Vegetation responses to conifer encroachment in a dry, montane meadow: a chronosequence approach

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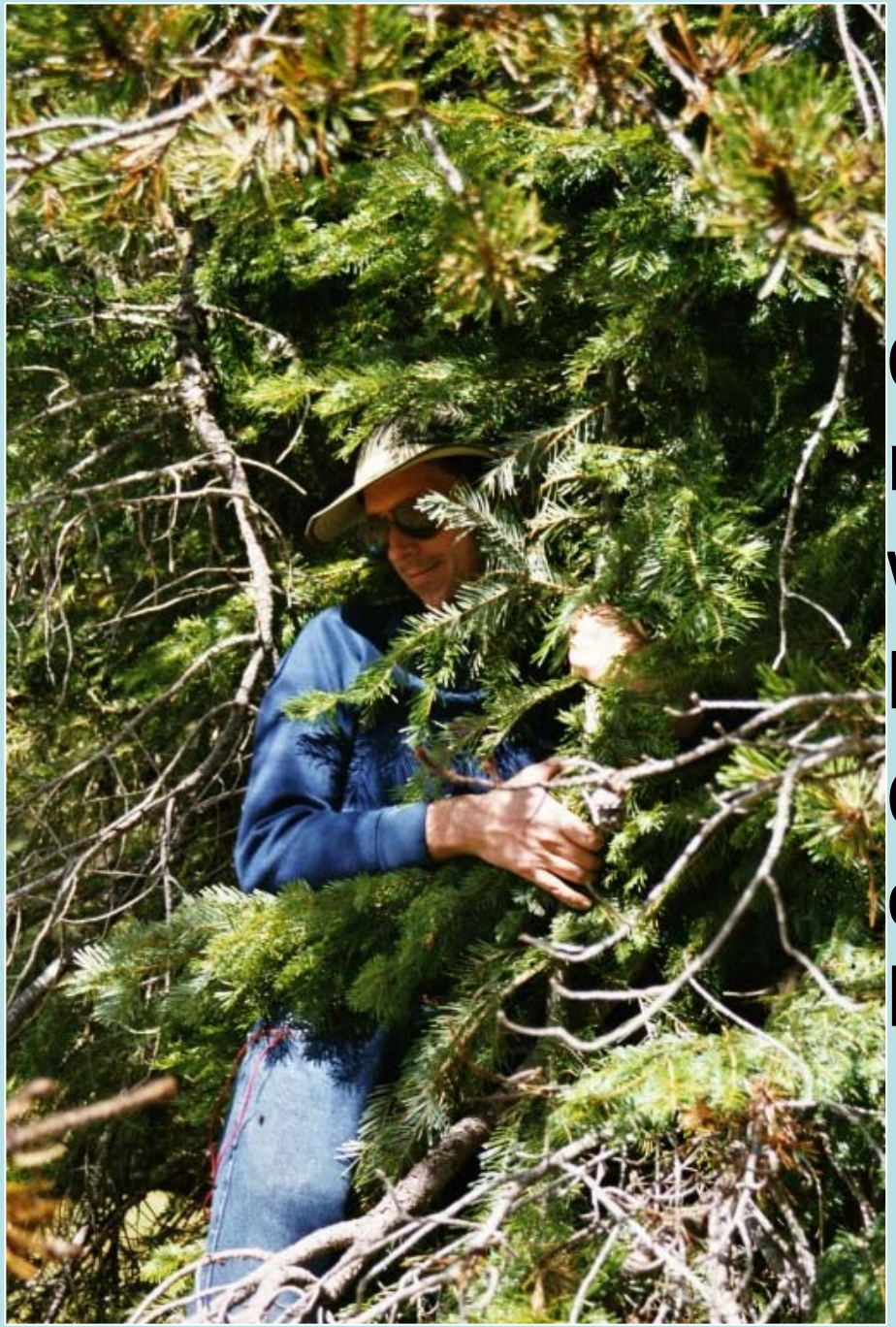
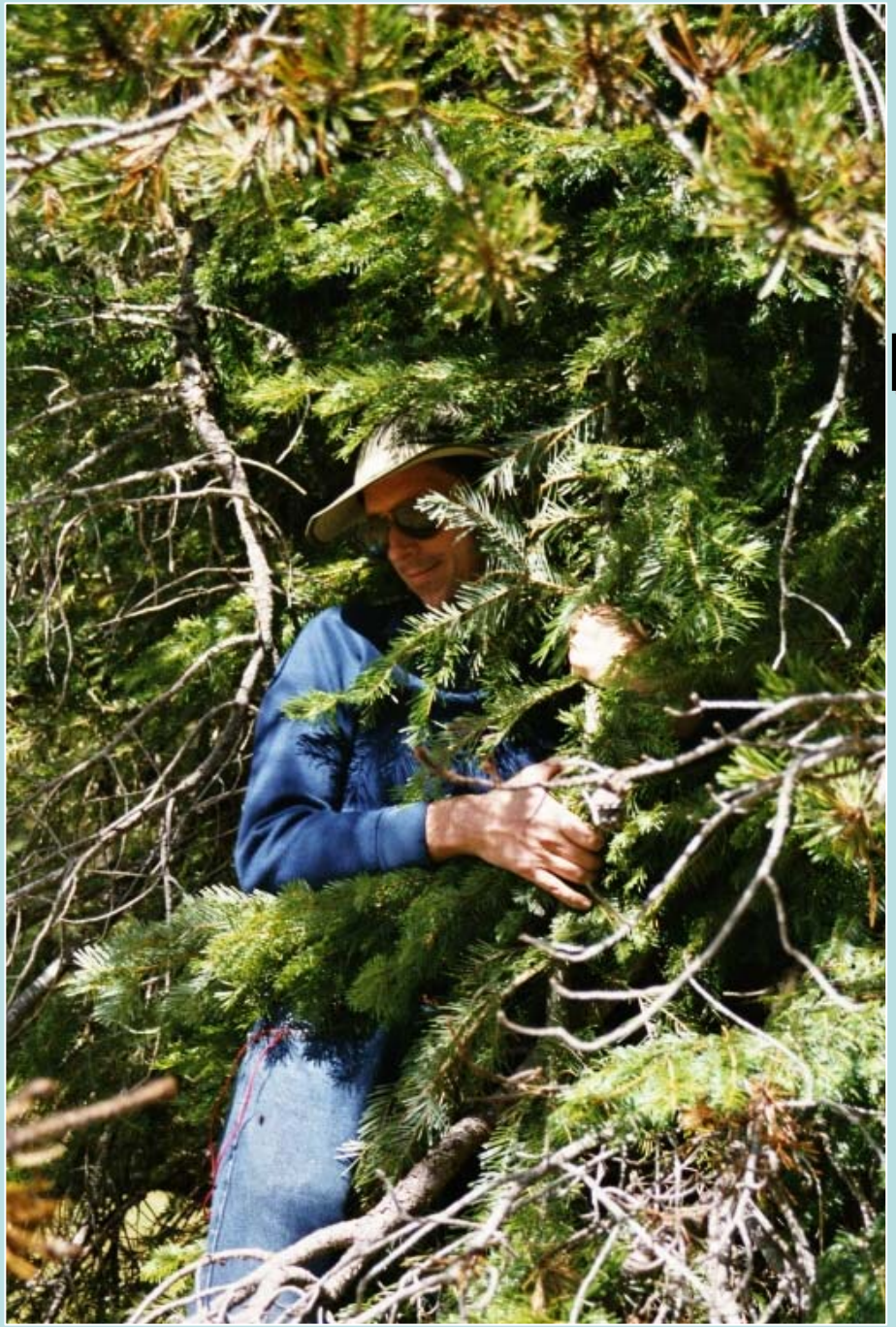
Photo: Jim Lutz


Value of open meadow communities
• Biodiversitiy
• Wildlife habitat
• Cultural resources



The problem...

- Conifer invasion of meadow habitat
- Widespread across PNW
- Concern over the loss of unique meadow habitat



The problem…

Focus on the causes

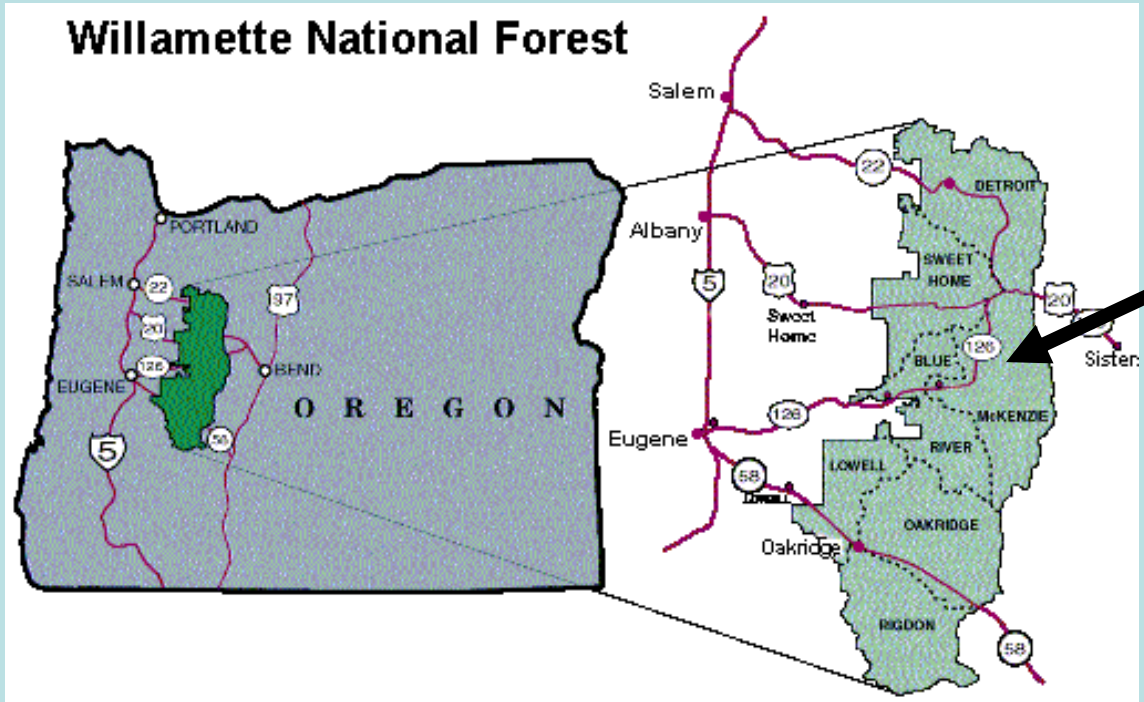
- Fire suppression
- Climate change
- Grazing

The problem...

- Very little understanding of consequences
  - Vegetation dynamics
  - Loss of biodiversity
  - Restoration potential

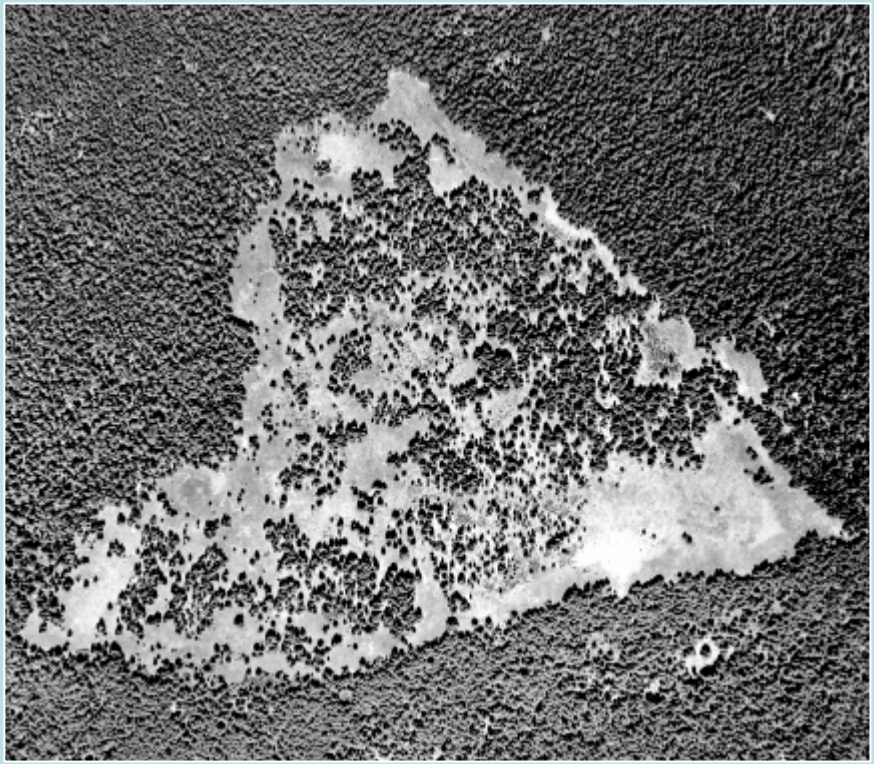
Bunchgrass Ridge, OR

- Dry, montane meadow
- Willamette NF Special Habitat Area

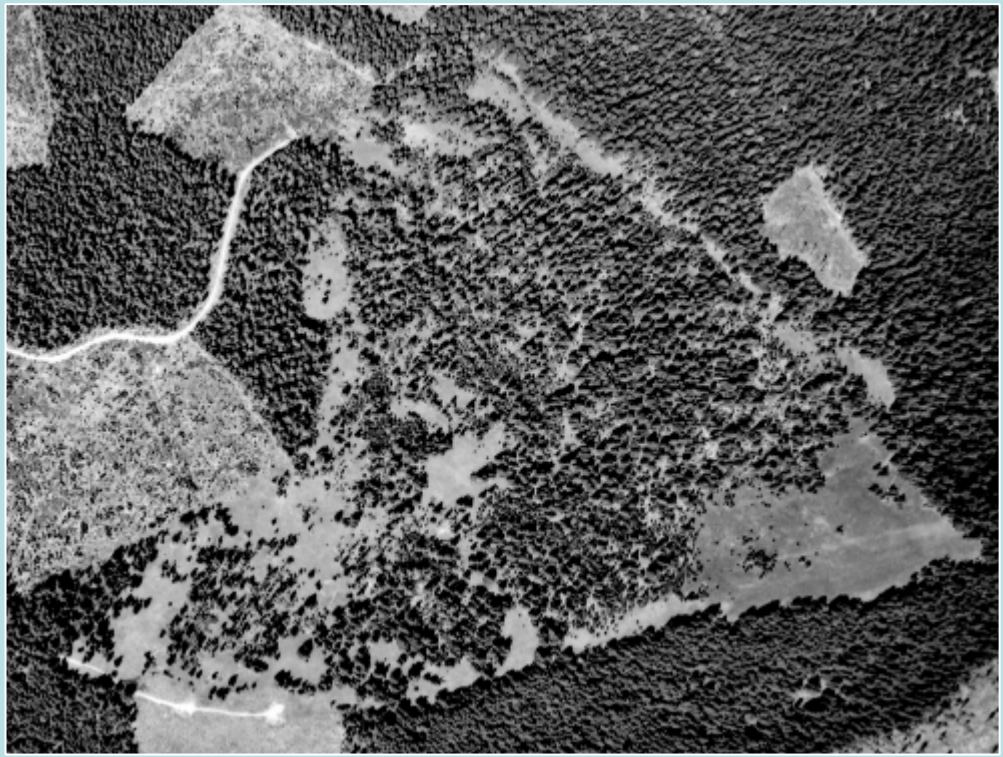


- ~ 1300 m
- History of conifer invasion
  - Grand fir (*Abies grandis*)
  - Lodgepole pine (*Pinus contorta*)
- Meadow soils

1959



1997



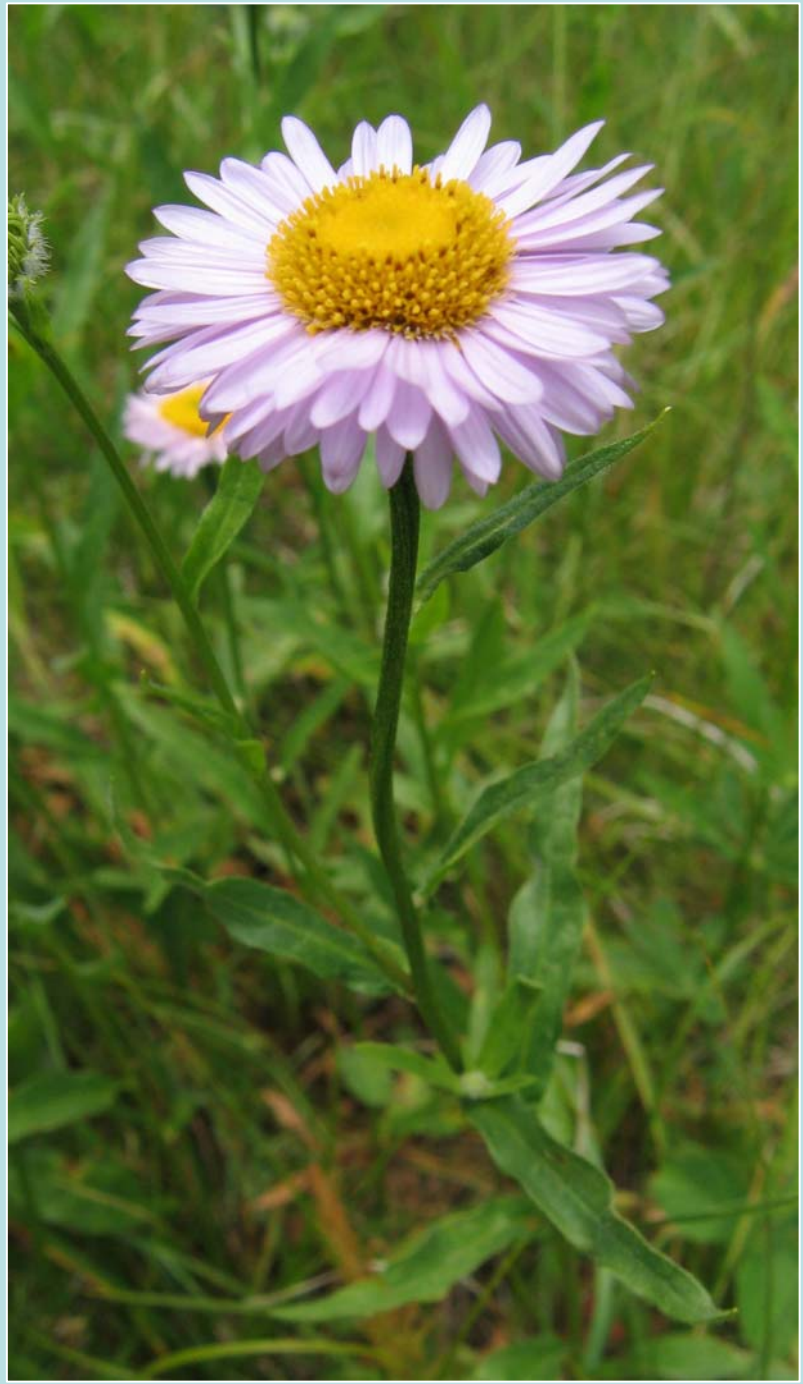
Objectives

1. Temporal changes in vegetation
2. Relationships with changes in the environment

Temporal changes in vegetation

- How does species composition change?

- How does abundance of meadow and forest species change?
  - Richness
  - Cover

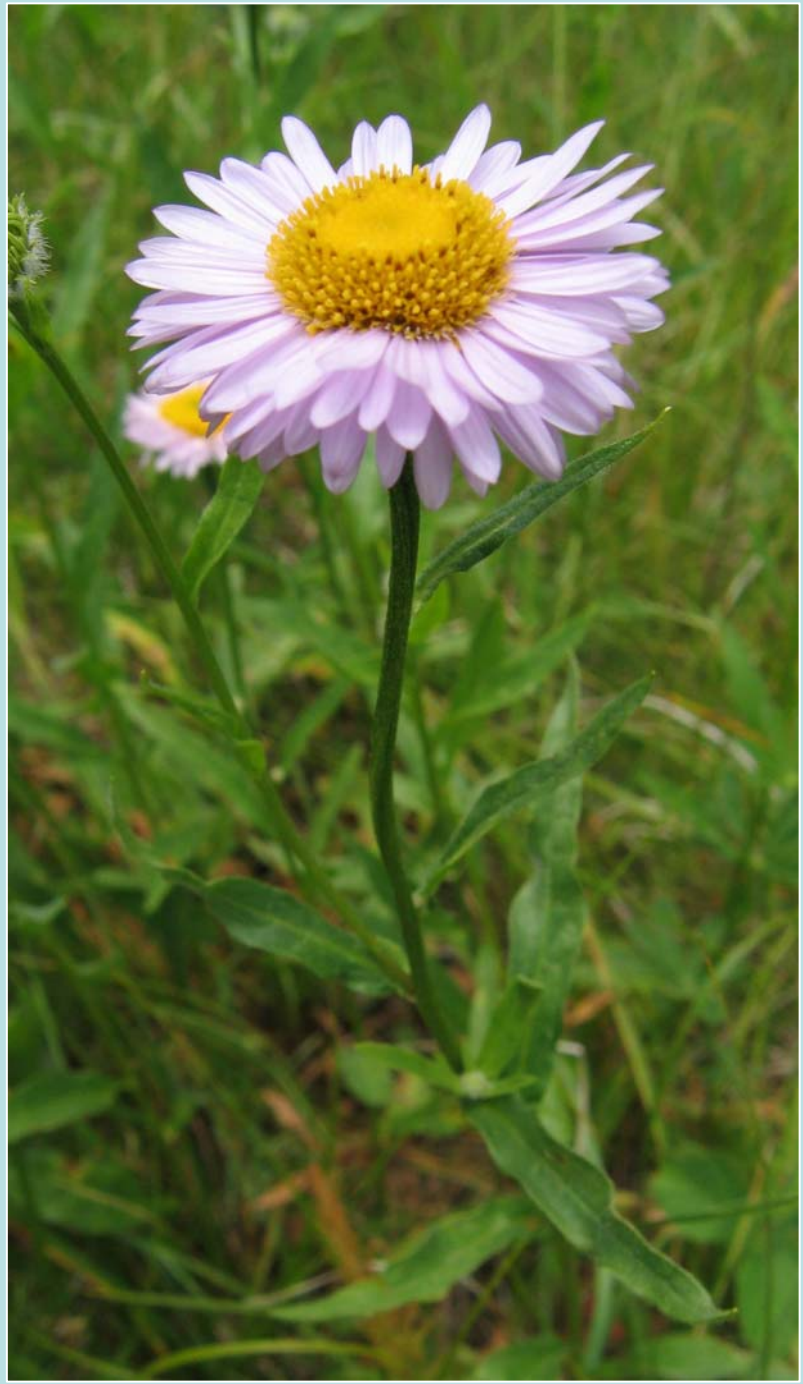


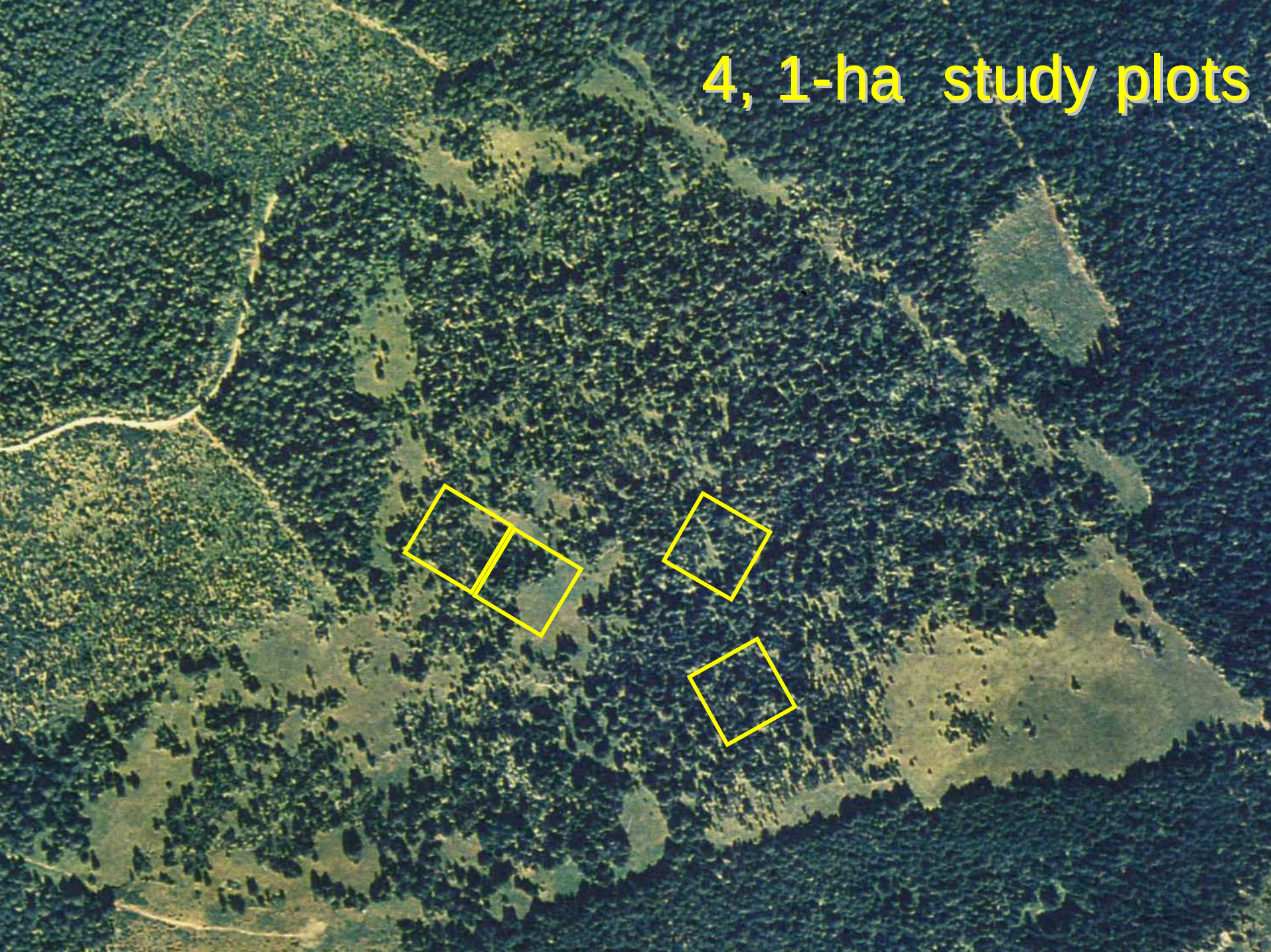
Environmental changes

- Relationship between light, forest structure and:
  - Species composition
  - Abundance of meadow, forest species
- Forest structure
  - Basal area, density
    - Grand fir: live, dead
    - Lodgepole pine: live, dead

Environmental changes

- Are relationships with environment weaker for forest than for meadow species?
  - Dispersal
  - Competition
  - Clonal growth




4, 1-ha study plots

Field sampling

- 356 10 x 10 m subplots
  - Basic sample unit
- Census of all overstory trees
  - Species, size, age, location
- Light levels
- Vegetation sampling

Chronosequence

- Temporal changes
  - Space for time substitution
- Seven encroachment classes
  - Open meadow to old forest

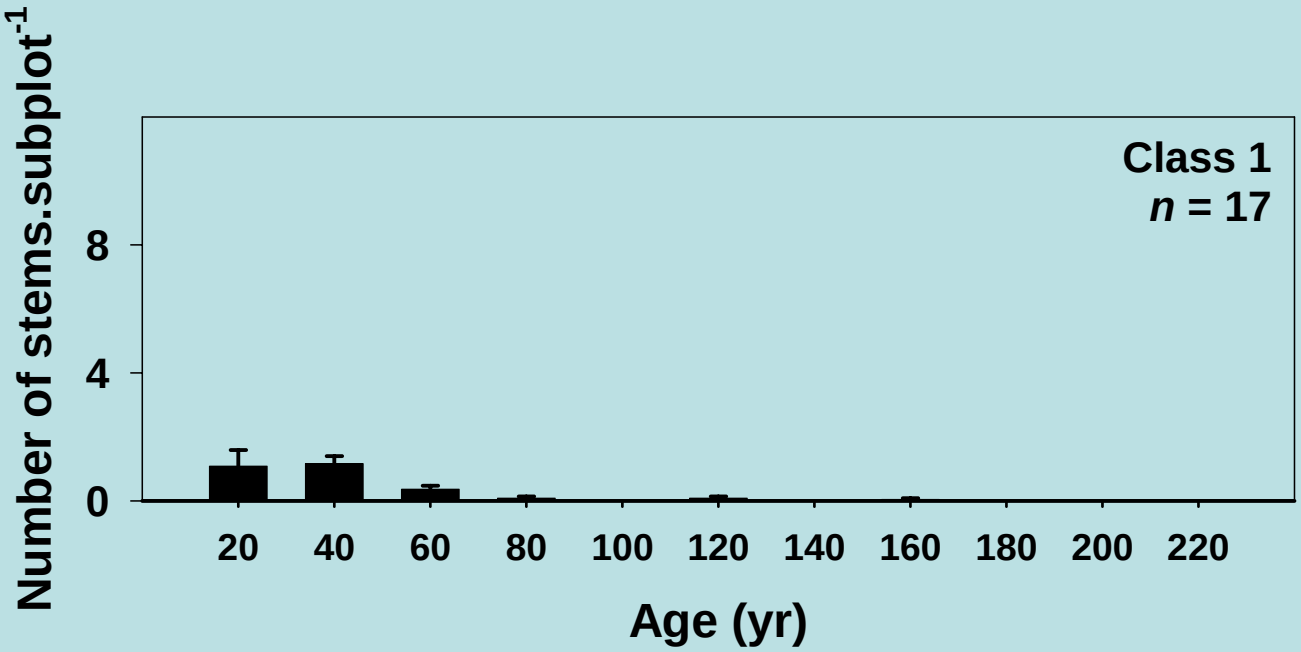
Chronosequence

- Cluster analysis
- 20 year age bins
- Relative Euclidean distance
- Ward’s linkage

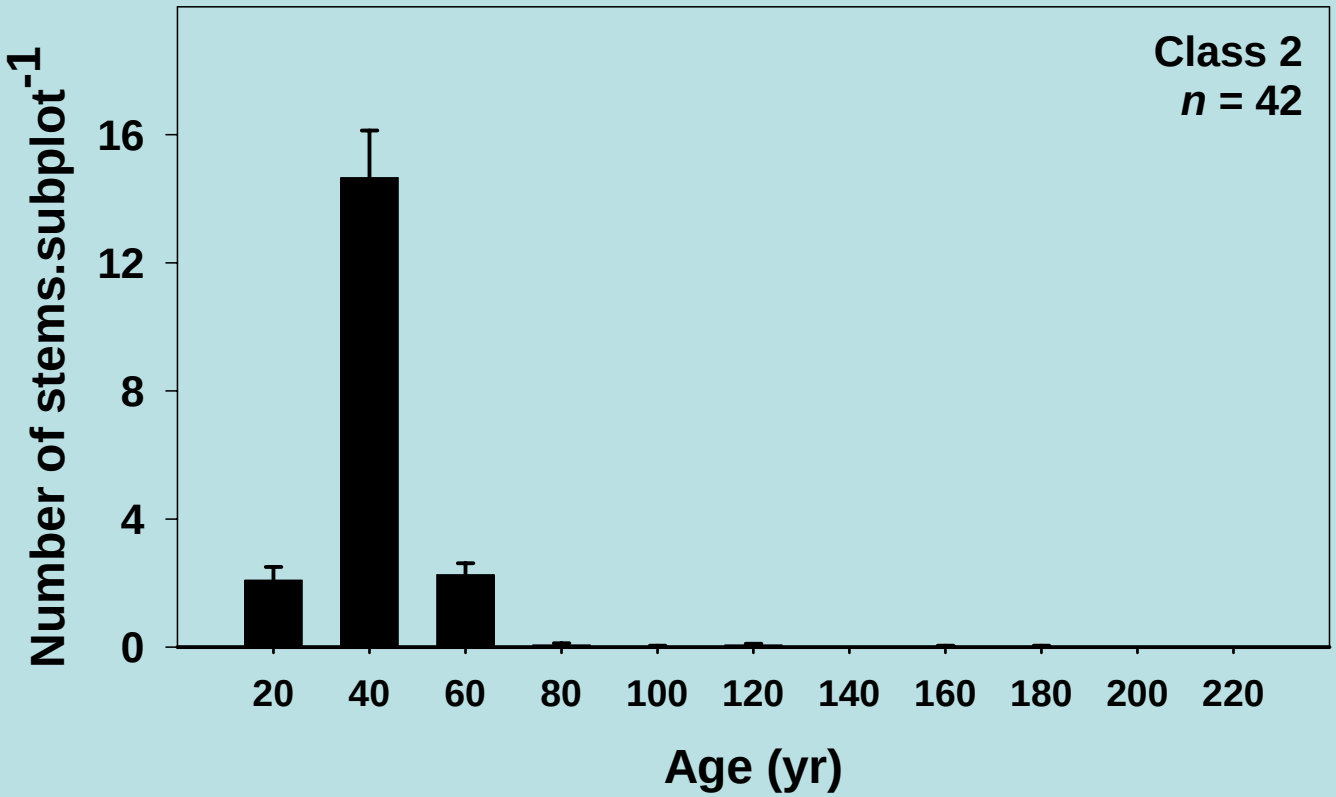
Encroachment Class 0, n=28

Orthocarpus imbricatus

Encroachment Class 1, n=17

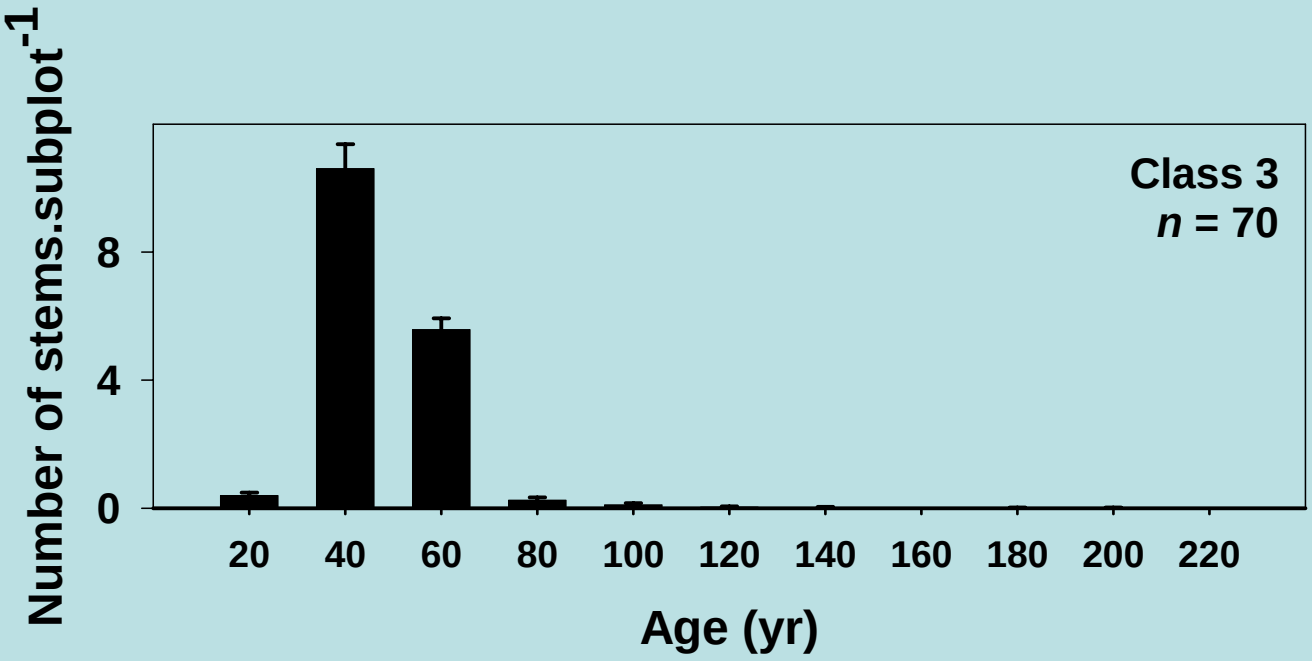


Encroachment Class 2, n=42

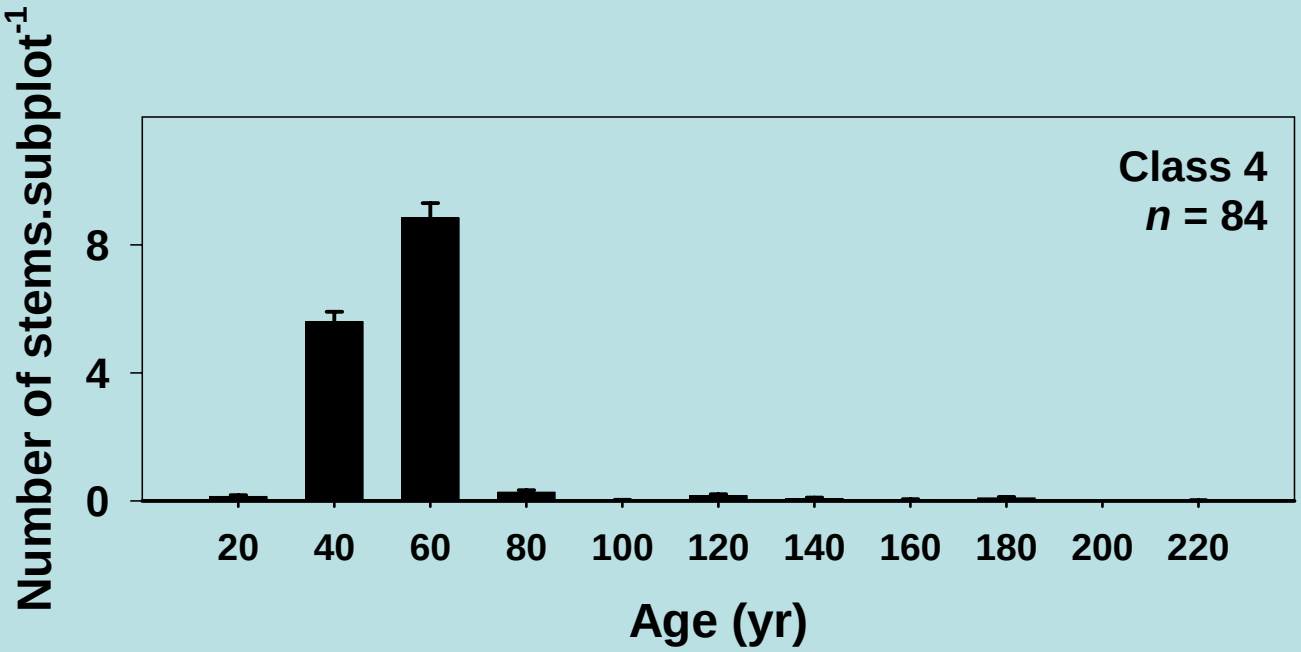


Encroachment Classes 2-3

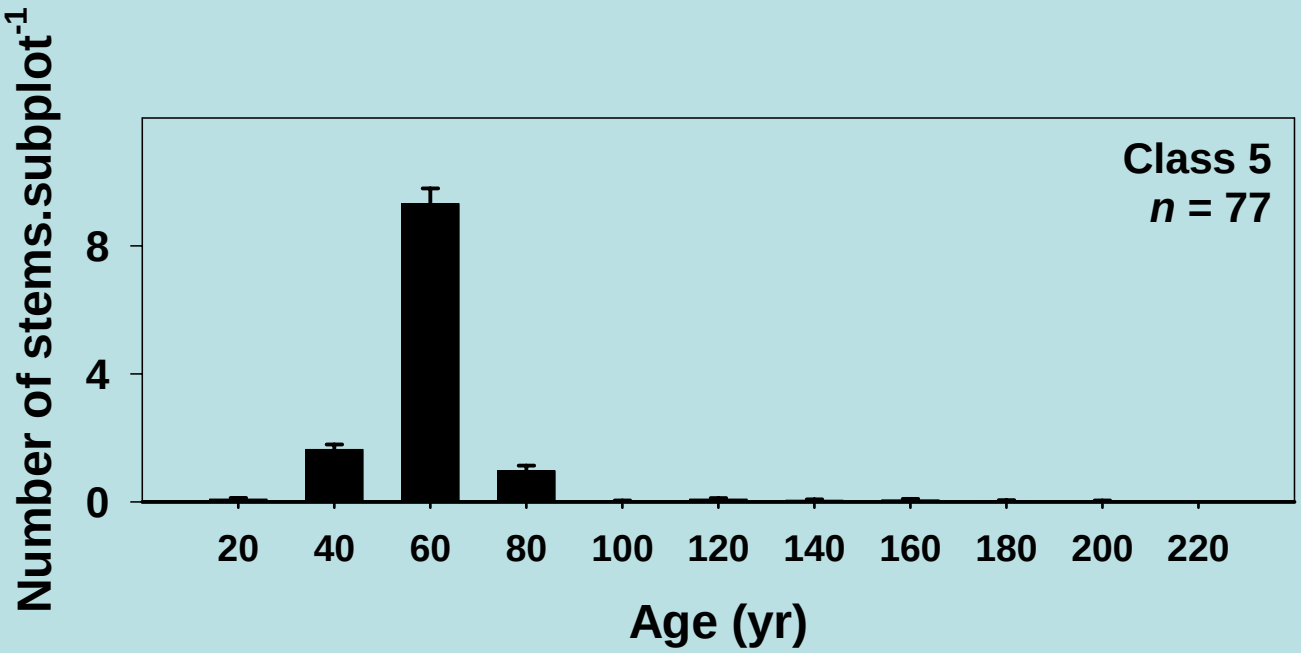
Encroachment Class 3, n=70



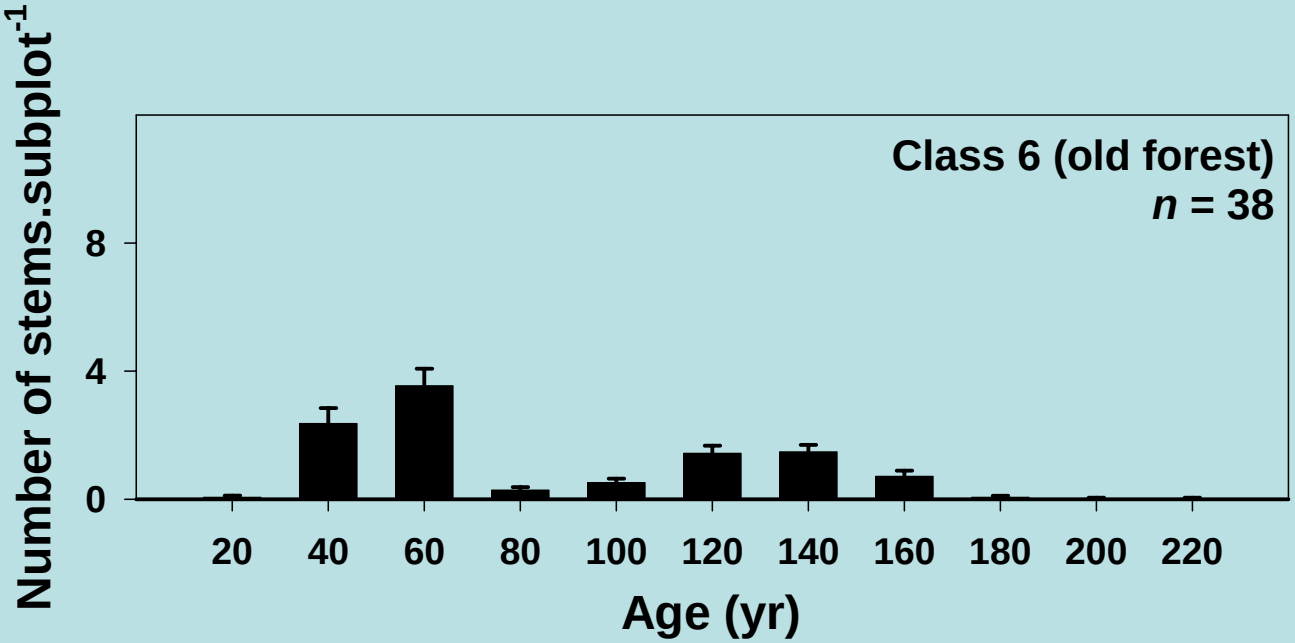
Encroachment Class 4, n=84



Encroachment Class 5, n=77



Encroachment Class 6, n=38



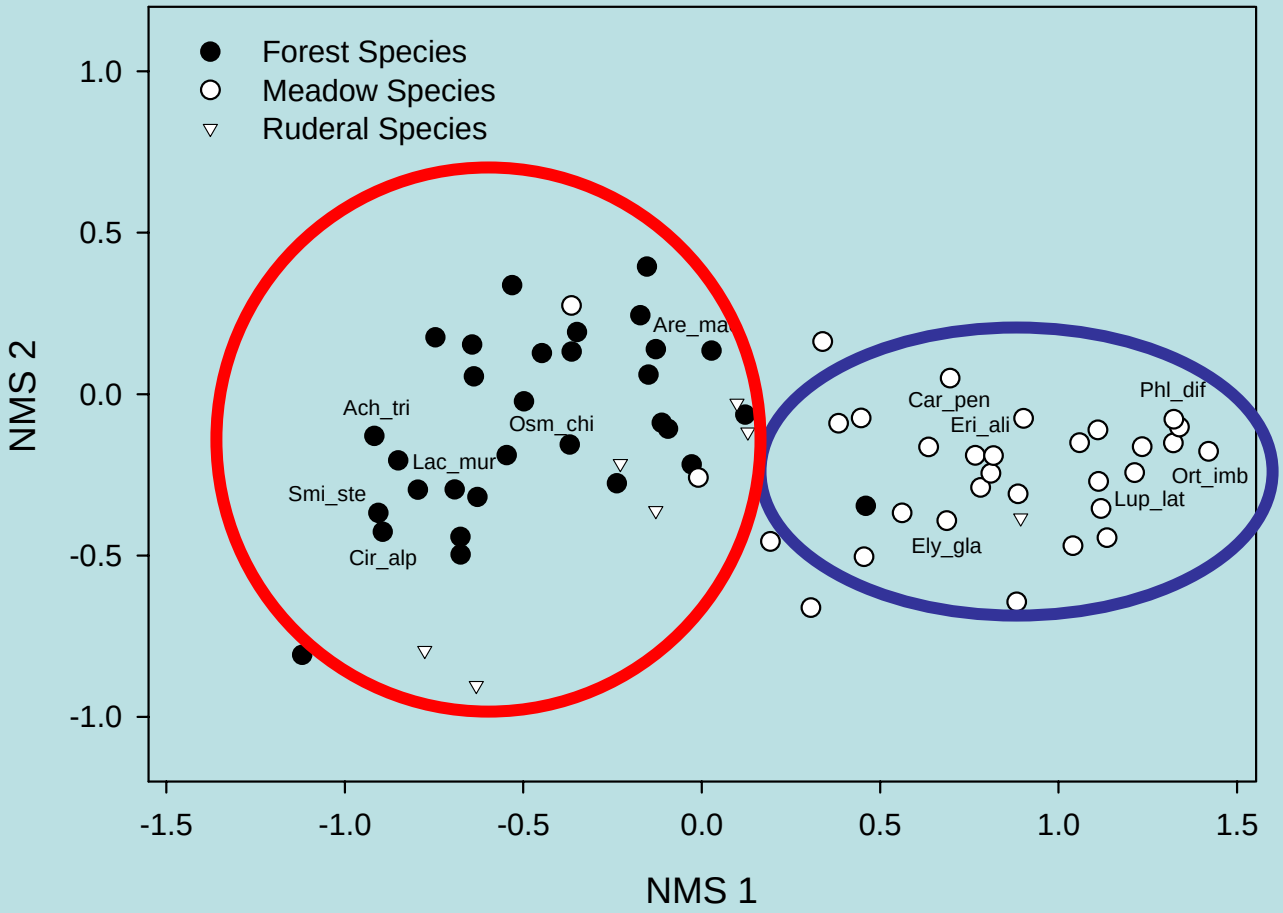
Encroachment Class 6, n=38

Compositional changes

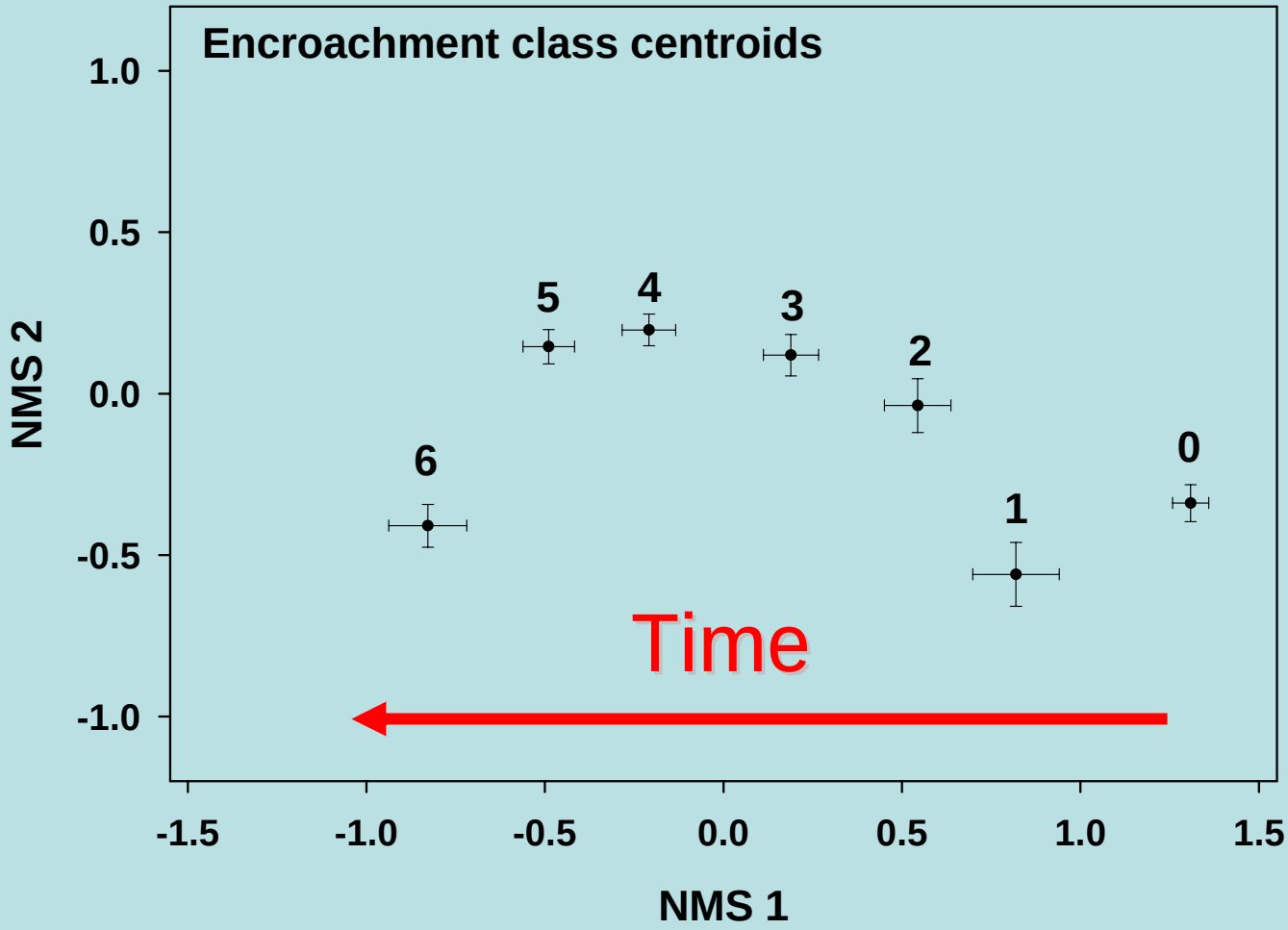
- Nonmetric Multidimentional Scaling (NMS) ordination
- Sørensen’s distance

Compositional changes

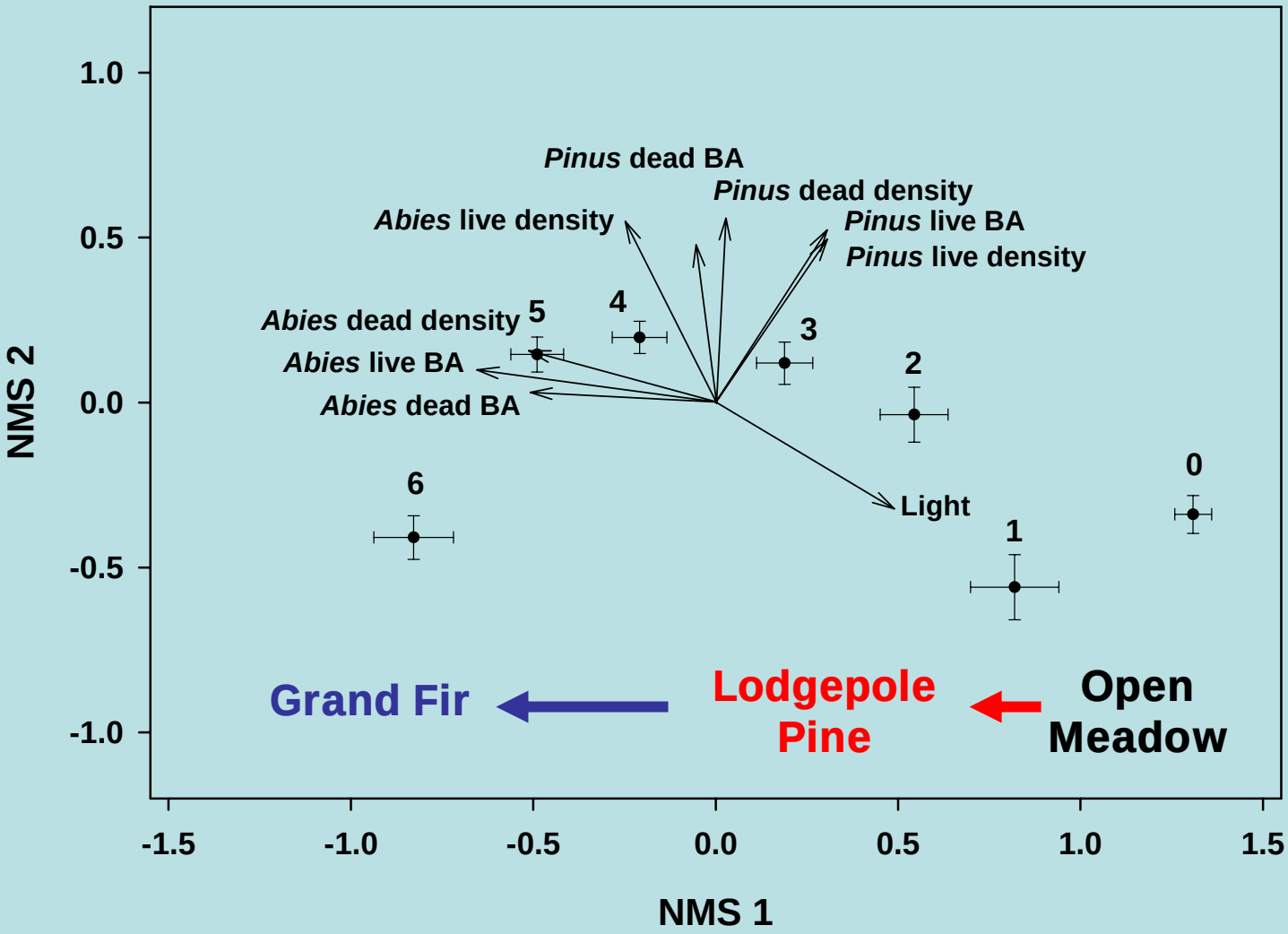
- Strong meadow to forest gradient



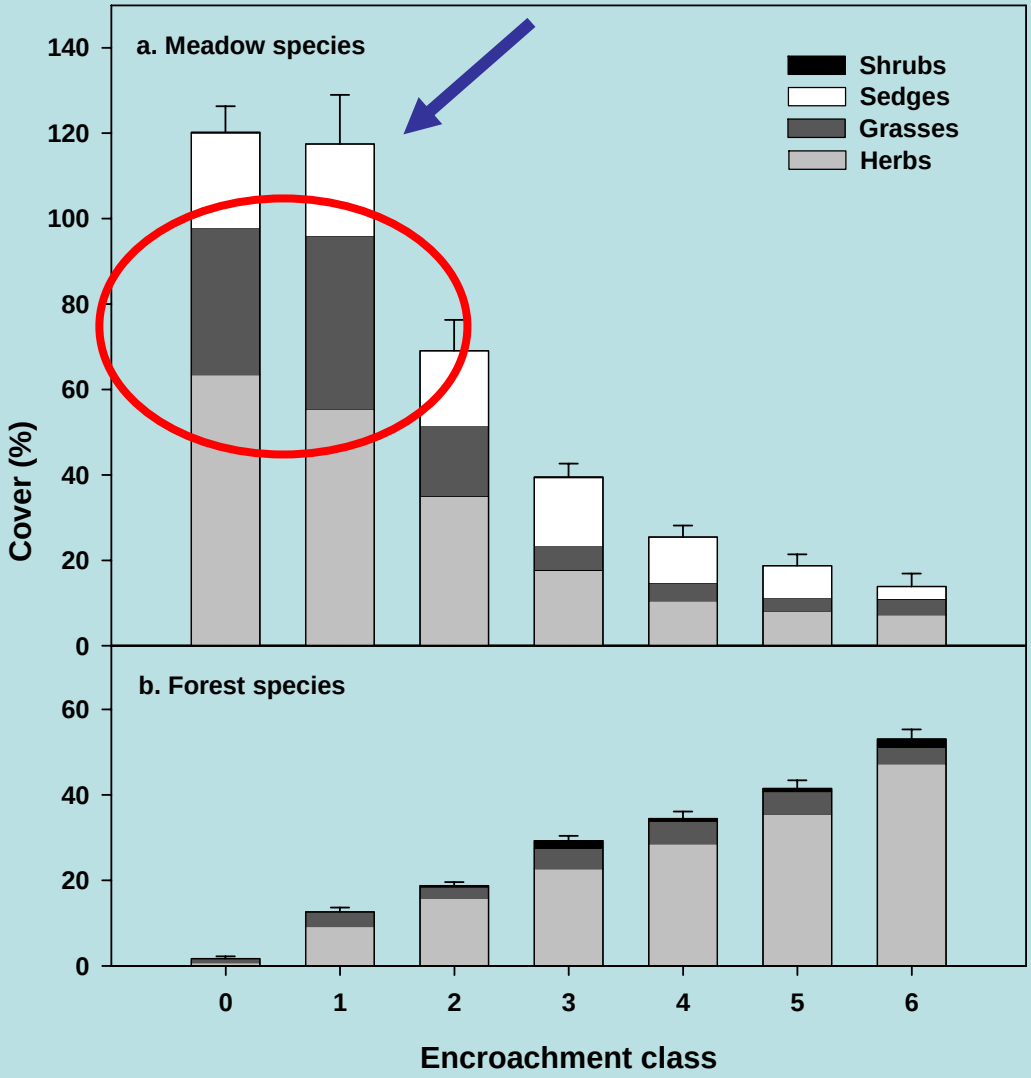
Compositional changes



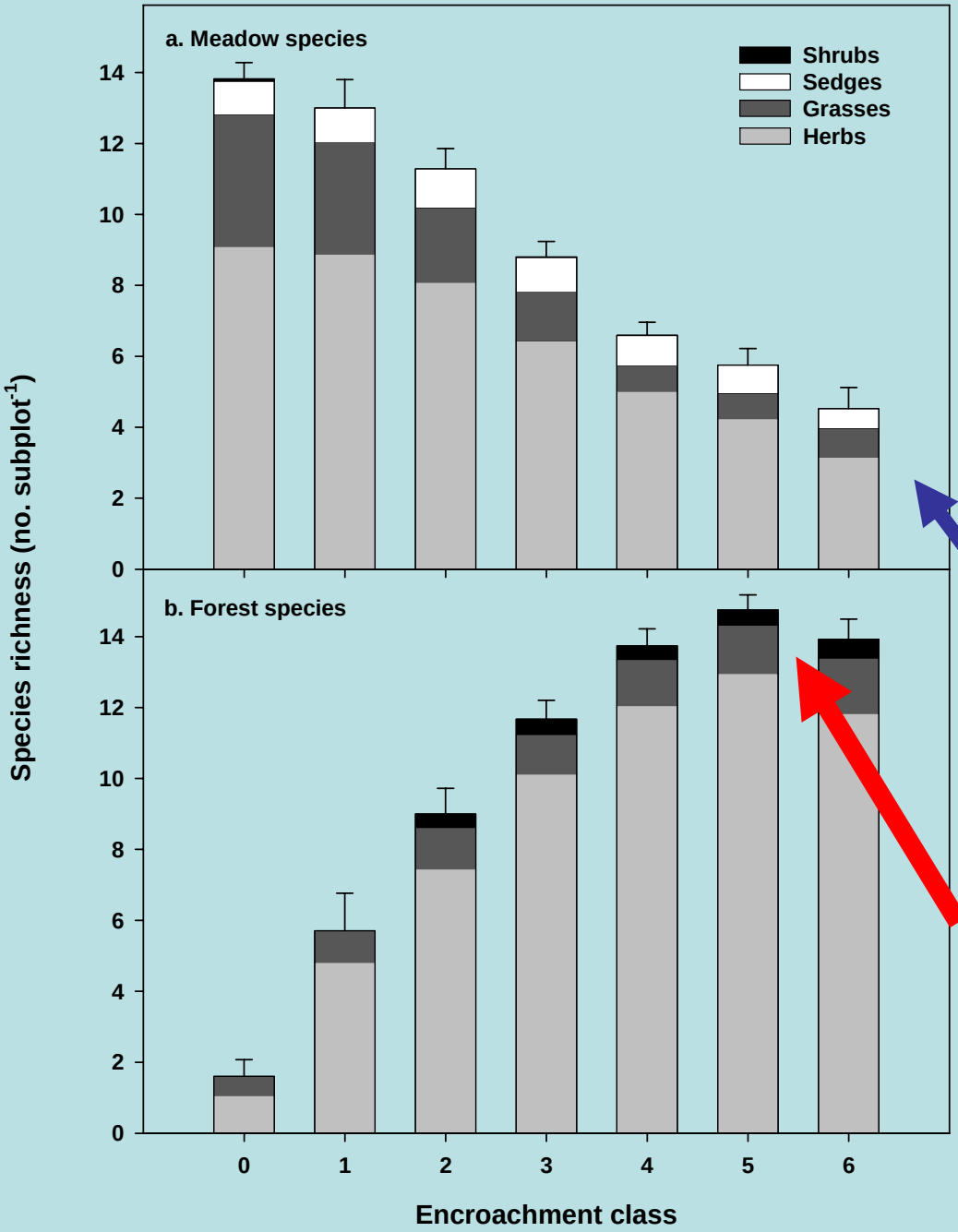
Composition and environment



Meadow / forest cover



- Threshold response for meadow species
- Gradual increase in forest species
  - Low overall cover



Meadow / forest richness

- Progressive meadow decline
- Not completely lost
- More rapid forest increase
- Decline from Class 5 to 6

Class 6 - Old Forest

- Distinct composition (NMS)
- Dominated by strongly clonal species
  - Limits cover / richness of other species

Smilacina stellata

Meadow / Forest species and environment

- Multiple regression models
  - Meadow species: richness, cover
  - Forest species: richness, cover
- Predictors
  - Light
  - Basal area, density
    - Grand fir: live, dead
    - Lodgepole pine: live, dead

Meadow / Forest species and environment

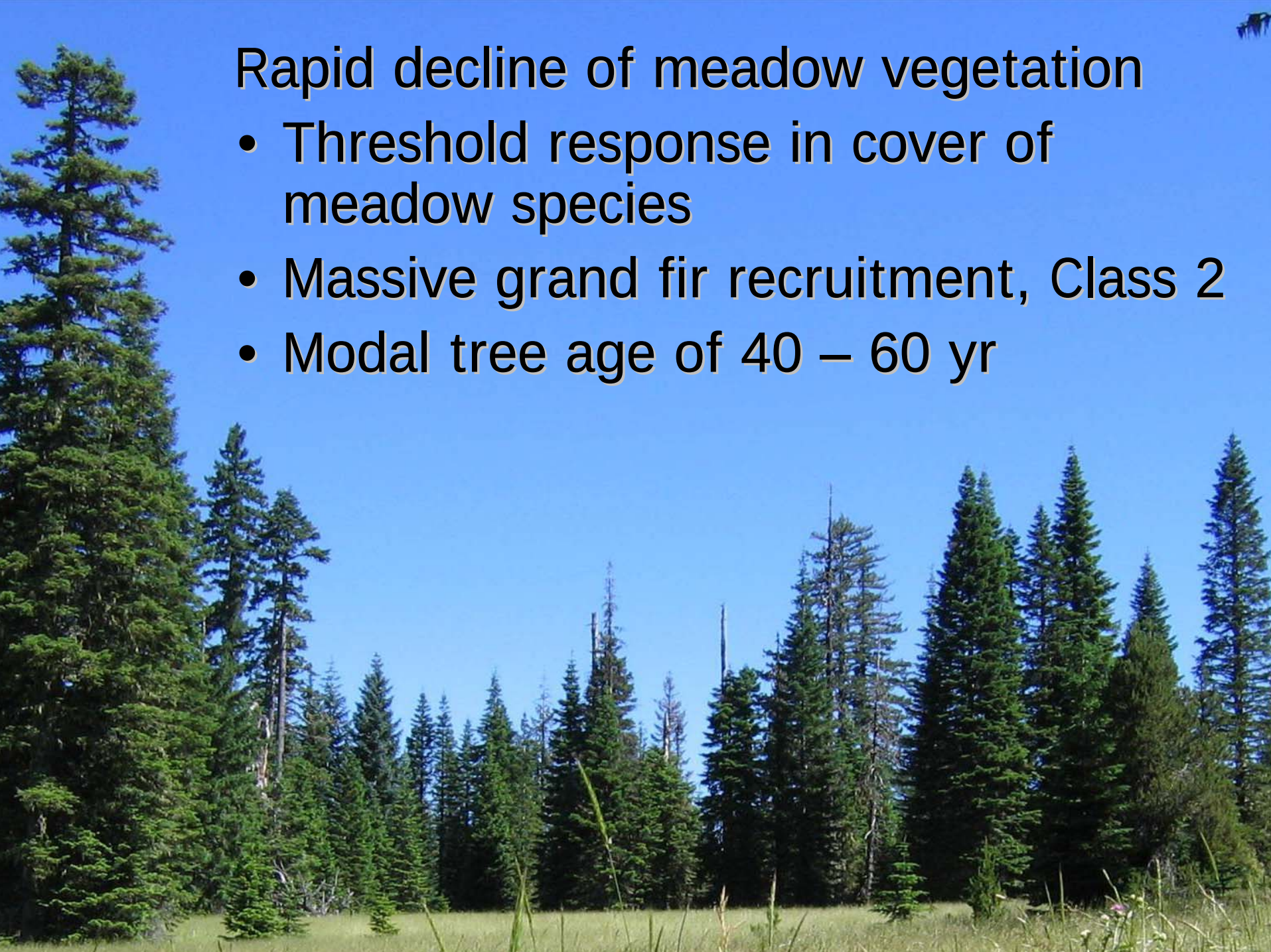
- Meadow cover $R^2 = 0.54$
- Meadow richness $R^2 = 0.48$

- Forest cover $R^2 = 0.34$
- Forest richness $R^2 = 0.42$

- Importance of light

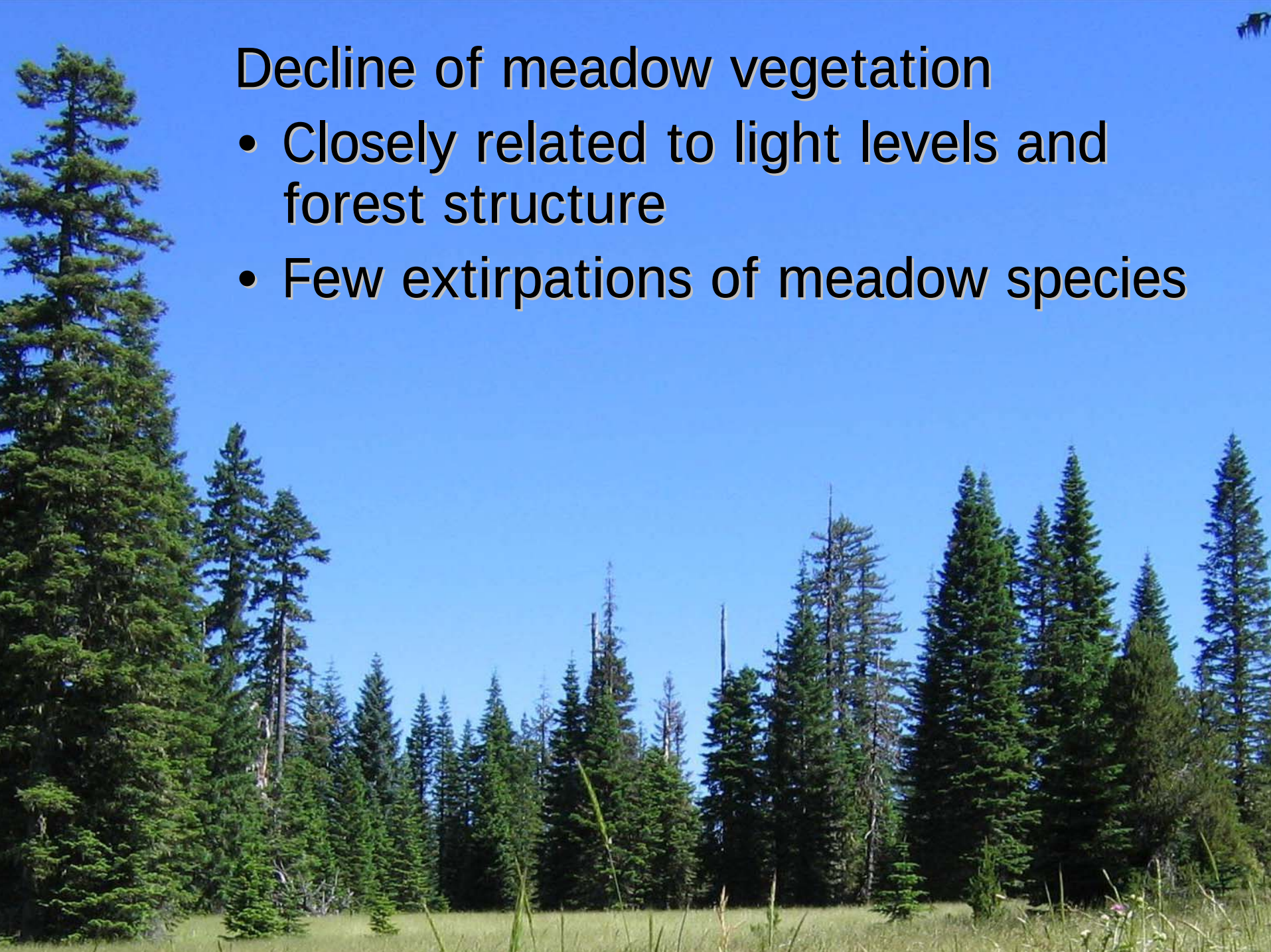
Strong meadow to forest gradient

- Clear progression over time
- Closely related to the lodgepole pine → grand fir transition



Rapid decline of meadow vegetation

- Threshold response in cover of meadow species
- Massive grand fir recruitment, Class 2
- Modal tree age of 40 – 60 yr



Decline of meadow vegetation

- Closely related to light levels and forest structure
- Few extirpations of meadow species

Assembly of forest communities

- Weaker relationship with light and forest structure
- Other factors
  - Dispersal
  - Competition
  - Clonal growth

Assembly of forest communities

- Early initial colonization
- Max. richness in Class 5
- Distinctive “old forest” communities

Management and Restoration?

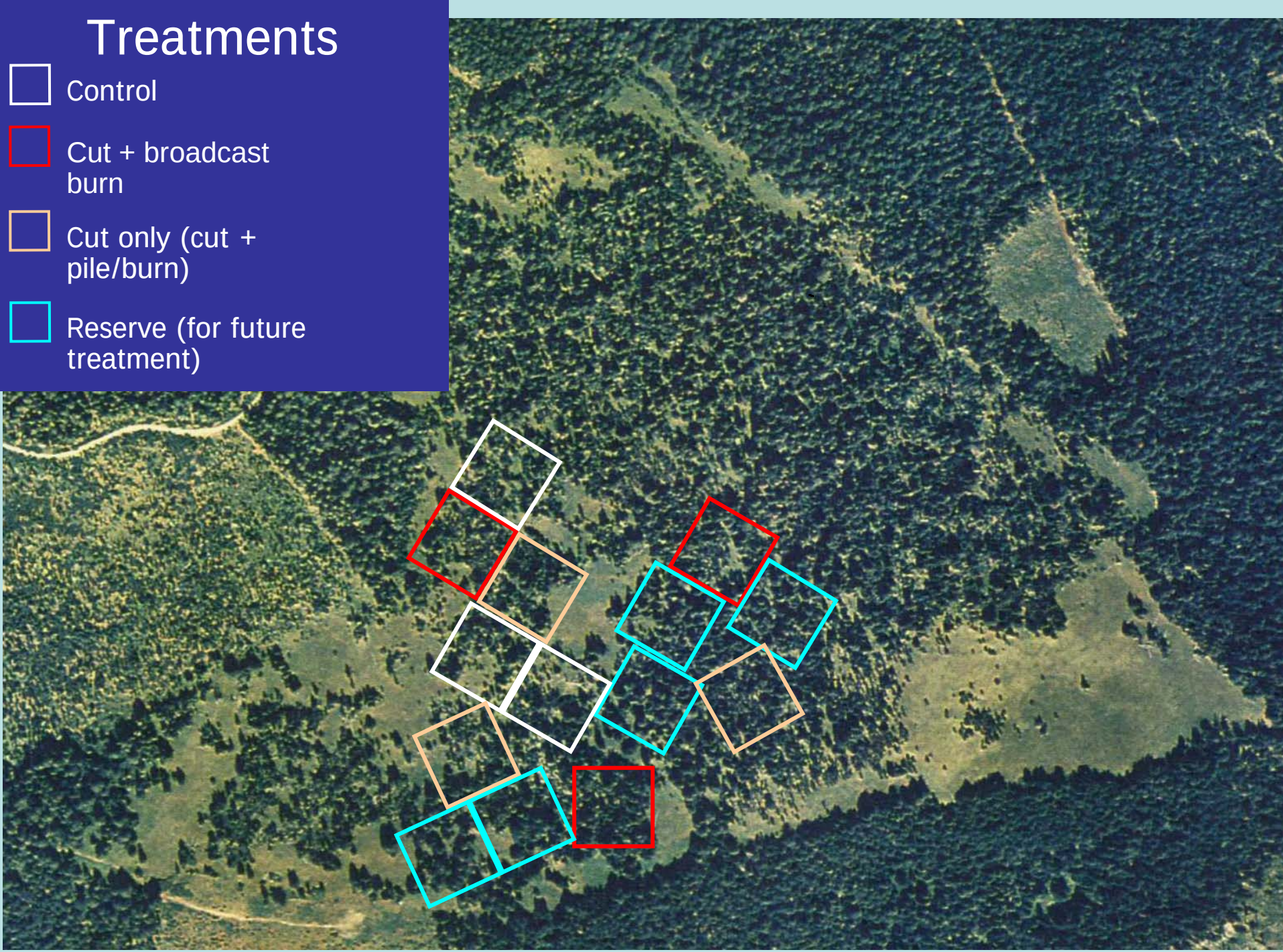
- Early removal of trees
- Persistence of meadow species
- Potential for meadow regeneration from the seed bank?
  - **NO!** (Lang 2006)

Next steps?

- Is restoration of invaded meadows possible?
- Age-dependant responses?
- Is fire a necessary for restoration?

Treatments

- Control
- Cut + broadcast burn
- Cut only (cut + pile/burn)
- Reserve (for future treatment)

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Thanks!

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