

Real-world examples of forest adaptation



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Context for forest adaptation in practice

- Other stressors and disturbances will likely override direct climate effects in near term



Context for forest adaptation in practice

- Need for continued acknowledgment of other contemporary objectives and approaches



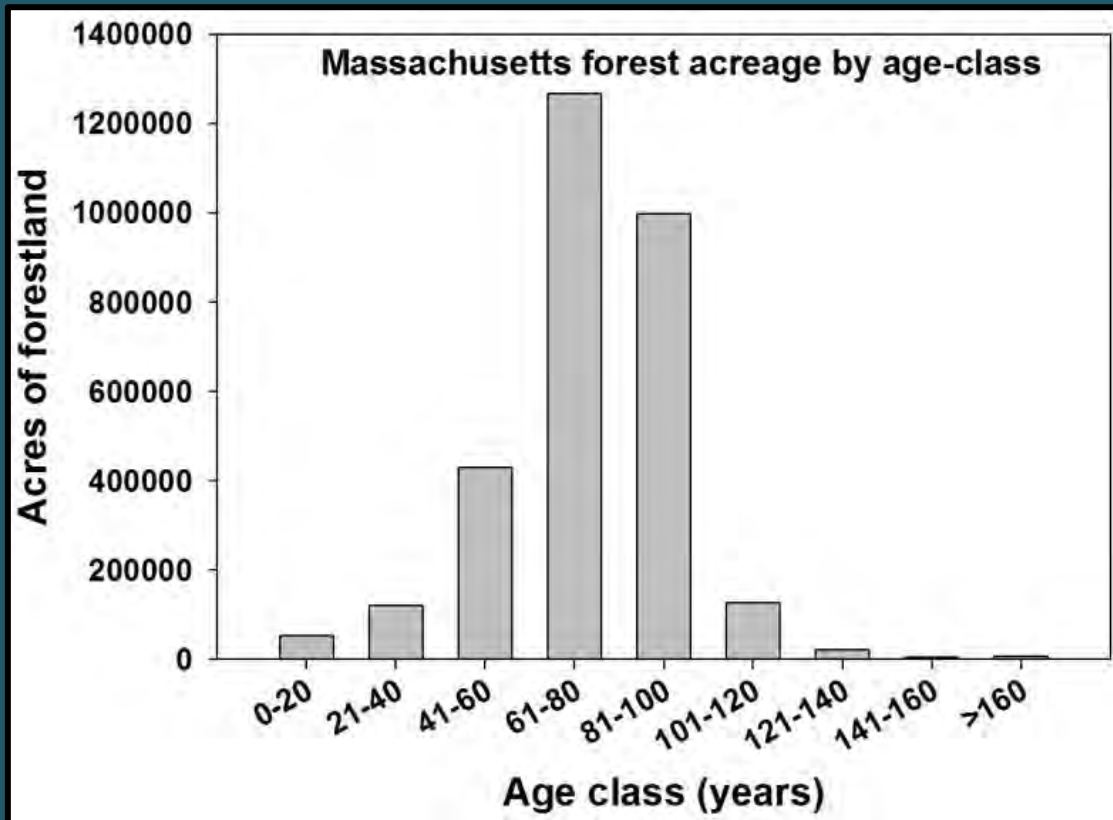
Extended irregular shelterwood reserves to regenerate mixed white pine-oak stand and retain mature structure



Group selection with seed tree-retention to restore yellow birch

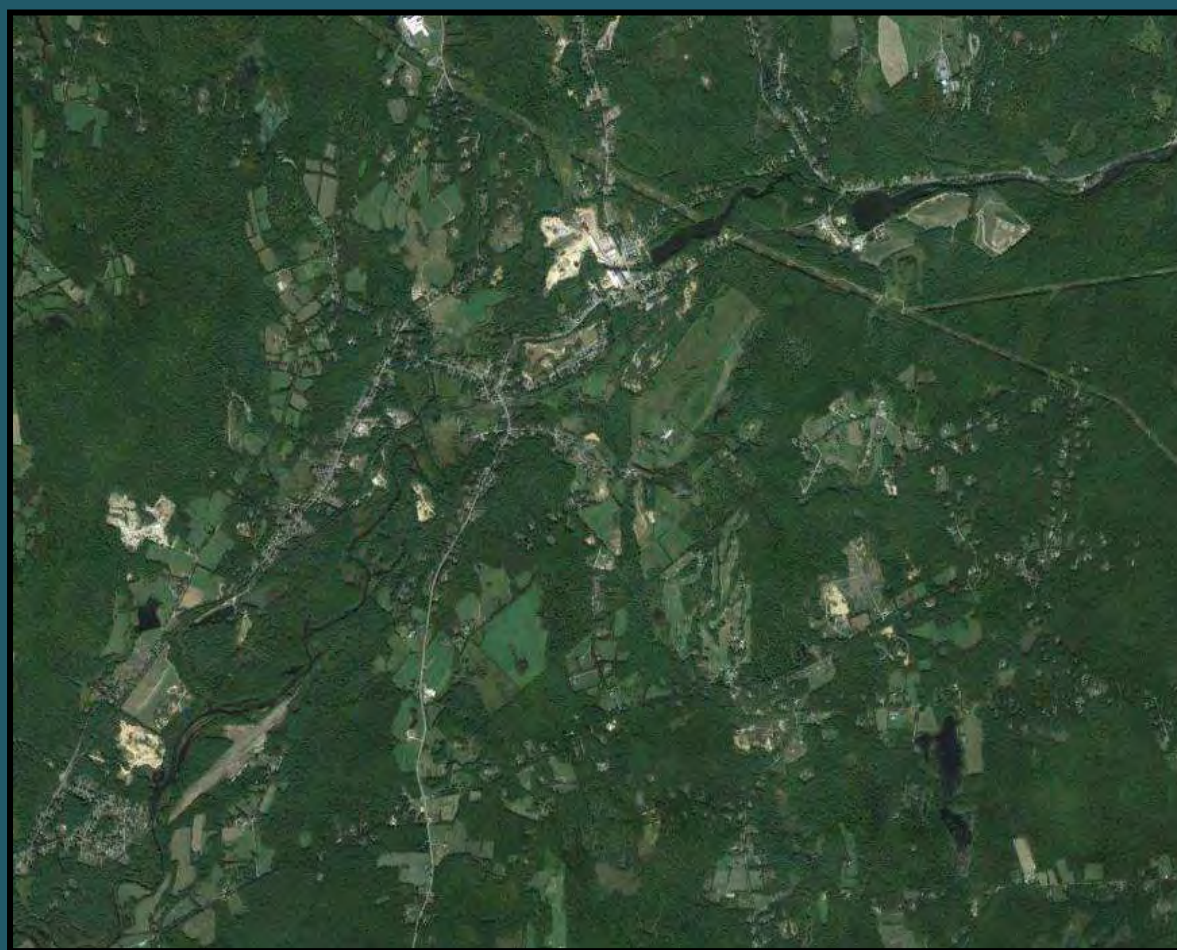
Context for forest adaptation in practice

- Relative homogeneity presents vulnerable condition, but is opportunity for “easy” adaptation gains through complexity-based management



Context for forest adaptation in practice

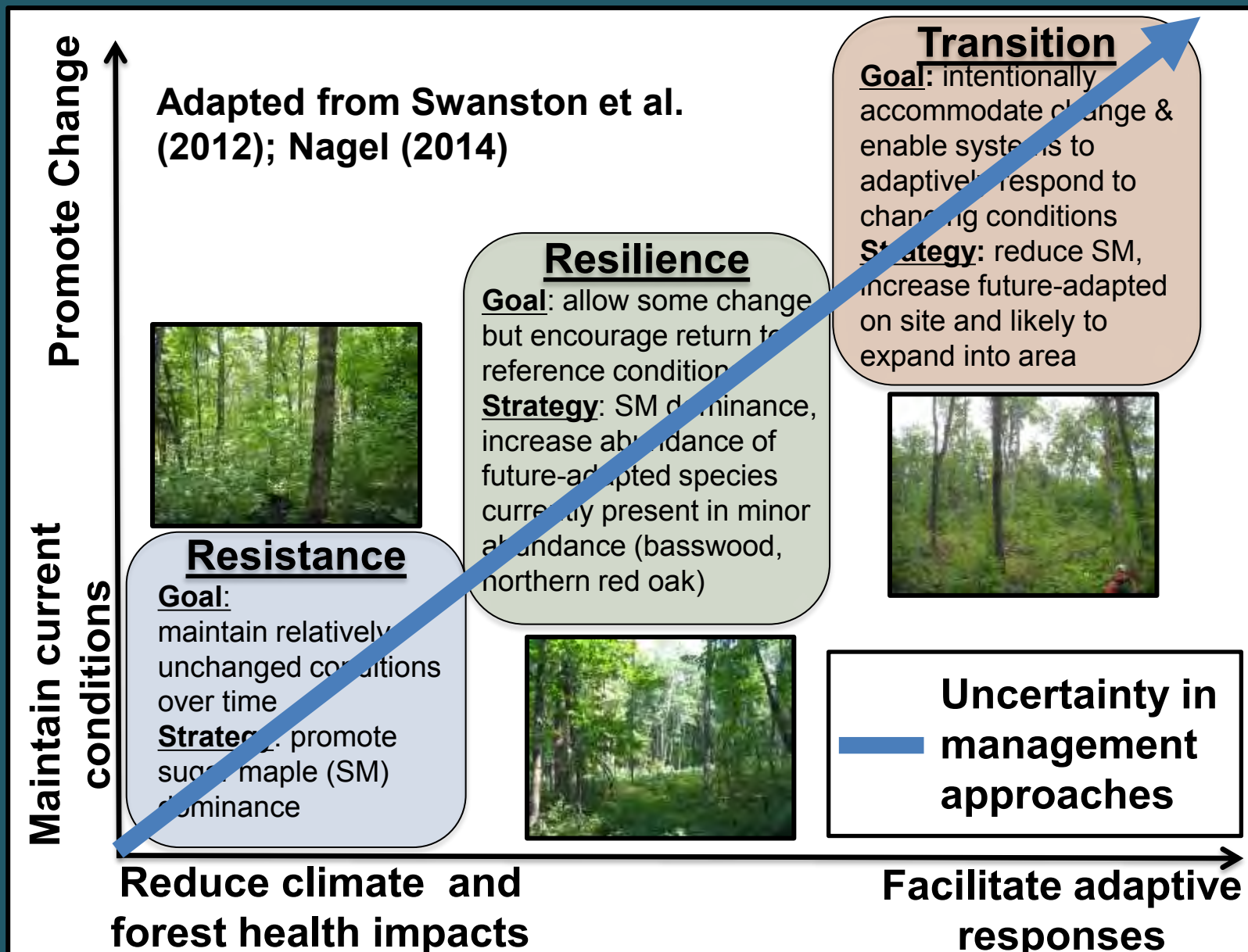
- First step to adaptation is making sure we have future forests across landscape



Examples along adaptation continuum



Continuum of management objectives



Resistance in practice: drought impacts



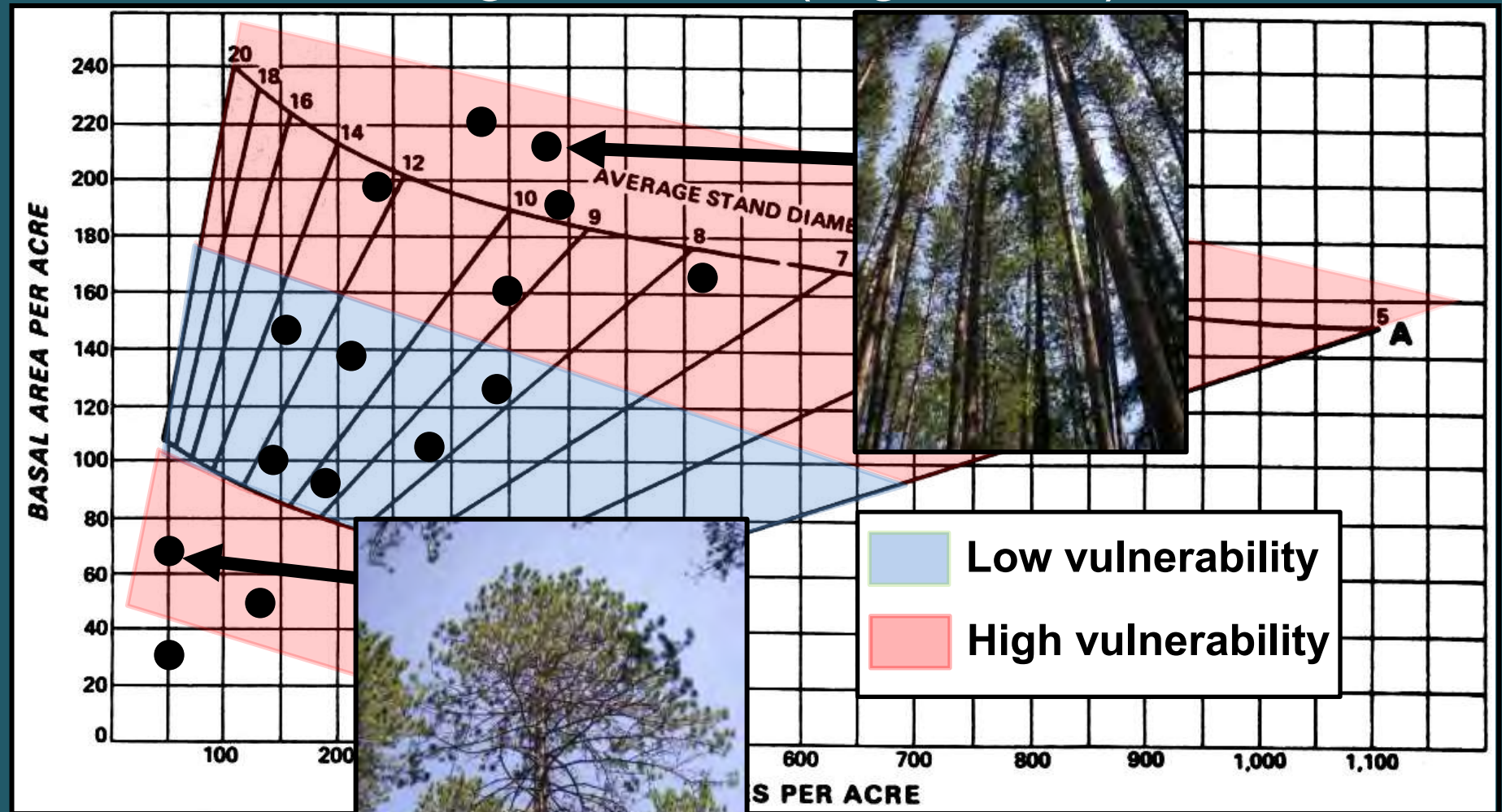
Resistance in practice: drought impacts

- Interest in use of thinning treatments to minimize impacts of predicted changes in climate and extreme weather (e.g., drought)
- Thinning represents near-term resistance strategy versus long-term adaptation approach (e.g., shifting composition)

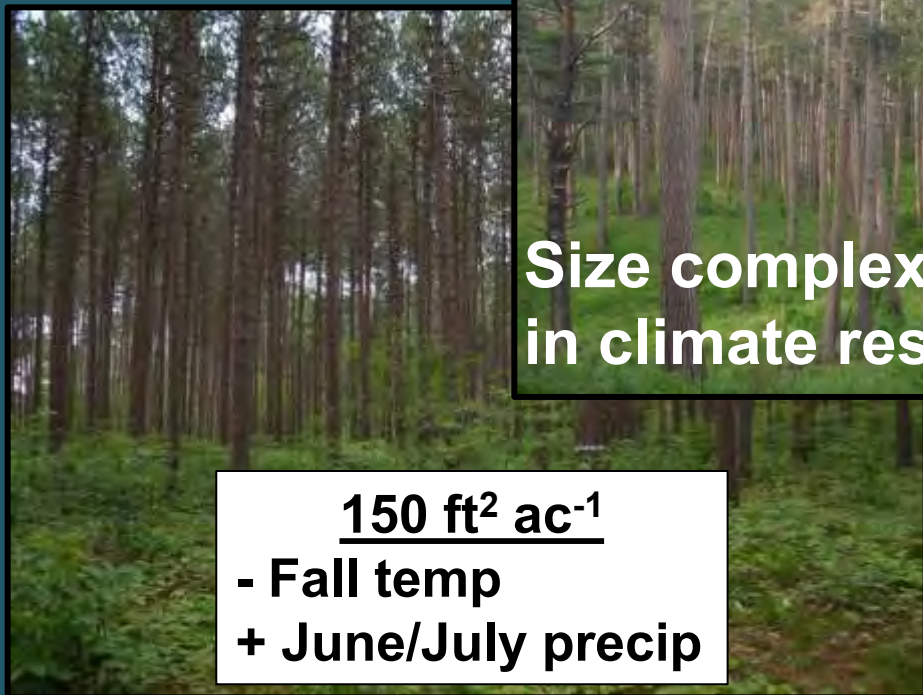
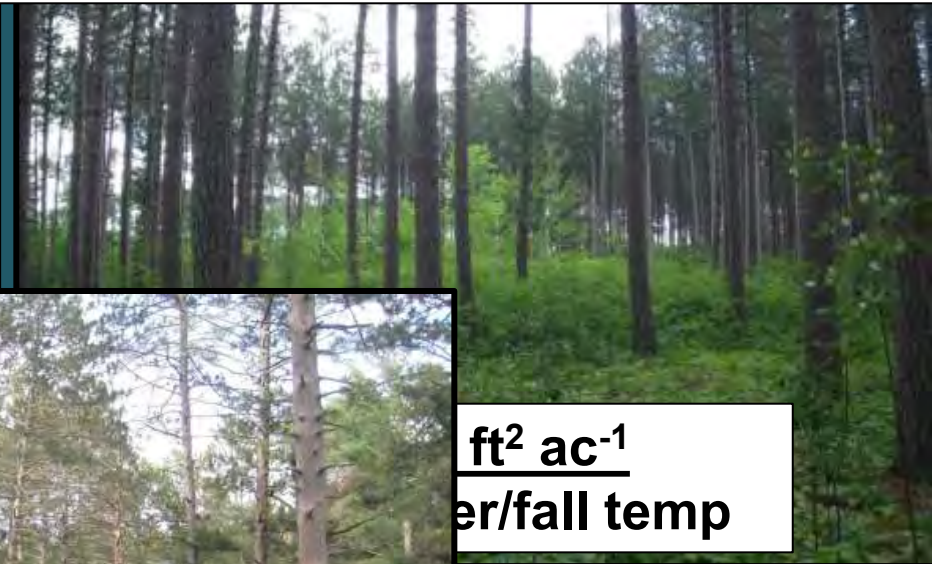
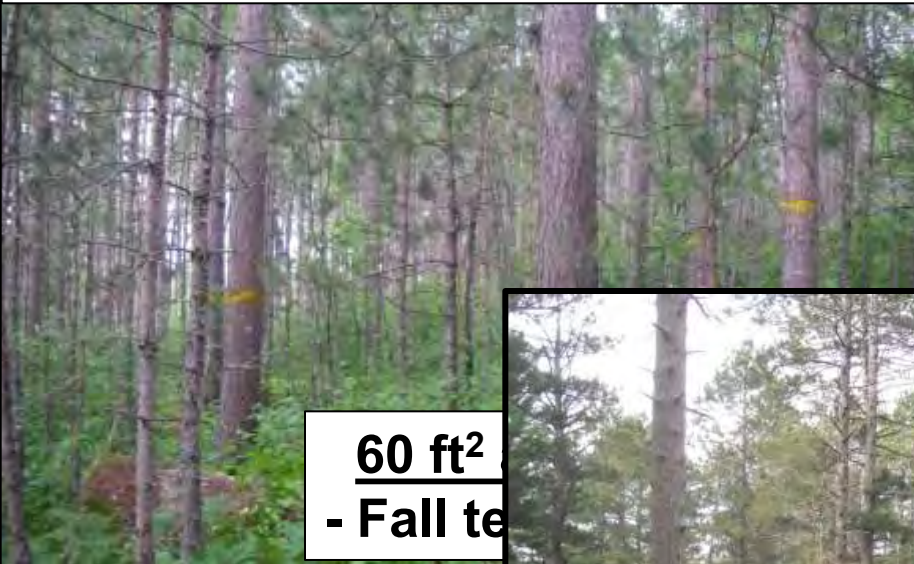


Resistance in practice: drought impacts

- Past vulnerability of thinned and unthinned stands to known drought events (e.g., 1988)



Varying climate sensitivity within species



Resilience and transition approaches



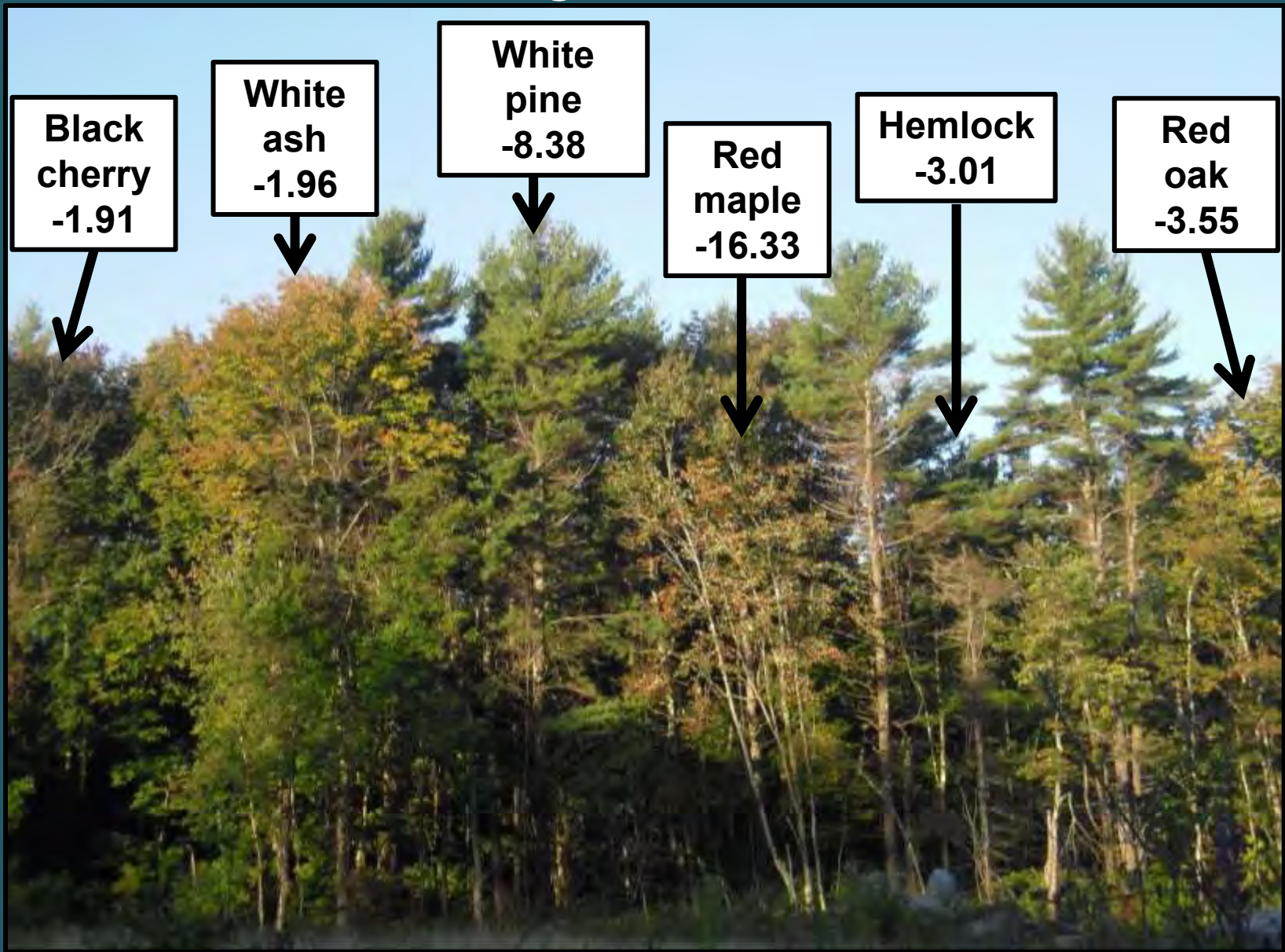
Resilience and transition approaches

- Key element of these approaches is increasing representation of future-adapted species
- Focus on regeneration methods that provide recruitment opportunities consistent with functioning of current forest systems (i.e., overstory trees are not going away anytime soon)

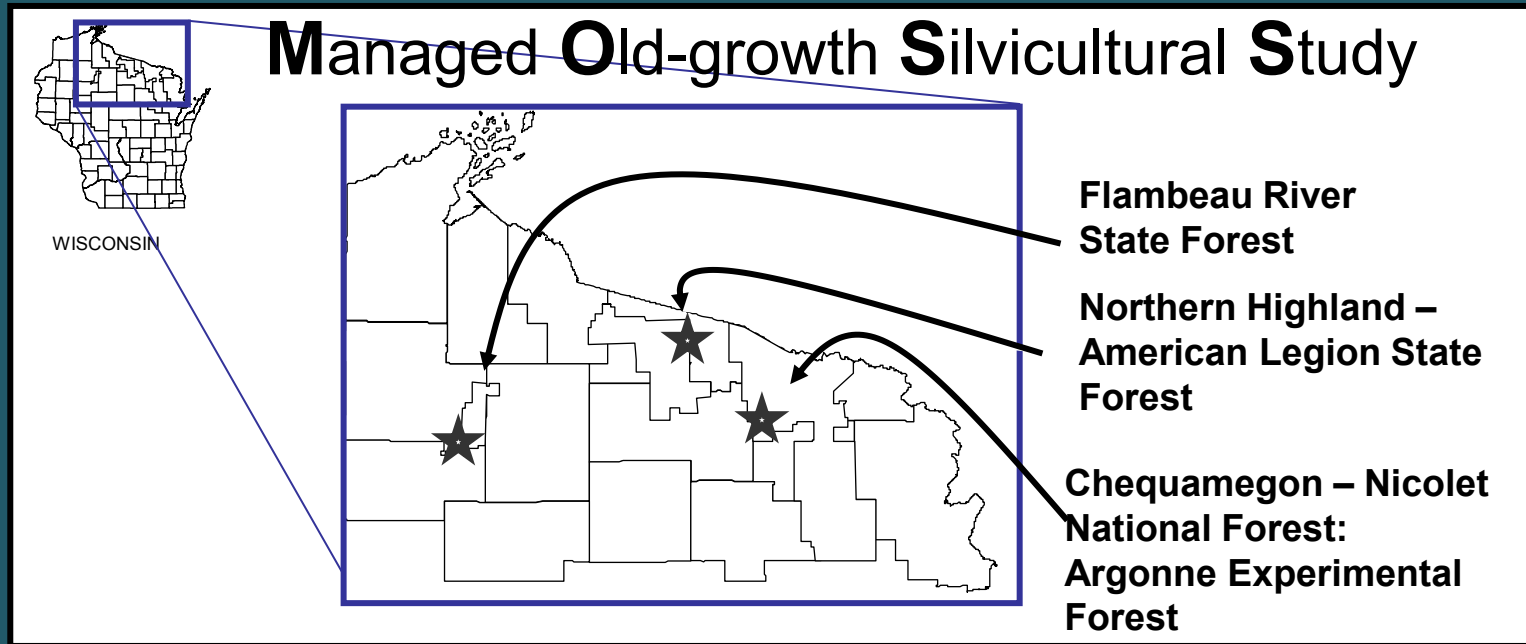


Resilience and transition approaches

The forest through a future climate filter



Resilience approaches in northern HW



- Goal is to increase structural and compositional complexity in second-growth northern hardwoods
- In light of projections for region, how might treatments increase representation of future-adapted species (largely midtolerants)

Species	Current suitability	Change in future suitability
sugar maple	14.61	-10.96
n. red oak	2.27	+1.88

Small gaps treatment (resistance)

- Total area \approx 120 acres
- Gaps: 35 ft diameter (single tree)
- 414-417 gaps/study area



300

0

300

600 Meters

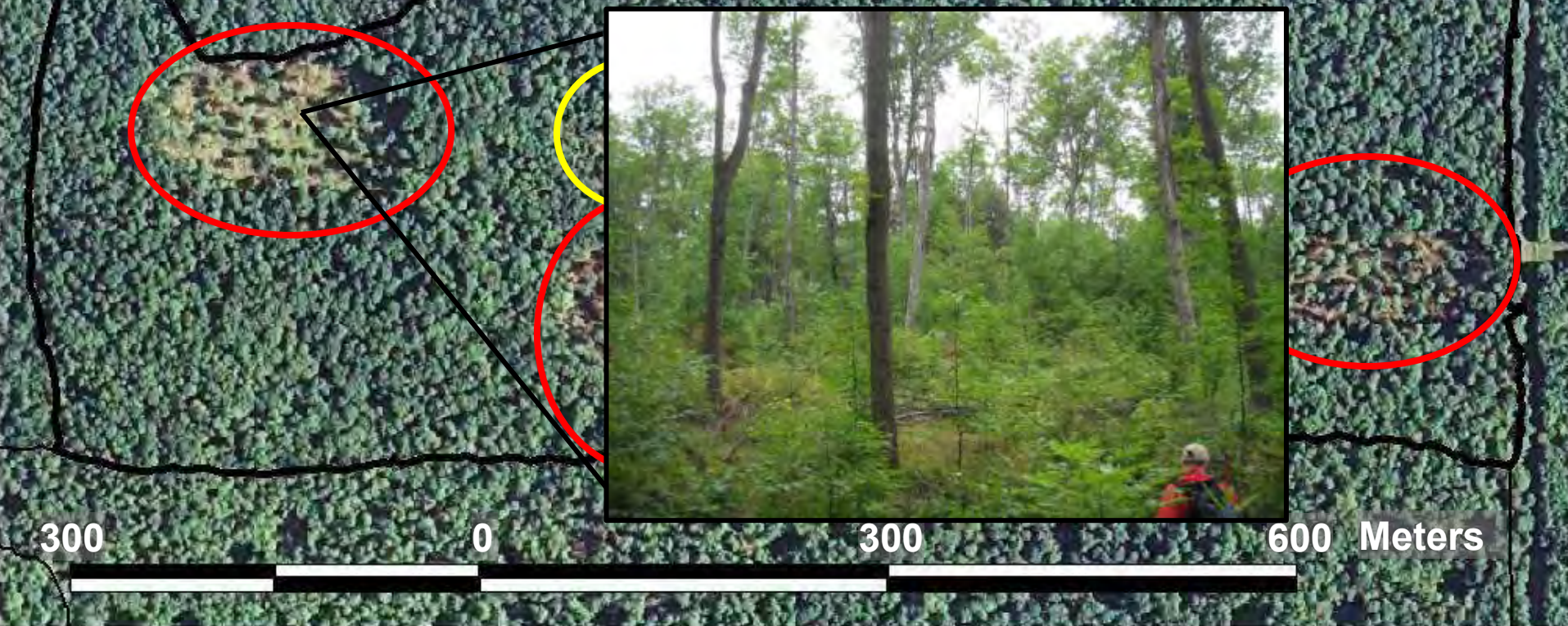
Large gaps treatment

- Total area \approx 120 acres
- Gaps: 60 ft diameter
80ft diameter
- 96-136 gaps/study area



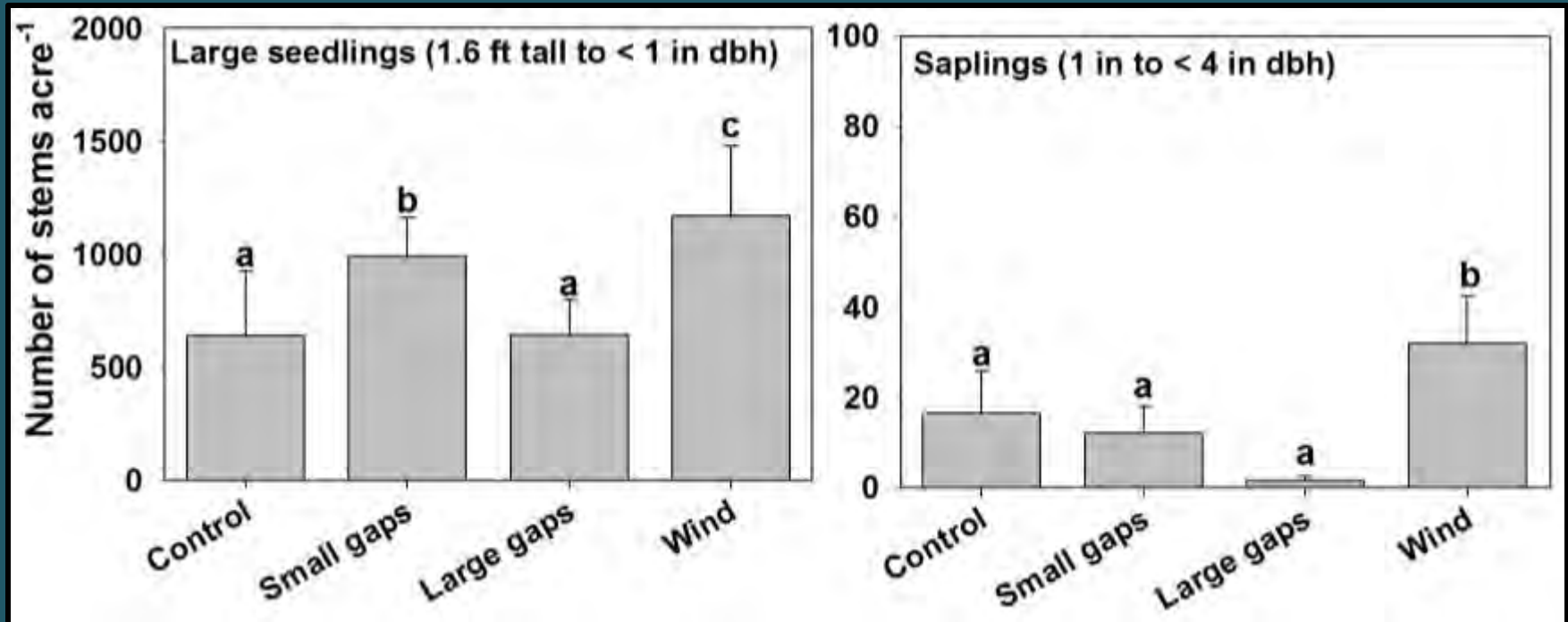
Wind treatment

- Total area \approx 120 acres
- 4 “large” shelterwoods (3 acres)
- 4 “small” shelterwoods (1 acre)



Regeneration of future-adapted species

Recruitment of future-adapted spp. outside of deer exclosures (black cherry, red oak, white ash*)

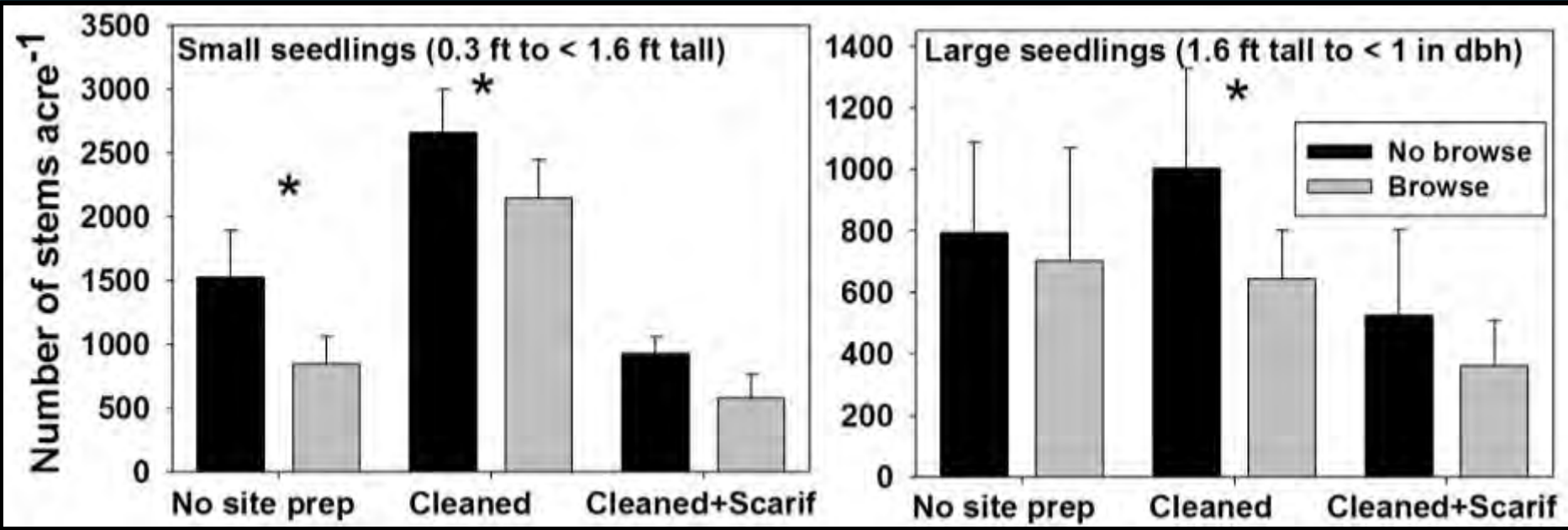


- Sugar maple remains dominant species by far (5-10k stems acre⁻¹), but emulation of mesoscale disturbance has increased future-adapted component



Regeneration of future-adapted species

Response to gap-level treatments (60-80 ft gaps)



- Addressing competition associated with natural system trajectory (i.e., towards sugar maple) and pervasive browsing impacts is critical for increasing future-adapted component

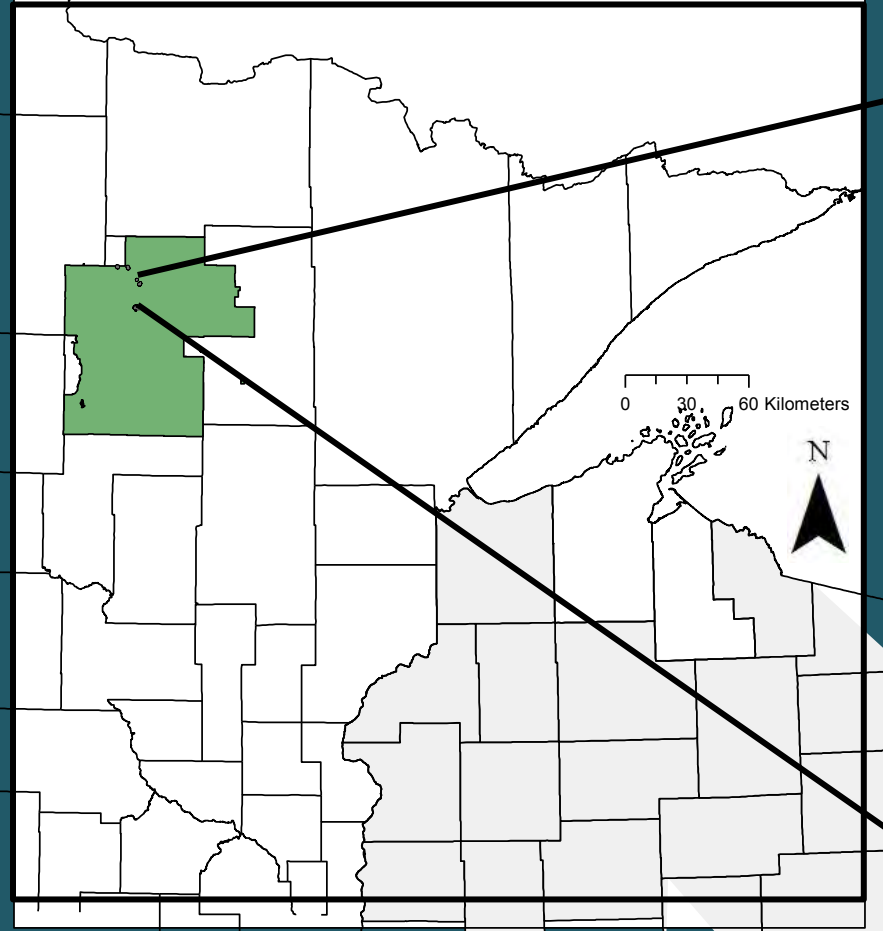


Integrating climate with other stressors



Transition approaches to address EAB

- Large-scale manipulative project on Chippewa National Forest in northern Minnesota
- 8 black ash swamps (20-40 ha in size)



Transition approaches to address EAB

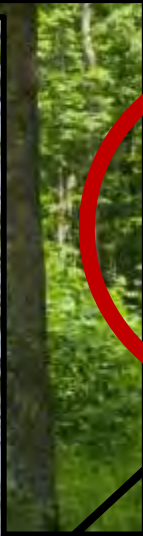
4 treatments

1. Group selection (0.1 ac gaps over 20% of stand)
2. Clearcutting (4 ac): pre-emptive harvest of ash
3. EAB infestation (girdling all ash)
4. Unharvested control

All treatments are 4 ac each (8 replicates)

Harvests/girdling occurred in winter 2012





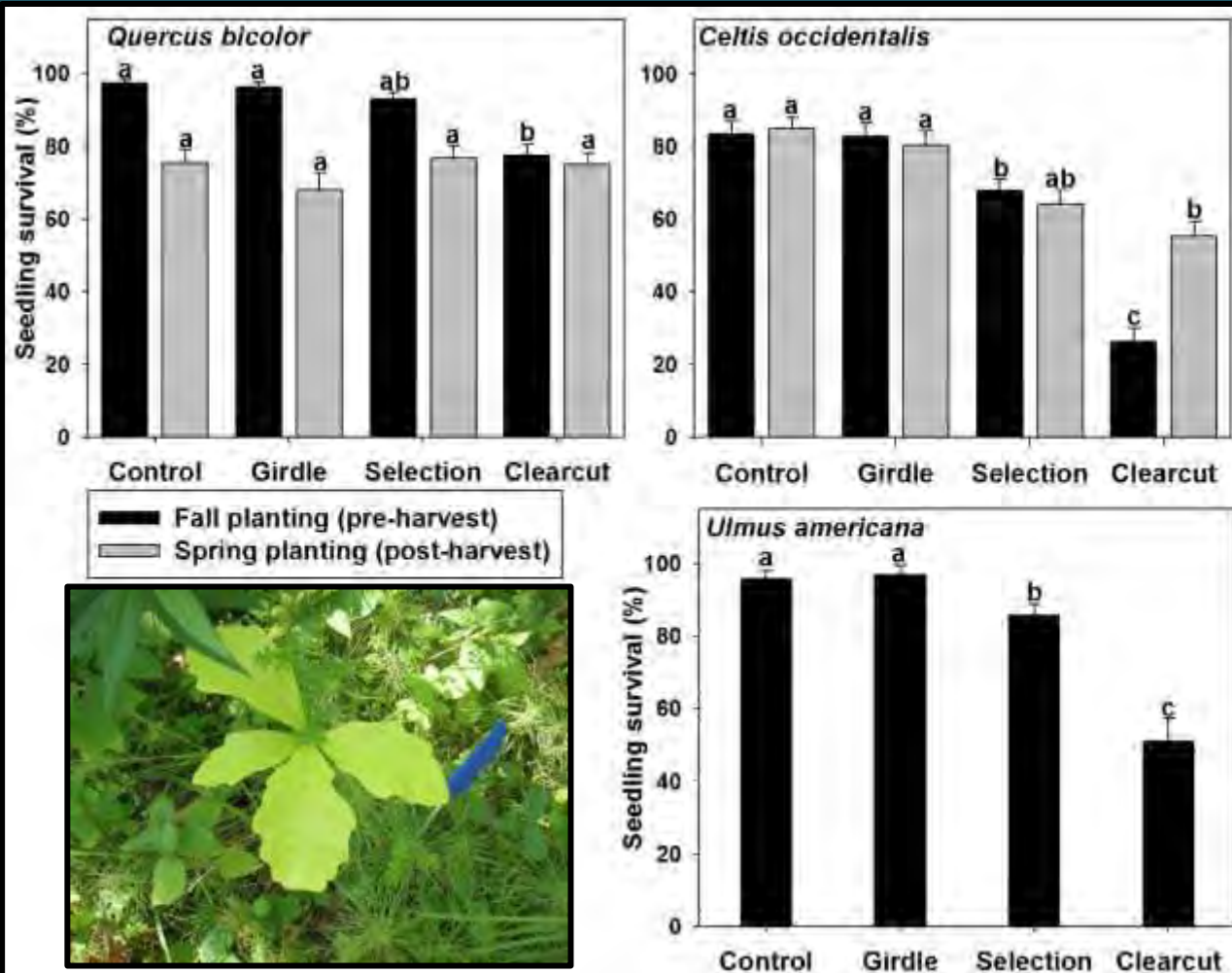
Transition approaches to address EAB

- Evaluating replacement species for transition
 - white cedar (-), yellow birch (+), tamarack (-), red maple (+), hackberry (+)*, swamp white oak (+)*, black spruce (-), quaking aspen (-), cottonwood (+), balsam poplar (-), American elm (resistant variety) (+)
 - Planted in all treatments (384 reps of each species per treatment)
- *Future-adapted species not currently present on site



Transition approaches to address EAB

- Seedling survival for potential replacement species



Survival greatest for pathologically-limited, or out-of-range species, particularly in treatments maintaining overstory black ash



Take-home points and conclusions

- Adaptation efforts should account for underlying processes and dynamics in system to inform site-level, silvicultural recommendations
 - Restoring or maintaining processes that provided windows of recruitment in past (fire, large gaps, etc.)
- In most cases, current overstory species are not going away anytime soon
 - Use of regeneration methods that maintain overstory trees during regeneration phase will keep options on site and ameliorate extremes



Take-home points and conclusions

- Continue to encourage, restore, and maintain system complexity using ecologically-based approaches
 - Can not ignore importance of structural features in facilitating adaptive response
- Resistance approaches (thinning) may draw on past knowledge of system, but most adaptive practices will require experimentation
 - Embrace uncertainty and learn through practice (mistakes are critical to advancing our management)



Acknowledgements



- **USFS NRS:** B. Palik, C. Woodall, R. Kolka, M. Slater, D. Kastendick, J. Elioff
- **Chippewa NF:** G. Swanson, S. Klinkhammer
- **UMN:** L. Nagel, M. Reinikainen, K. Gill, P. Klockow
- **UMaine:** S. Fraver
- **USGS:** J. Bradford
- **MN DNR:** J. Almendinger, K. Rusterholz, G. Mehmel
- **NIACS:** S. Handler, M. Janowiak, C. Swanston
- **St. Louis County:** J. Meyer, M. Pannkuk, T. Lindgren
- **Funding:** MN Environment and Natural Resources Trust Fund, Northeast Climate Science Center, USFS-Northern Research Station, Harvard Forest

