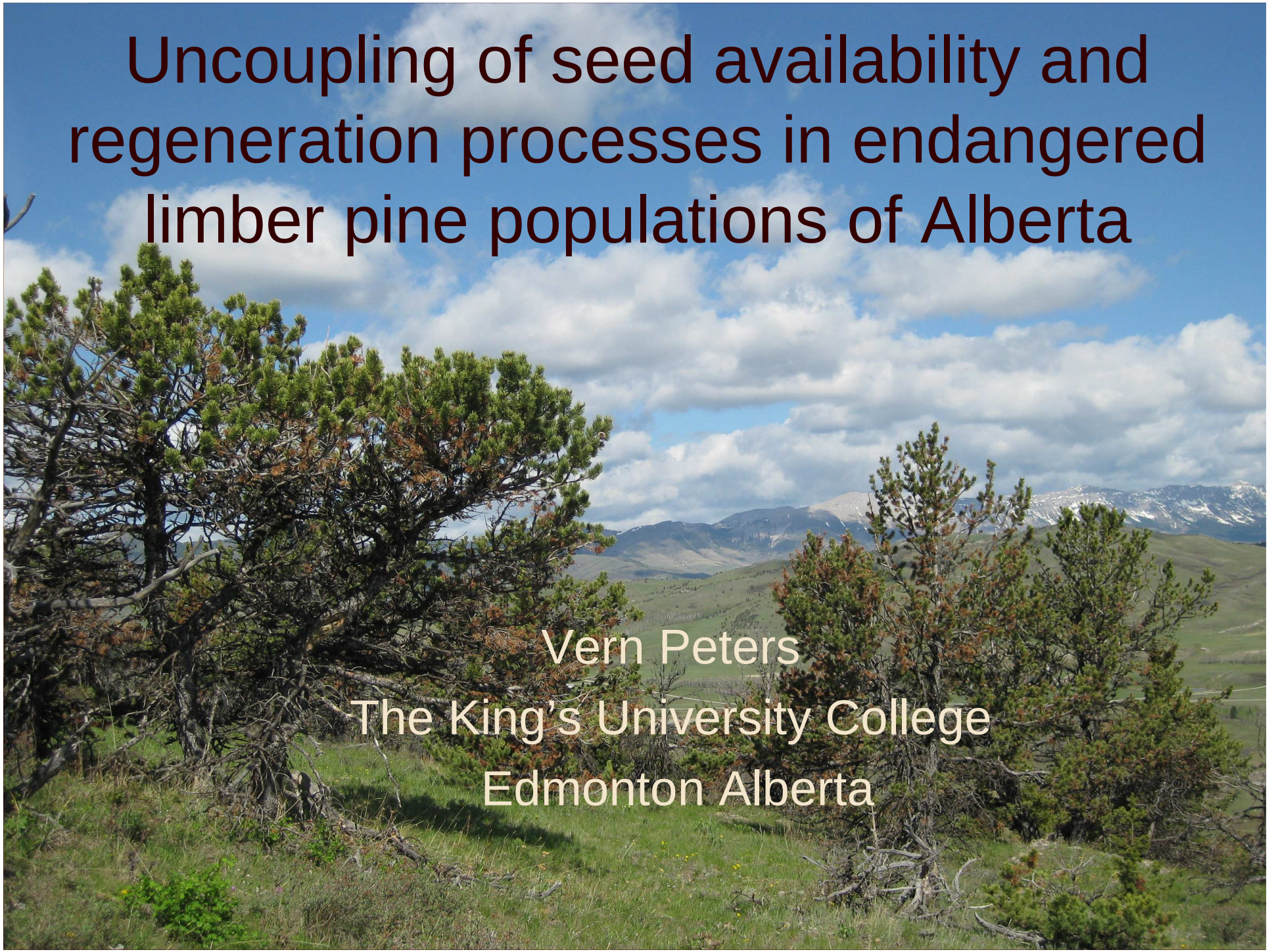
Uncoupling of seed availability and regeneration processes in endangered limber pine populations of Alberta



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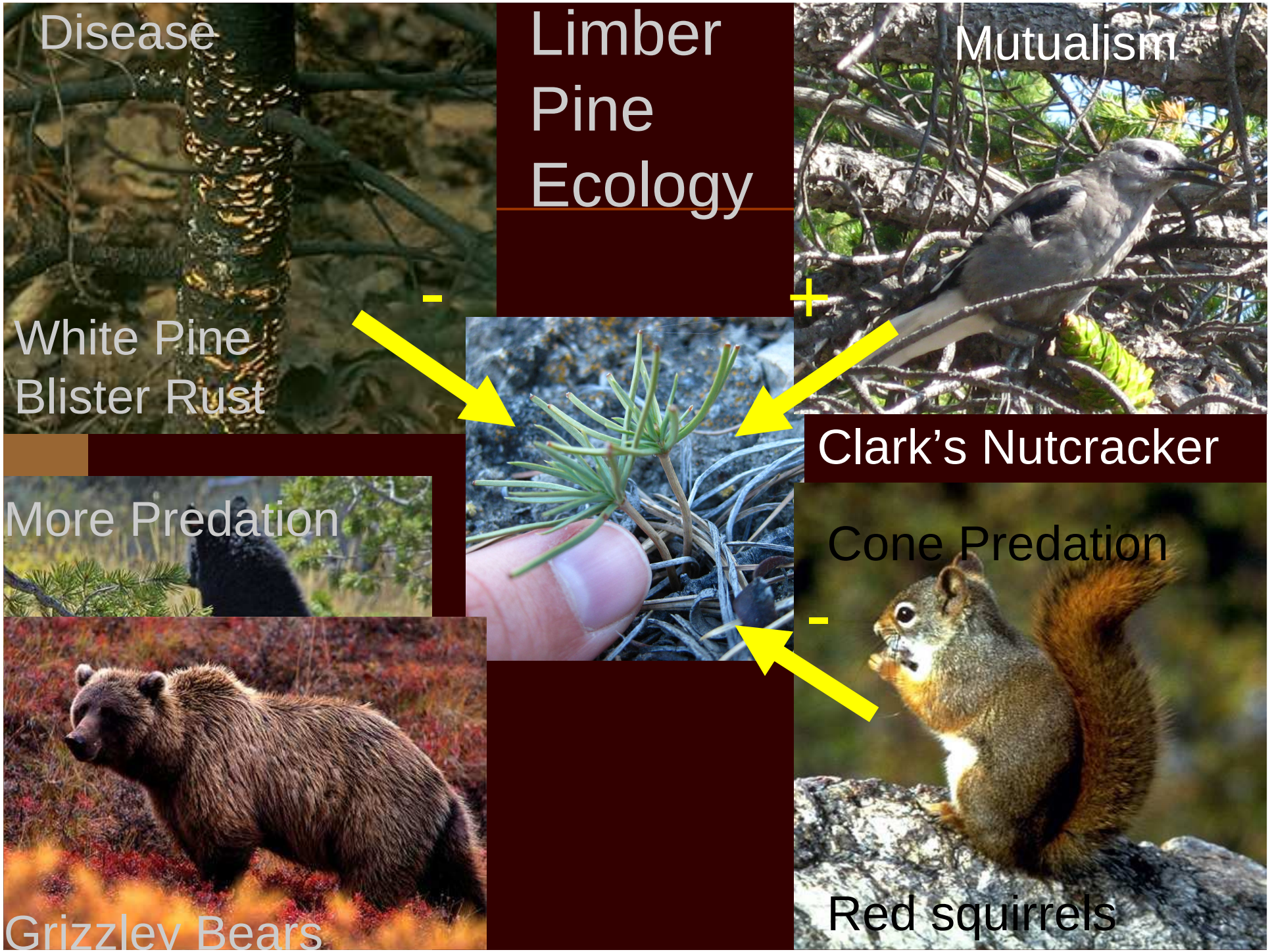
Conservation Issue:

- Mortality exceeds regeneration
- “Endangered species” – 2009 in Alberta


Disease
White Pine
Blister Rust
Limber
Pine
Ecology
Mutualism
Clark's Nutcracker
More Predation
Grizzley Bears
Cone Predation
Red squirrels
-
+
-

Objectives

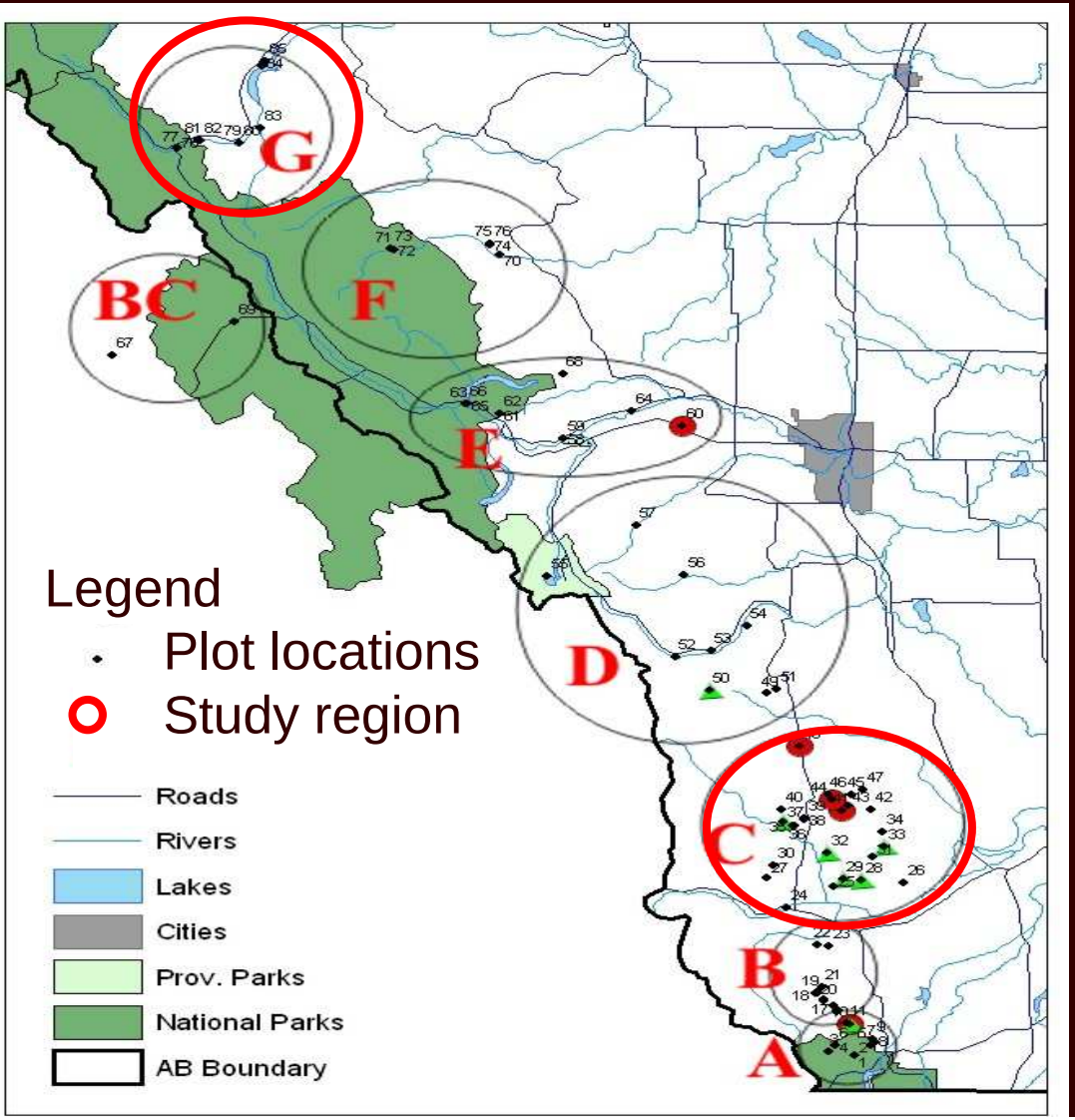
Seed Predation

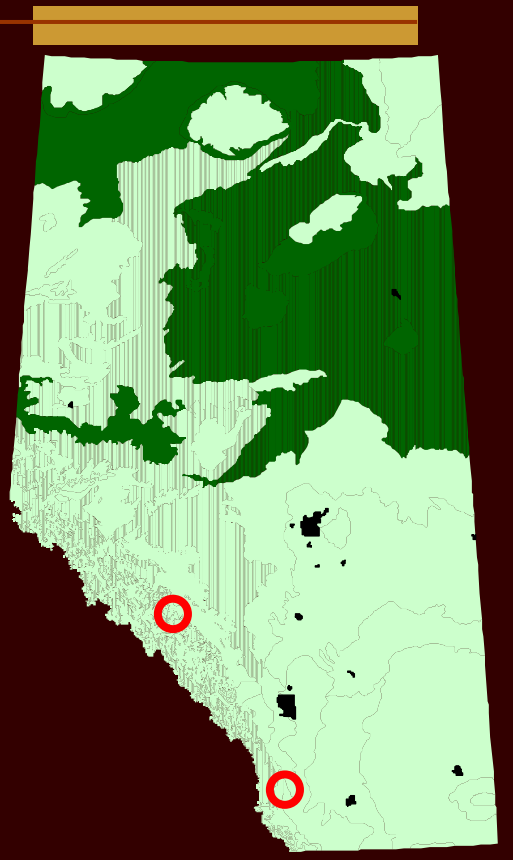
- To determine whether cone (seed) escape differs in light versus severely infested landscapes
  - Hyp: More seeds escape in light infections

Regeneration

- To determine whether recent regeneration differs in light versus severely infected landscapes
  - Hyp: More regeneration occurs in light infections

Existing Limber pine field sites with stand inventory, disease, and prior cone production data.





Alberta, Canada

SAMPLING DESIGN – LANDSCAPE LEVEL CONE REMOVAL

- 2 metapopulations separated by 400 km with 8-9 limber pine populations in each

High WPBR - Porcupine Hills

2 Stand Types

(Limber Pine and Douglas Fir Mix)

Low WPBR - Kootenay Plains

3 Stand Types - Limber Pine,

Spruce Mix, Lodgepole Pine Mix

WPBR increase in Northern Study Areas

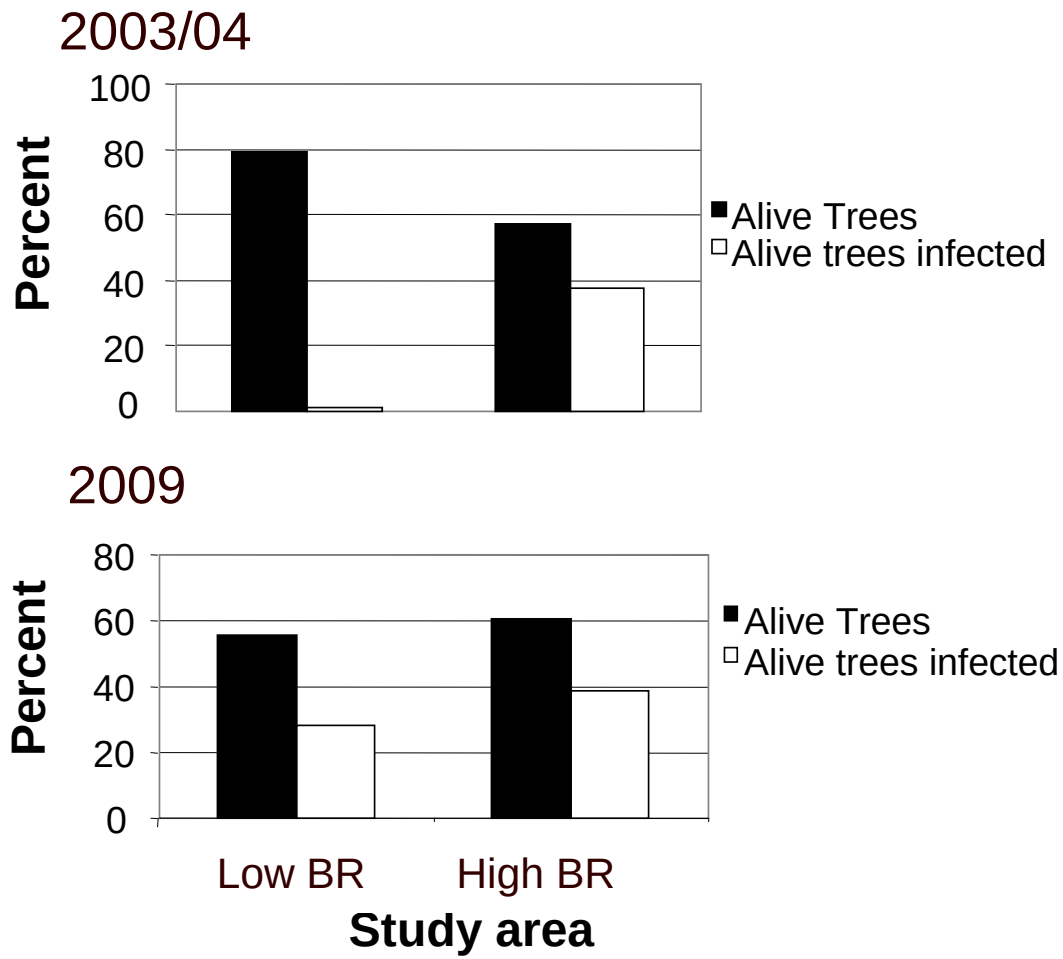
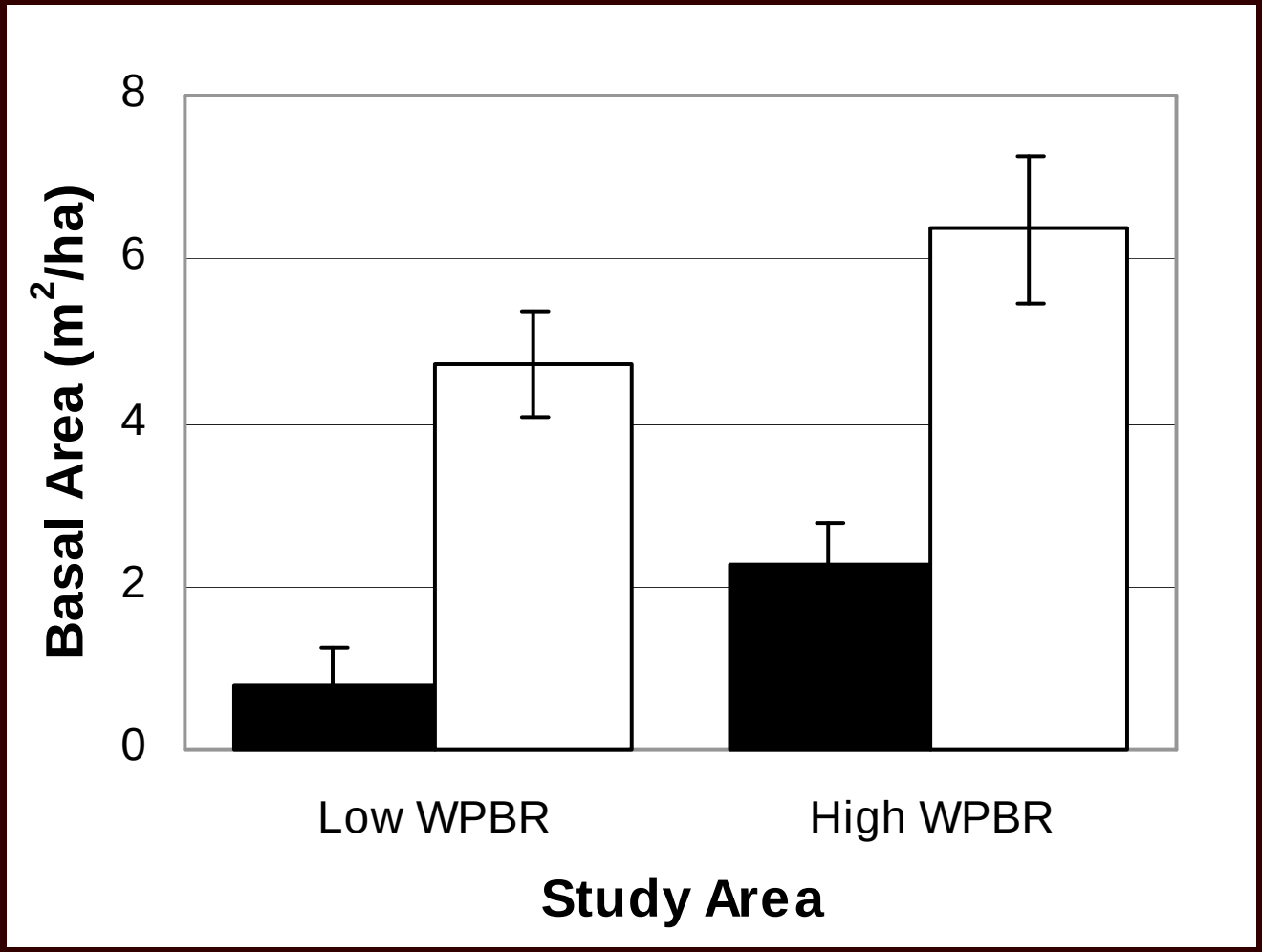


Figure 1: Change in WPBR levels in two metapopulations in Alberta over time ((n =3-4)

Data from
Smith, C. Parks Canada
Langor, D., CFS
WPBR Survey

Basal Area of Dead and Live Limber Pine (n = 8–9 populations per study area)



SAMPLING DESIGN – POPULATION

- 17 Populations Sampled

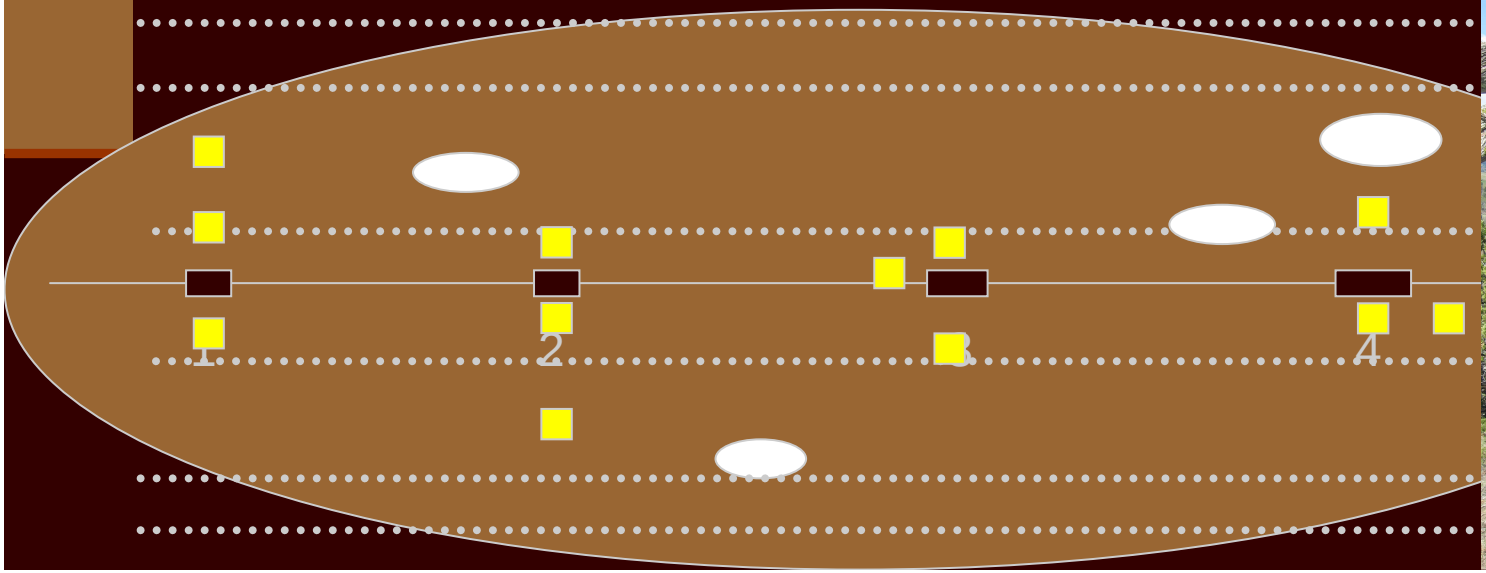
Cone Removal by squirrel

- Low (2008, 2009) and High (2010) cone years
- 4 plots, 10 trees/plot

Squirrel Abundance

- 6 Midden transects – 3 km (60 ha)/population

Regeneration - ■ 12 plots per stand



Methodology – Cone Production

Pre-dispersal: Easy

Post-dispersal: Tough

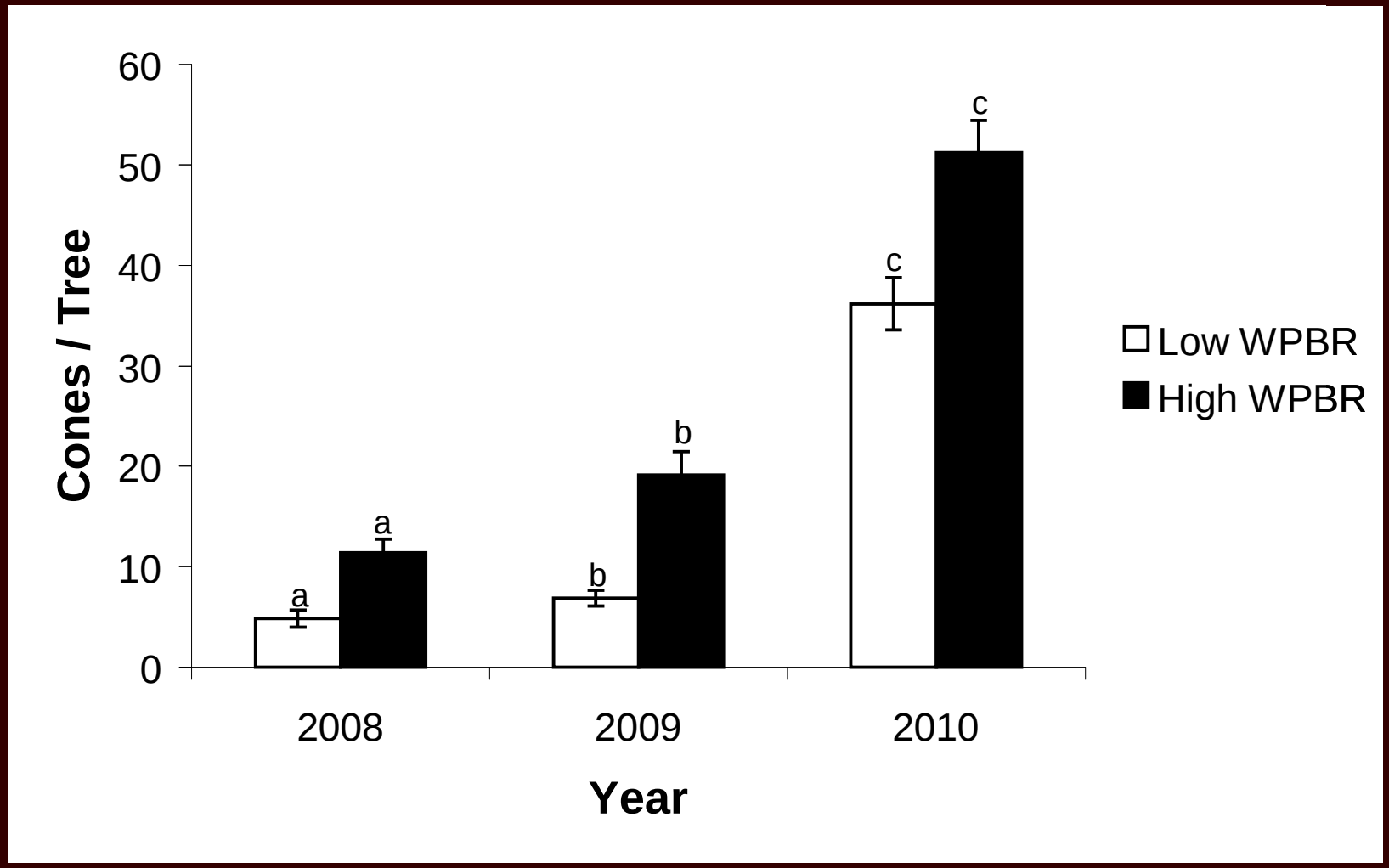
Risk – underestimating cone removal

Methodology – Midden Use

Active Middens vs. feeding stations

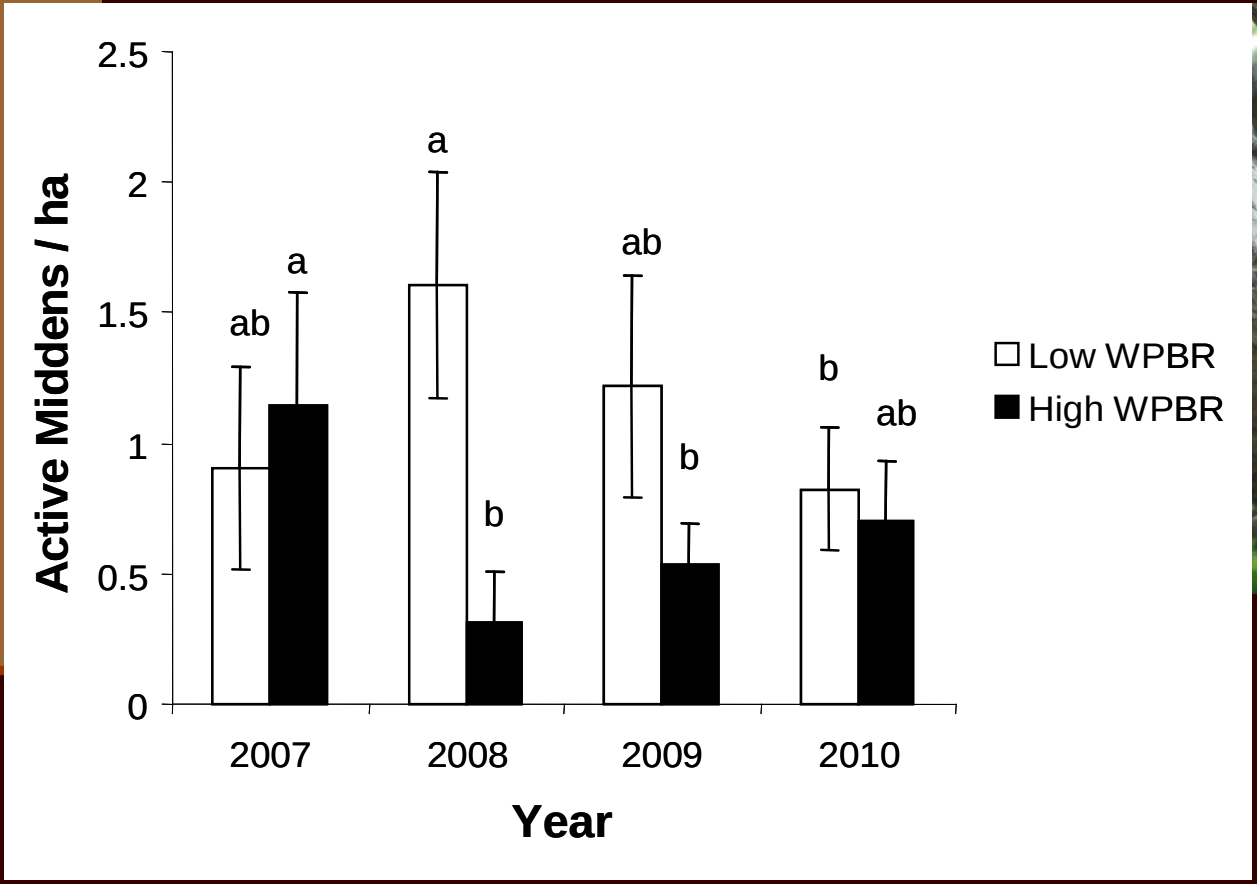
Interannual variation in cone production

(n = 9 and 8 populations, respectively)



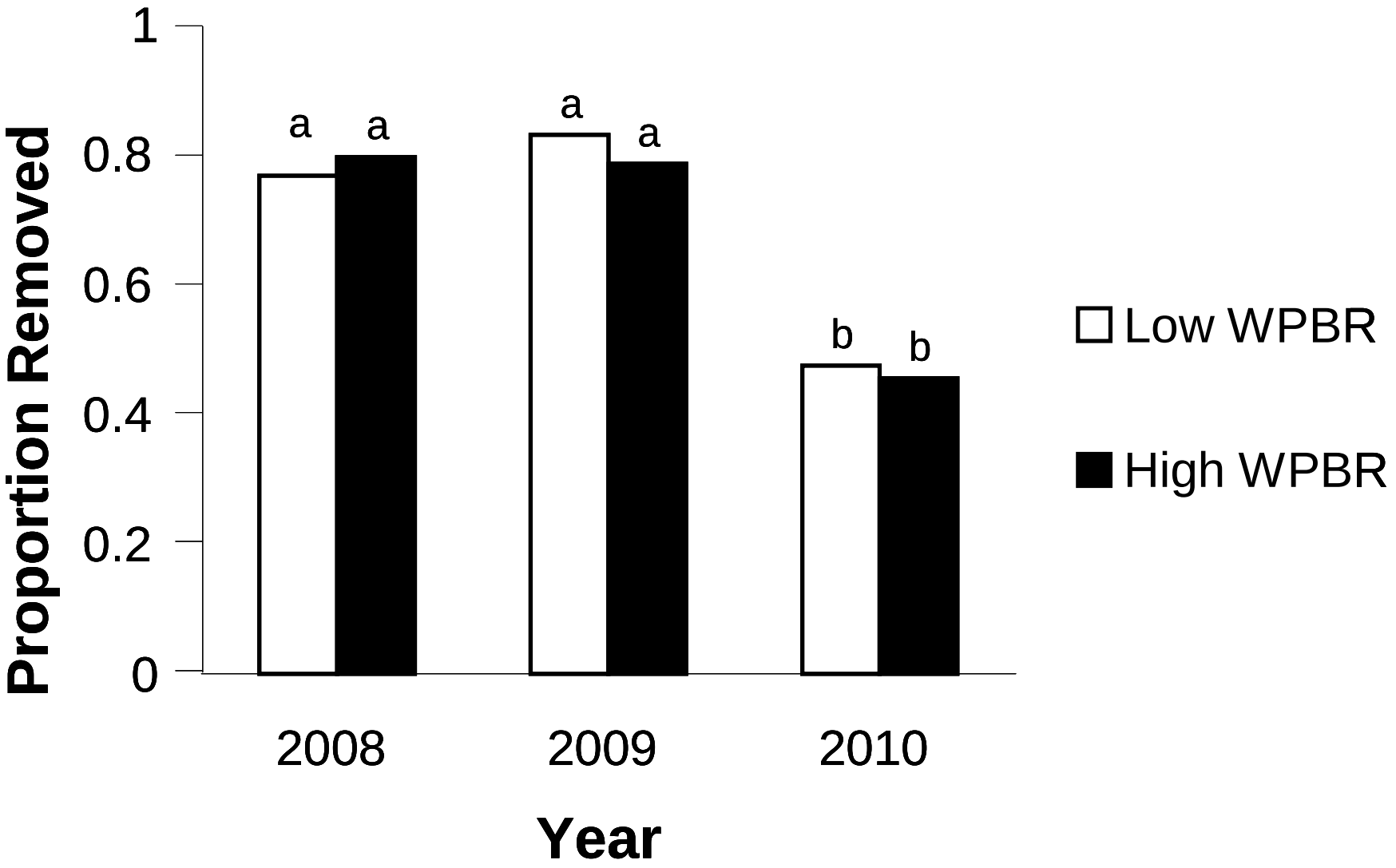
Squirrel Abundance in low versus high BR study areas

(+/- std. error, n = 9 and 8 populations, respectively)

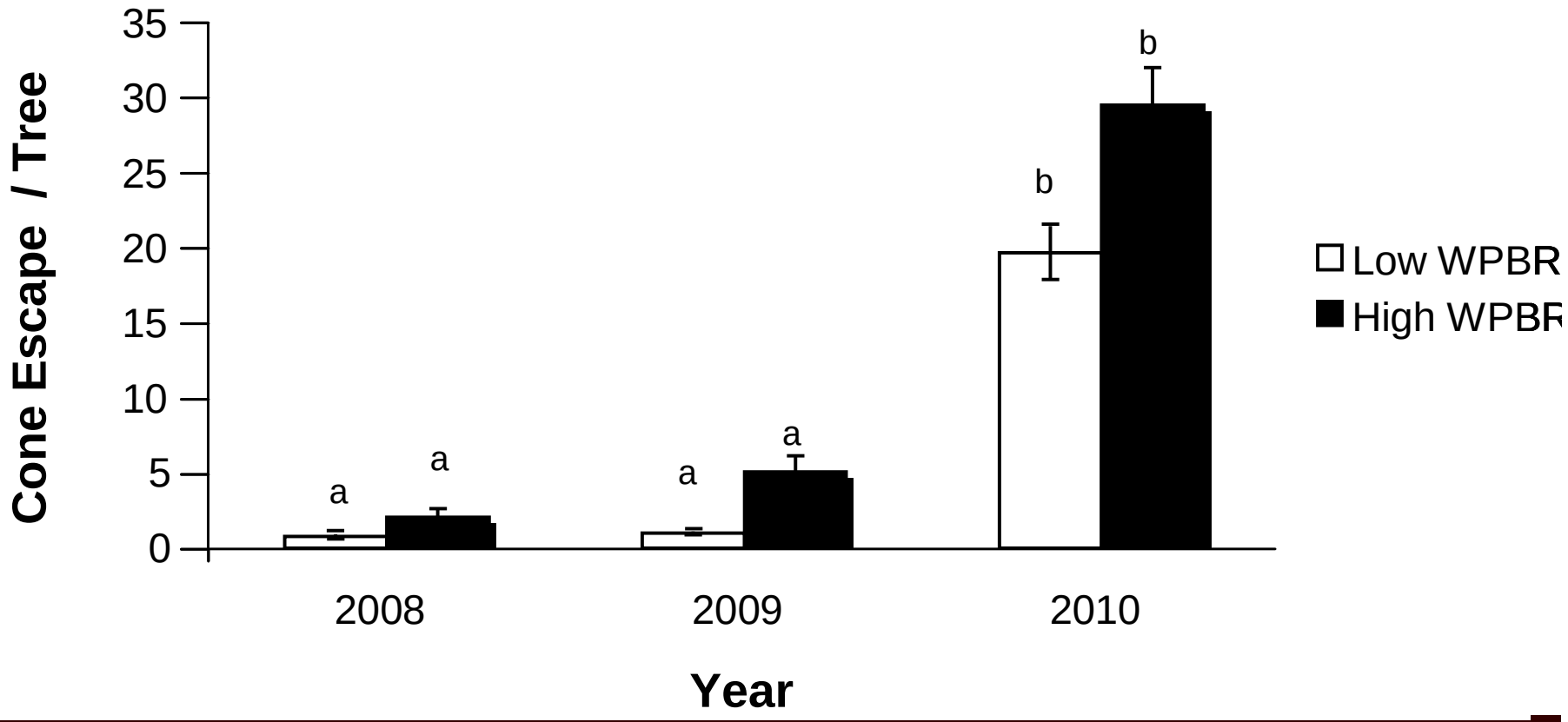


More Squirrels occurred in the low WPBR region

Cone predation amongst years
(n = 9 and 8 populations, respectively)



Interannual Cone escape
(n = 9 and 8 populations, respectively)



Nuts, Nuts, Get ‘em!

Squirrel predation and WPBR

Tree

- Squirrels reduce the amount of seed available for dispersers
- Interannual differences in cone availability are more important than WPBR levels between landscapes
- Mast years are likely necessary to attract nutcrackers (1000 cones/ha)

Likely reduces gravity-dispersed regeneration

Regeneration

Fundamental Question in Seed Ecology

- Is regeneration limited by:

1) seed availability

   or

2) substrate availability

   or

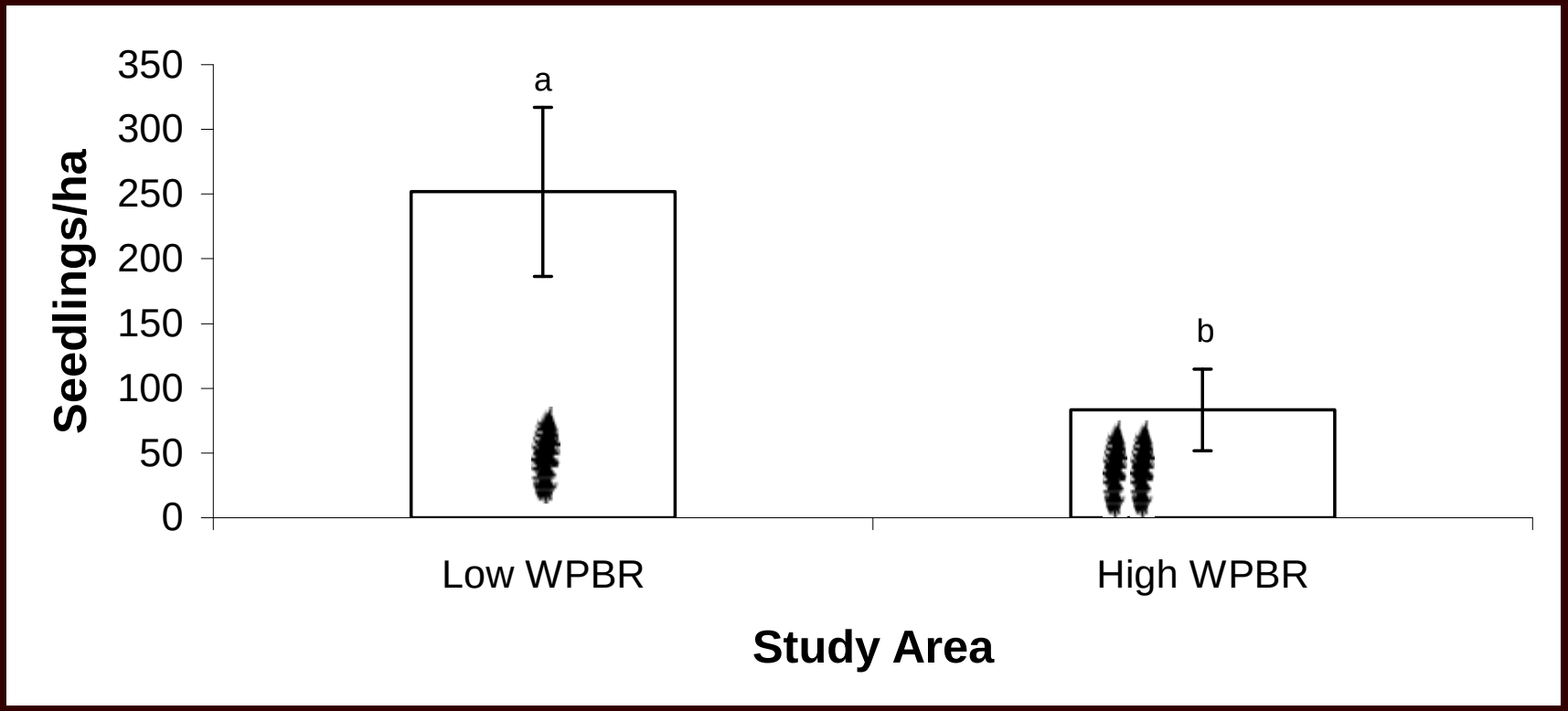
3) disease

- Production
- Predation
- Dispersal

- Seedbed
- Disturbance
- Succession

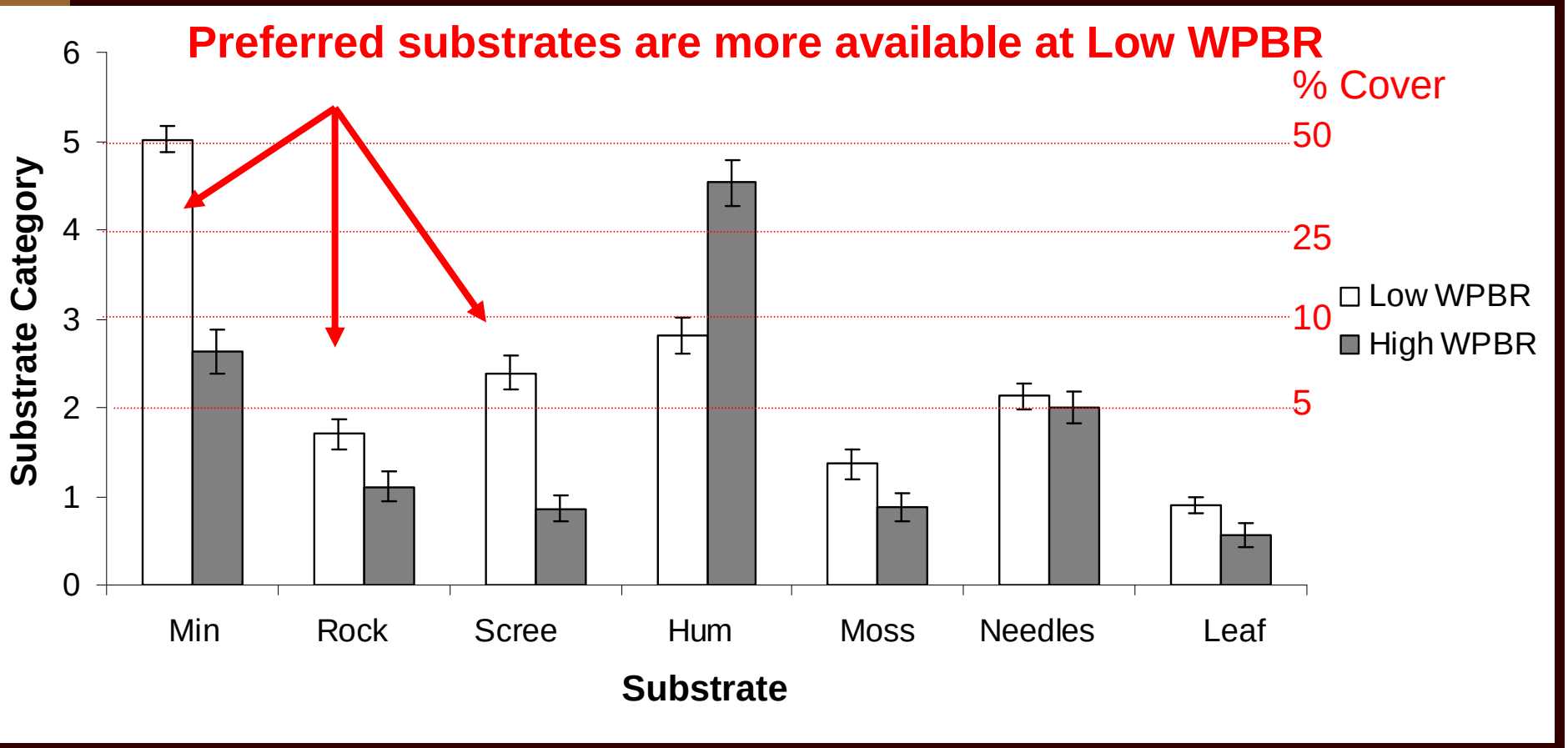
Regeneration and WPBR

(n = 9 and 8 populations, respectively)



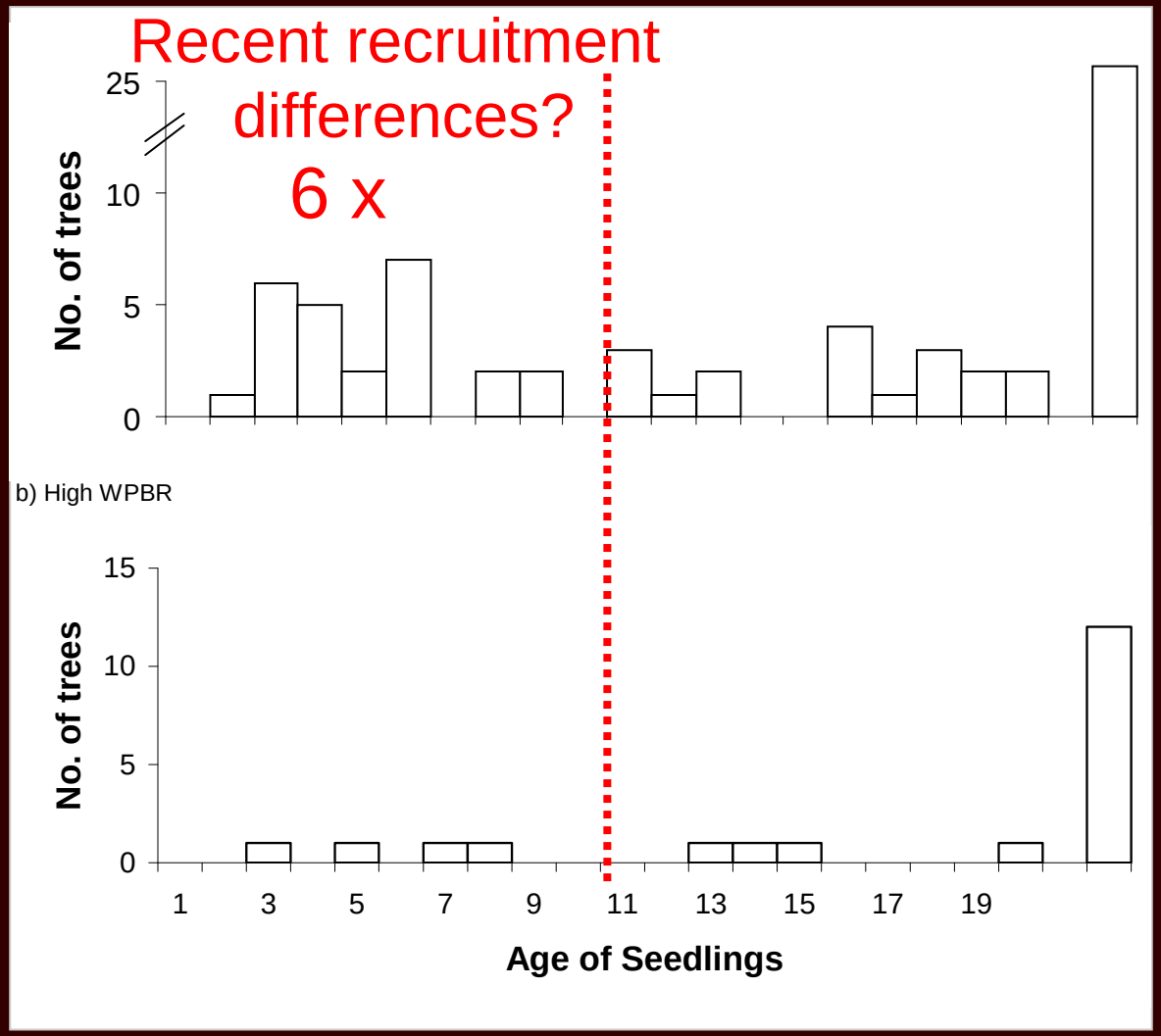
Why is regeneration so low where more seed is available (i.e. escaping squirrels?)

Regeneration and Substrate Availability



- Substrates may be limiting regeneration at high WPBR

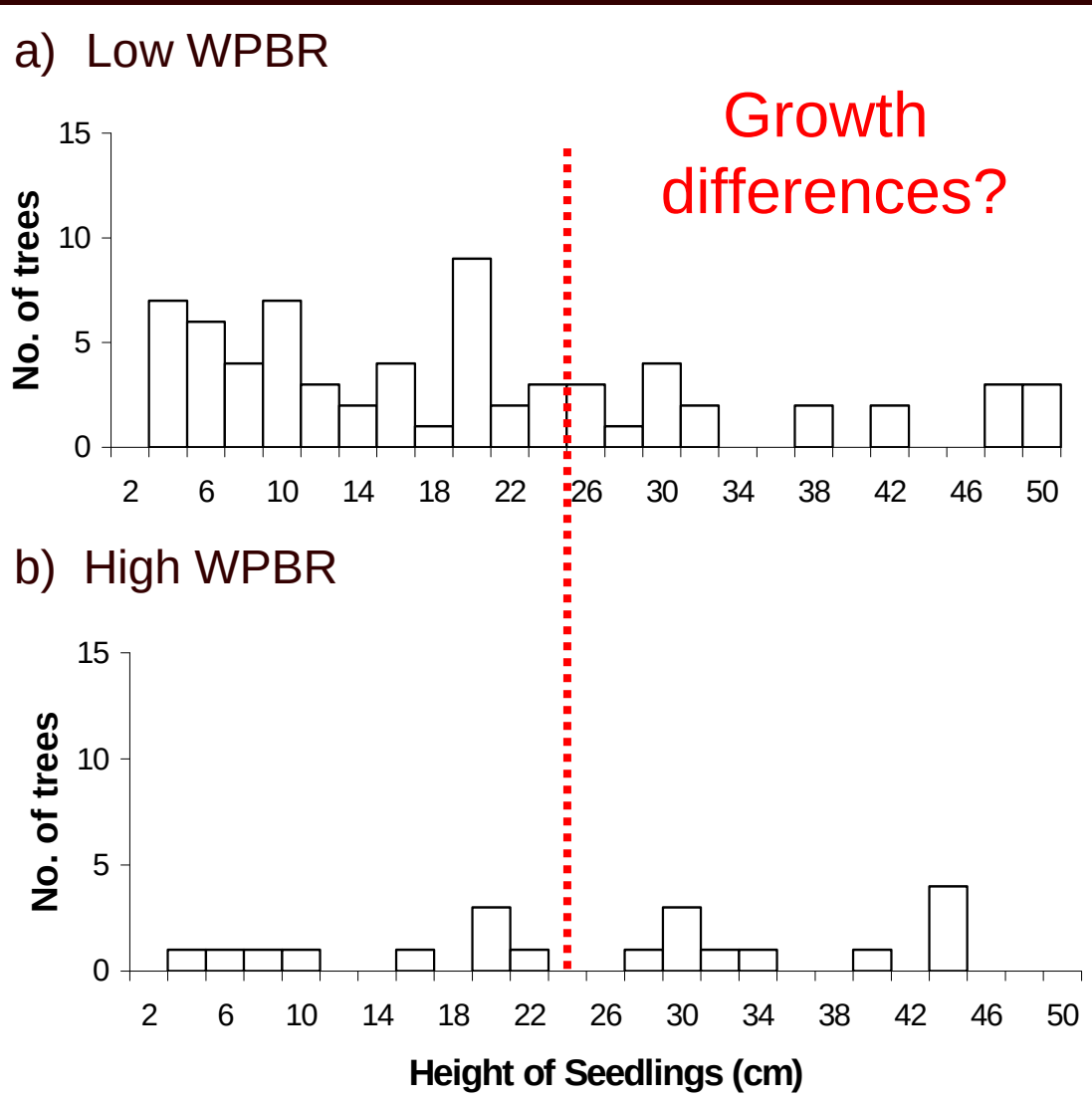
Timing of Limber Pine Regeneration
(n = 9 and 8 populations, respectively)



-Substrates are still available

-Grazing effects?
-Recruitment rates are lower

Size Structure of Seedlings
(n = 9, and 8 populations, respectively)



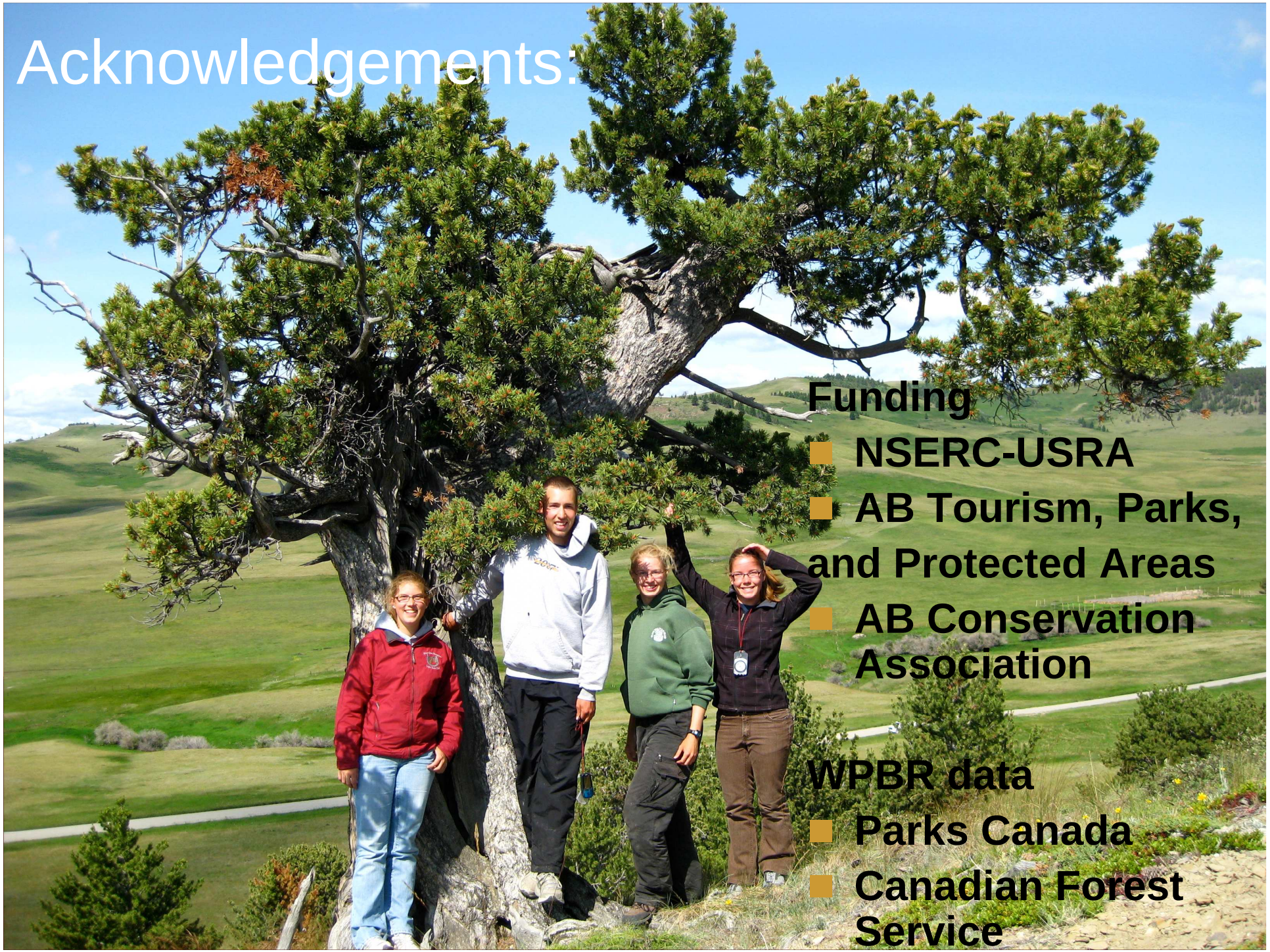
Proportionally fewer trees in larger size classes at Low WPBR sites

- Seedlings are “recruiting” into larger size classes in both study areas

Preliminary Conclusions

- Seed is primarily available in select years.
  - Interannual availability is more important than differences in availability relative to WPBR
- Seed available for nutcrackers is limited in high- and low-WPBR landscapes.
- Regeneration is inadequate in high WPBR landscapes
  - Regeneration is uncoupled from seed production processes (more seed but less suitable substrate)

Acknowledgements:



Funding

- NSERC-USRA
- AB Tourism, Parks, and Protected Areas
- AB Conservation Association

WPBR data

- Parks Canada
- Canadian Forest Service

Questions??