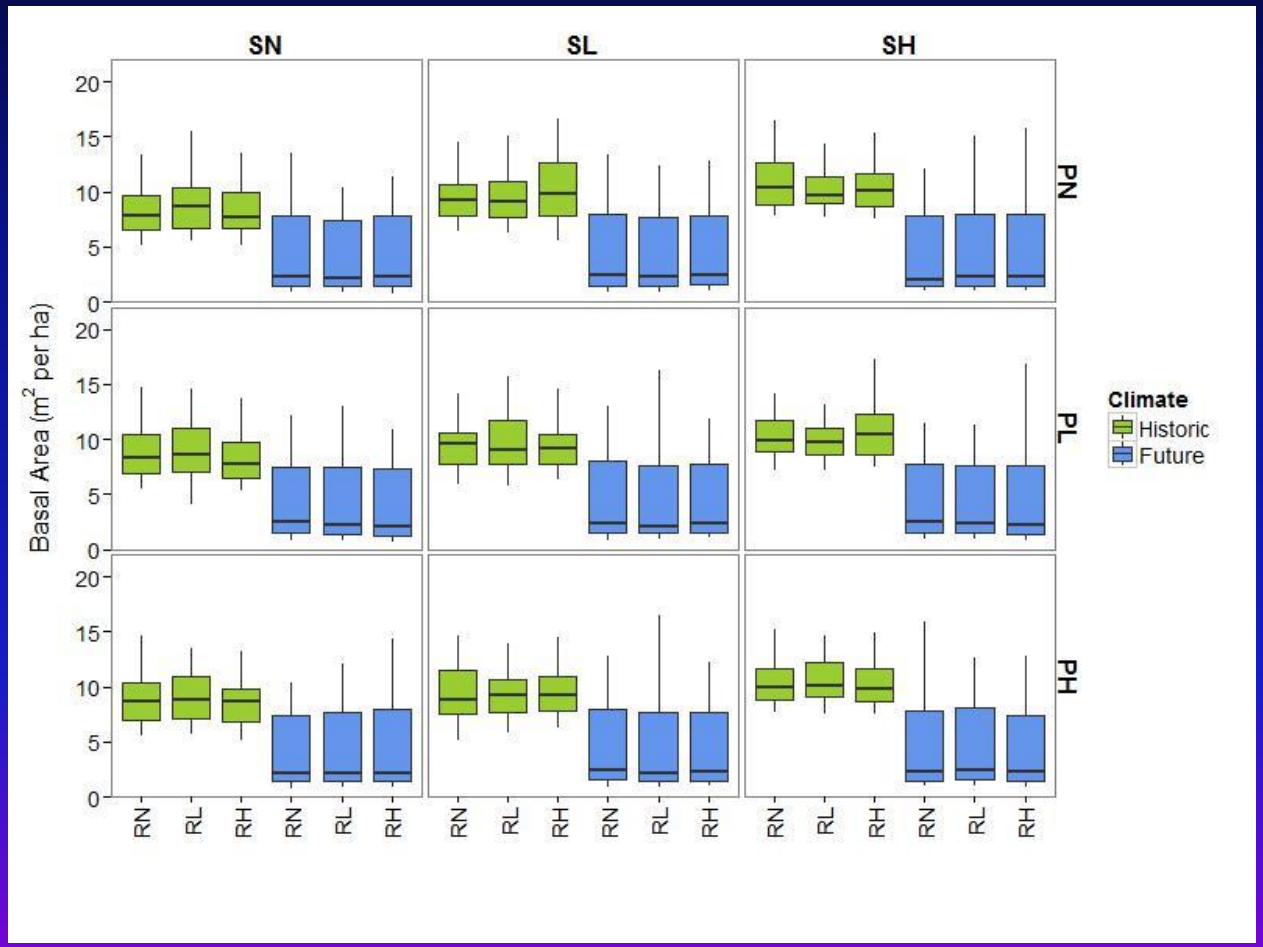


- **Climate**
  - Historical
  - RCP8.5-hot, dry – A2
- **Fire management**
  - No suppression
  - Low suppression (50%)
  - High suppression (92%)
- **Restoration treatments**
  - None
  - Low (10 ha/yr)
  - High (100 ha/yr)
- **Planting**
  - None
  - Low (10 ha/yr)
  - High (100 ha/yr)

Simulated 100 years; 10 reps; 2 landscapes=2-3 months simulation

Simulation results

Whitebark pine basal area in Crown upper subalpine



Climate
- Historical
- Future: hot, dry

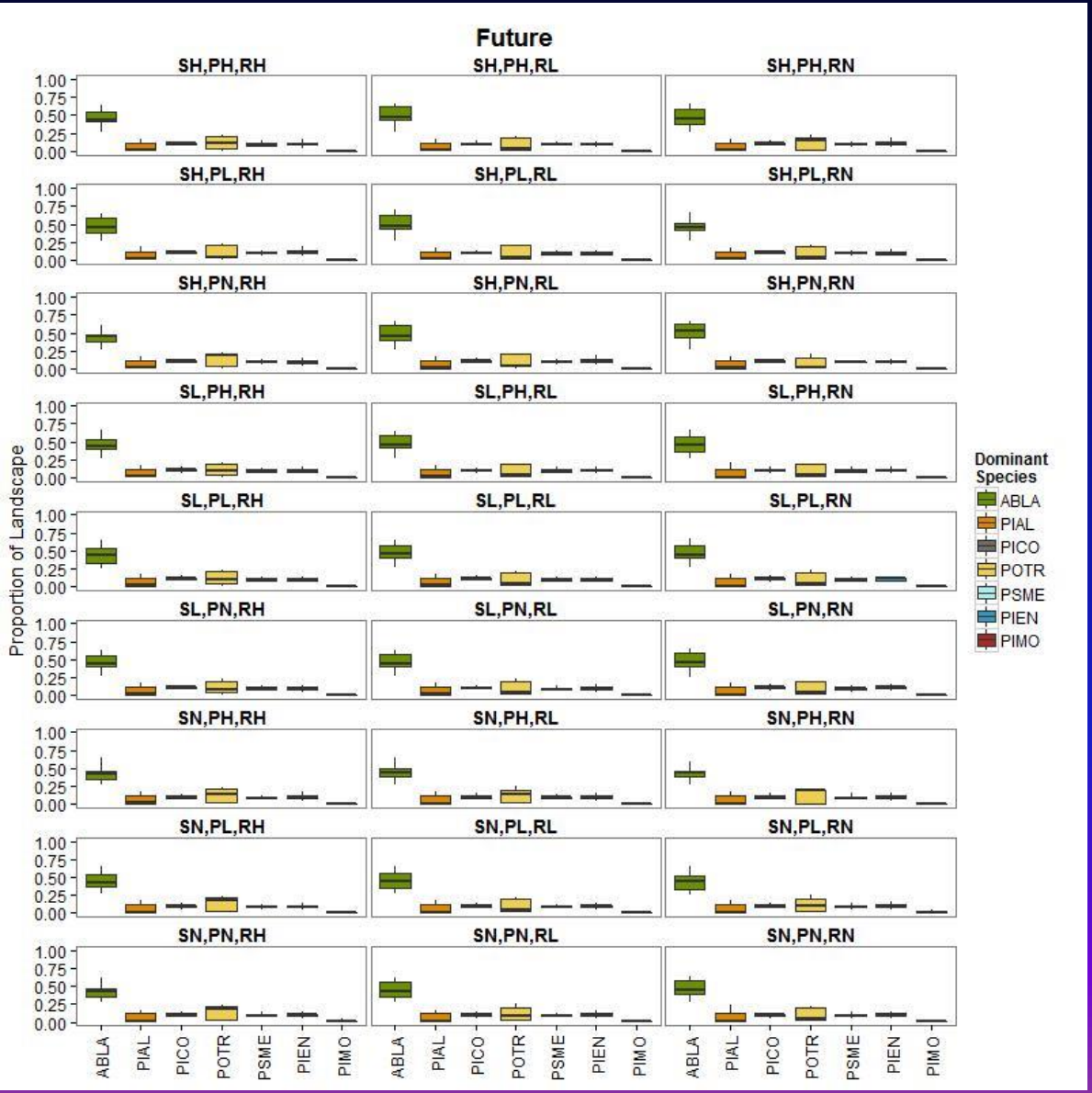
Fire management
- N-No suppression
- L-Low supp (50%)
- H-High supp (92%)

Restoration treat
- N-None
- L-Low (10 ha/yr)
- H-High (100 ha/yr)

Planting
- N-None
- L-Low (10 ha/yr)
- H-High (100 ha/yr)

Simulation results

Crown upper subalpine landscape composition



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Planting
- N-None
- L-Low (10 ha/yr)
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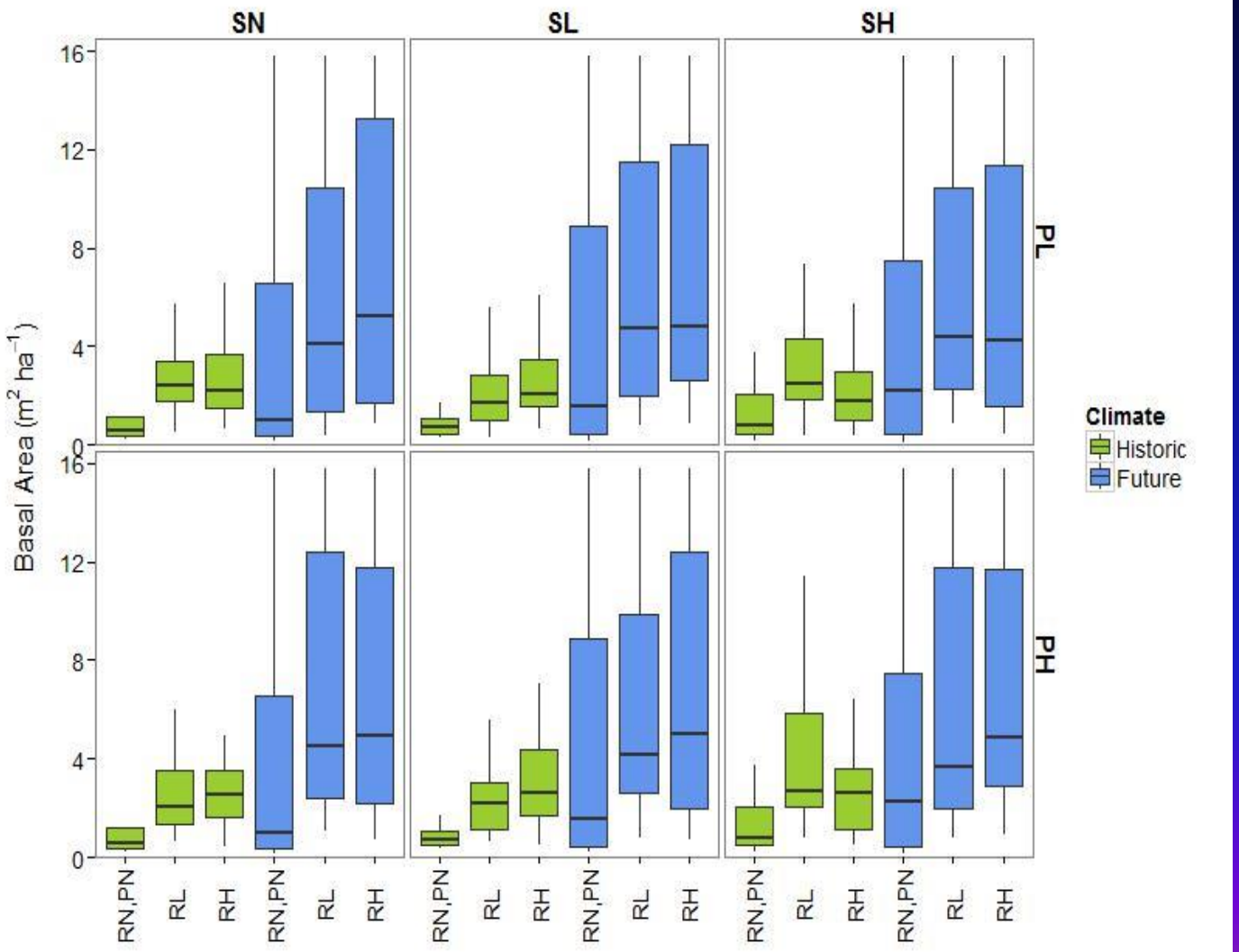
- **Historical climates**
  - PIAL gone regardless
  - Just a little action helps
  - Aspen increases
- **Future climate**
  - PIAL does better
  - Need restoration
  - Makes resilient forests

Simulation results

Whitebark pine basal area in EFBR upper subalpine



Climate
- Historical
- Future: hot, dry

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Restoration treat
- N-None
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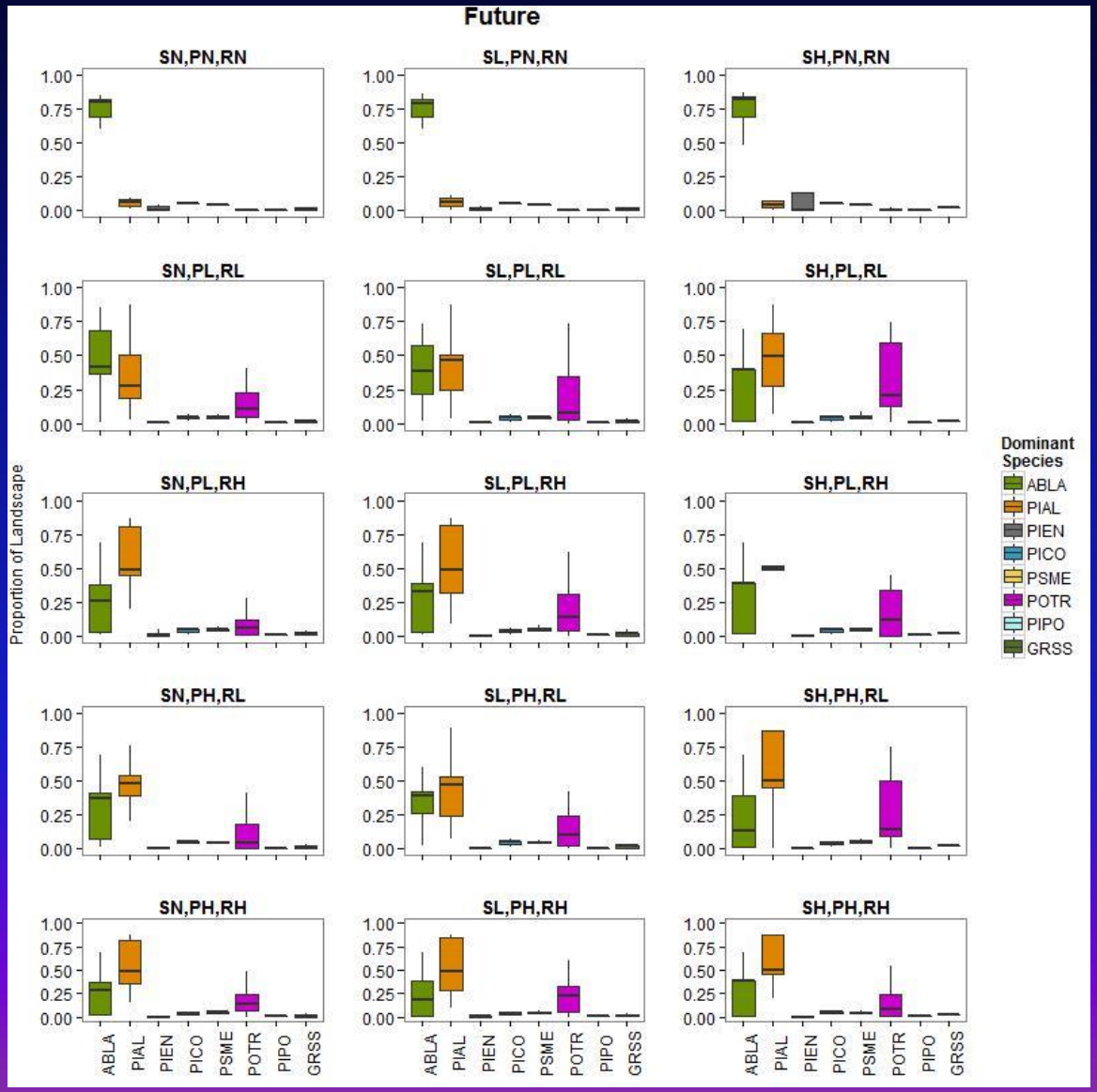
Planting
- N-None
- L-Low (10 ha/yr)
- H-High (100 ha/yr)

Simulation results

EFBR upper subalpine landscape composition



Climate

- Historical
- Future: hot, dry

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Restoration treat

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Planting

- N-None
- L-Low (10 ha/yr)
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- **Historical climates**
  - PIAL gone if no action
  - Just a little action helps
  - Aspen increases
- **Future climate**
  - PIAL does better
  - Need restoration
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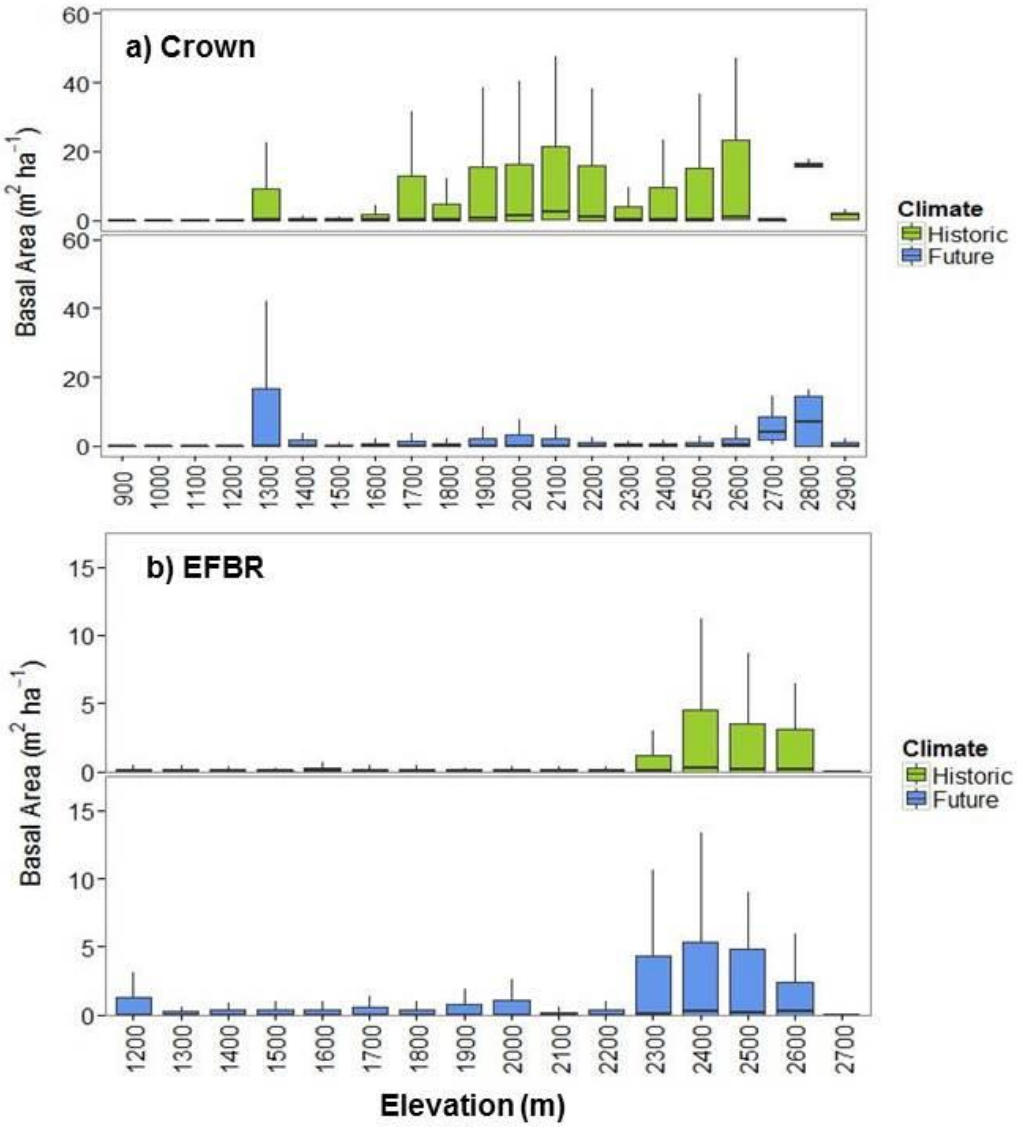
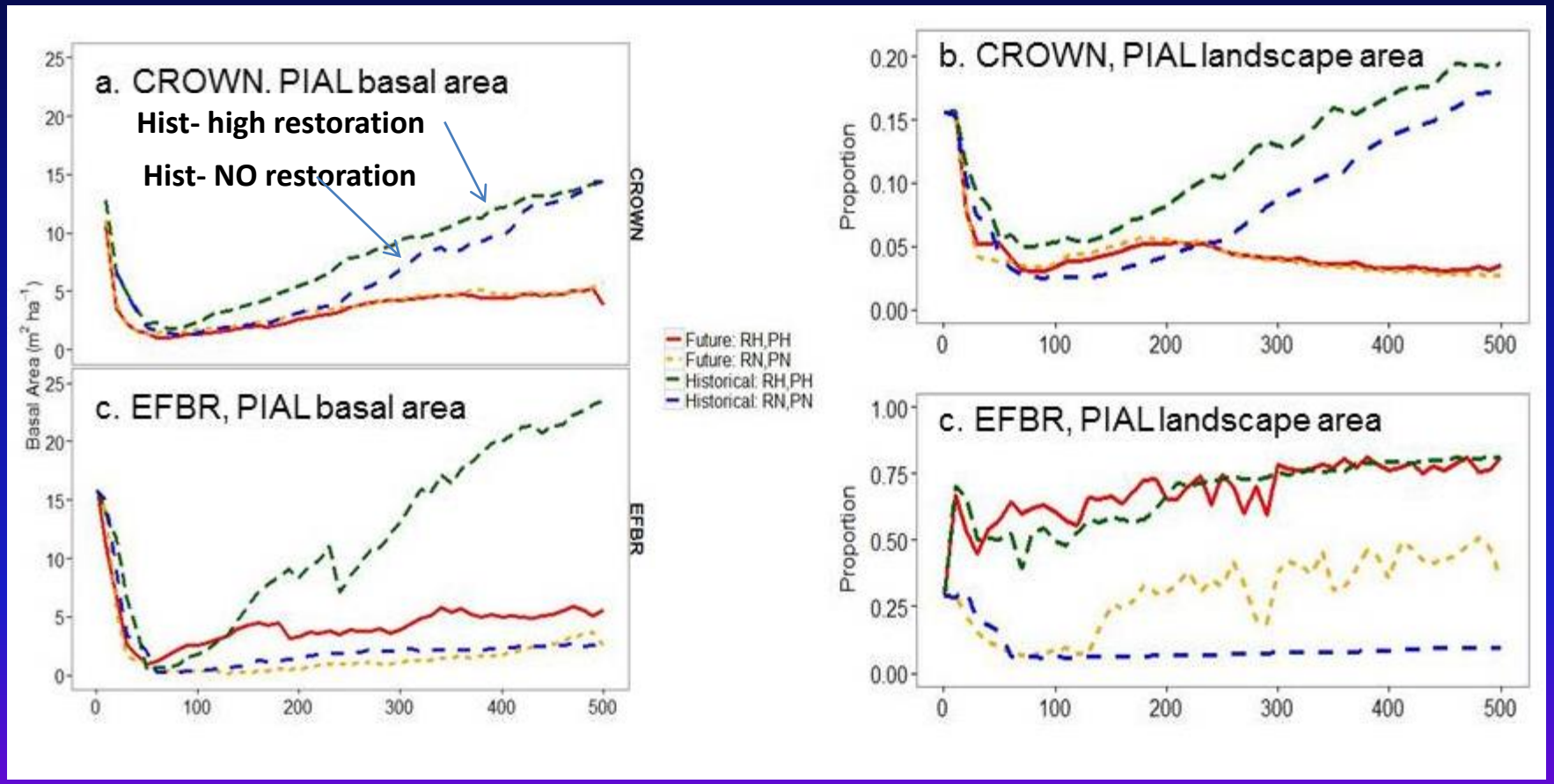
Influence of Elevation



Simulation results

Whitebark pine abundance over the long term
No fire suppression

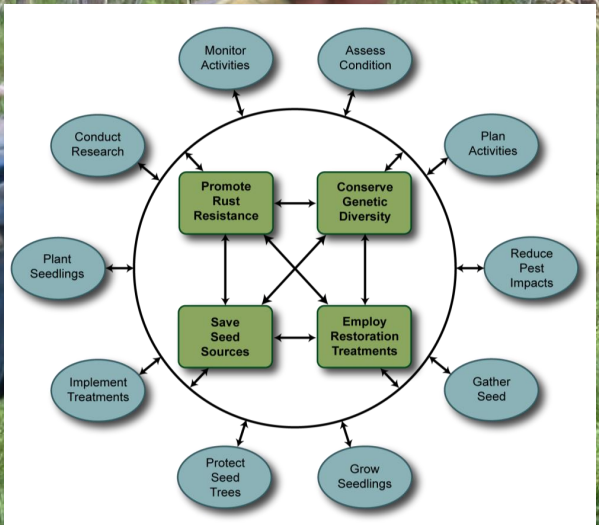


Recommendations

from Simulation + Literature Review

Action:

Reduce Disturbance Impacts



Recommendations:

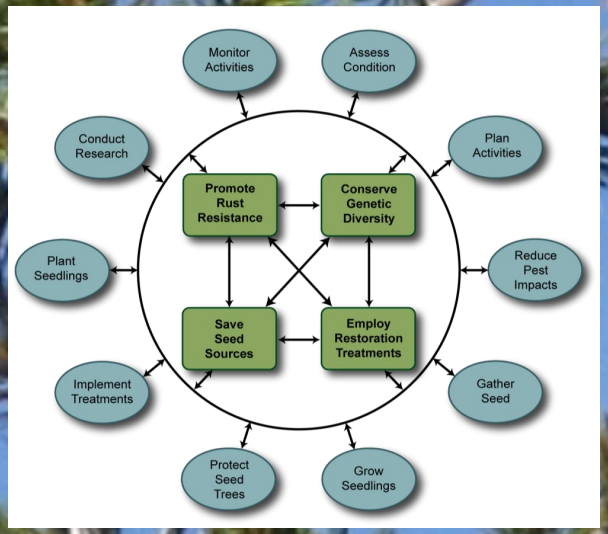
- Create heterogeneous landscapes
- Reduce competition
- Reduce fuels at multiple scales
- Avoid single objective treatments

Recommendations

from Simulation + Literature Review

Action:

Gather Seeds



Recommendations:

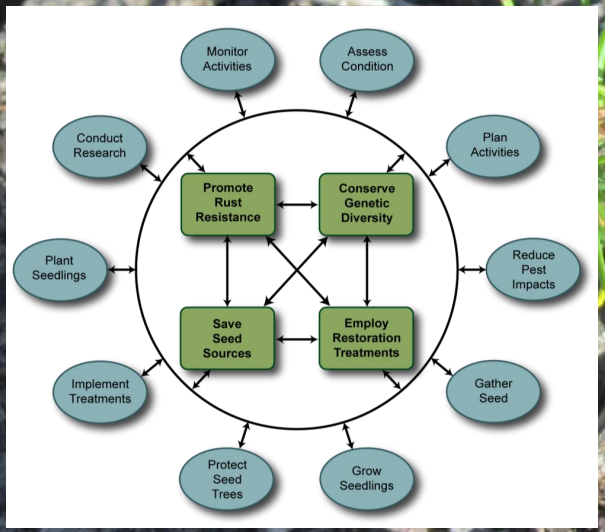
- Collect from many populations
- Create seed libraries
- Shift plus trees
- Collect from many phenotypes

Recommendations

from Simulation + Literature Review

Action:

Plant Seedlings



Recommendations:

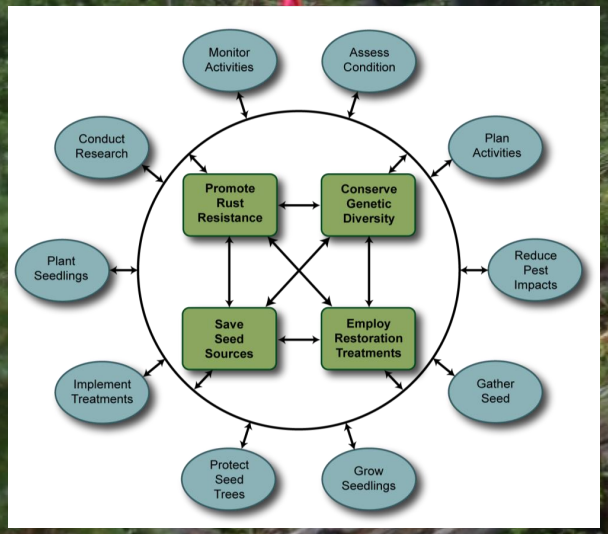
- Plant high elevation sites first
- Use microsites
- Ensure mycorrhizae
- Use larger spacings
- Plant where whitebark present

Recommendations

from Simulation + Literature Review

Action:

Implement Treatments

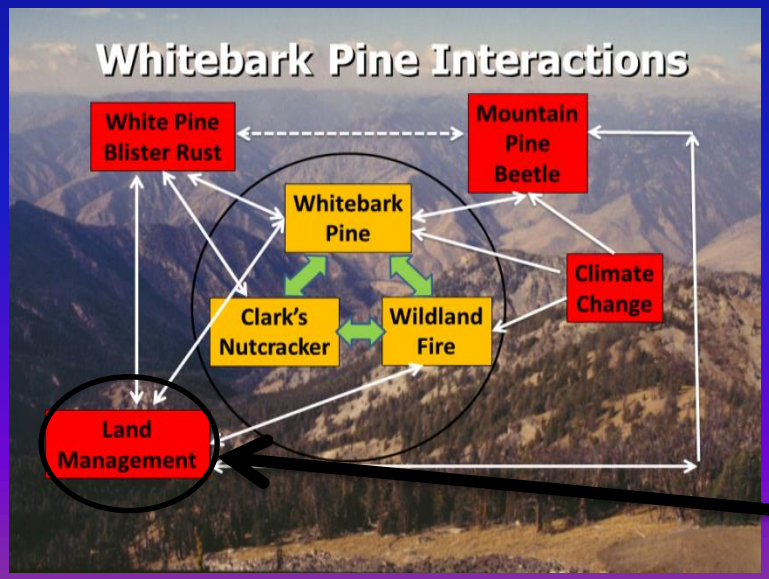


Recommendations:

- Cut more not less
- Rx burn under hotter prescriptions
- Liberally reduce competition
- Reduce fuels to mitigate future wildfires

Conclusions

- Whitebark pine can exist on future NRM landscapes
- Must enhance rust resistance and perform restoration activities
- Whitebark pine dynamics greatly depends on complex interactions
- Climate projections have too much uncertainty to be useful now
- Climate change impacts manifest differently on different landscapes
- Restoration can save the whitebark pine, even in the face of warming climates
- It will take a long time and high level of agency commitment



Here we can make a difference

Demonstration of uncertainty

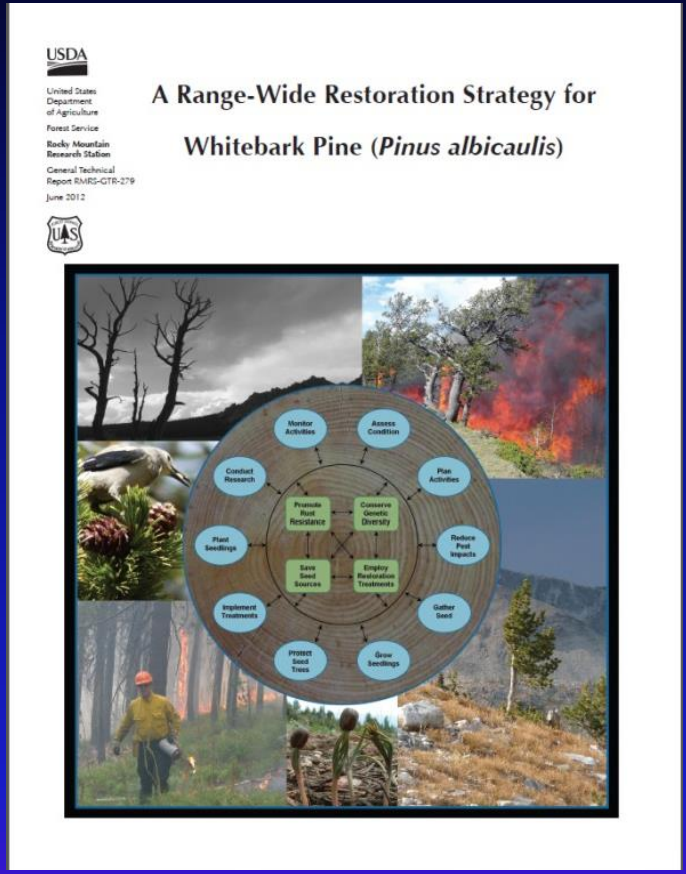
Whitebark pine encroachment into a sagebrush grassland

Near Dillon Montana

New study with Emily Guiberson, BLM

References:

Keane, Robert E.; Holsinger, Lisa M.; Mahalovich, Mary F.; Tomback, Diana F. 2016[in press]. Restoring whitebark pine ecosystems in the face of climate change. Gen. Tech. Rep. RMRS-GTR-XXX. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station XXX p



Keane, Robert E.; Holsinger, Lisa M.; Mahalovich, Mary F.; Tomback, Diana F. 2016. Evaluating future success of whitebark pine ecosystem restoration under climate change using simulation modeling. Restoration Ecology http://onlinelibrary.wiley.com/doi/10.1111/rec.12419/suppinfo