

# Conifer encroachment of montane meadows: effects on vegetation, seed banks and potential for restoration

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*Photo: Jim Lutz*

- Value of unique, open meadow communities
  - Biodiversity
  - Wildlife habitat
  - Cultural resources



# The problem...

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



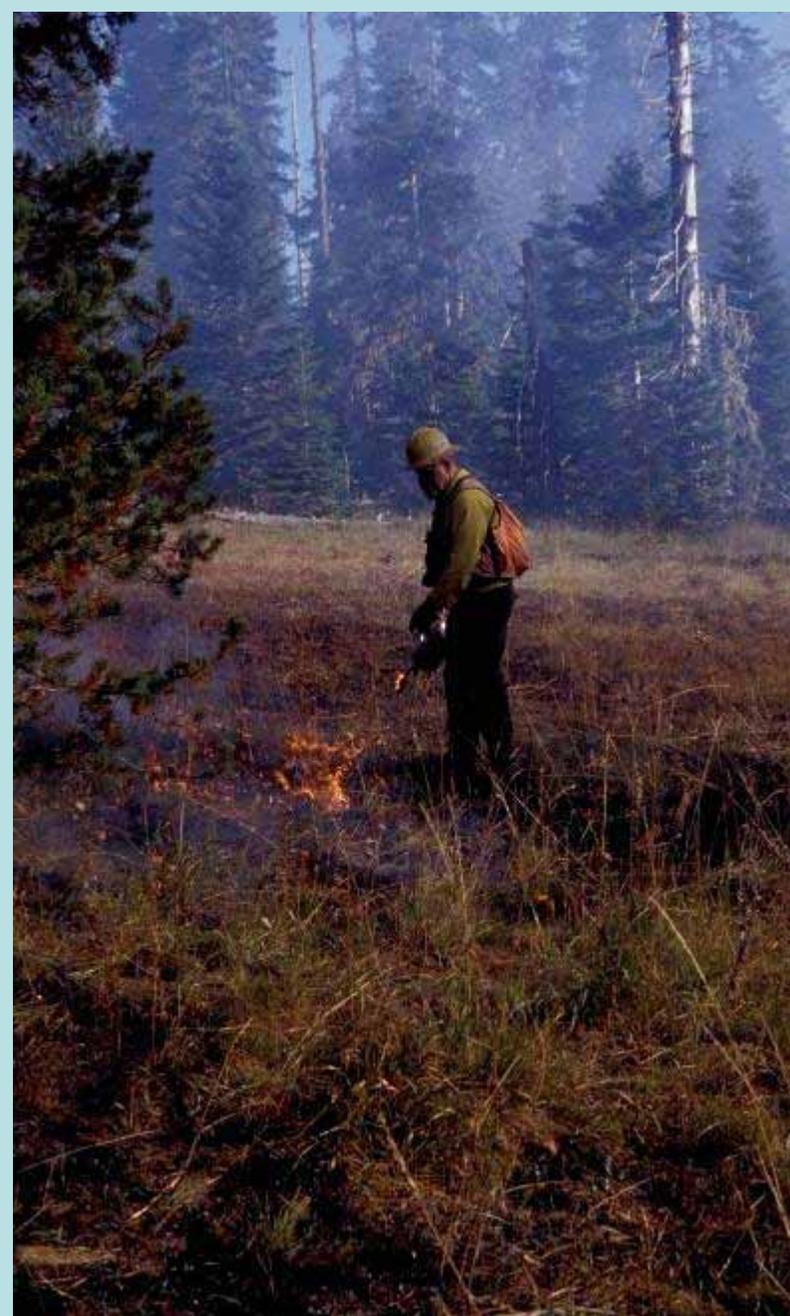
# The problem...

- Focus on the causes
  - Fire suppression
  - Climate change
  - Grazing



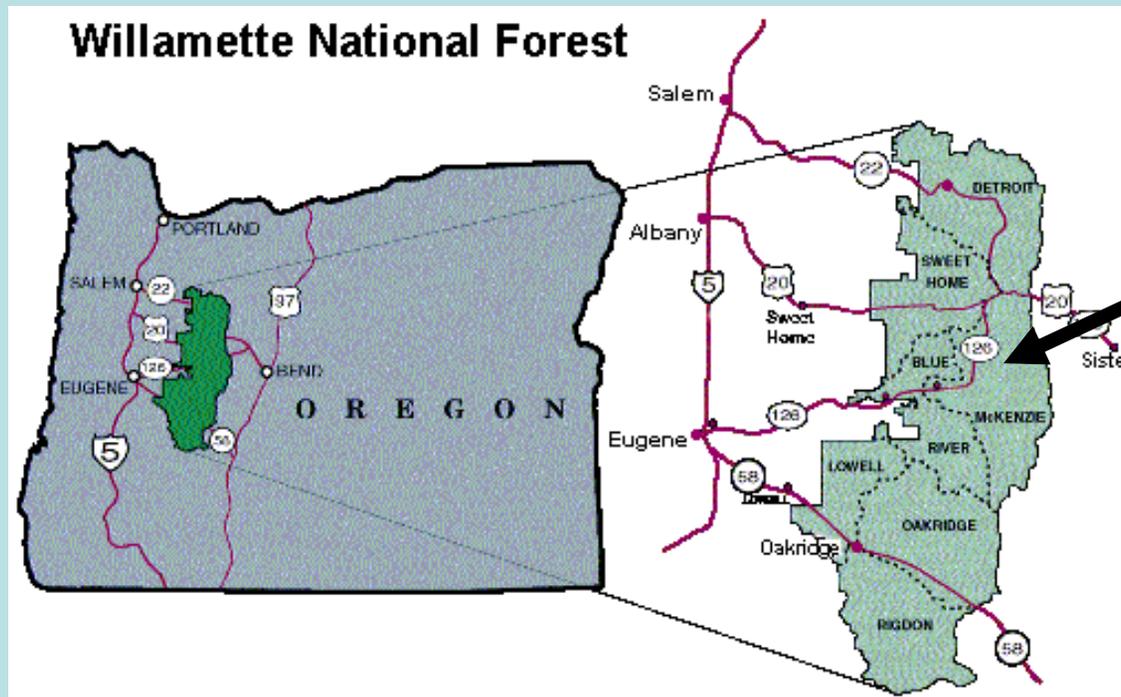
# The problem...

- Very little understanding of:
  - Vegetation dynamics
  - Restoration potential
  - Effectiveness of restoration treatments



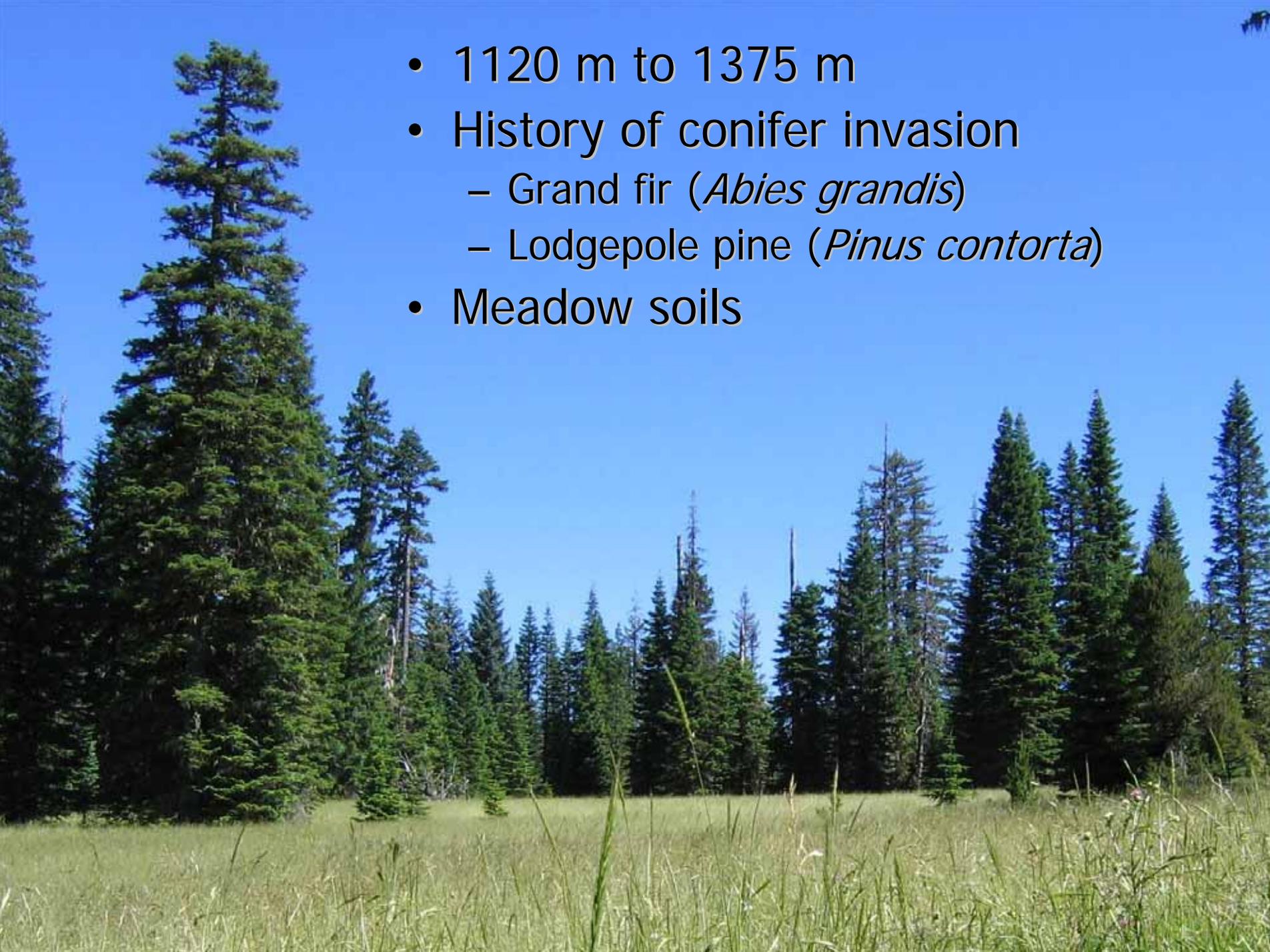
# Bunchgrass Ridge, OR

- Dry, montane meadow
- Willamette NF Special Habitat Area

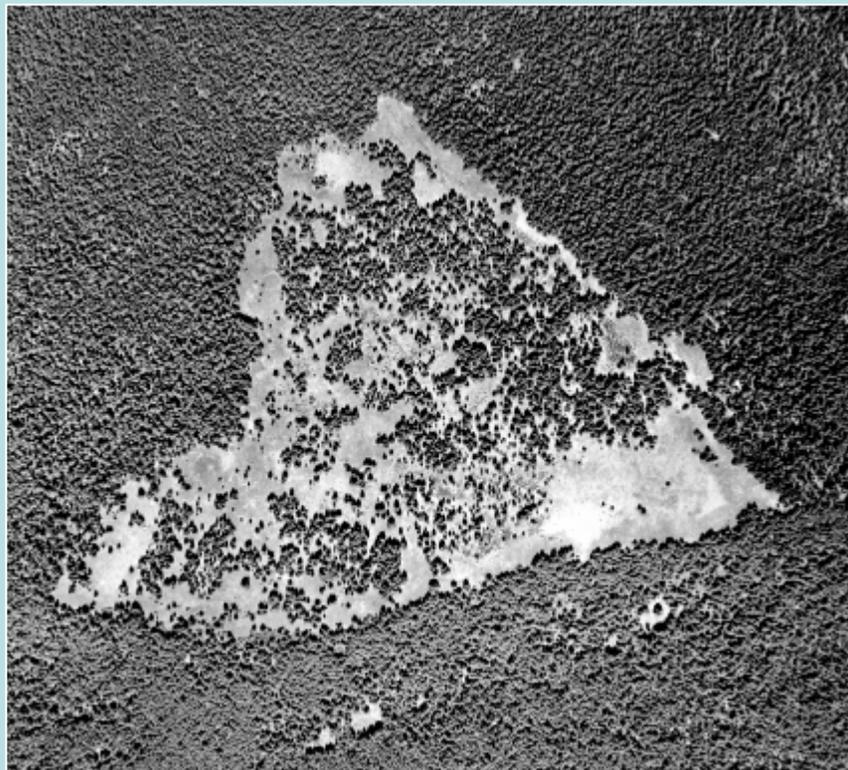


Bunchgrass  
Meadow

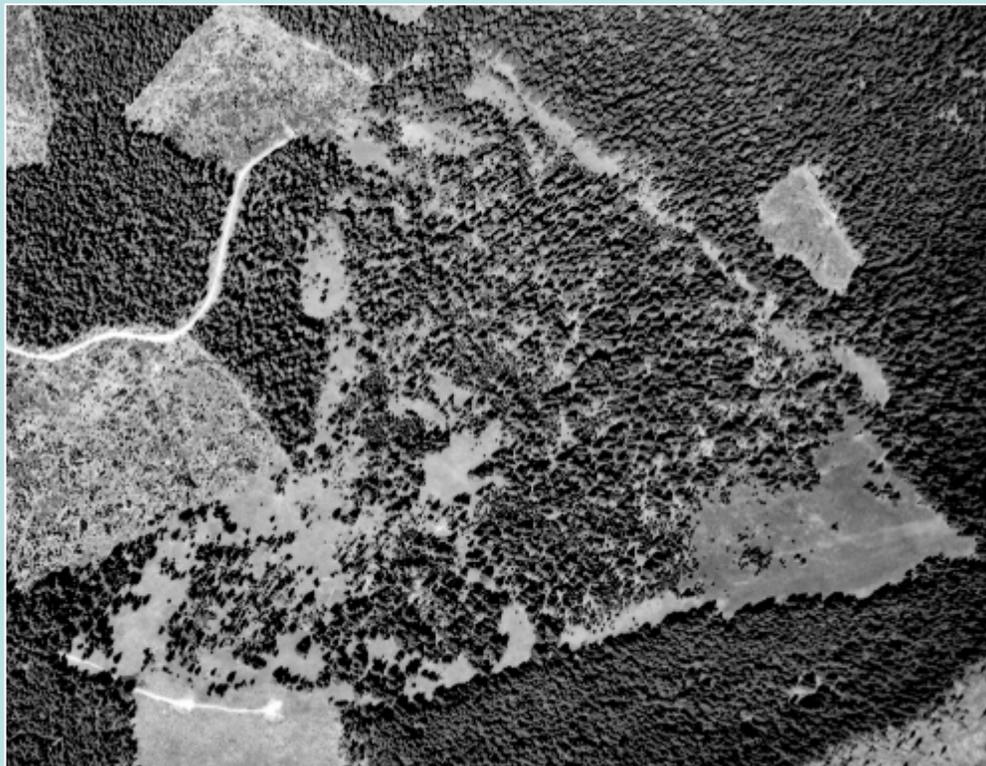
- 1120 m to 1375 m
- History of conifer invasion
  - Grand fir (*Abies grandis*)
  - Lodgepole pine (*Pinus contorta*)
- Meadow soils



1946



1997

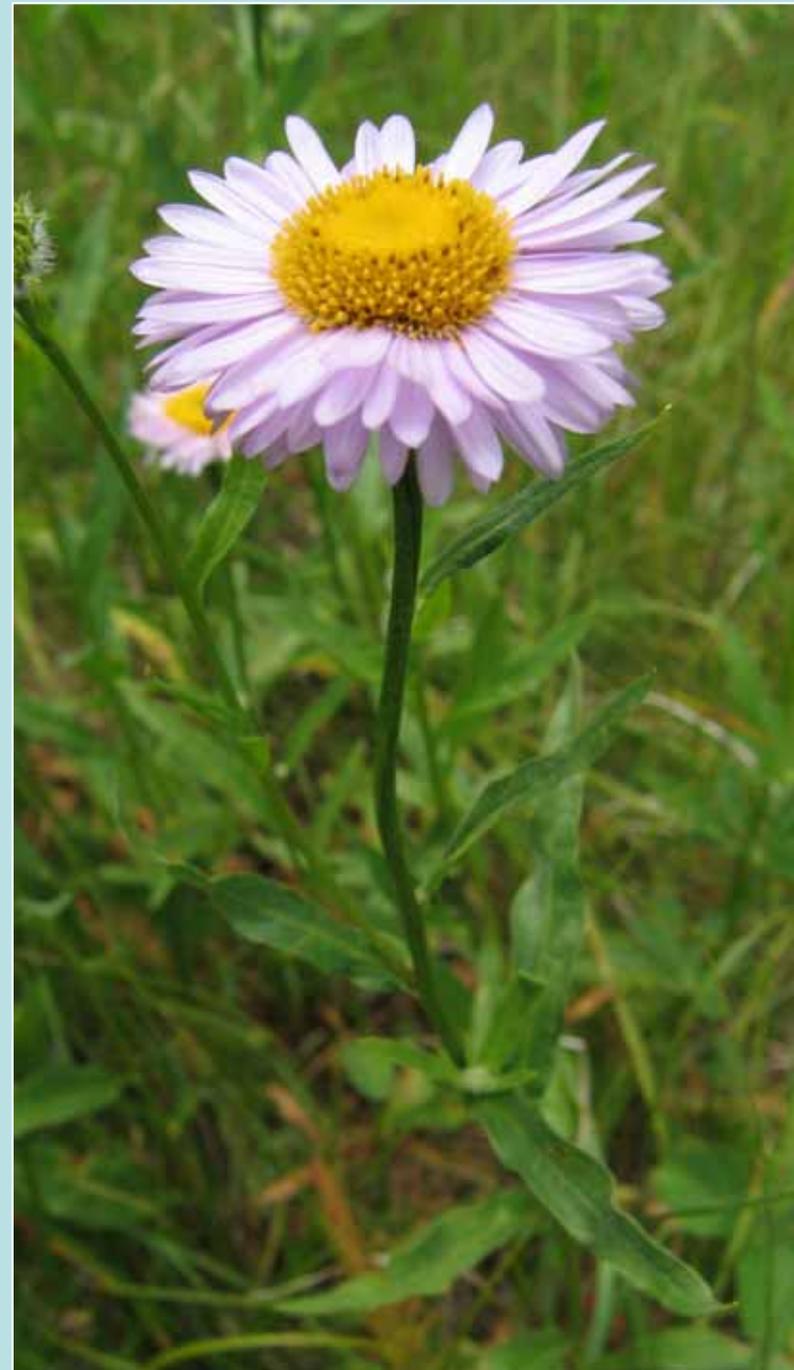


1. **Vegetation Dynamics** — R Haugo
2. **Seed bank Dynamics** — N Lang
3. **Experimental Restoration** — In progress



# Vegetation Dynamics

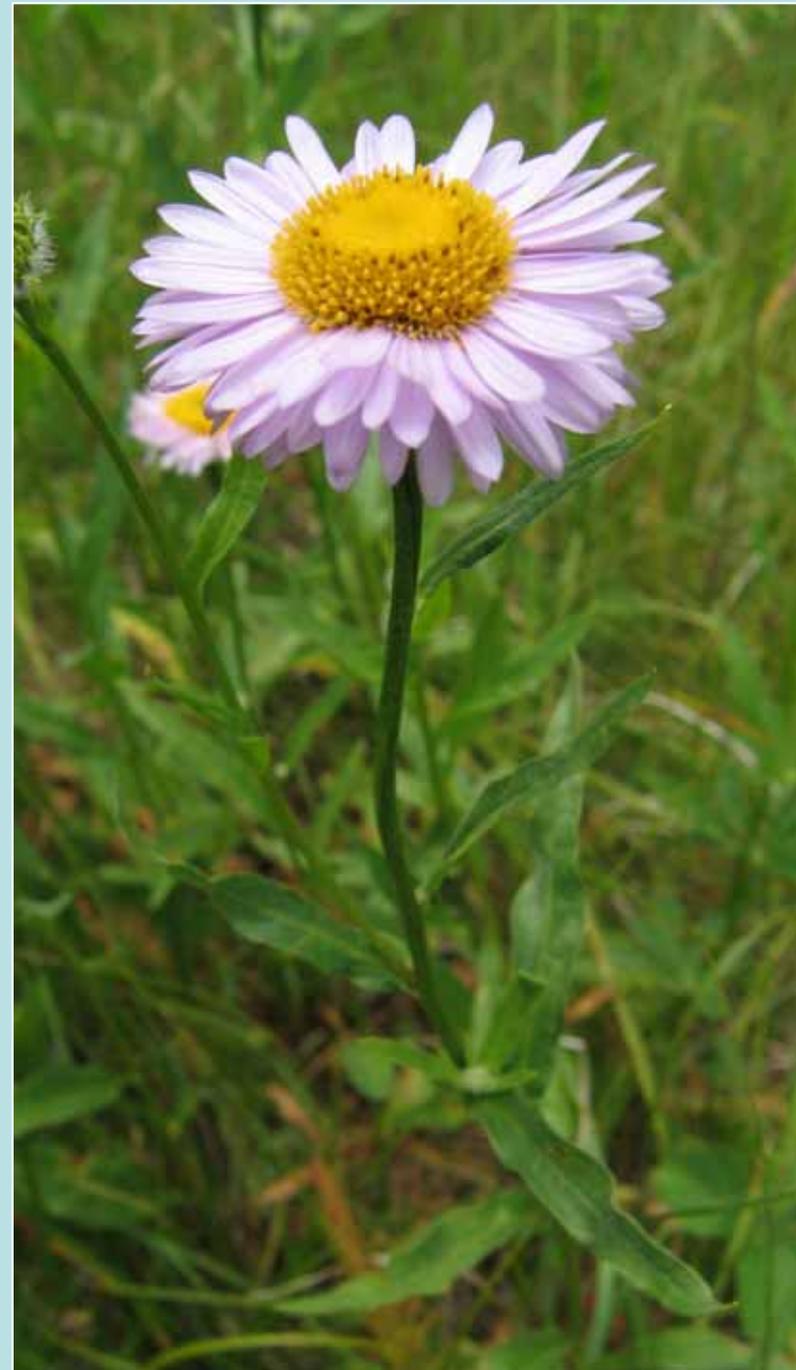
- Temporal changes in vegetation
  - Community composition
  - Meadow and forest species
    - Abundance (cover)
    - Richness



*Erigeron aliceae*

# Vegetation Dynamics

- Relationship between vegetation and environmental changes
  - Light levels and stand structure



*Erigeron aliceae*



# Field sampling

- 4, 1 ha blocks
- 356 10 x 10 m subplots
  - Basic sample unit
- Census of all overstory trees
  - Species, size, age, location
- Light levels
- Vegetation sampling



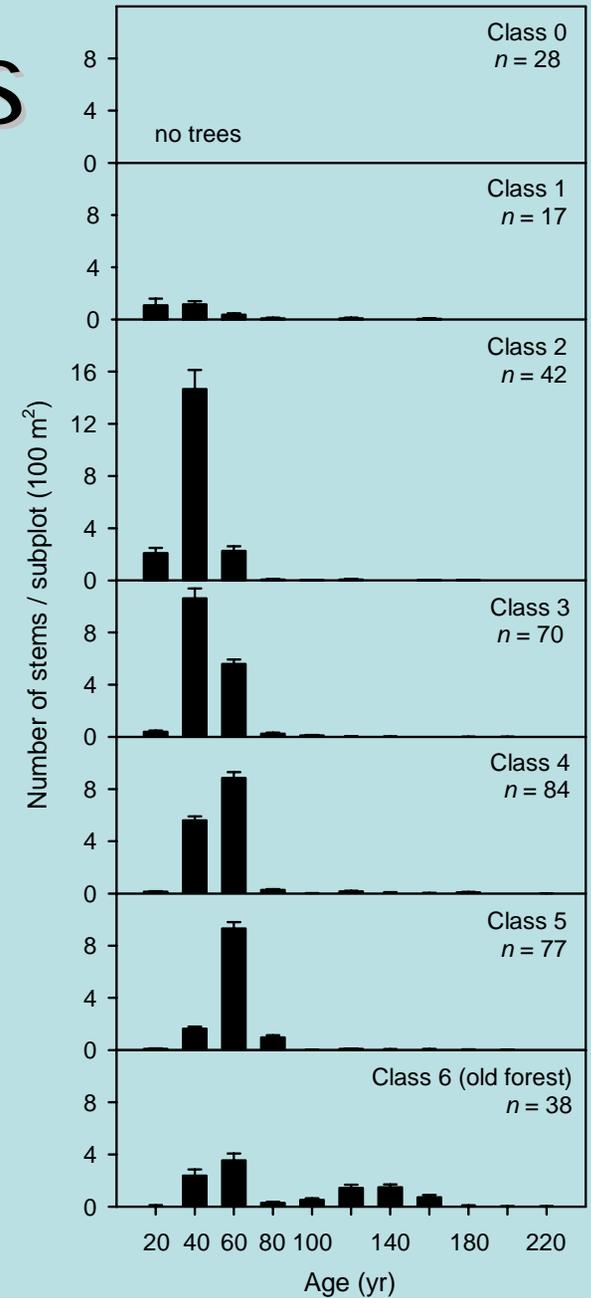


# Chronosequence

- Temporal changes
  - > space for time substitution
- Seven encroachment classes
  - Class 0 (open meadow) to Class 6 (old forest)

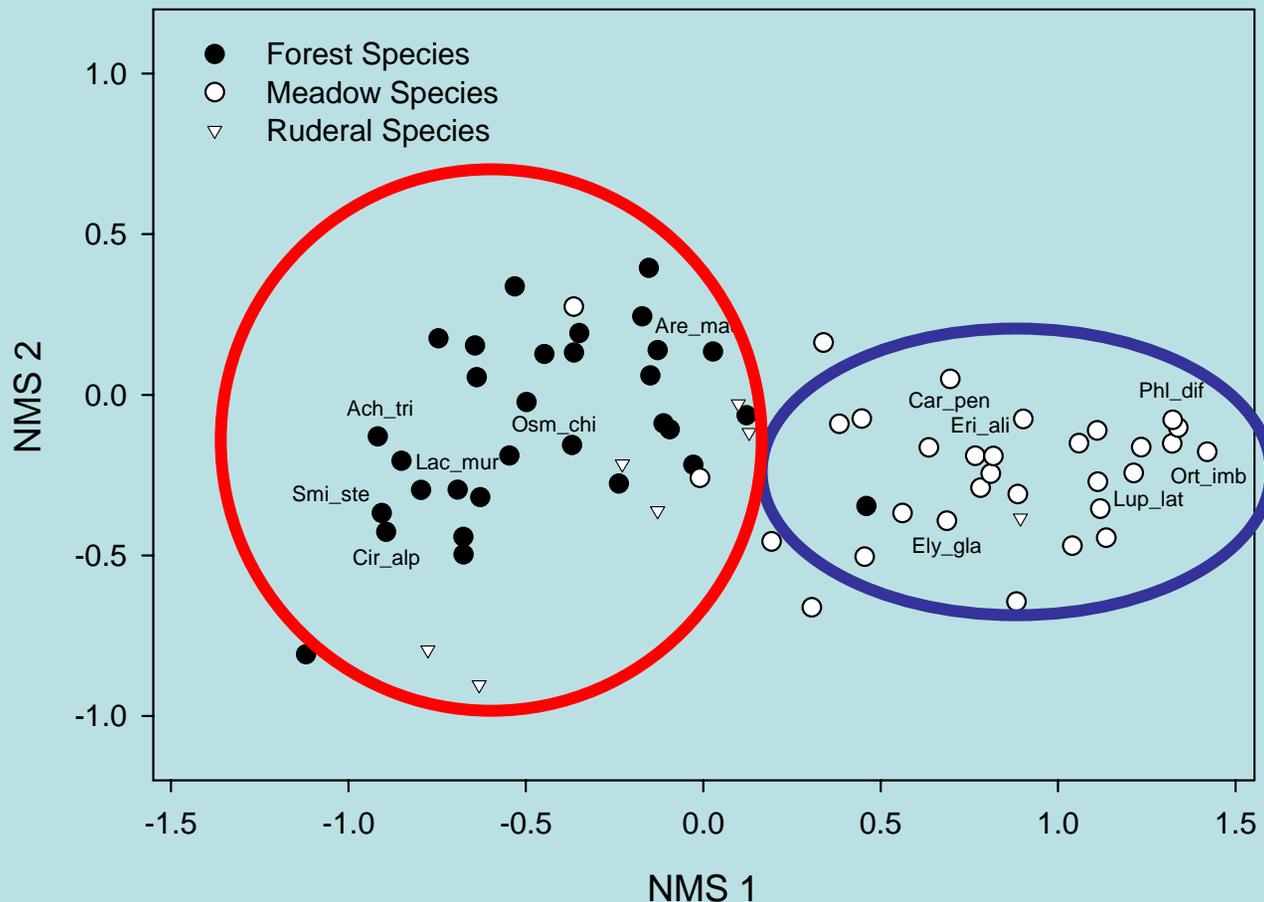
*Aquilegia formosa*

# Encroachment Classes



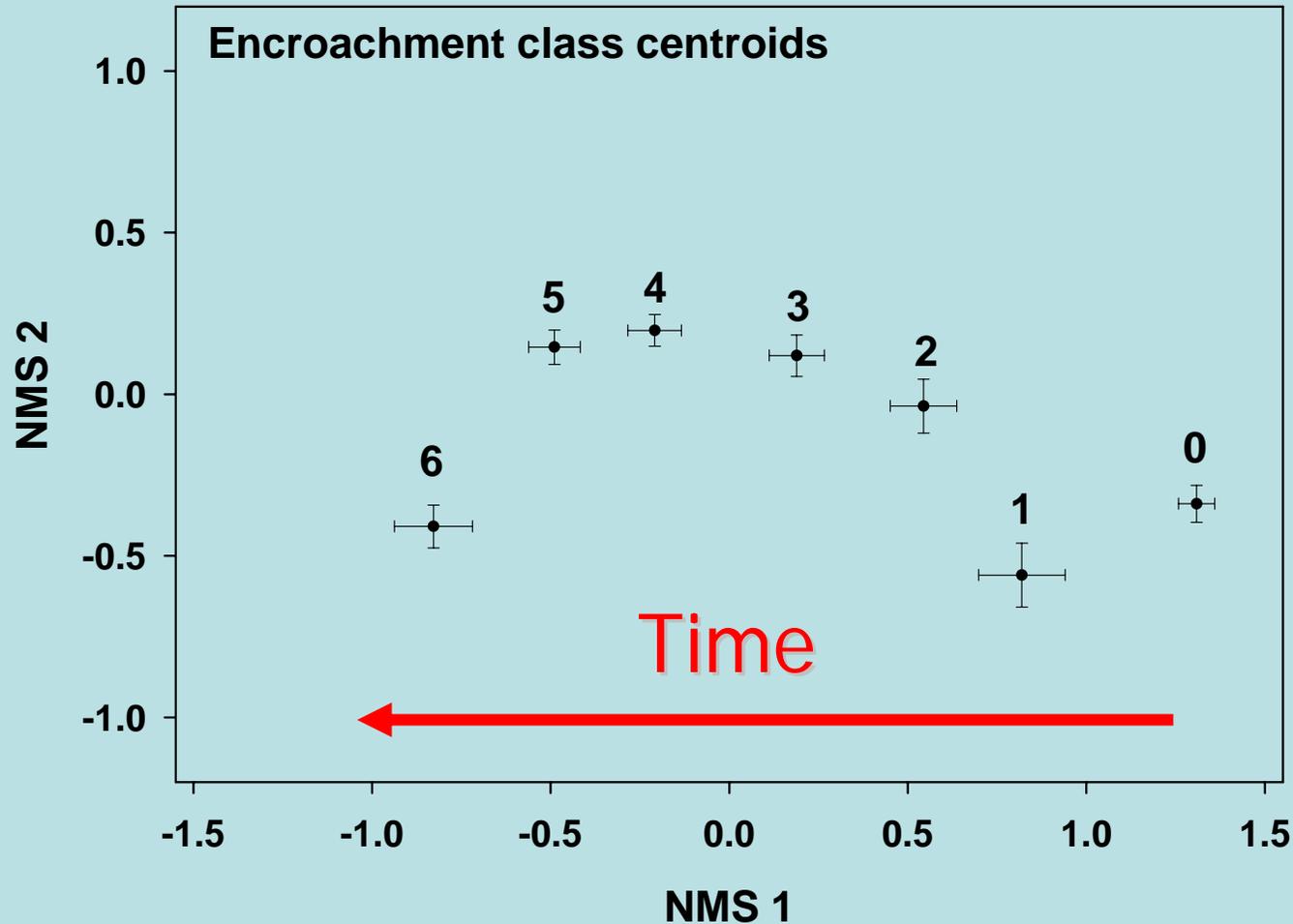
# Compositional changes

- Nonmetric Multidimensional Scaling (NMS) ordination
- Strong meadow to forest gradient



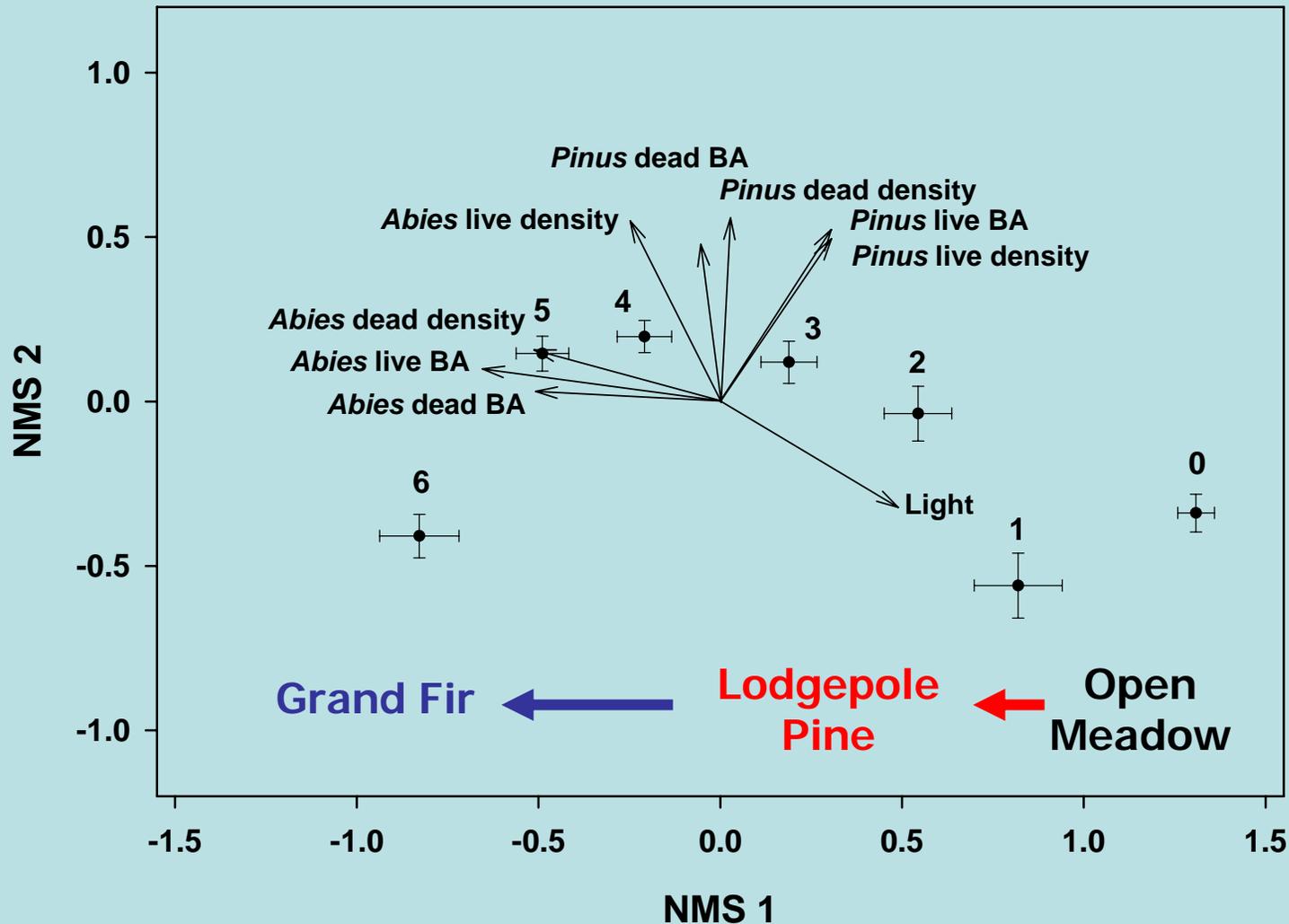
# Compositional changes

- NMS and age class centroids

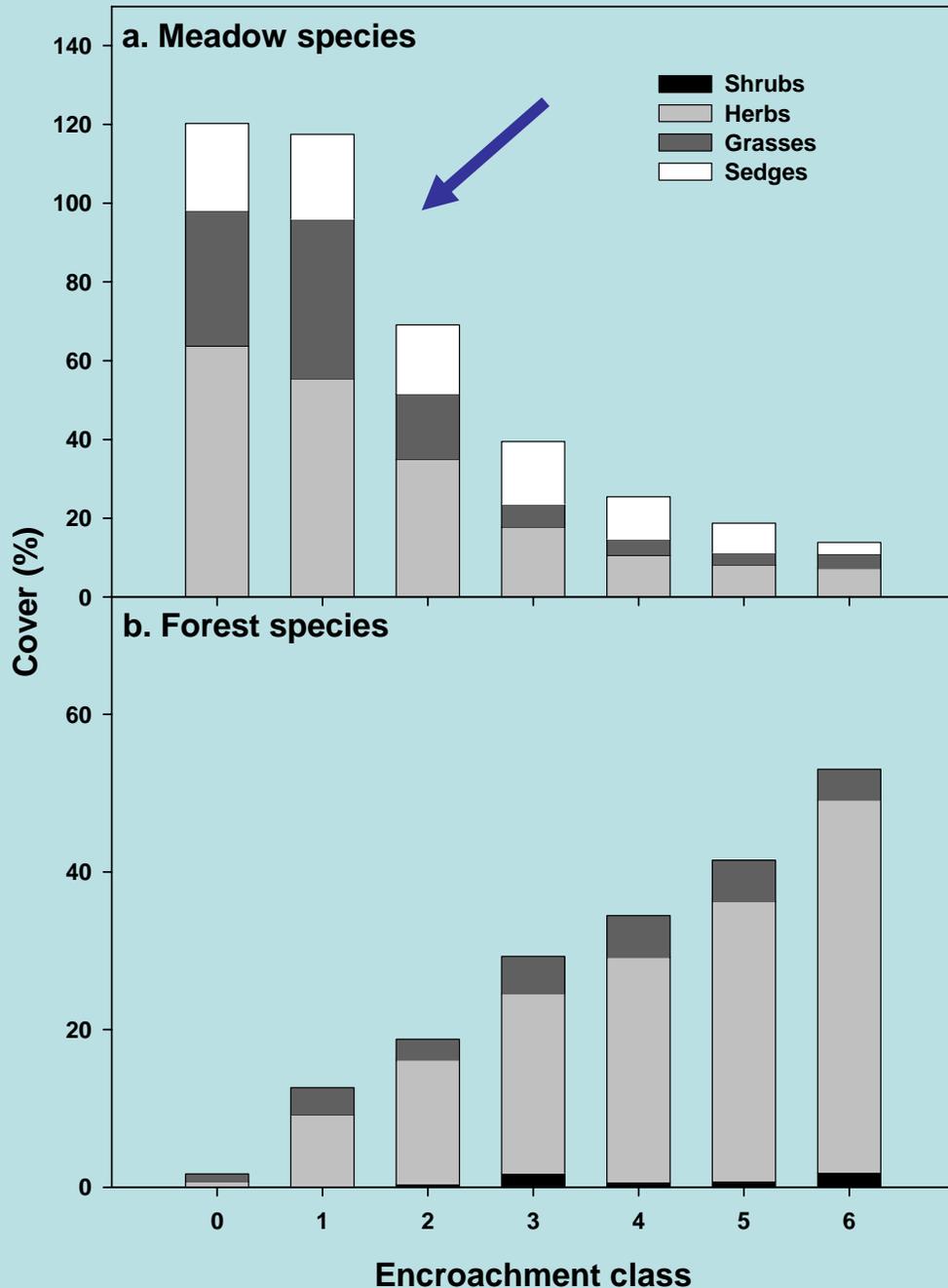


# Composition and Environment

- Spearman rank correlations

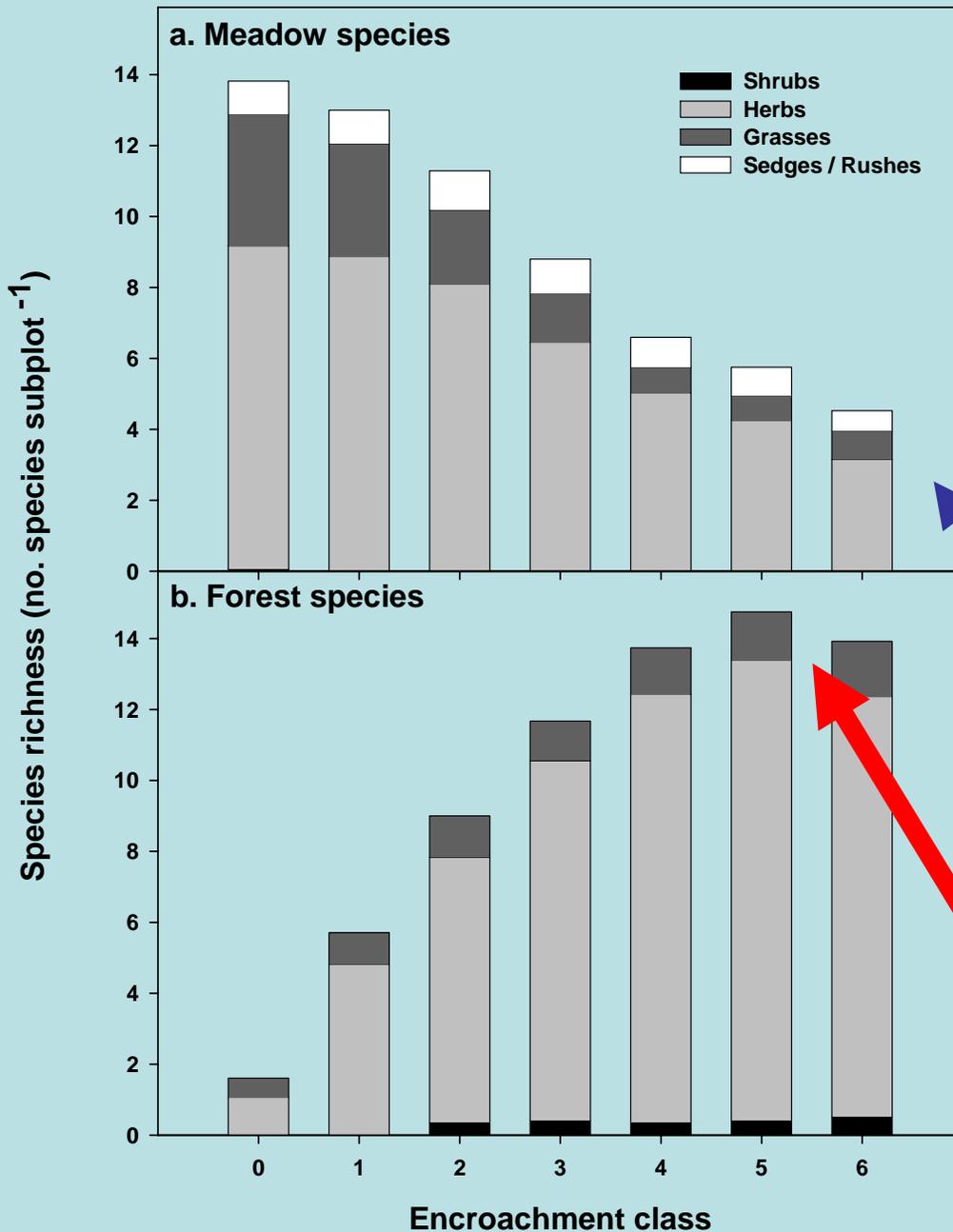


# Meadow / Forest Cover



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

# Meadow / Forest Richness



- Progressive meadow decline
- Not completely lost

- More rapid forest increase
- Decline from Class 5 to 6

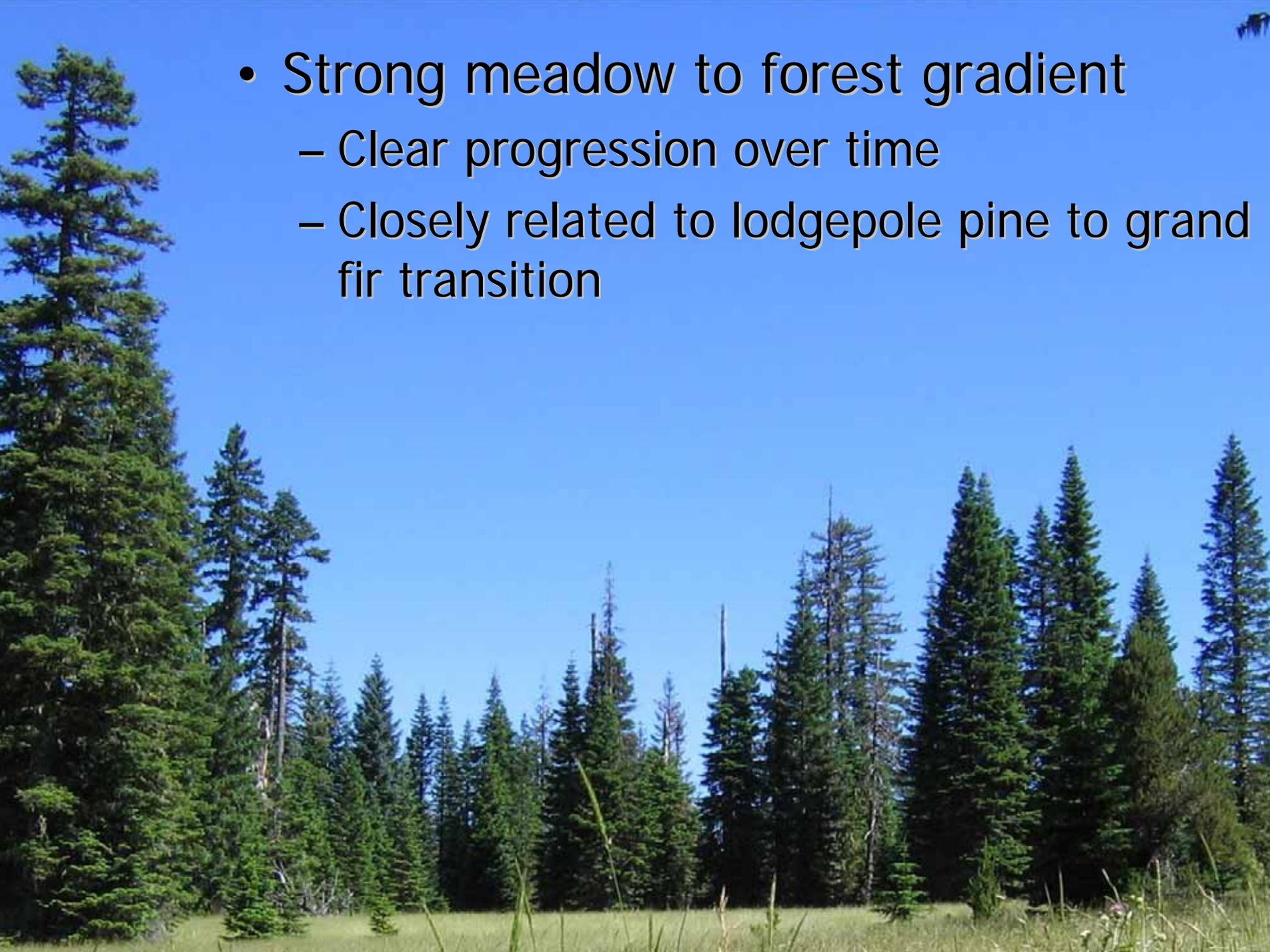
# Class 6 - Old Forest

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

*Smilacina stellata*



- Strong meadow to forest gradient
  - Clear progression over time
  - Closely related to lodgepole pine to grand fir transition



- Rapid decline of meadow vegetation
  - Threshold response in cover meadow cover
  - Mode tree age of 40 – 60 years
- Did not experience complete extirpation



- Decline of meadow vegetation
  - Closely related to light levels and forest structure
- Colonization of forest species
  - Weaker relationship with light and structure
  - Distinctive old forest understories



- Management and Restoration?
  - Early removal of trees
  - Persistence of meadow species
  - Potential for regeneration from the seed bank?



# Seed Bank Response

- Temporal changes in composition of the soil seed bank
  - Open Meadow
  - Young Forest
  - Old Forest

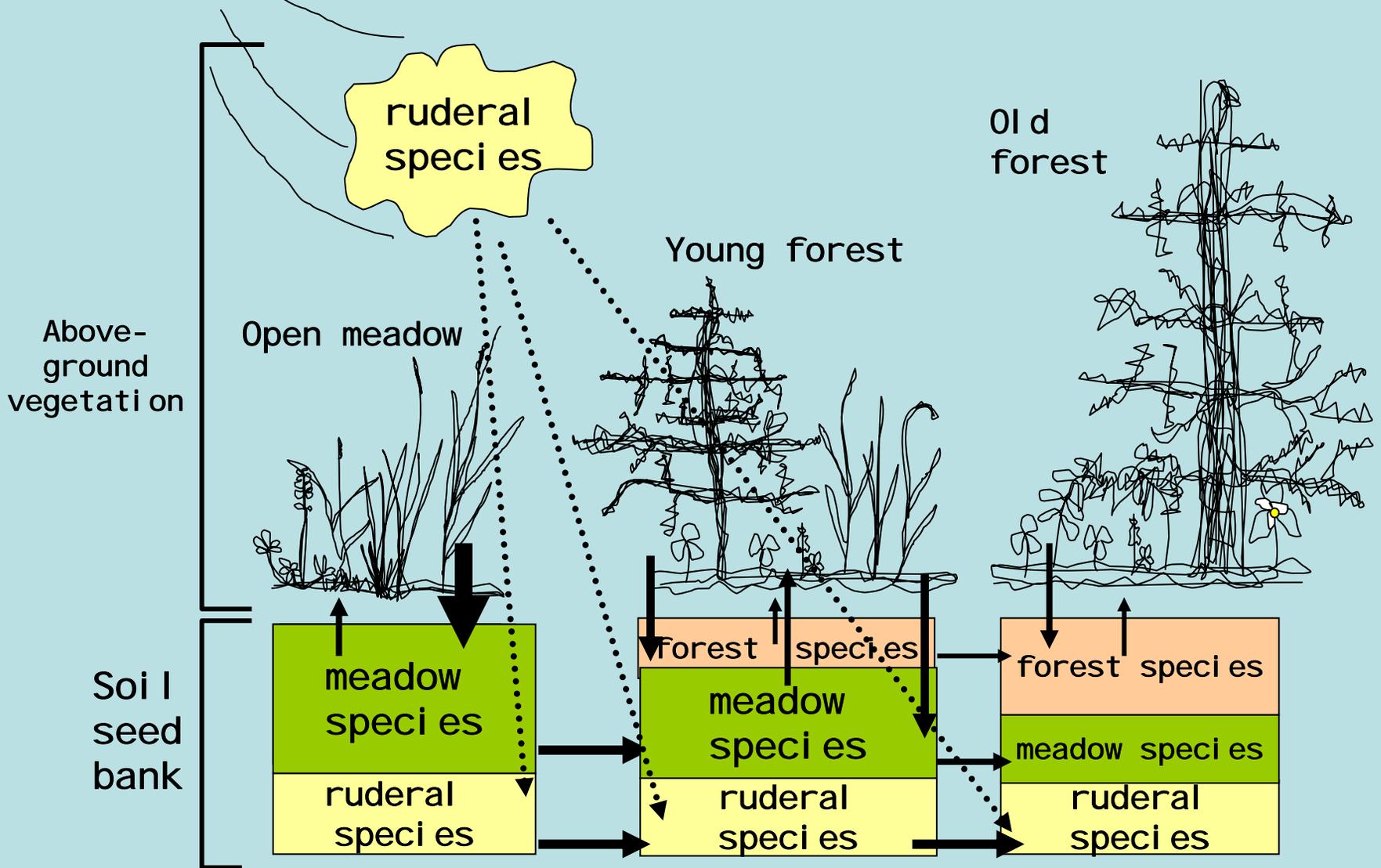


# Seed Bank Response

- Relationship between the seed bank and above ground vegetation



# Conceptual Diagram of Seed Bank Dynamics at Bunchgrass



# Seed Bank Methods:

- 209 10 x 10m subplots sampled
- 3 soil plugs per subplot



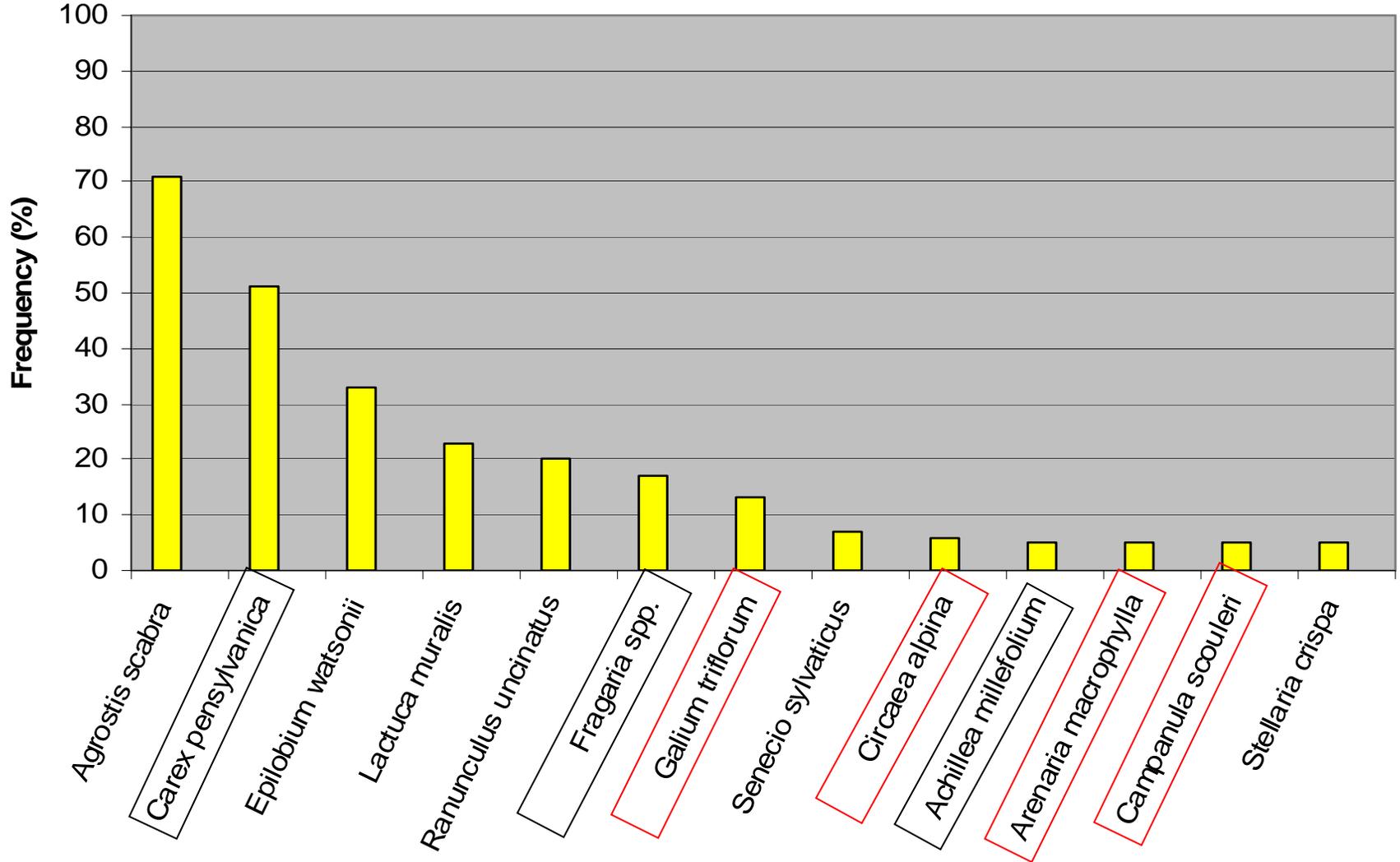
- Age classes
  - Open meadow
  - Young forest
  - Old forest



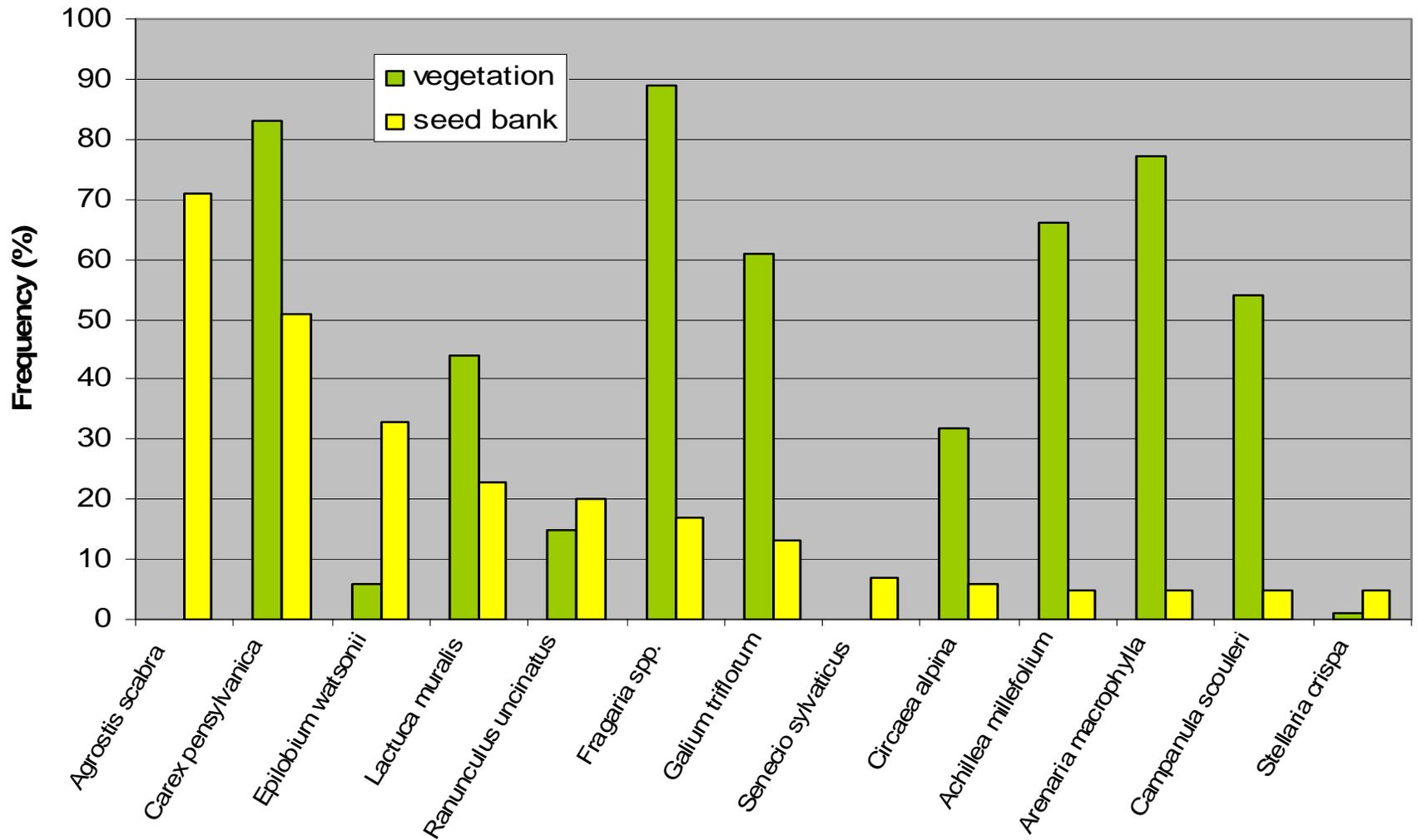
- Greenhouse germination



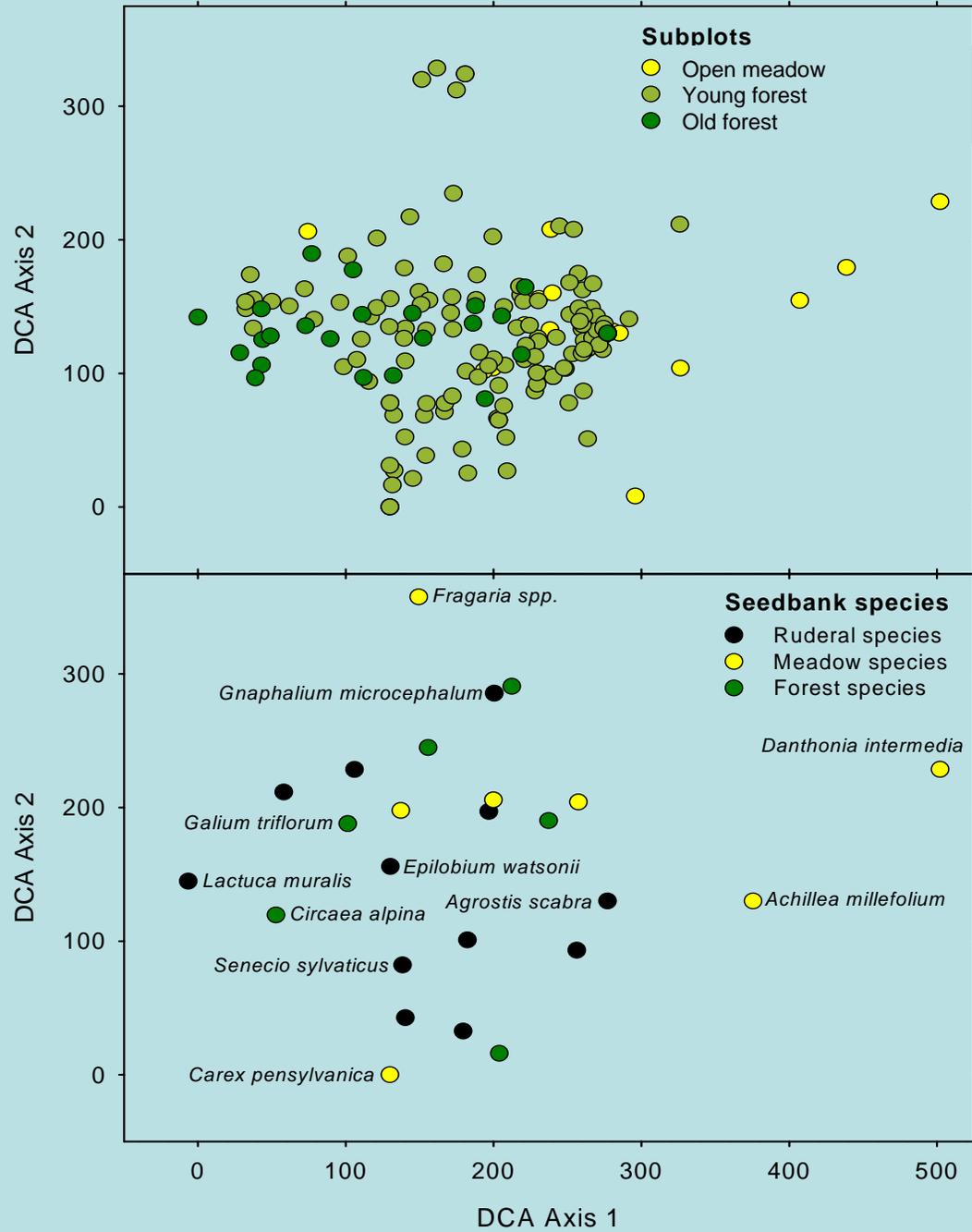
# Primary Seed Bank Species



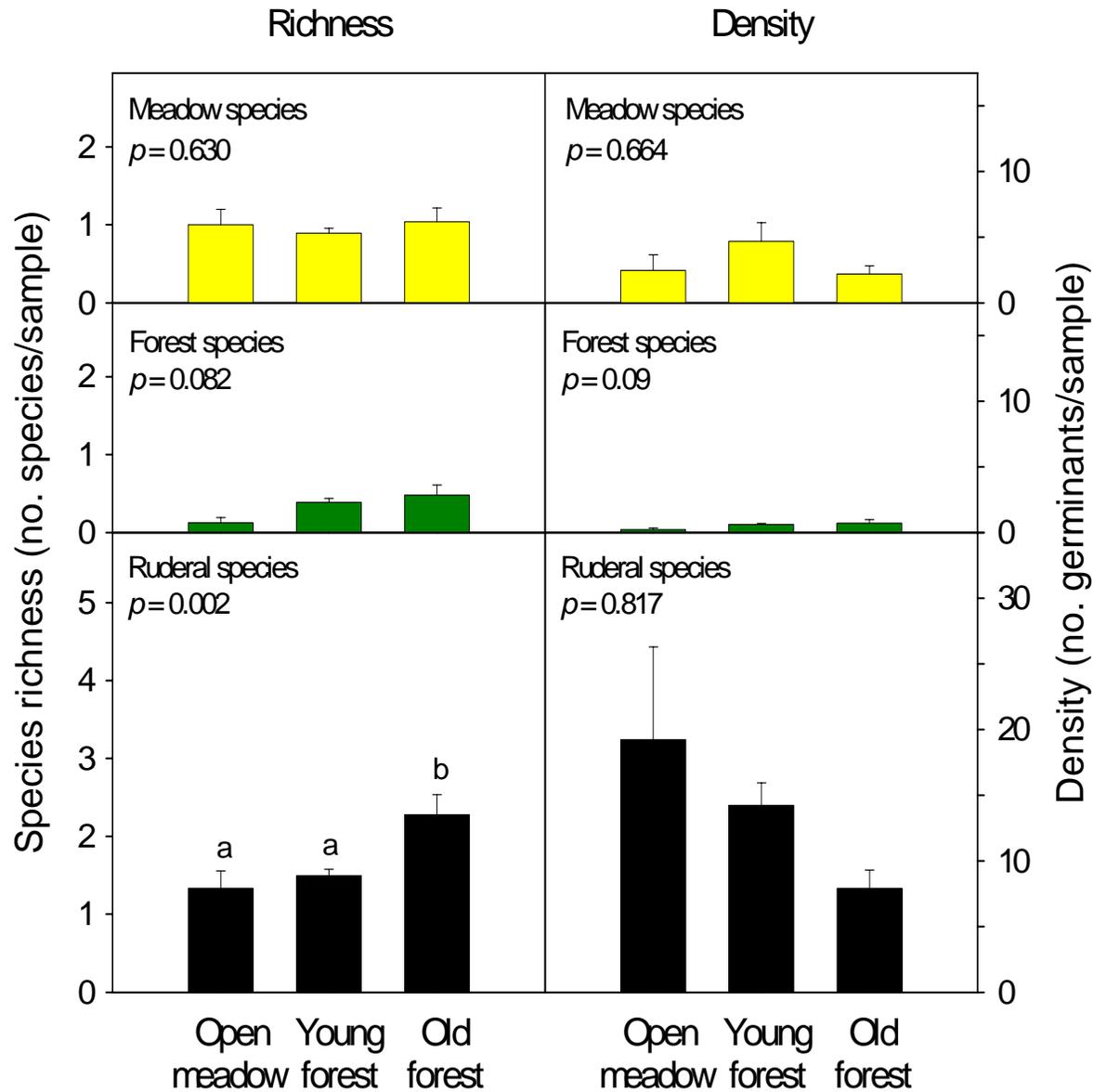
## Primary Seed Bank Species and Occurrence in the Vegetation



# DCA Ordination



# Meadow, Forest, and Ruderal Species



## Seed Bank Conclusions:

1. The seed bank composition is dominated by ruderal species, with limited contribution from meadow and forest species.
2. The seed bank does not closely resemble the above-ground vegetation.
3. Few meadow species persist under meadow or forest vegetation.

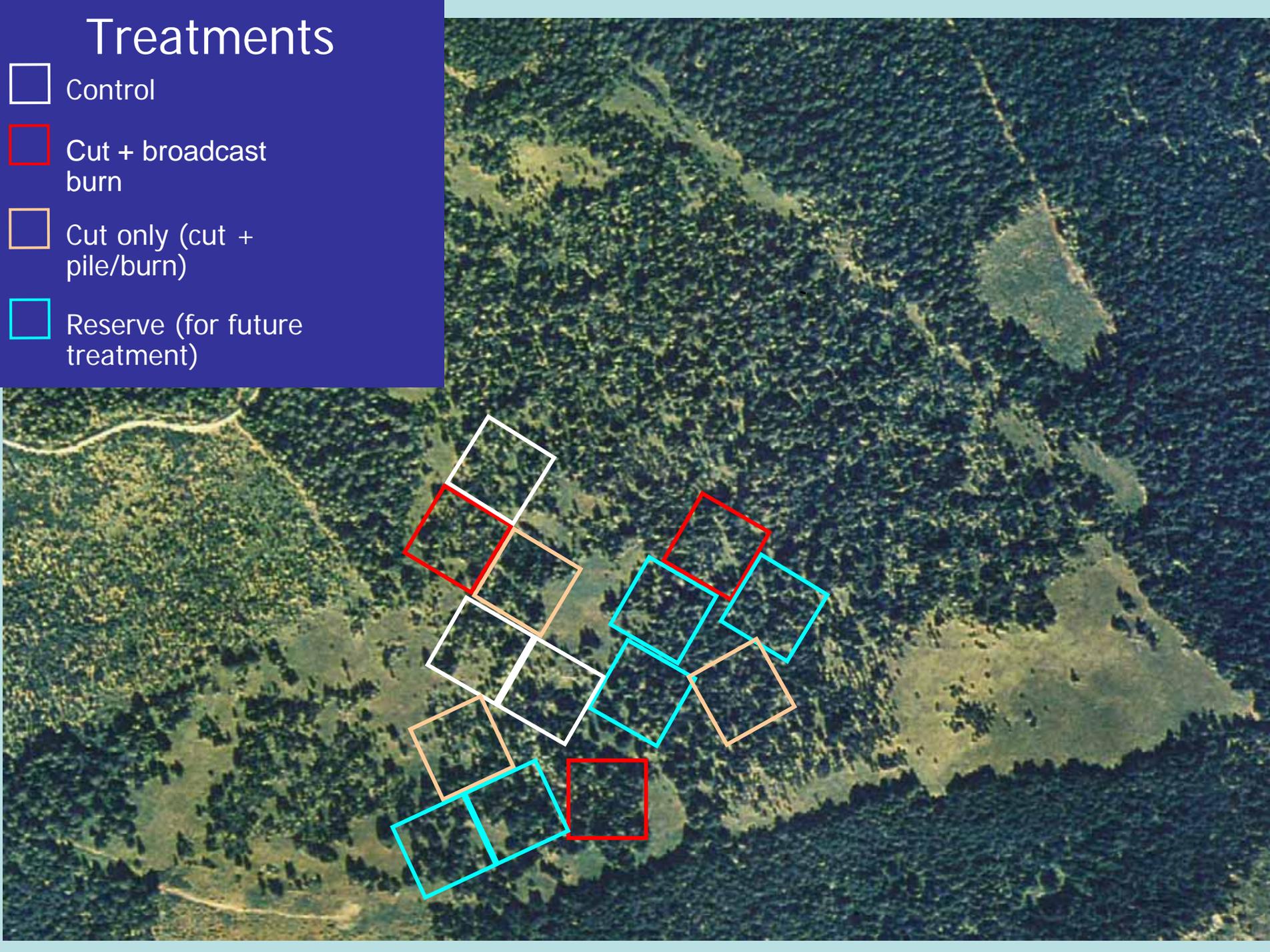
A photograph of a forest with many trees and fallen branches on the ground. The trees are mostly thin and vertical, with some larger, thicker trunks in the foreground. The ground is covered with fallen branches and some green vegetation. The lighting is somewhat dim, suggesting a shaded forest interior.

## Meadow Restoration?

- Is restoration of invaded meadows possible?
- Impacts of forest age?
- Is fire a necessary component of meadow restoration?

# Treatments

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





- **Harvest**
  - Winter '05-06
  - Summer '06
- **Burn**
  - Autumn '06

# Thanks!

- Fred Swanson, Joe Antos, John Cissel
- 2003, 2004, 2005 field crews
- McKenzie District, Willamette NF – Cheryl Friesen and many others
- Joint Fire Sciences Program

