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

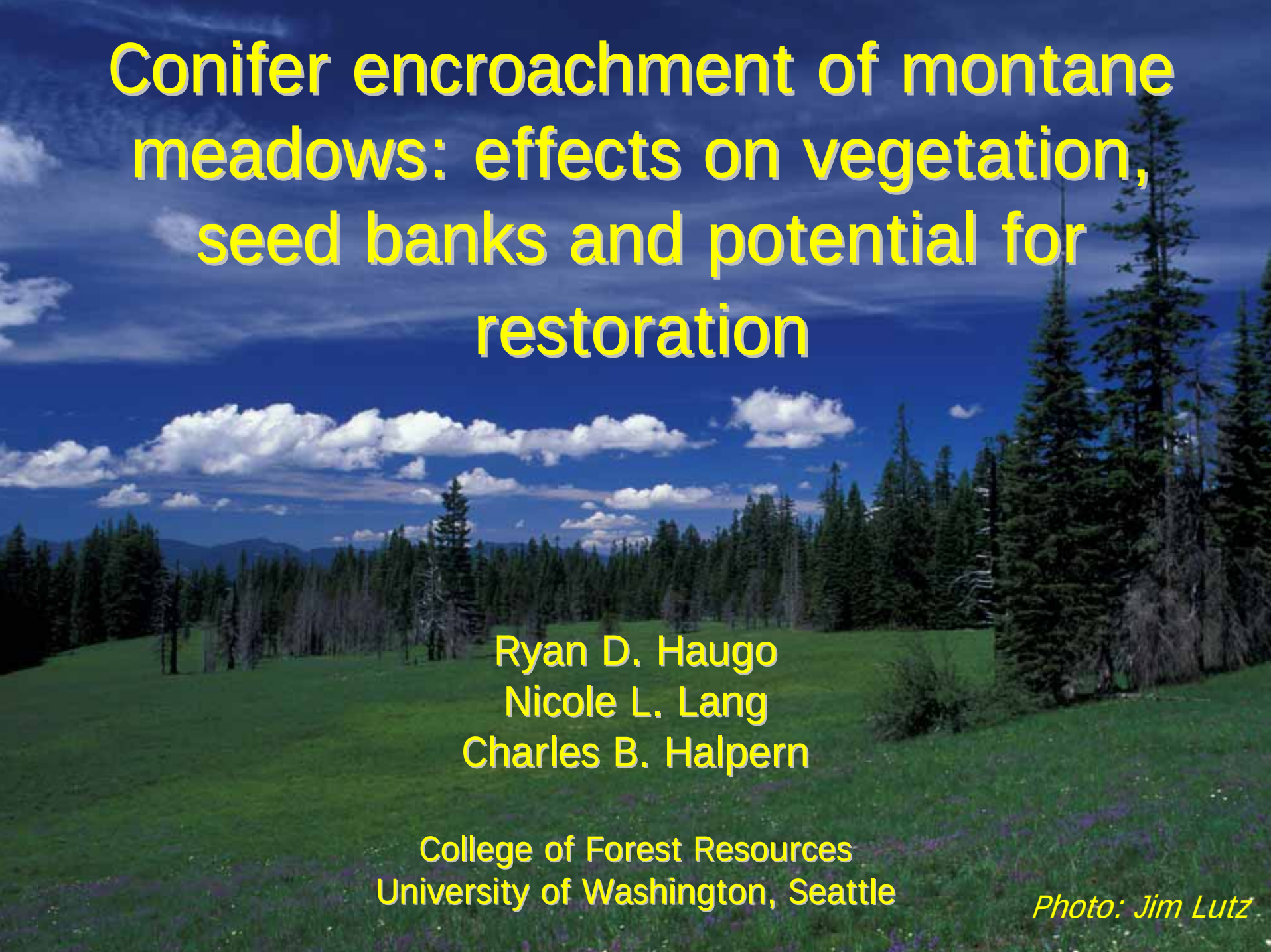

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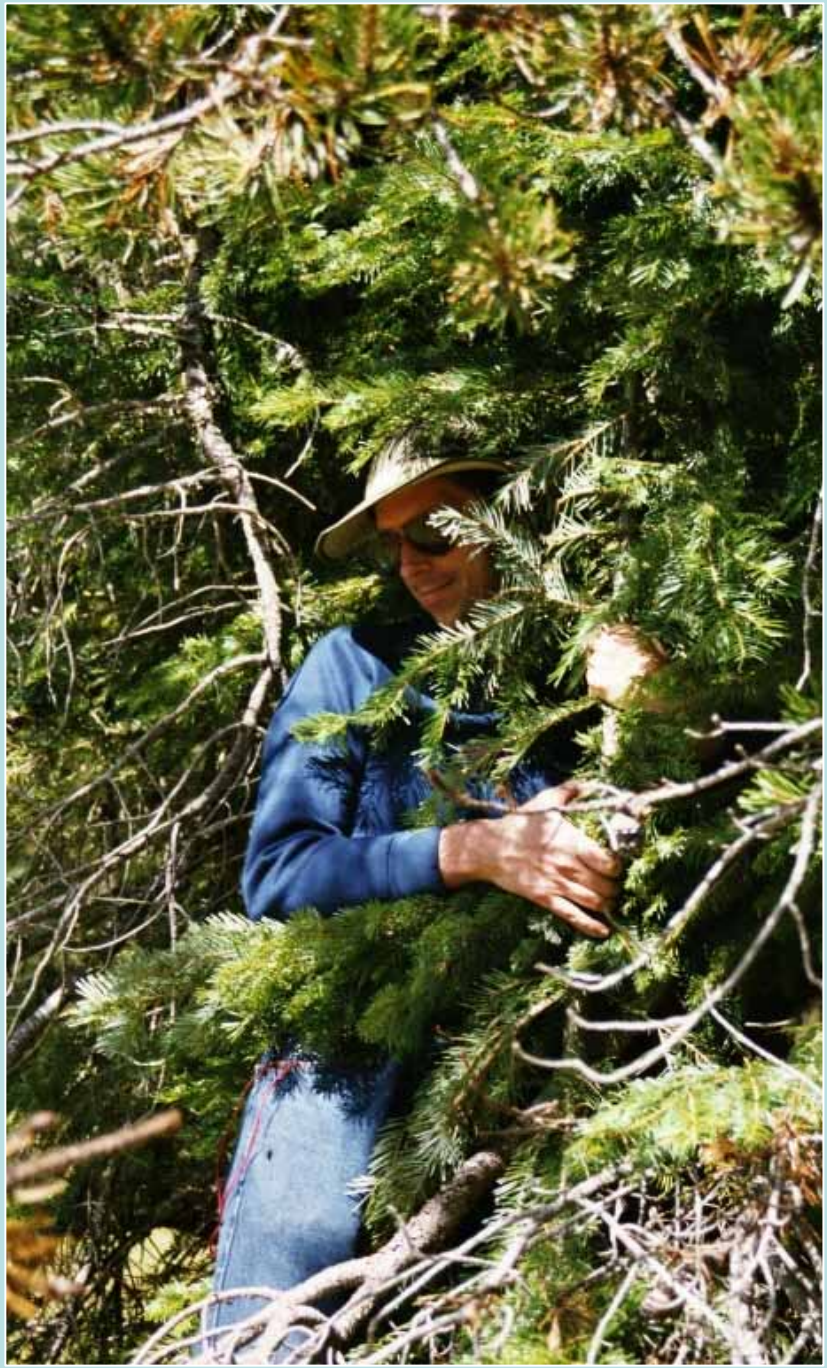
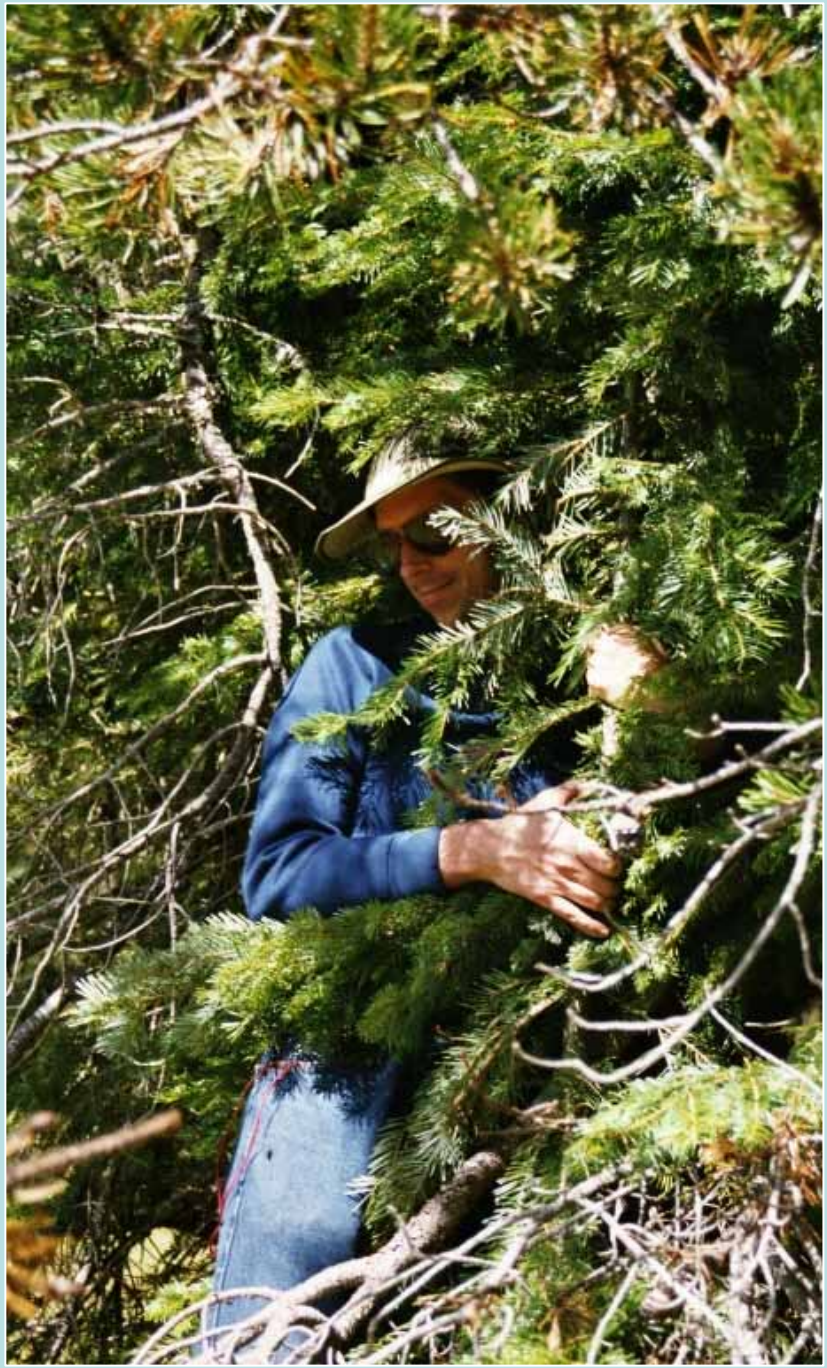
Photo: Jim Lutz

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



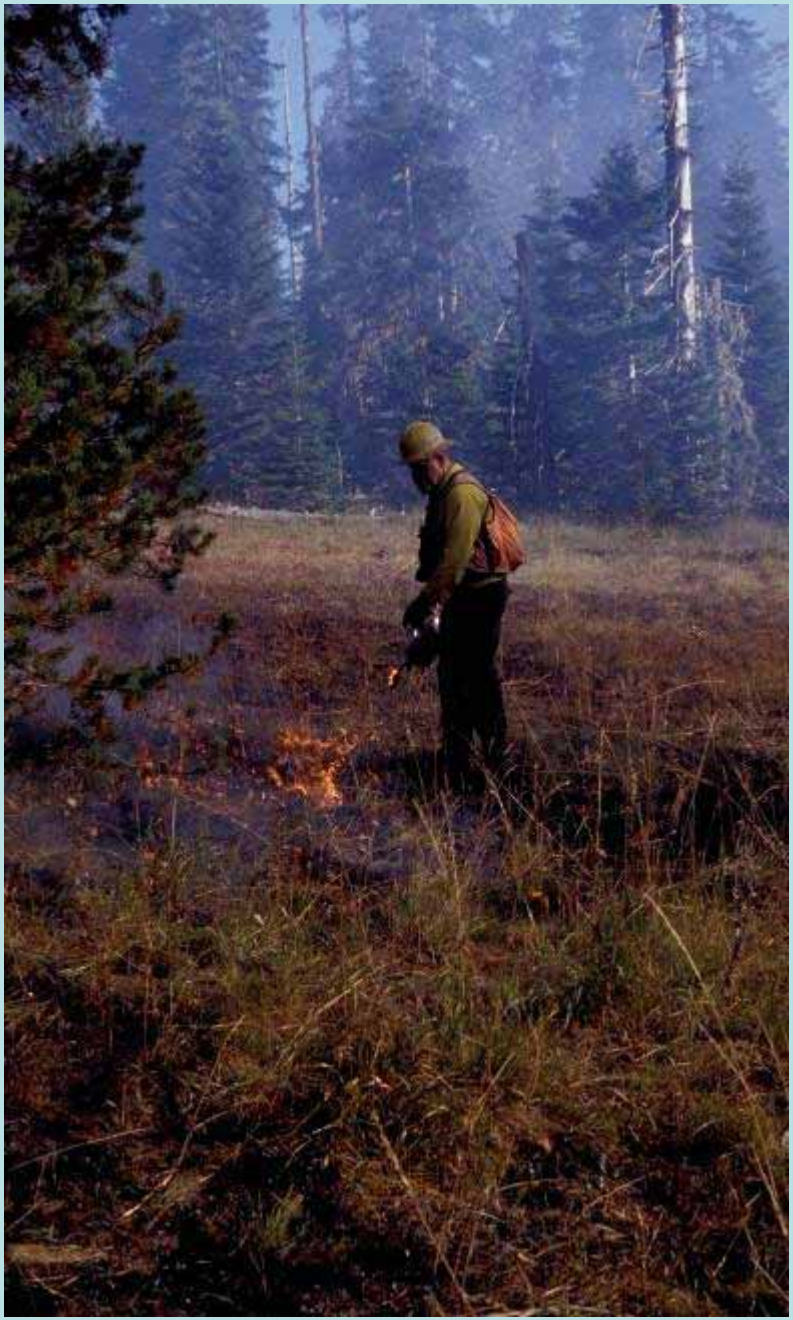
The problem...

- 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

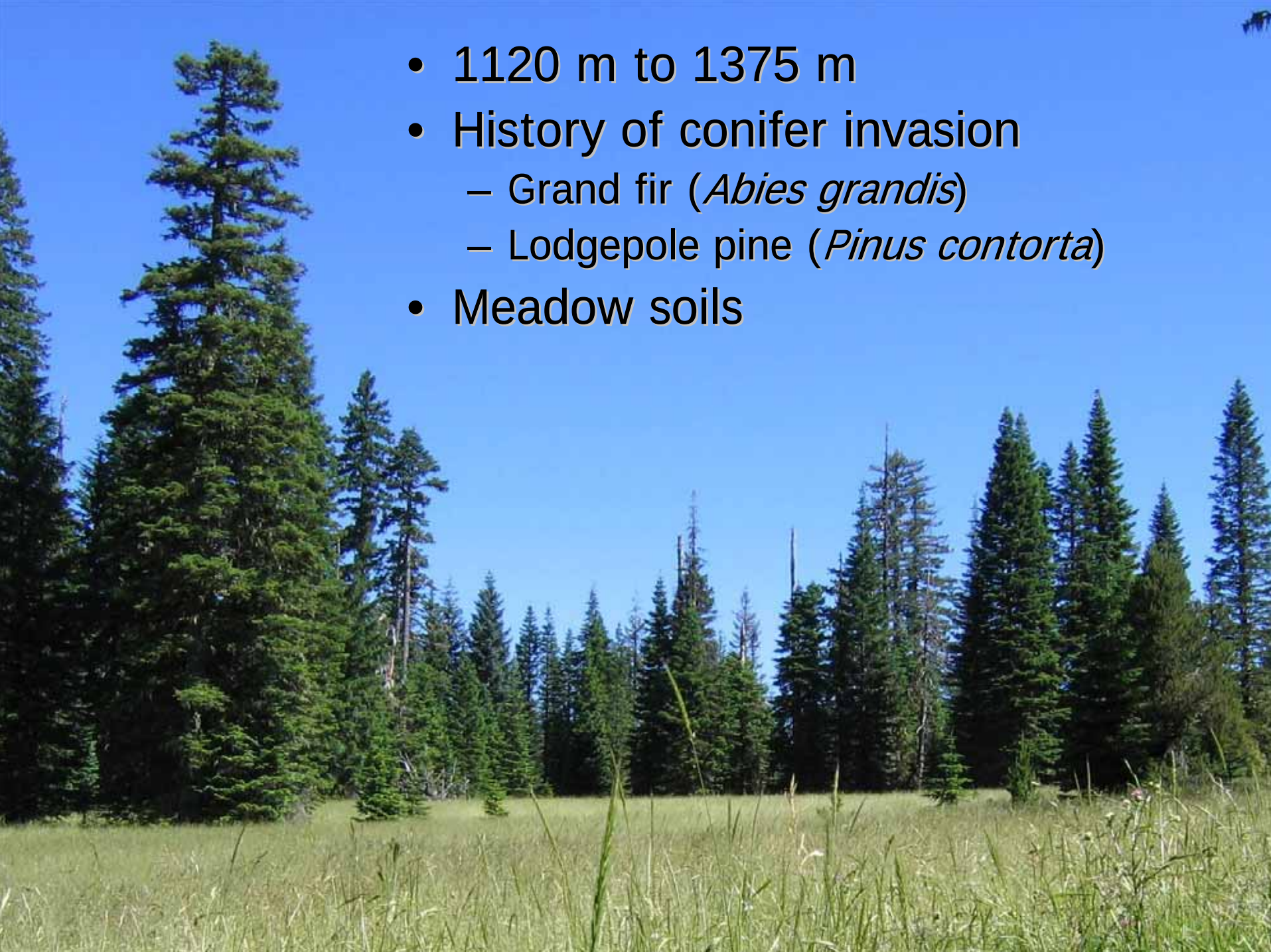


The problem...

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

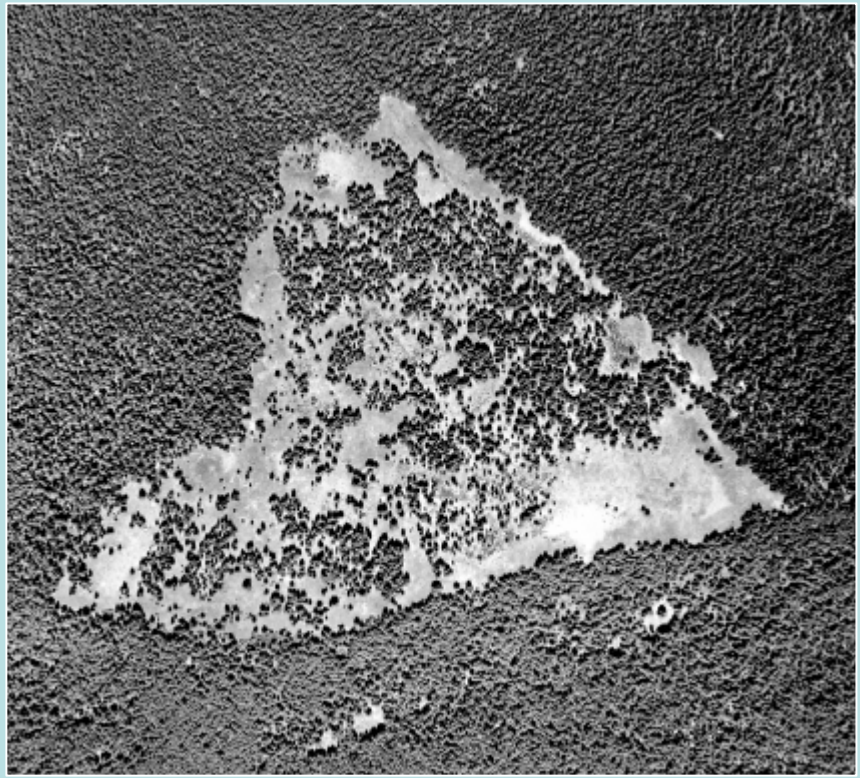
Bunchgrass Ridge, OR

- Dry, montane meadow
- Willamette NF Special Habitat Area

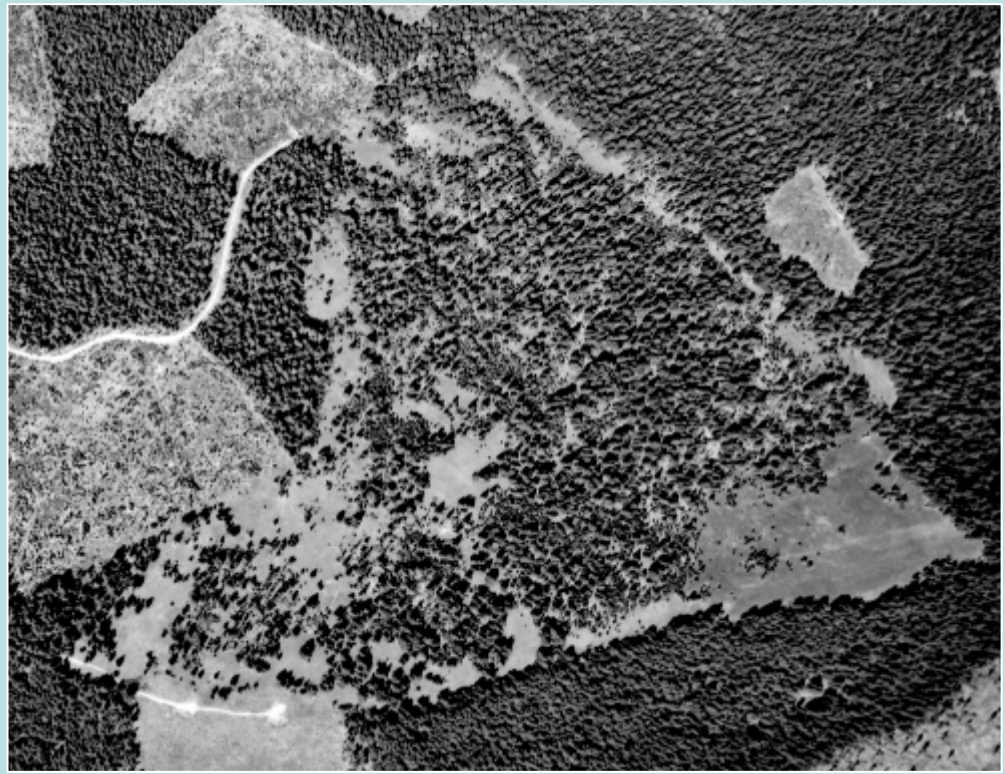


- 1120 m to 1375 m
- History of conifer invasion
  - Grand fir (*Abies grandis*)
  - Lodgepole pine (*Pinus contorta*)
- Meadow soils

1946



1997




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

Vegetation Dynamics

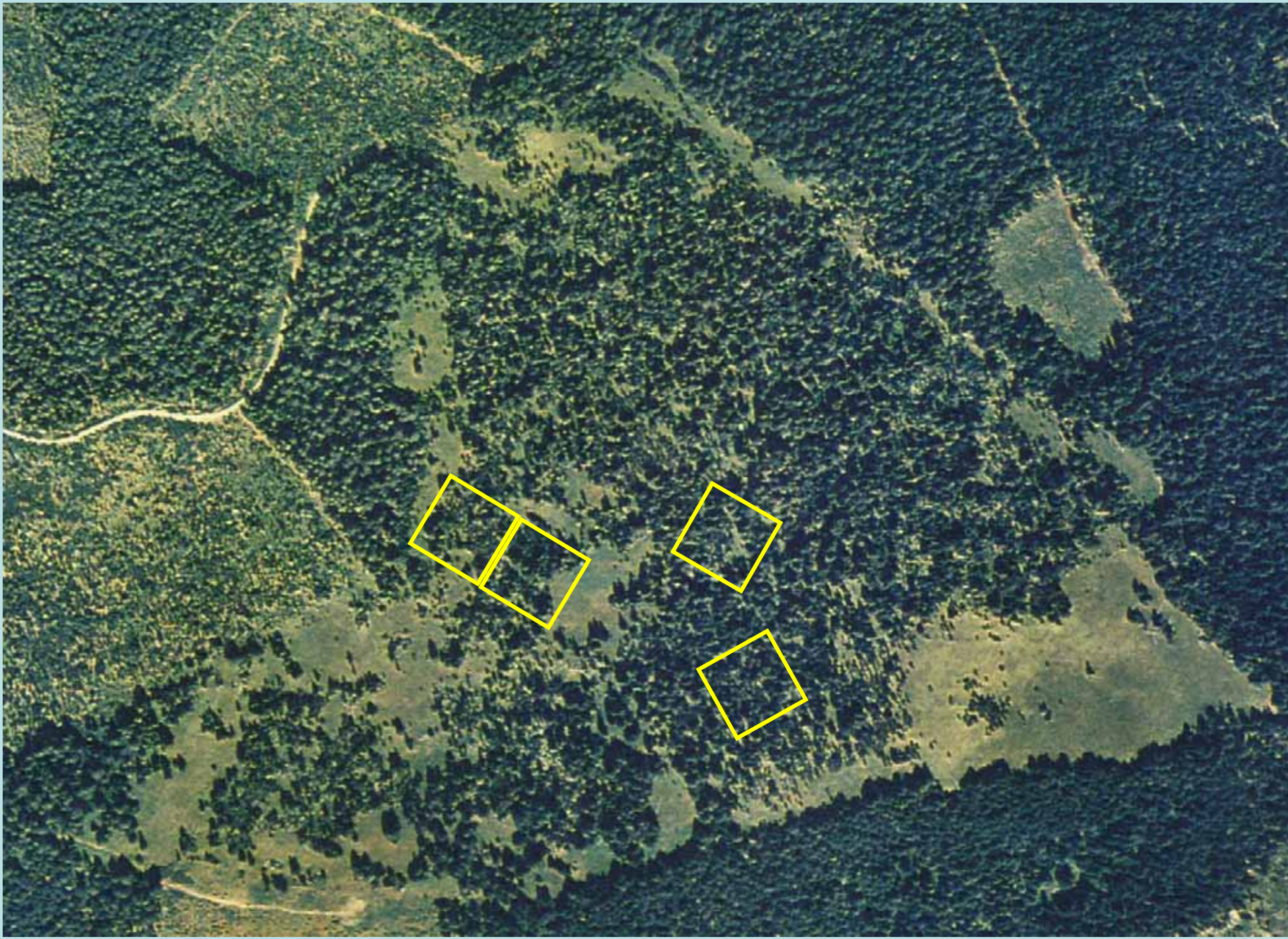
- Temporal changes in vegetation
  - Community composition
  - Meadow and forest species
    - Abundance (cover)
    - Richness

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

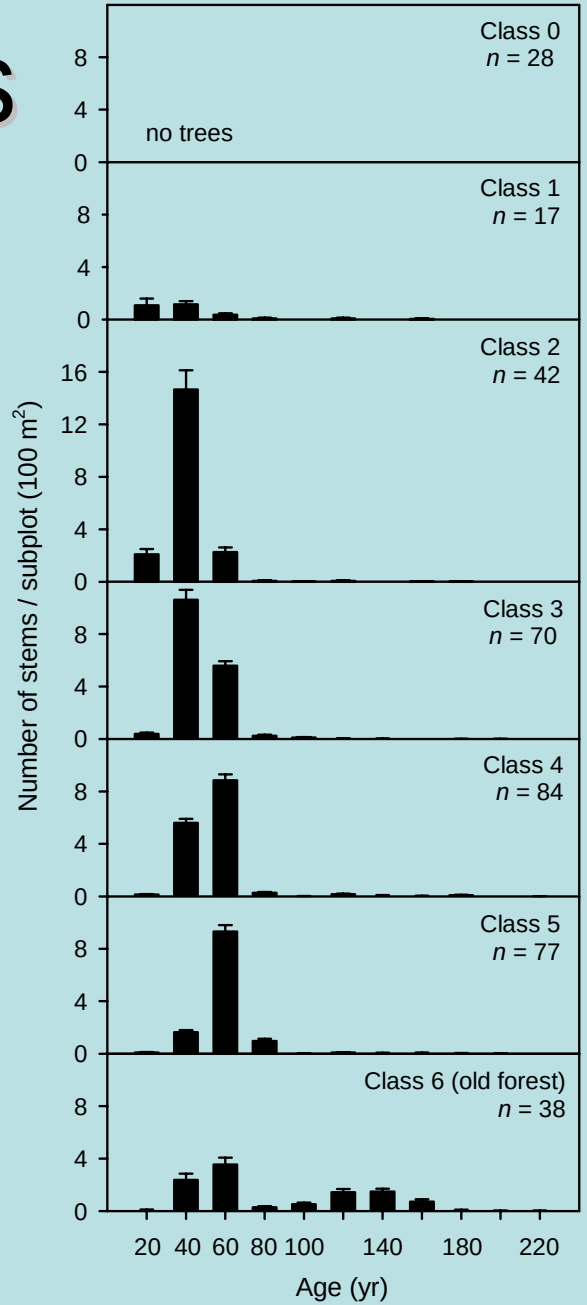
Chronosequence

- Temporal changes
  -> space for time substitution

- Seven encroachment classes
  – Class 0 (open meadow) to Class 6 (old forest)

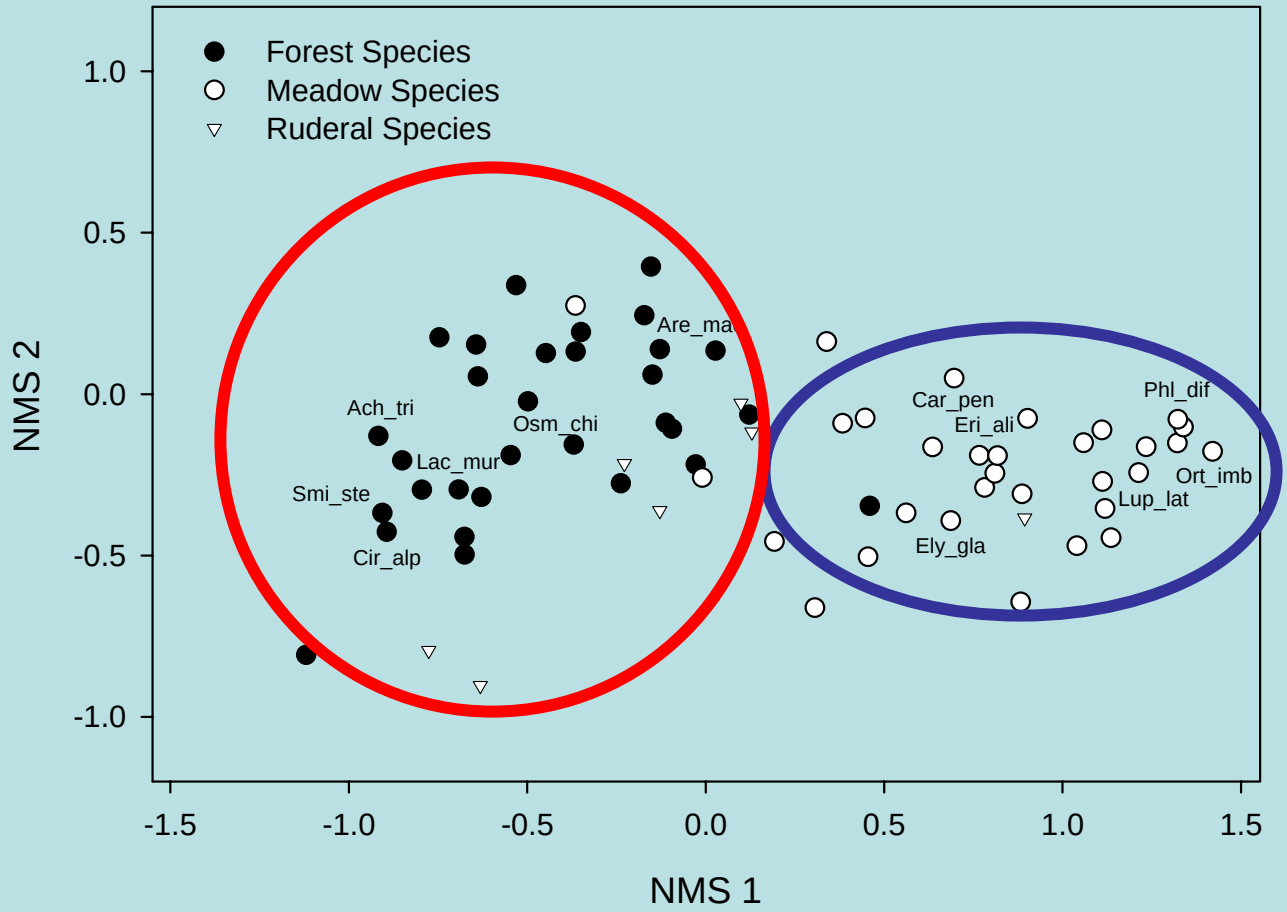
Aquilegia formosa

Encroachment Classes



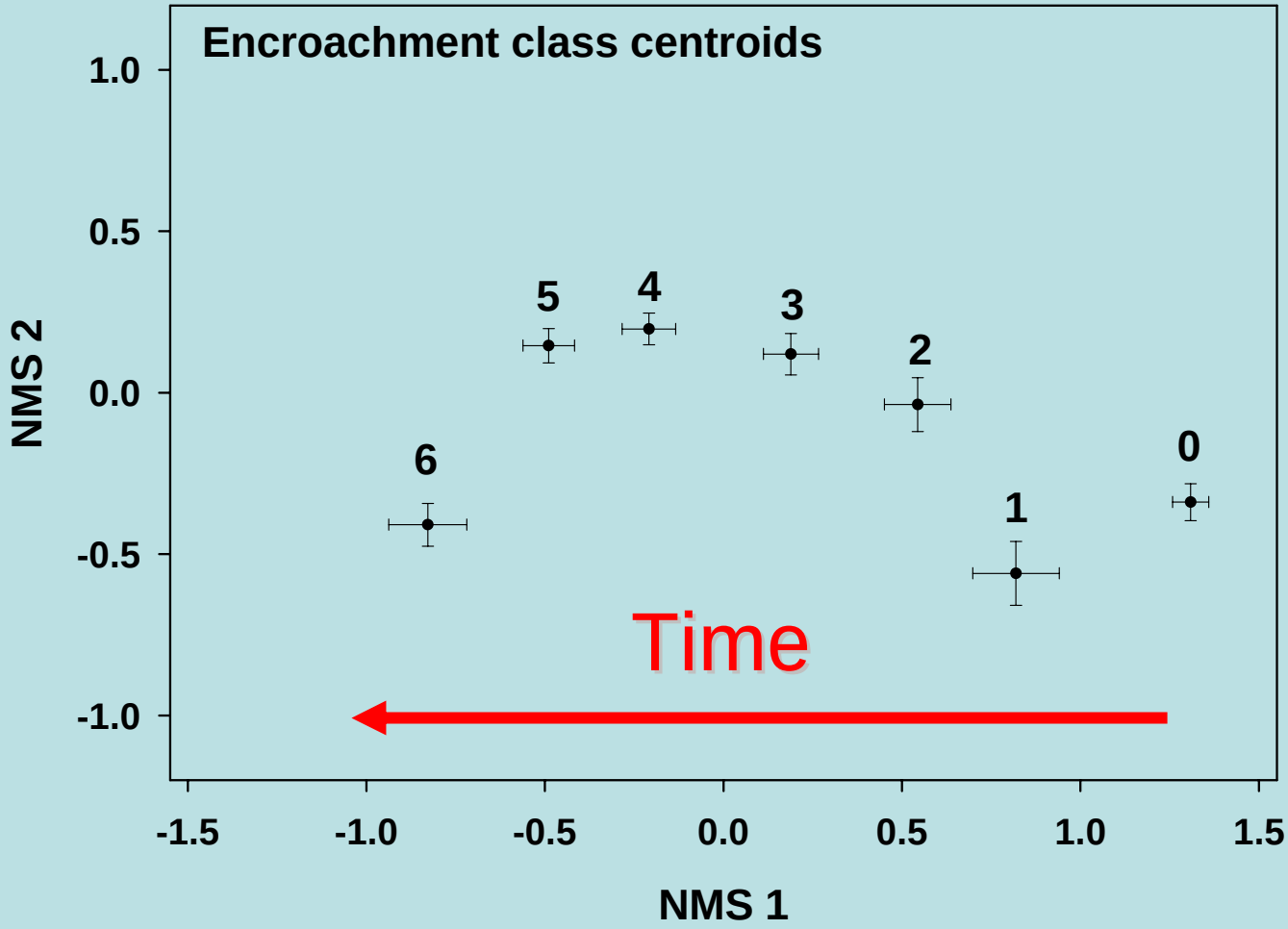
Compositional changes

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



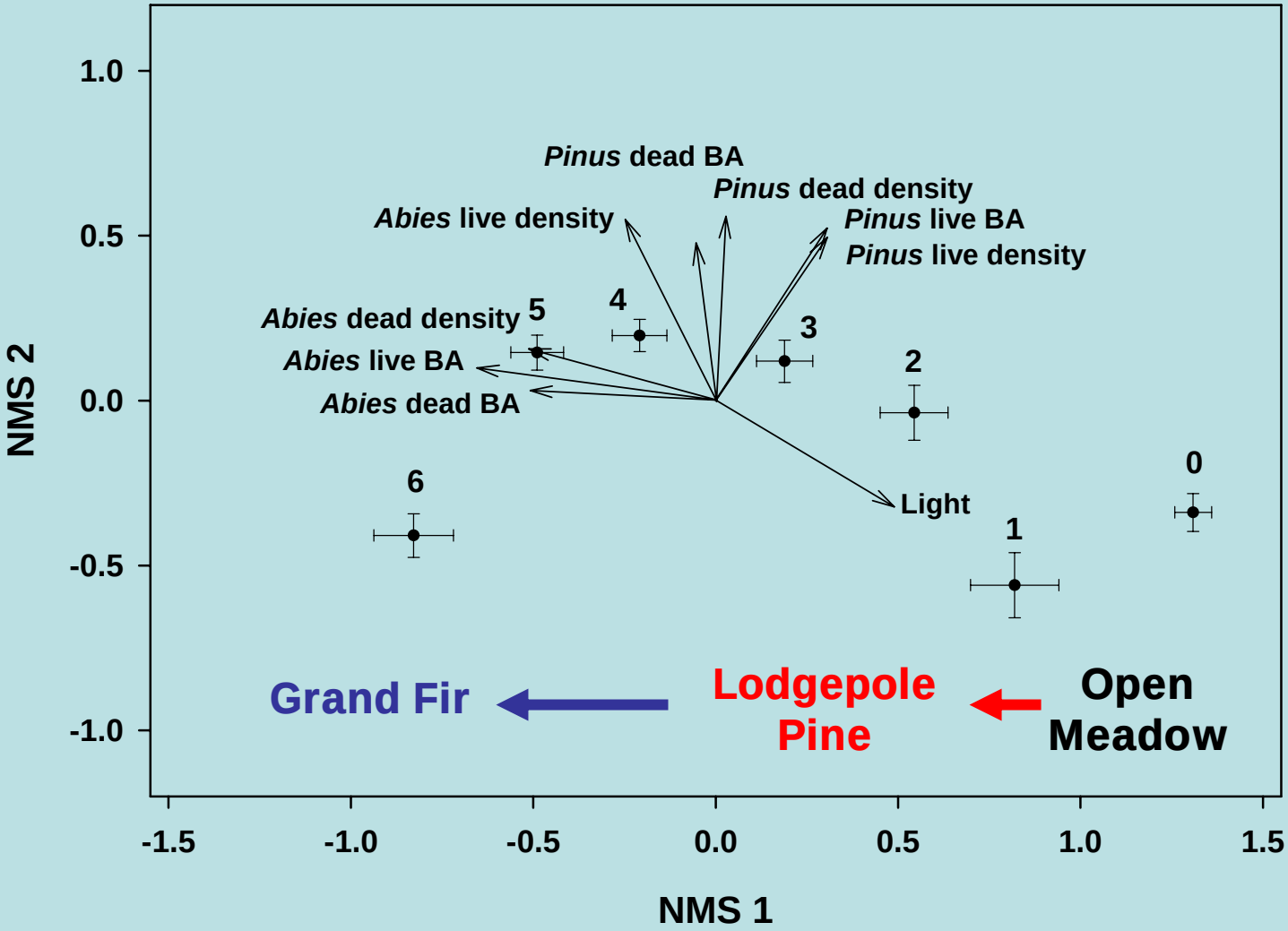
Compositional changes

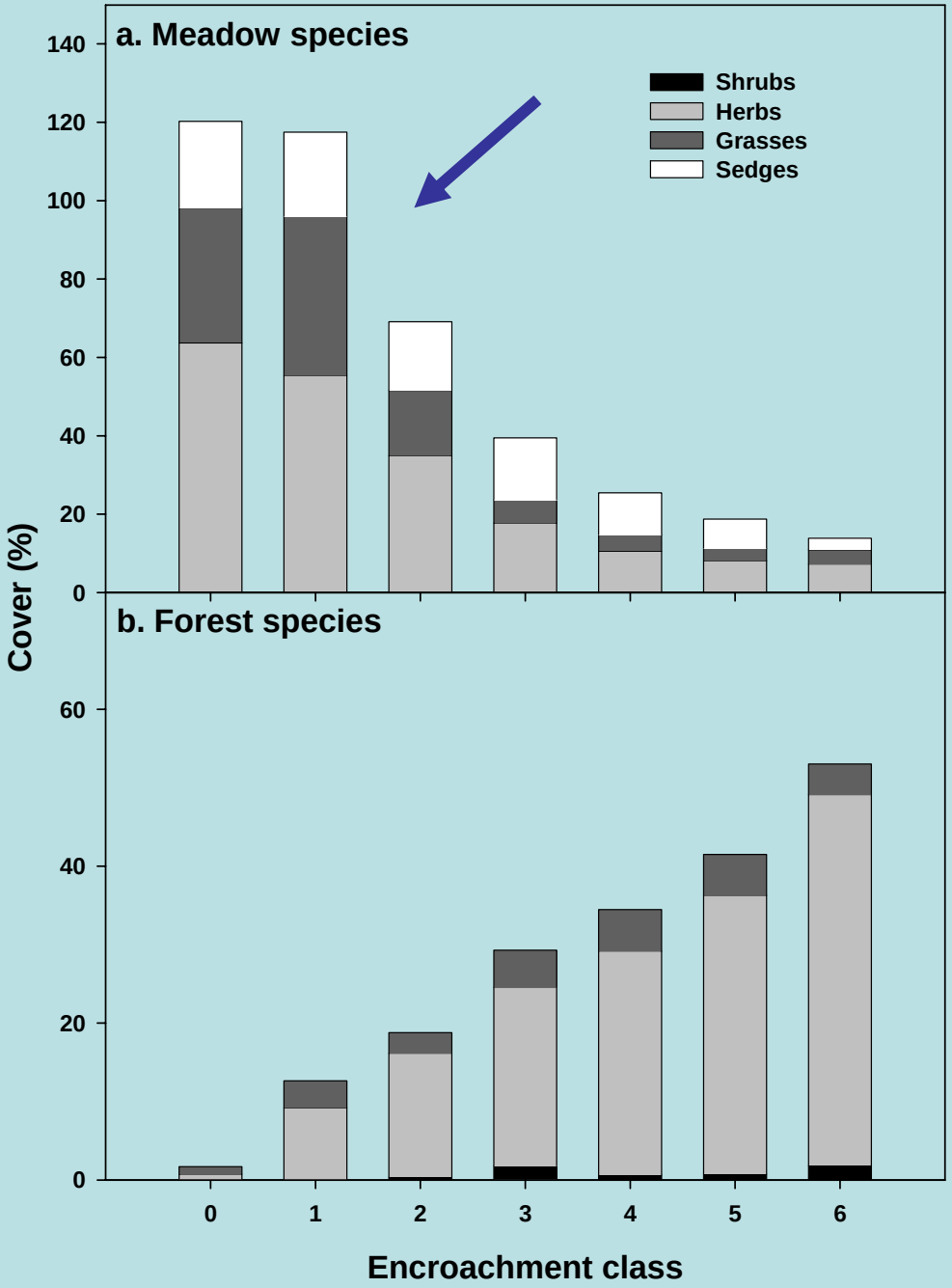
- NMS and age class centroids



Composition and Environment

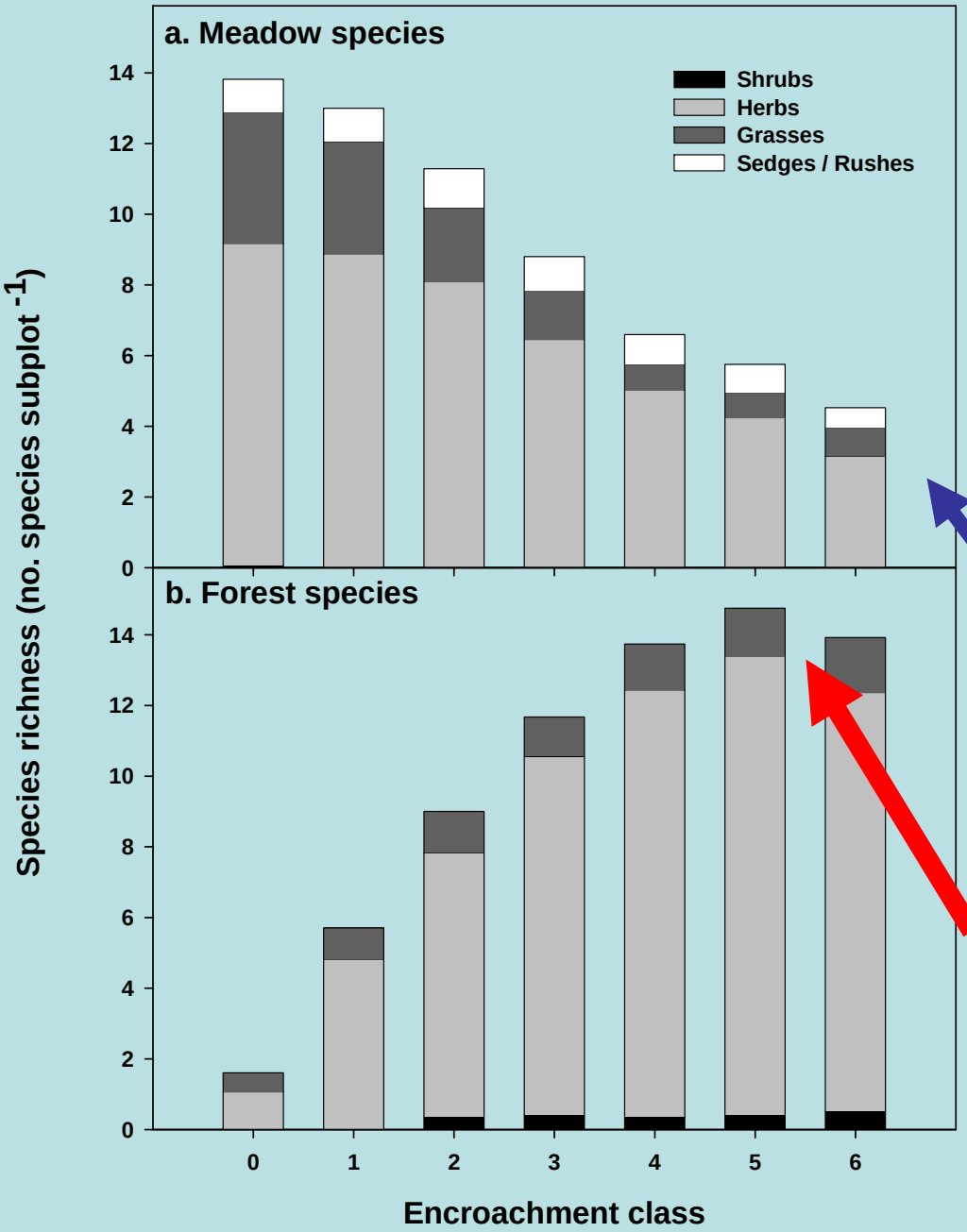
- Spearman rank correlations





Meadow / Forest Cover

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



Meadow / Forest Richness

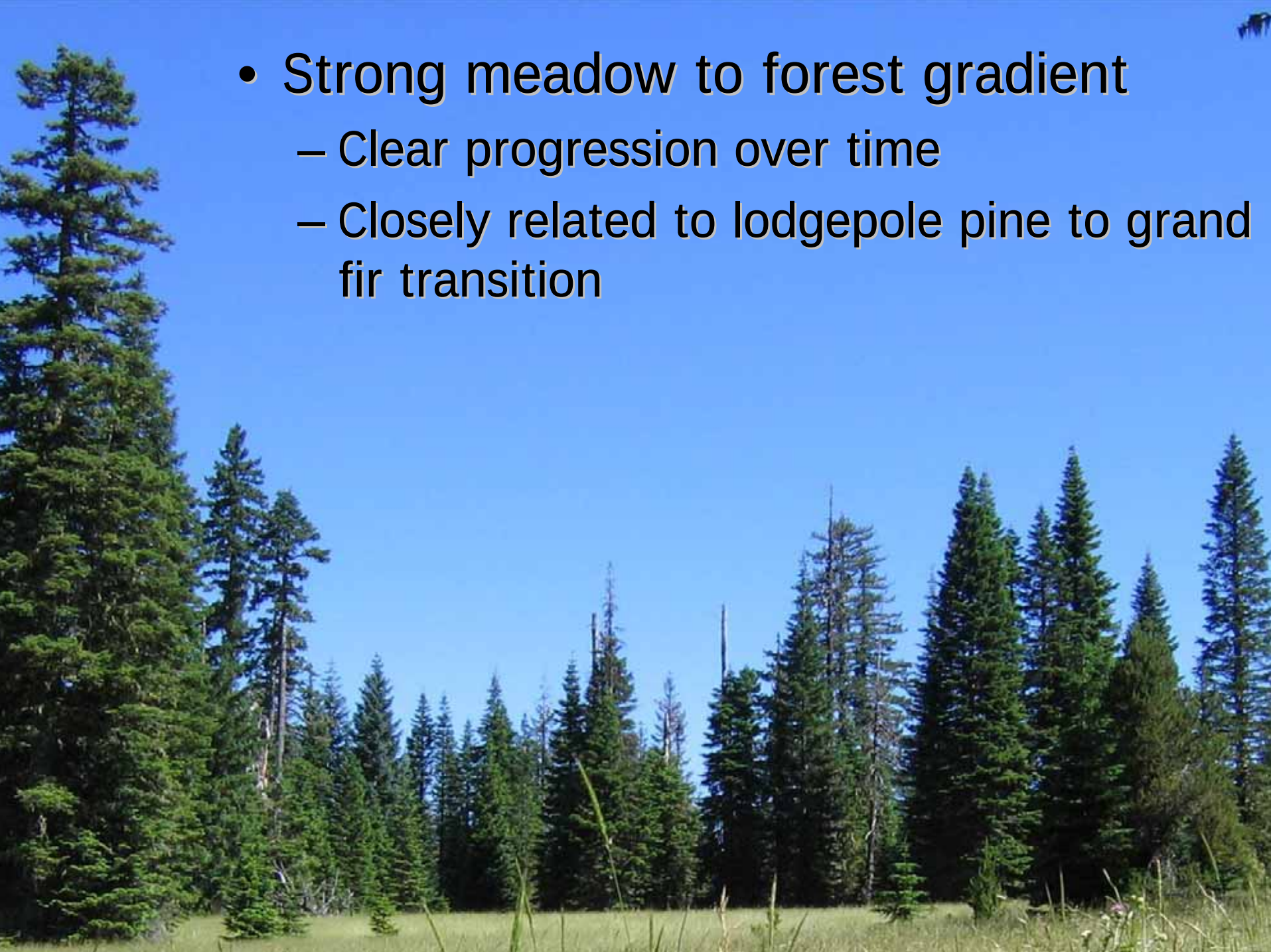
- Progressive meadow decline
- Not completely lost

- 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?

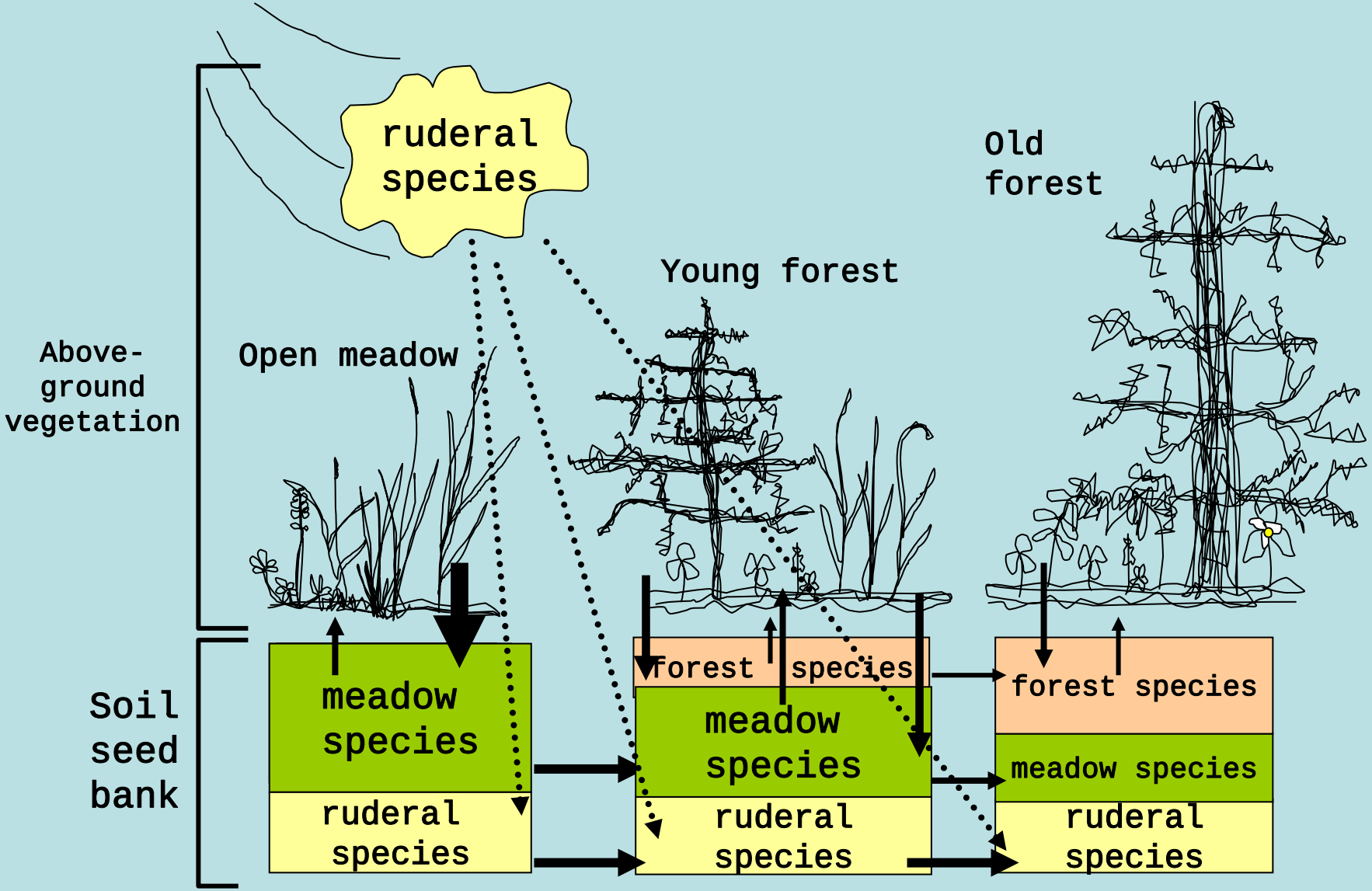
Seed Bank Response

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

Seed Bank Response

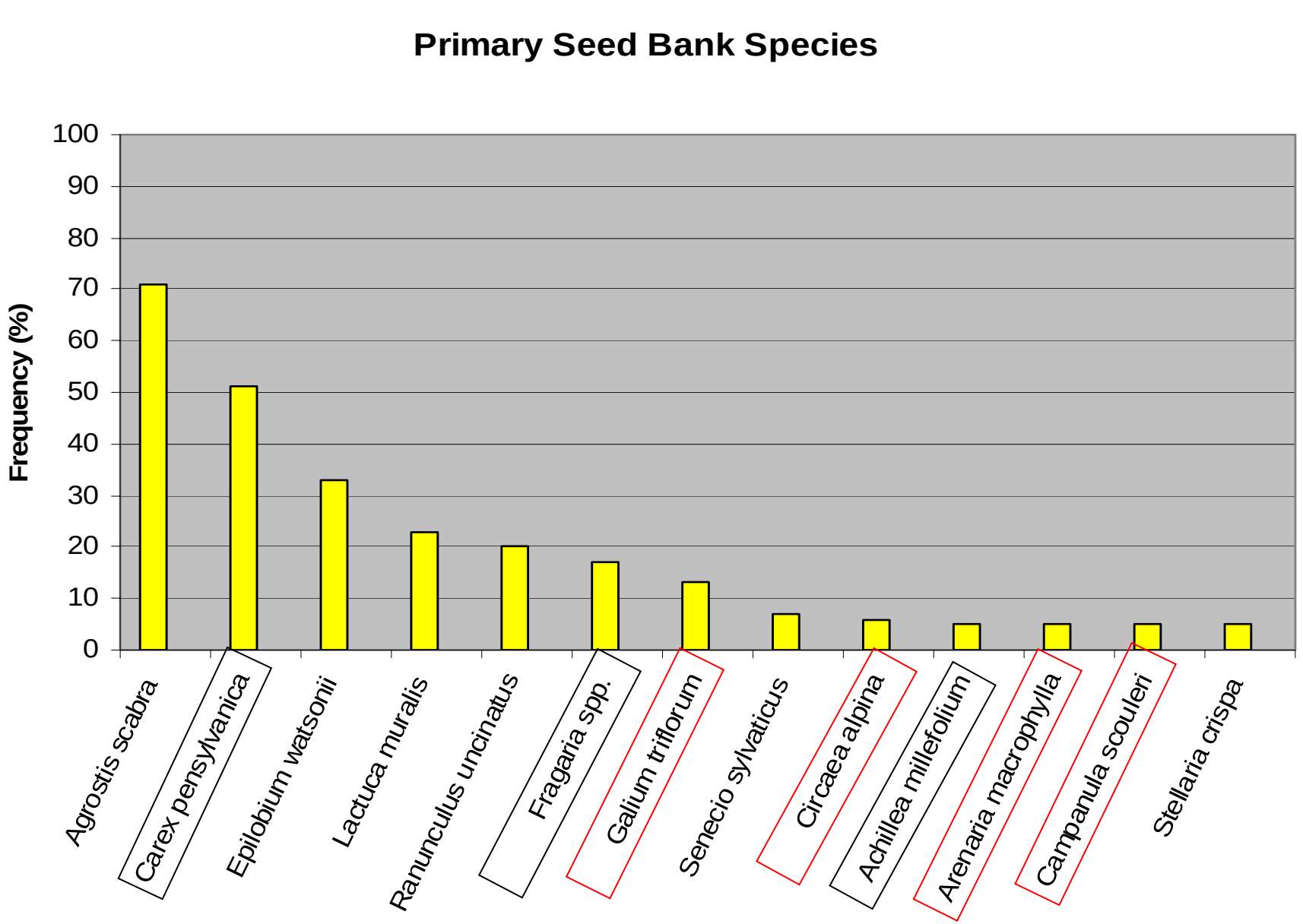
- Relationship between the seed bank and above ground vegetation

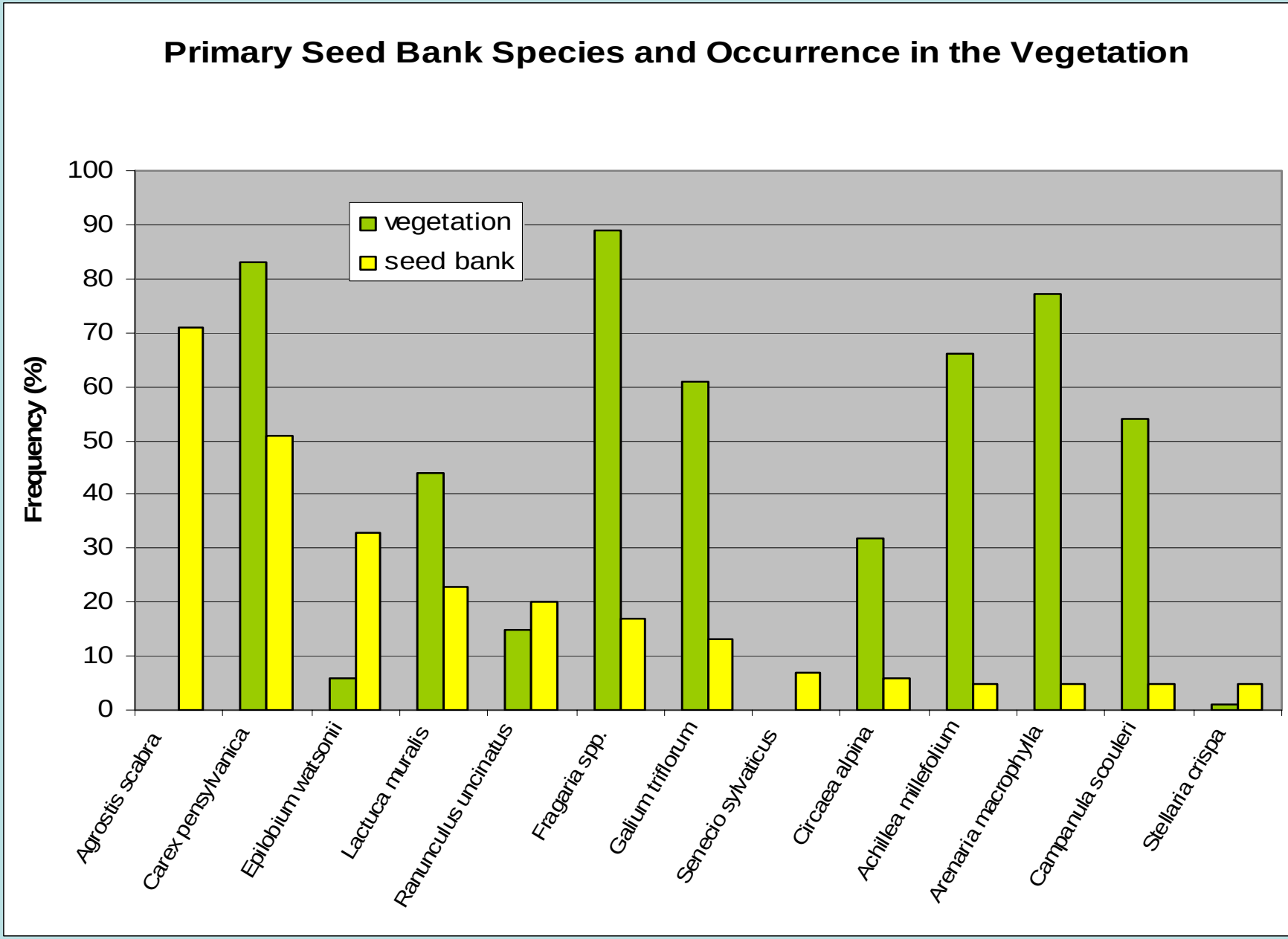
Conceptual Diagram of Seed Bank Dynamics at Bunchgrass



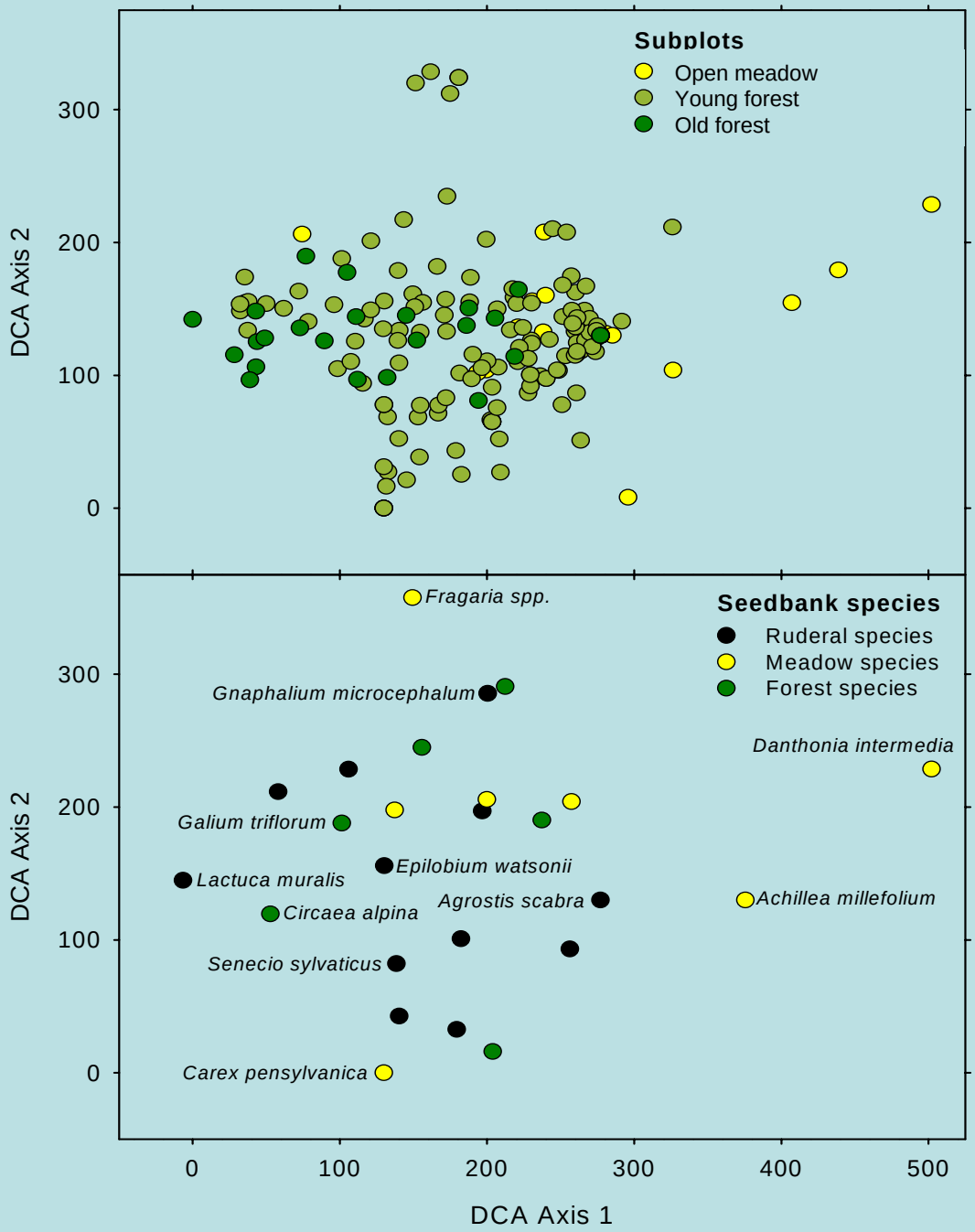
Seed Bank Methods:

- 209 10 x 10m subplots sampled
- 3 soil plugs per subplot
- Age classes
  - Open meadow
  - Young forest
  - Old forest
- Greenhouse germination

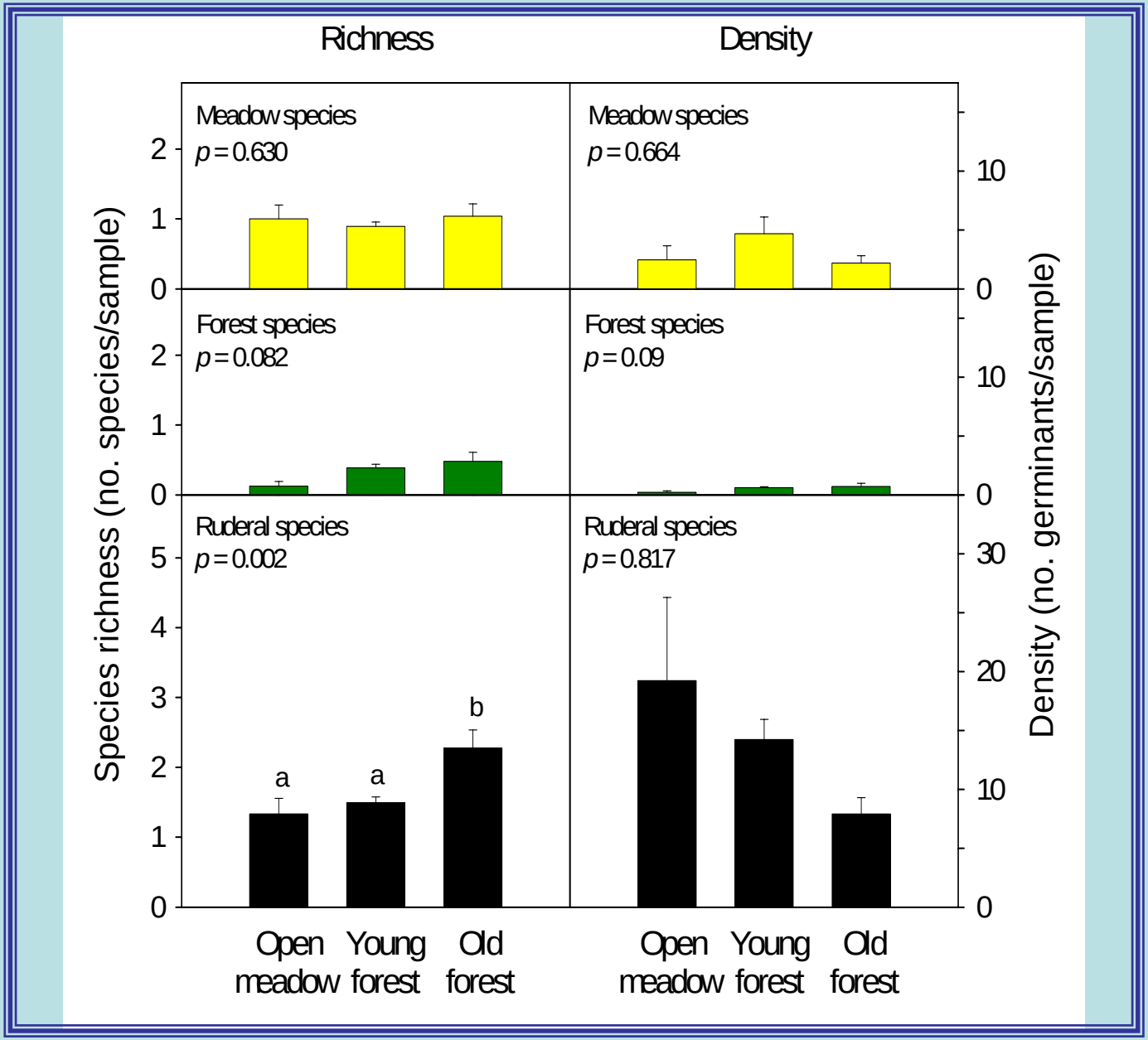

Primary Seed Bank Species
Frequency (%)
100
90
80
70
60
50
40
30
20
10
0
Agrostis scabra
Carex pensylvanica
Epilobium watsonii
Lactuca muralis
Ranunculus uncinatus
Fragaria spp.
Galium triflorum
Senecio sylvaticus
Circaea alpina
Achillea millefolium
Arenaria macrophylla
Campanula scouleri
Stellaria crispa


Primary Seed Bank Species and Occurrence in the Vegetation
Frequency (%)
100
90
80
70
60
50
40
30
20
10
0
vegetation
seed bank
Agrostis scabra
Carex pensylvanica
Epilobium watsonii
Lactuca muralis
Ranunculus uncinatus
Fragaria spp.
Galium triflorum
Senecio sylvaticus
Circaea alpina
Achillea millefolium
Arenaria macrophylla
Campanula scouleri
Stellaria crispa

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.

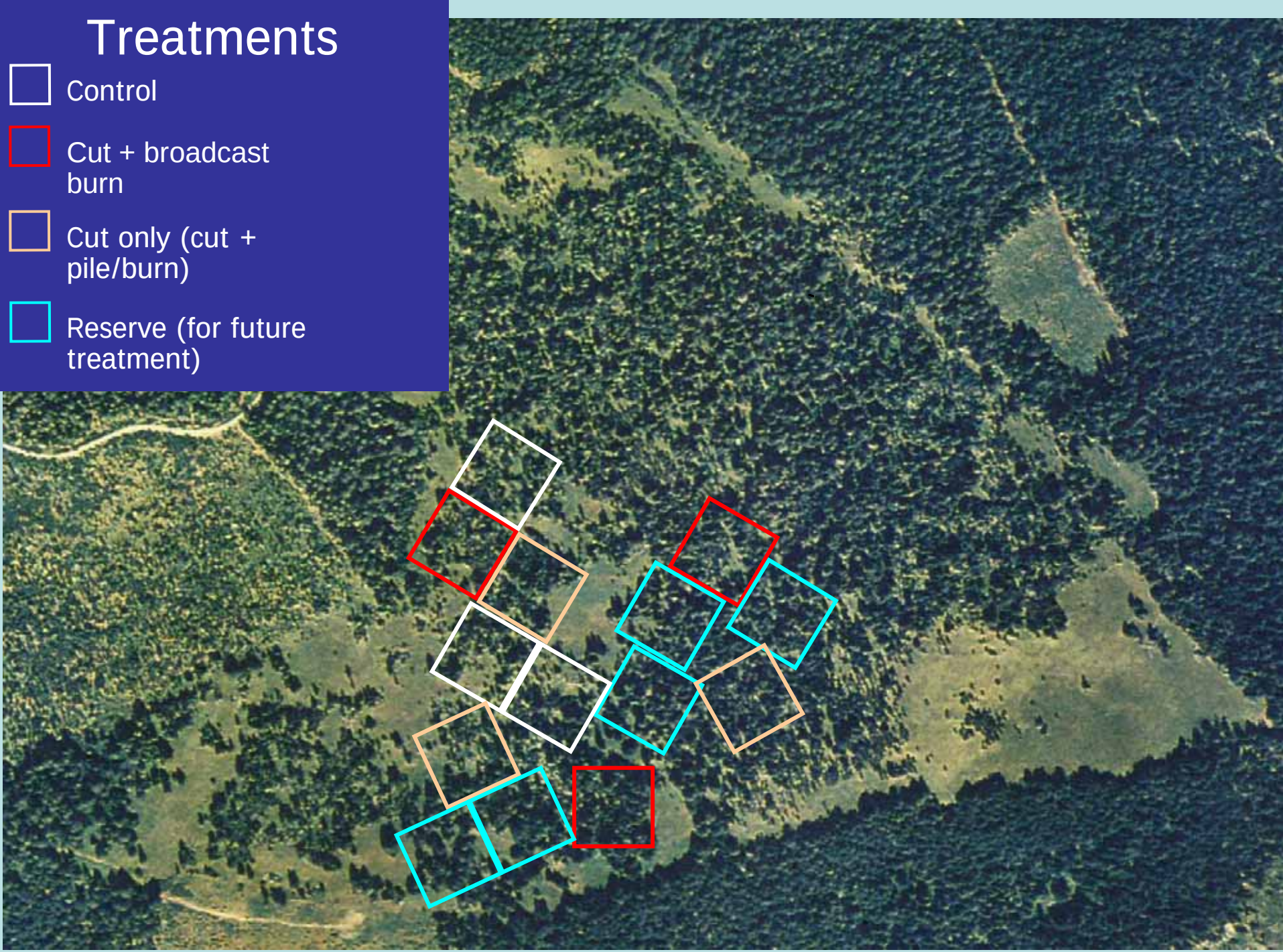
3. Few meadow species persist under meadow or forest vegetation.

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