

# **Bunchgrass Ridge: Understanding the past to guide the future**

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# Outline

- Mountain Meadows, Tree Invasion and Restoration
- Intro to Bunchgrass Ridge
- Retrospective Studies
- Restoration Experiment





# Mountain Meadows of the Pacific Northwest



Montane - wet



Montane - rocky



Subalpine, pumice flat

# Tree Invasion

- Widespread both PNW and western US
- Rapid 20th century changes





# Loss of Biological Diversity

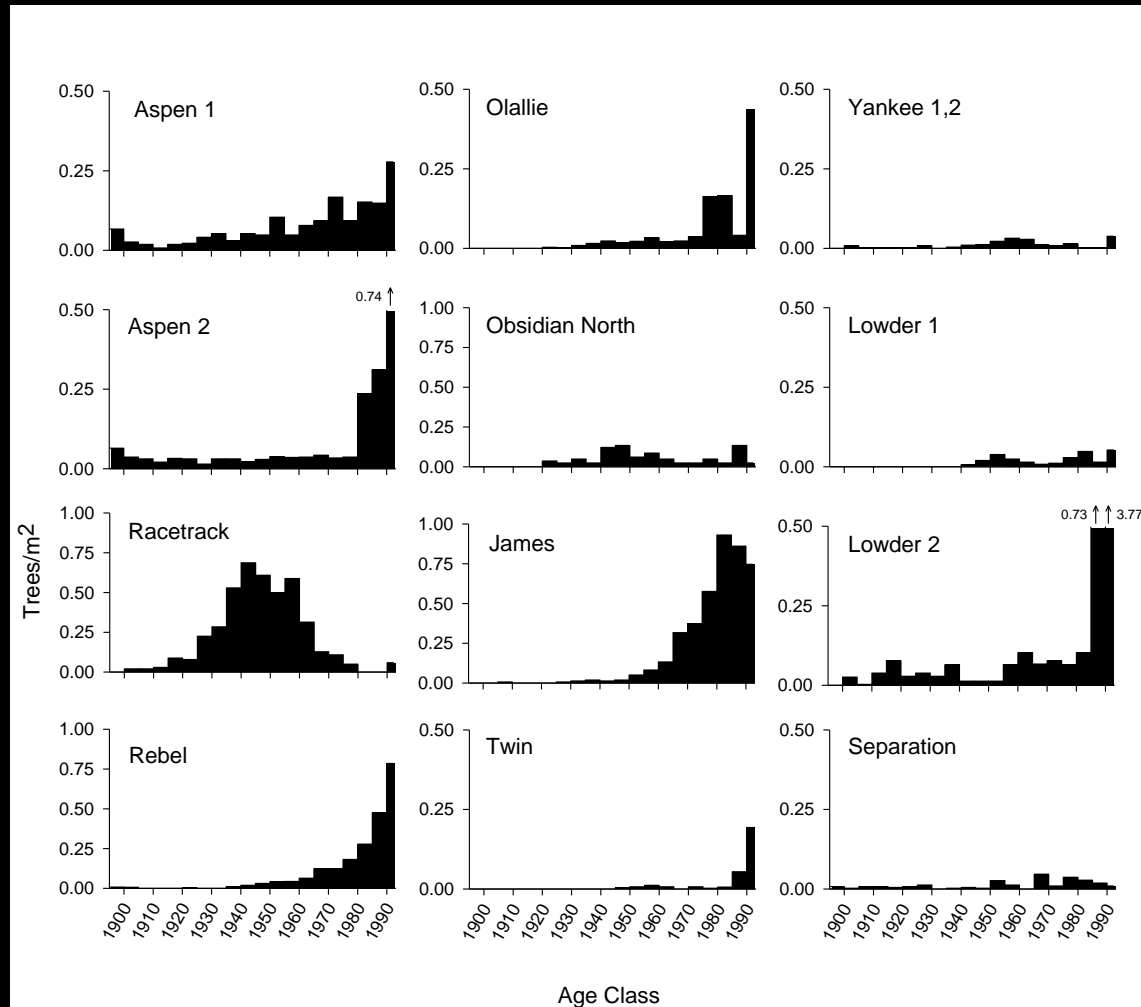


# Tree Invasion

- Variety of possible causes
- Both human and “natural”
  - Grazing, fire suppression, climate change
  - Highly variable among locations



# Tree Invasion – Three Sisters



Miller and Halpern 1998



# Meadow Restoration

- Interest in maintaining and restoring openings
- Biological, cultural, aesthetic reasons for restoration





# Meadow Restoration

- Advantages
  - Many good reference points for composition / structure



# Meadow Restoration

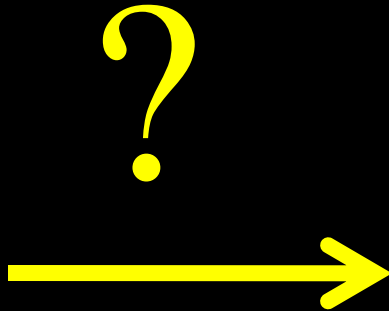
- Challenges:
  - Uncertain role of natural disturbance and other ecological processes





# Meadow Restoration

- Is restoration possible?
- If so, by which methods?
- Which factors limit restoration?



# Bunchgrass Ridge

- Collaborative research center
- Dynamics and restoration of montane meadows



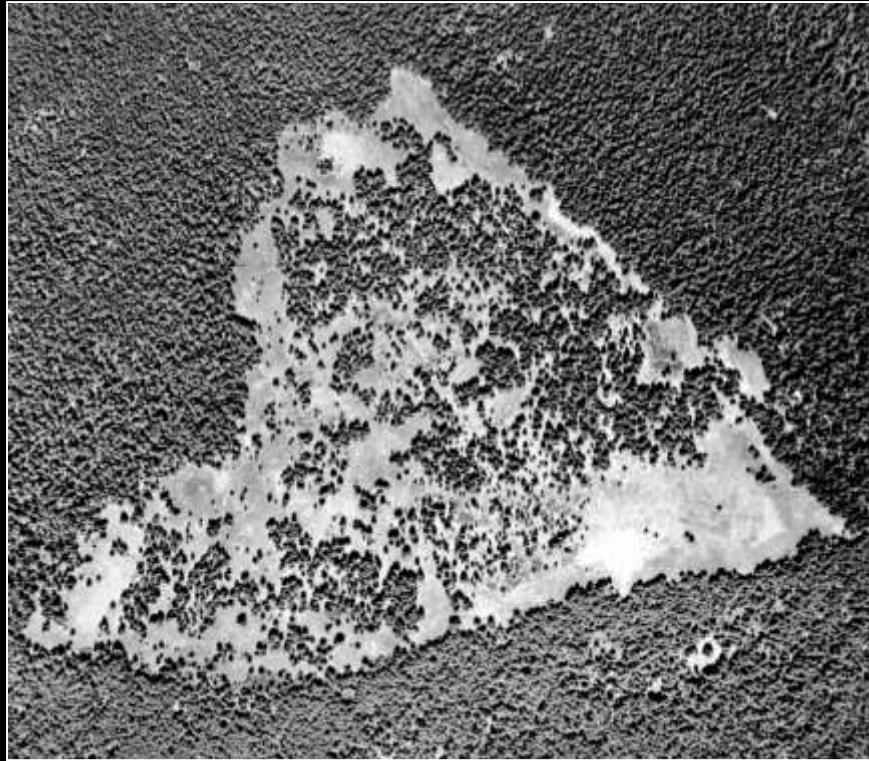


# Bunchgrass Ridge

- Retrospective studies
  - Patterns and consequences of encroachment
  - Implications for restoration
- Restoration experiment
  - Is restoration possible?
  - Is fire necessary?
  - Do initial conditions affect outcome?



# Bunchgrass Ridge



1959



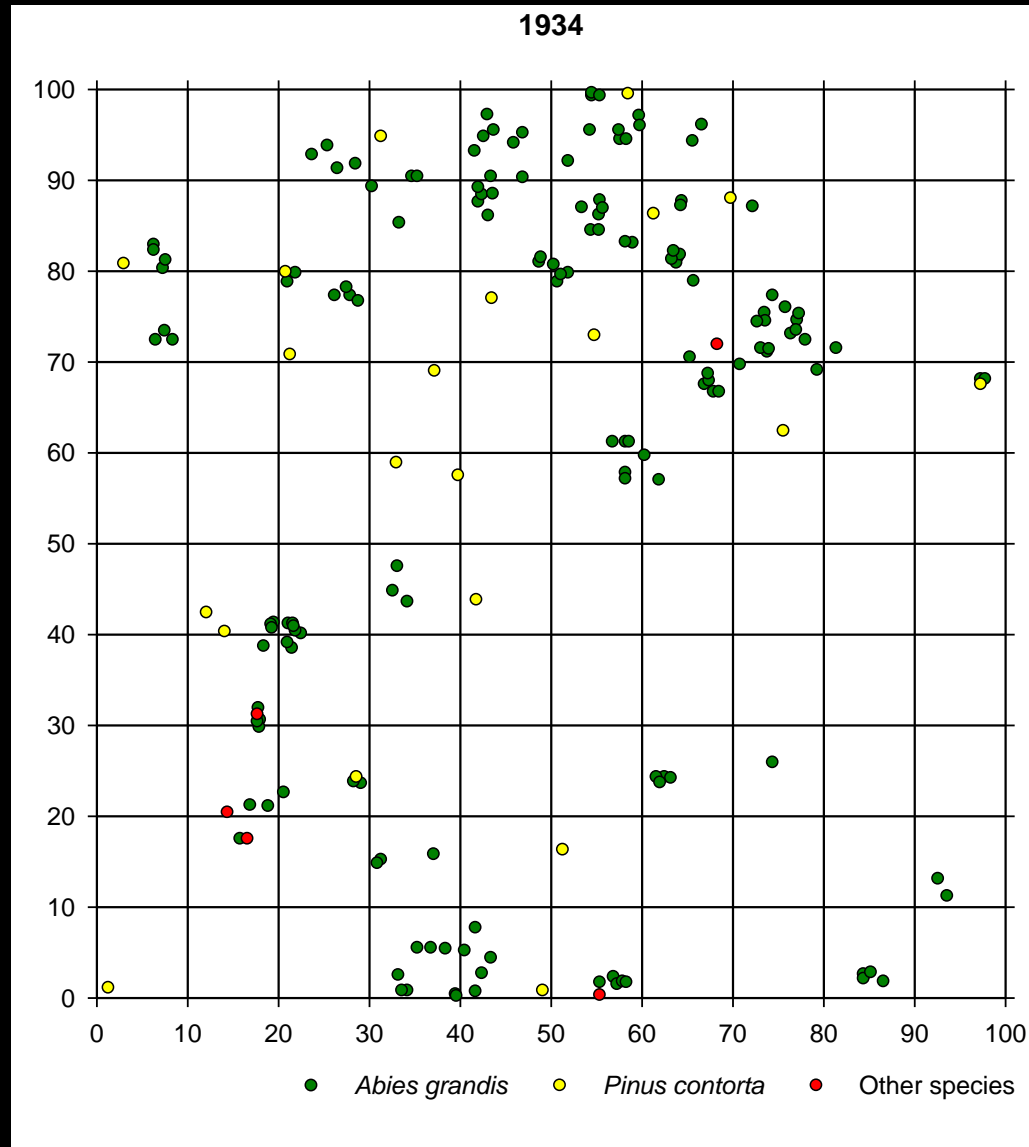
1997



# Bunchgrass Ridge

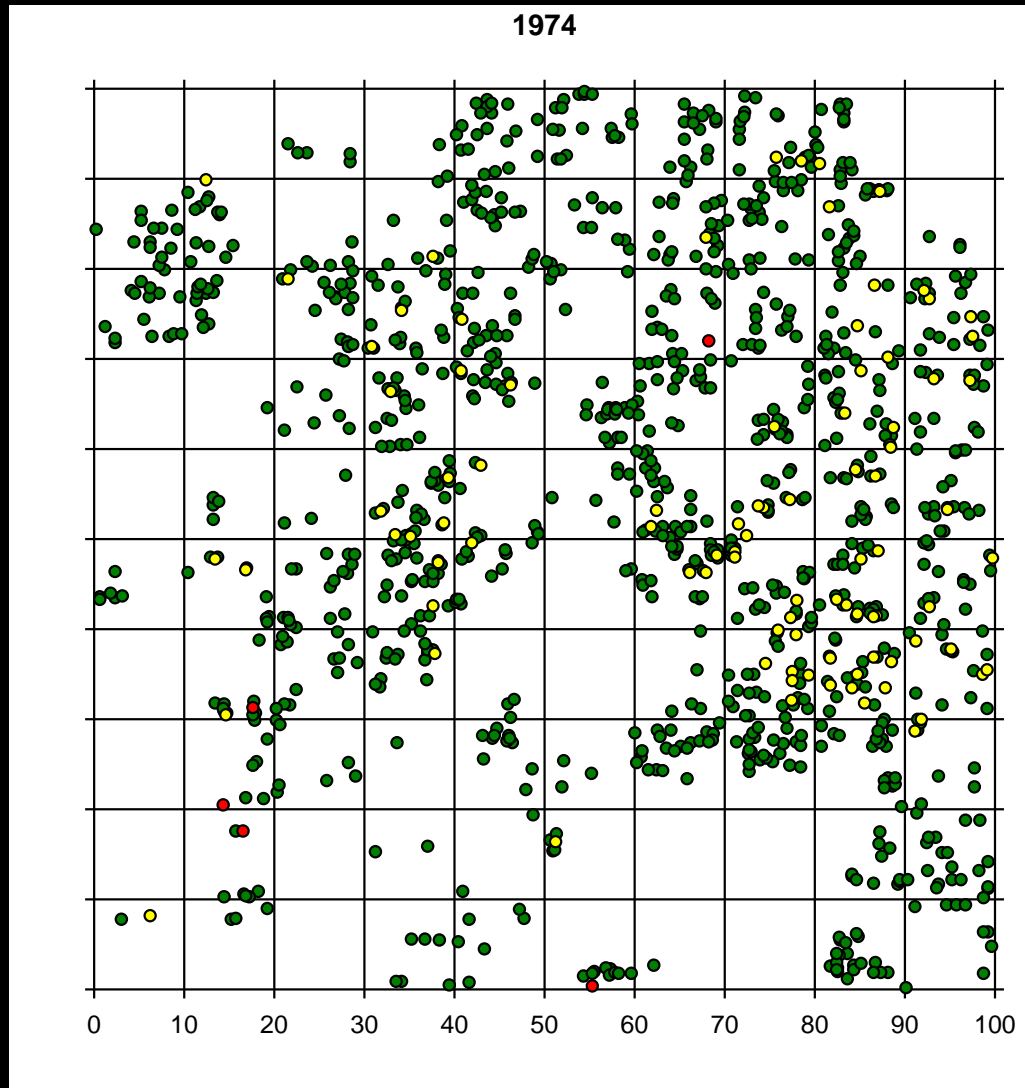


# Bunchgrass Invasion History - 1934

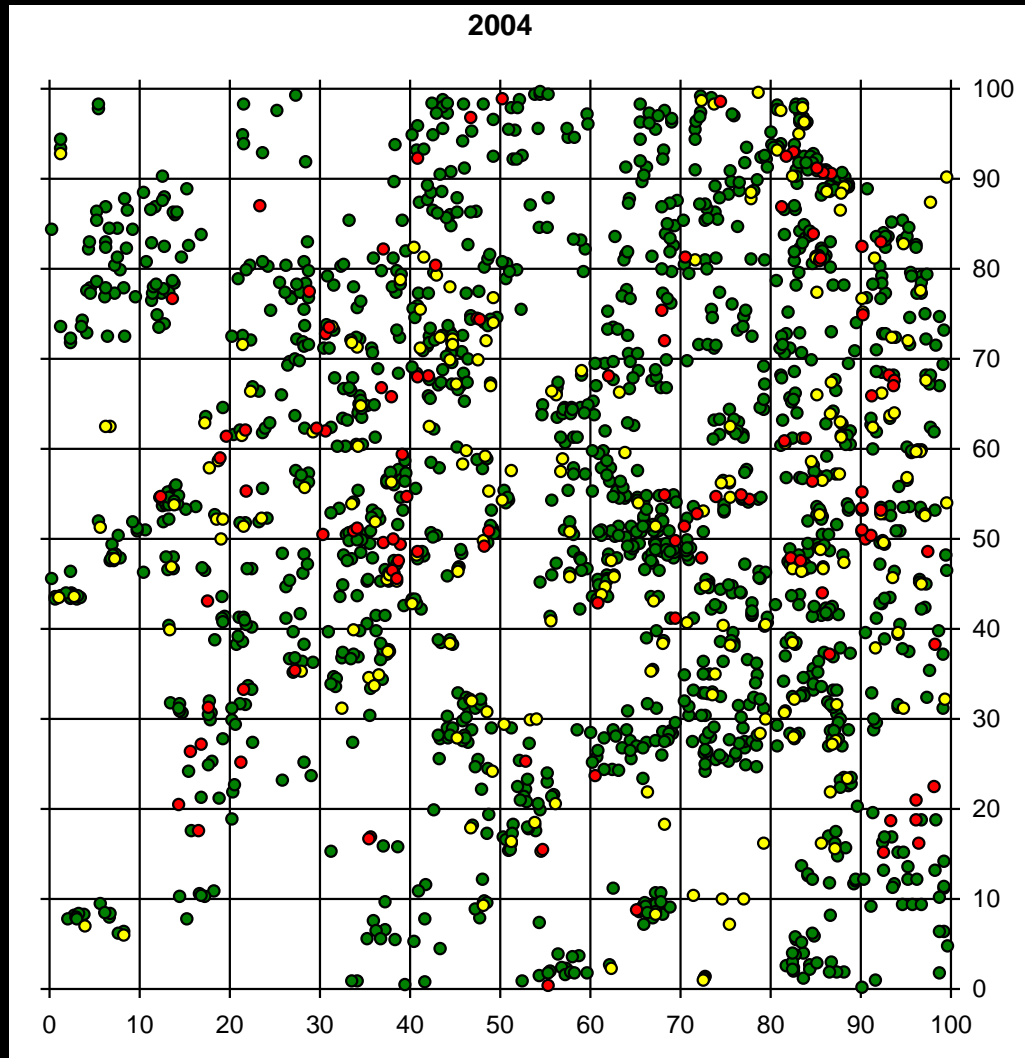




# Bunchgrass Invasion History - 1974

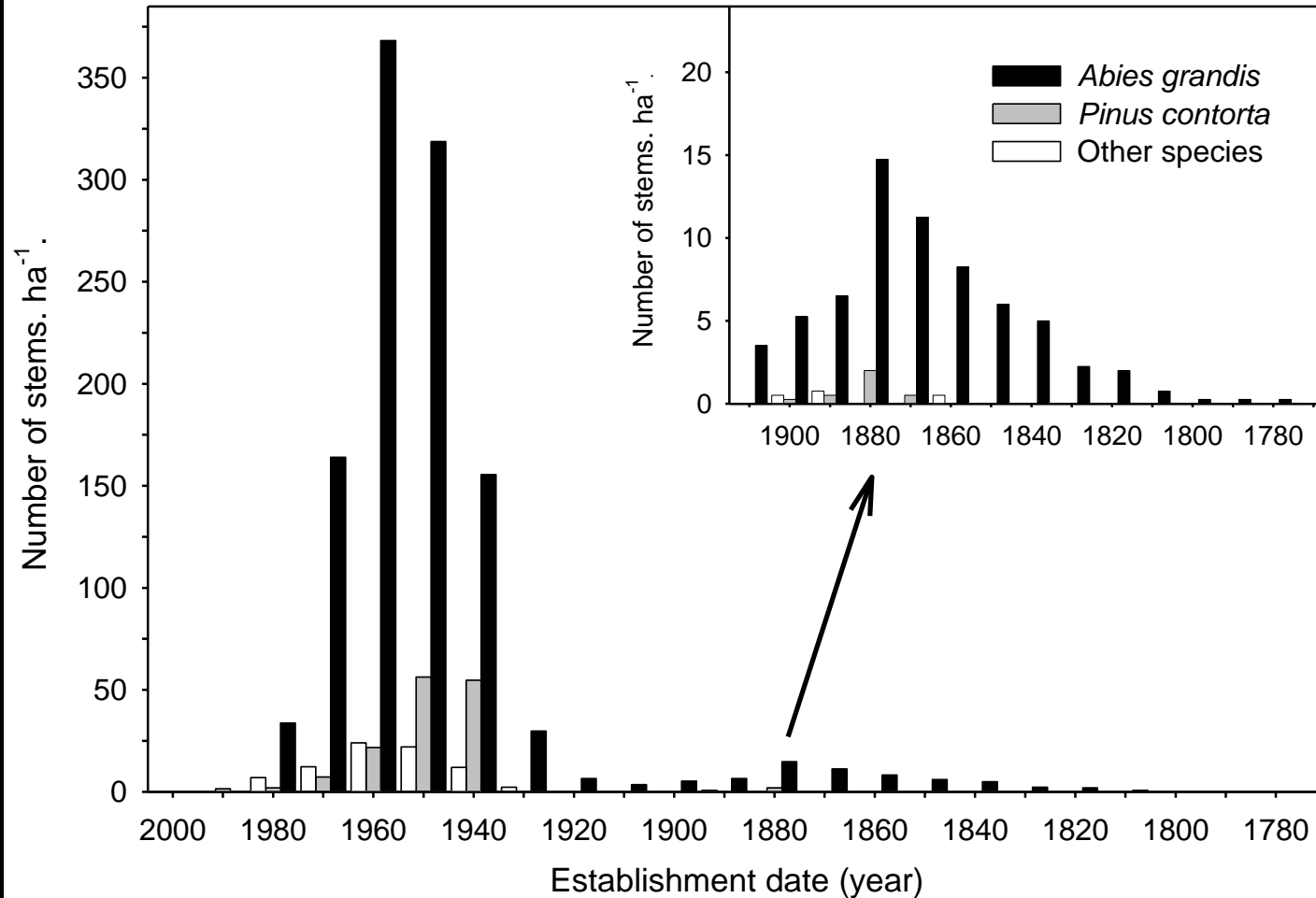


# Bunchgrass Invasion History - 2004





# Bunchgrass Invasion History



# Bunchgrass Invasion History

- Edge expansion and from new foci
- Lodgepole facilitation of grand fir





# Ecological Limitations

- Influence of invading trees on meadow soils - Griffiths et al. 2005
  - Bacterial to mycorrhizal soil communities
  - Accumulation of needle litter
  - Alteration of nitrogen cycling



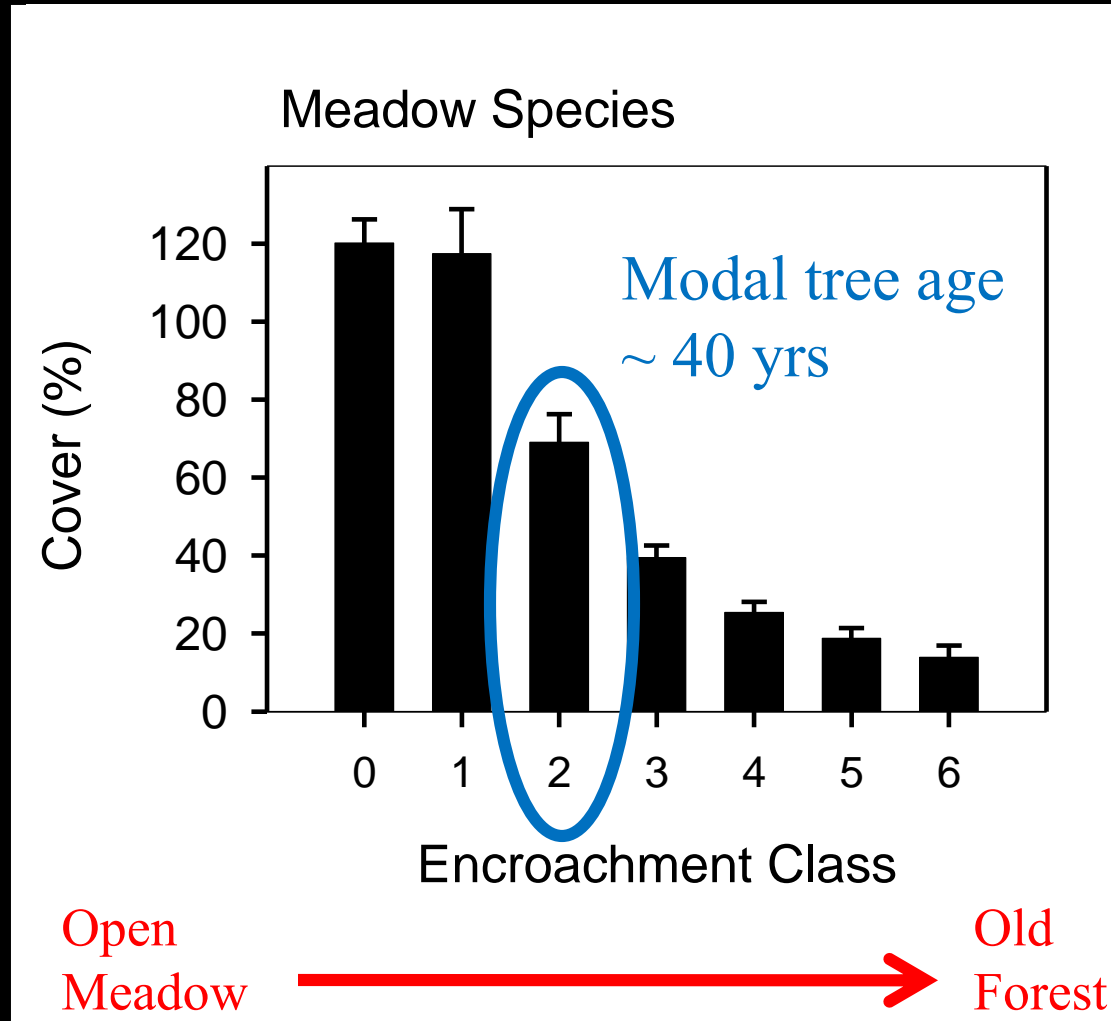
# Ecological Limitations

- Ideal: vegetative recovery of meadow species
- Rapid loss of meadow species



# Ecological Limitations

- Rapid loss of meadow species



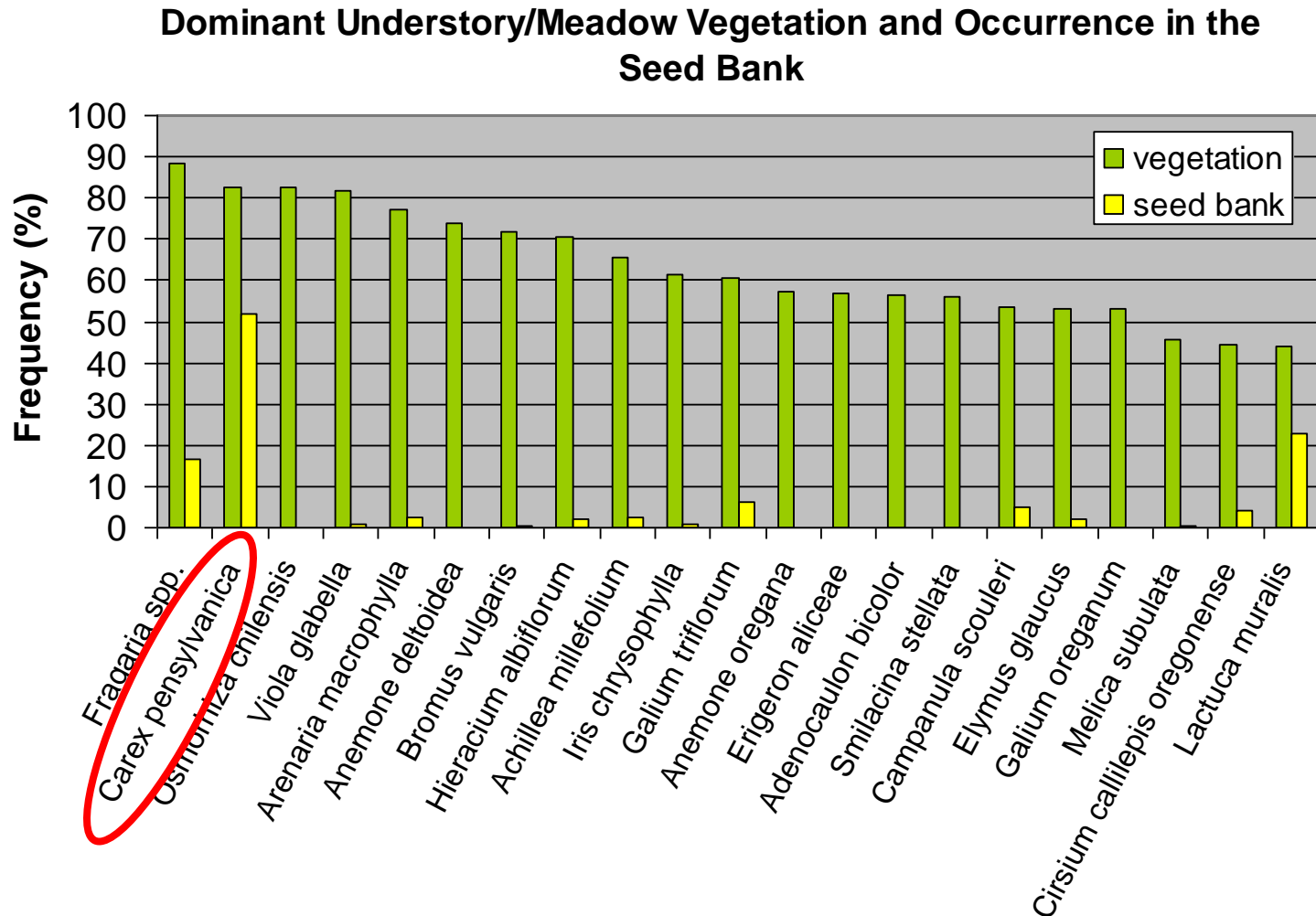


# Ecological Limitations

- Soil seed bank



# Bunchgrass Soil Seed Bank



# Ecological Limitations

- If species are not present in seed bank...
  - Seed dispersal
    - Not all species flower, dispersal distances are short
  - Vegetative spread
    - Slow
  - Artificial seeding
    - Genetic comparability
    - Logistics of seed collection, storage, distribution



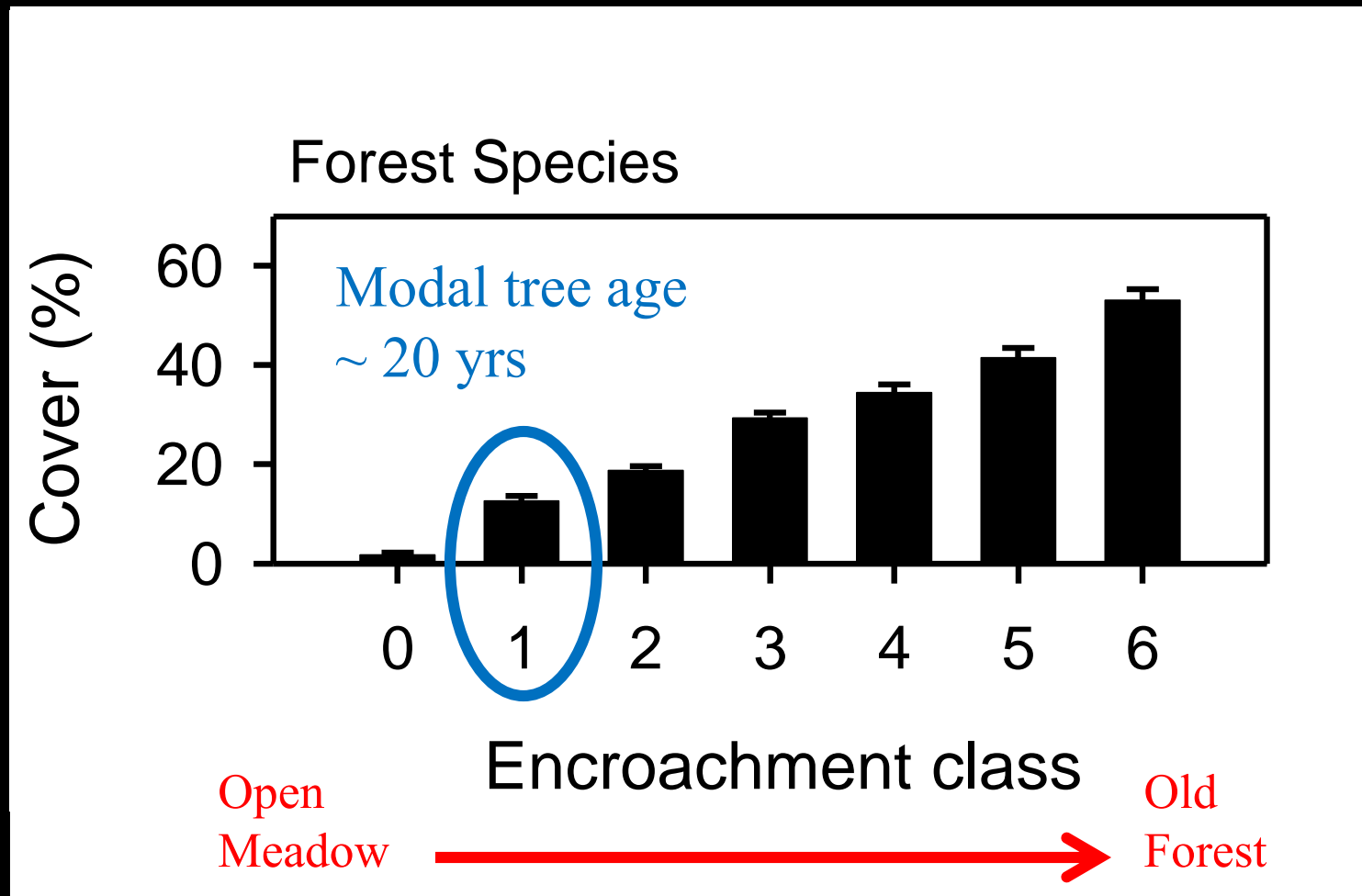
# Ecological Limitations

- Competition with forest herbs



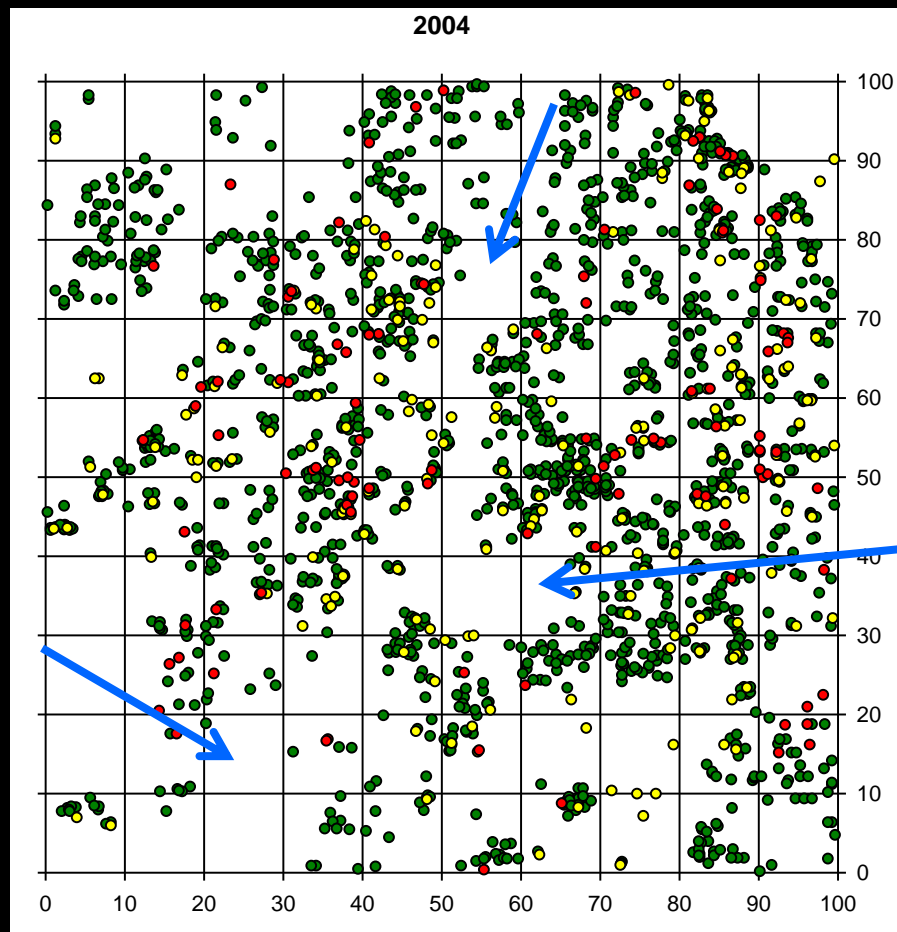
# Ecological Limitations

- Competition with forest herbs



# Hope for Restoration?

- Limited influence of lodgepole on meadow spp
- Small meadow “pockets” – foci for recovery?





# Bunchgrass Restoration

- Tree removal with and without fire
- Range of tree ages / densities



# Operational Considerations

- Roadless designation
- Potential for damage to meadow soil
  - Felling and skidding on snow...





# Operational Considerations





# Operational Considerations

- Slash disposal
  - Broadcast Burn – “Burn” Treatment
  - Pile + Burn – “No Burn” Treatment





# Broadcast Burning

- Advantages
  - No further manipulation of slash
- Disadvantages
  - Weather conditions – highly restrictive
  - Risk of fire spread
  - Need for fire lines, water access, etc.
  - Significant soil disturbance
  - Increased nutrient availability





# Pile + Burn

- Advantages
  - Can occur during low fire danger
  - Less operational support
- Disadvantages
  - Labor intensive





# Pile Burning

- Highly disturbed soils
  - ~ 10% of plot surface area
- Greatly increased nutrients
- Vegetation recovery?



# 1<sup>st</sup> Year Vegetation Responses





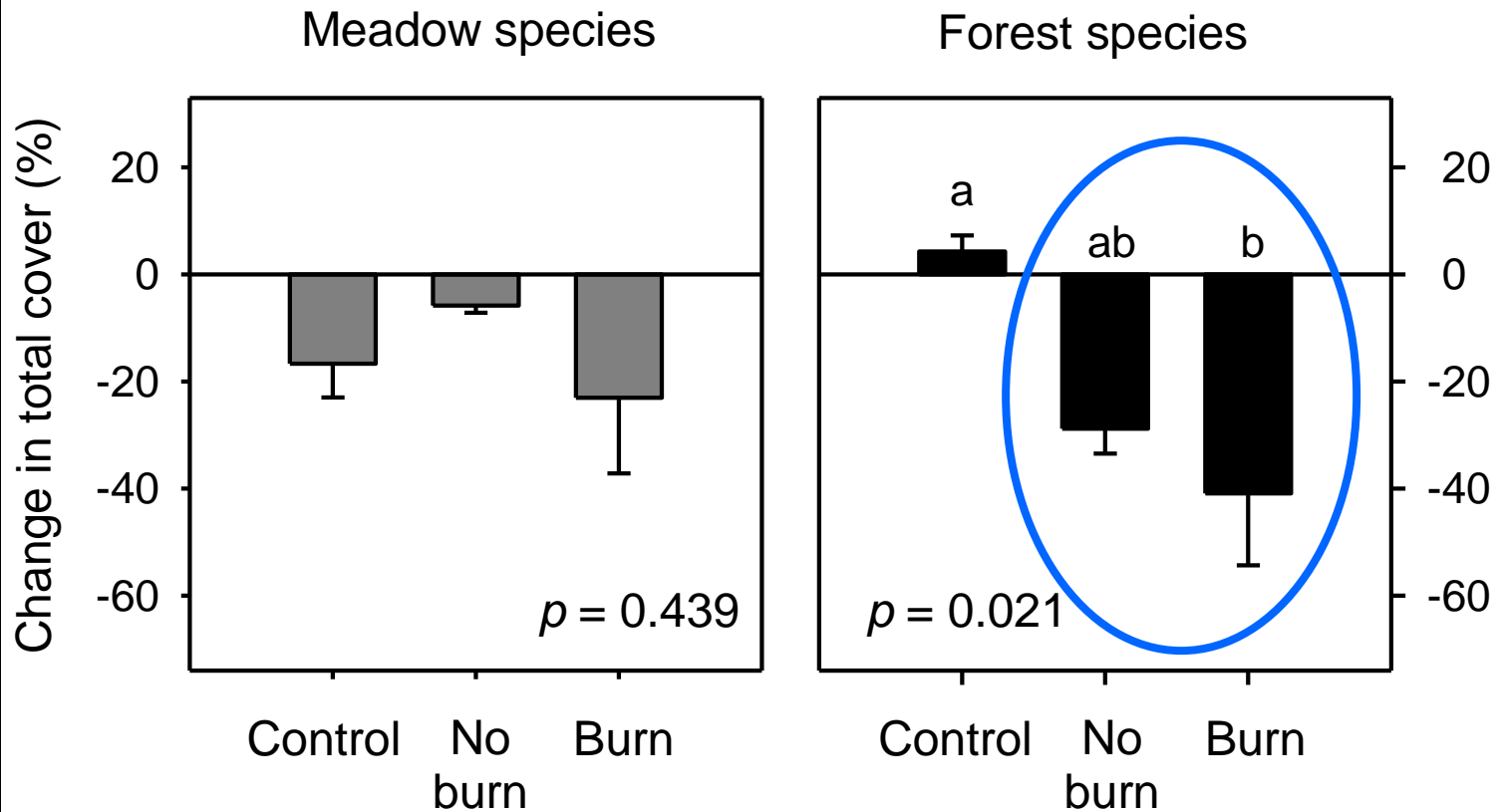
# 1<sup>st</sup> Year Vegetation Responses

- Meadow species
  - No change in richness, abundance
- Forest species
  - Declines in richness, abundance





# 1<sup>st</sup> Year Vegetation Responses



# 1<sup>st</sup> Year Vegetation Responses

- Weedy species – limited presence
- Will this last?



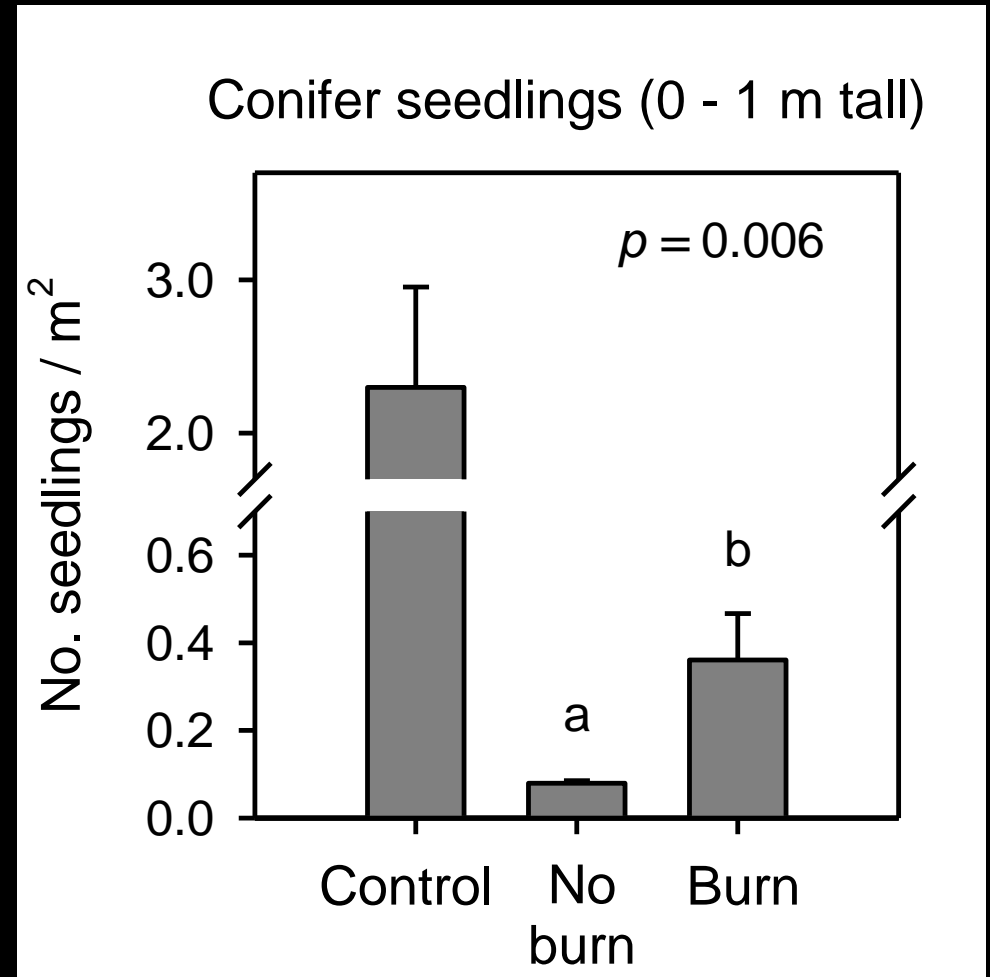
*Rumex acetosella*



*Phacelia heterophylla*

# 1<sup>st</sup> Year Vegetation Responses

- Conifer establishment:  
Burn > No burn
- Legacy of tree –  
soil effects?





# Summary - Retrospective

- Lodgepole – grand fir facilitation
- Rapid changes:
  - Soils
  - Vegetation
- Lodgepole – grand fir differences
- Weedy seed bank
- Recommendations:
  - **Early intervention!!**



# Summary - Experiment

- Effective harvest over snow
- Broadcast burning
  - Soil disturbance and increased N
- Pile burning
  - Intense local disturbance
- Tree removal benefits meadow species
  - With or without fire
- Limited weedy response in 1<sup>st</sup> year
- Long term success???





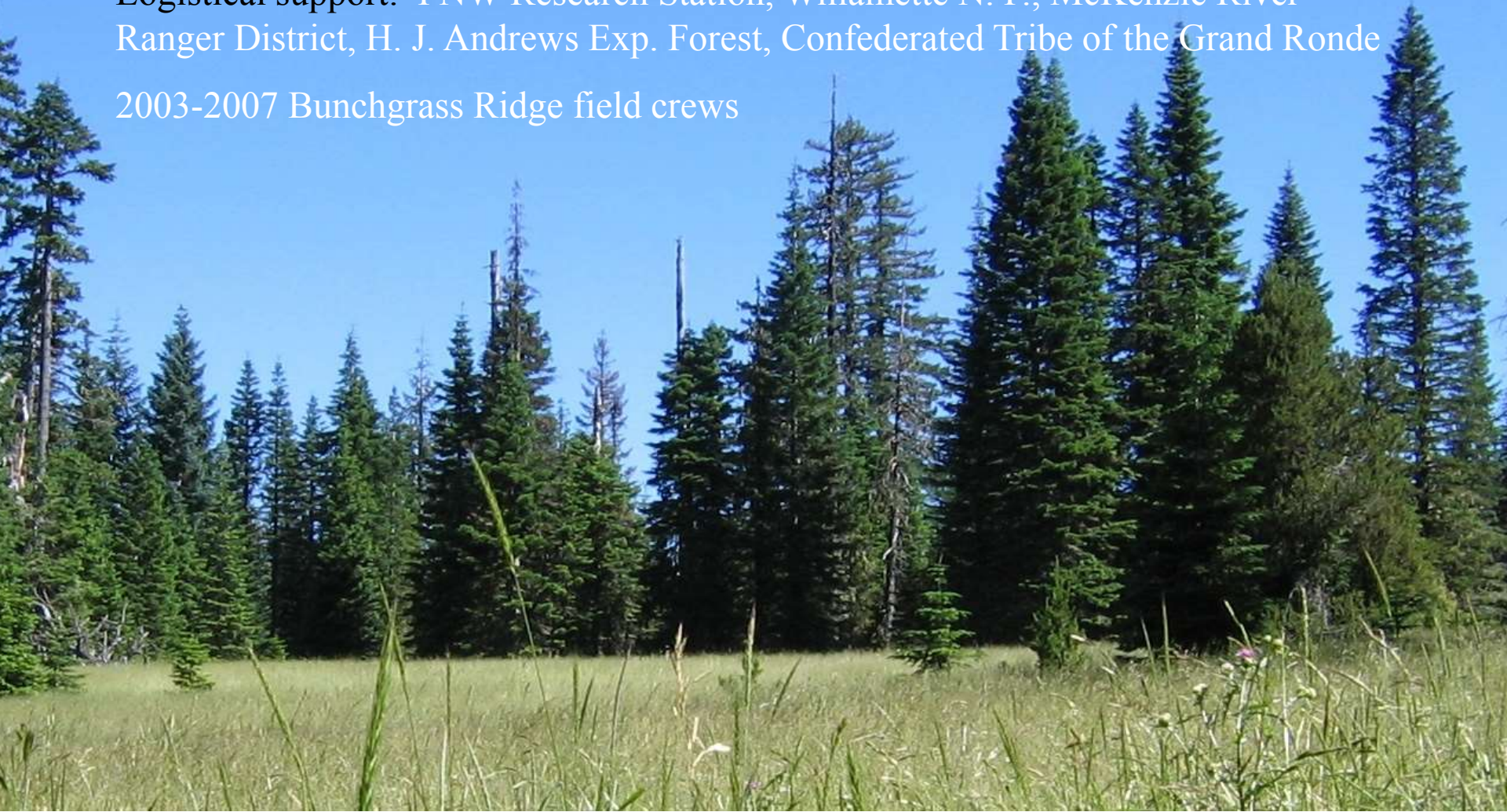
# Acknowledgements

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2003-2007 Bunchgrass Ridge field crews





<http://depts.washington.edu/bgridge/>

