

# Assisted tree migration: motivations, misconceptions, and applications



THE UNIVERSITY OF VERMONT  
**FORESTRY**

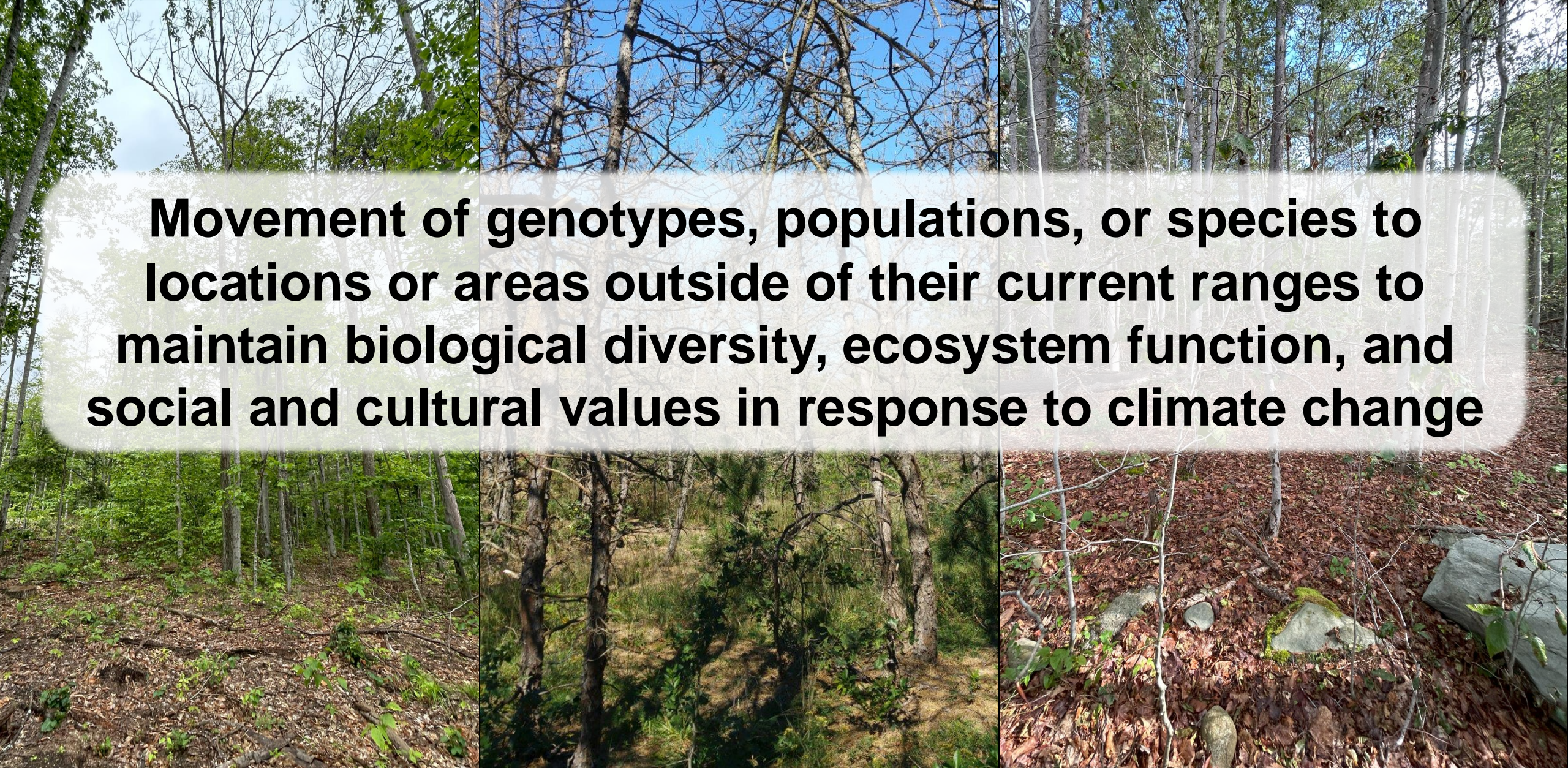
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Rubenstein School  
University of Vermont



**NECASC**  
Northeast Climate Adaptation Science Center



# Types of Assisted Tree Migration

The image is a 2x3 grid of photographs illustrating forest dynamics. The top row shows: 1) a forest with some green trees and some bare trees; 2) a forest with mostly bare trees against a blue sky; 3) a forest with mostly green trees. The bottom row shows: 1) a forest with green trees and a ground covered in brown leaves; 2) a forest with a mix of green and bare trees; 3) a forest with a ground covered in brown leaves and some green plants. A large white text box is overlaid in the center of the grid.

**Movement of genotypes, populations, or species to locations or areas outside of their current ranges to maintain biological diversity, ecosystem function, and social and cultural values in response to climate change**

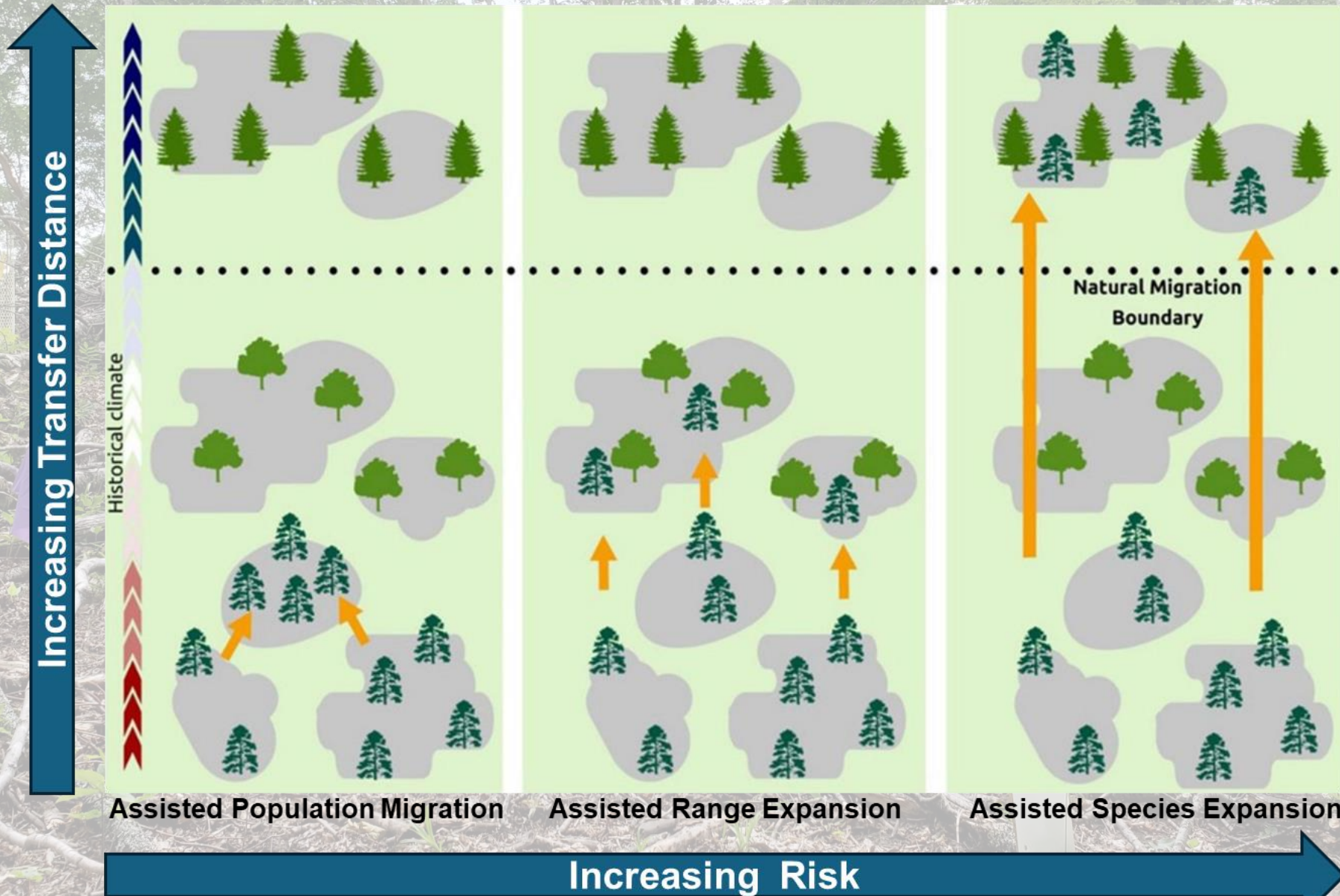


# Types of Assisted Tree Migration





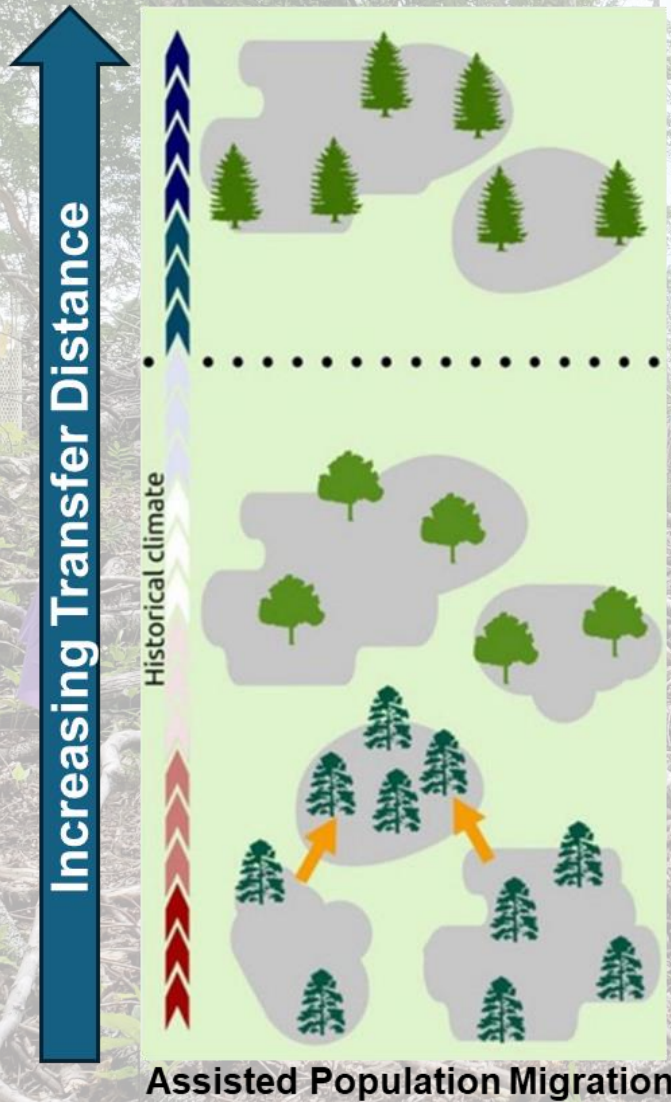
# Types of Assisted Tree Migration



Bower et al. (2024)



# Types of Assisted Tree Migration



## Assisted Population Migration:

moving seed sources or populations to new locations within the historical species range (assisted gene flow)

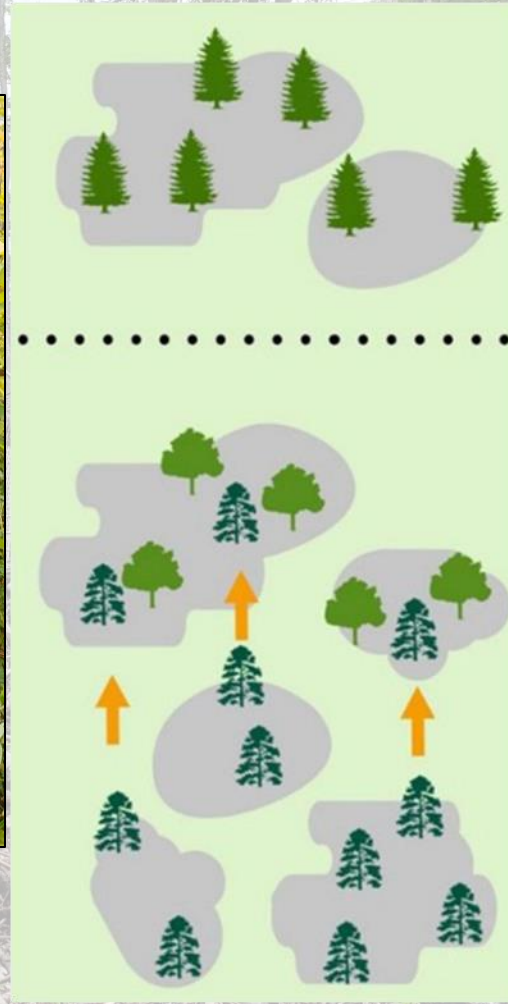
Increasing Risk



# Types of Assisted Tree Migration

Increasing Transfer Distance

Historical climate



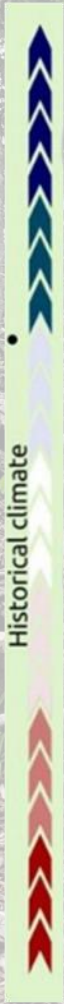
Assisted Range Expansion

**Assisted Range Expansion:** moving seed sources or populations from current range to suitable areas just beyond historical range, *facilitating or mimicking natural dispersal*

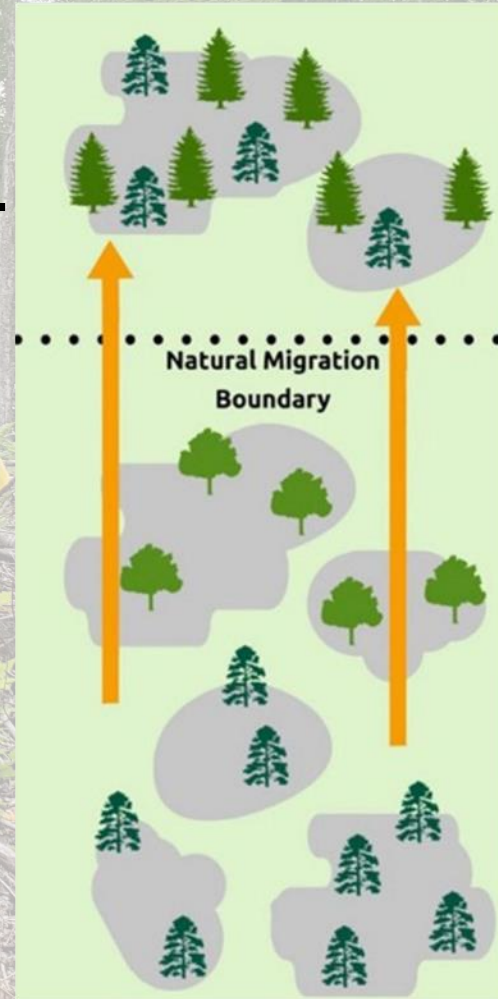
Increasing Risk



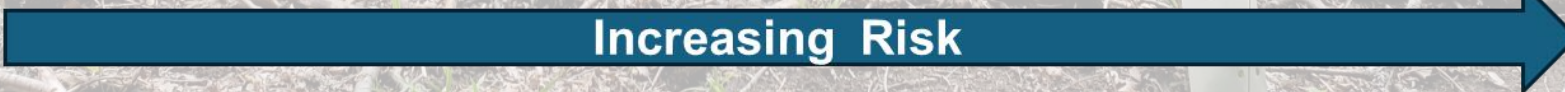
# Types of Assisted Tree Migration



**Assisted species expansion:**  
moving seed sources or populations to a location far outside the historical species range, ***beyond locations accessible by natural dispersal***



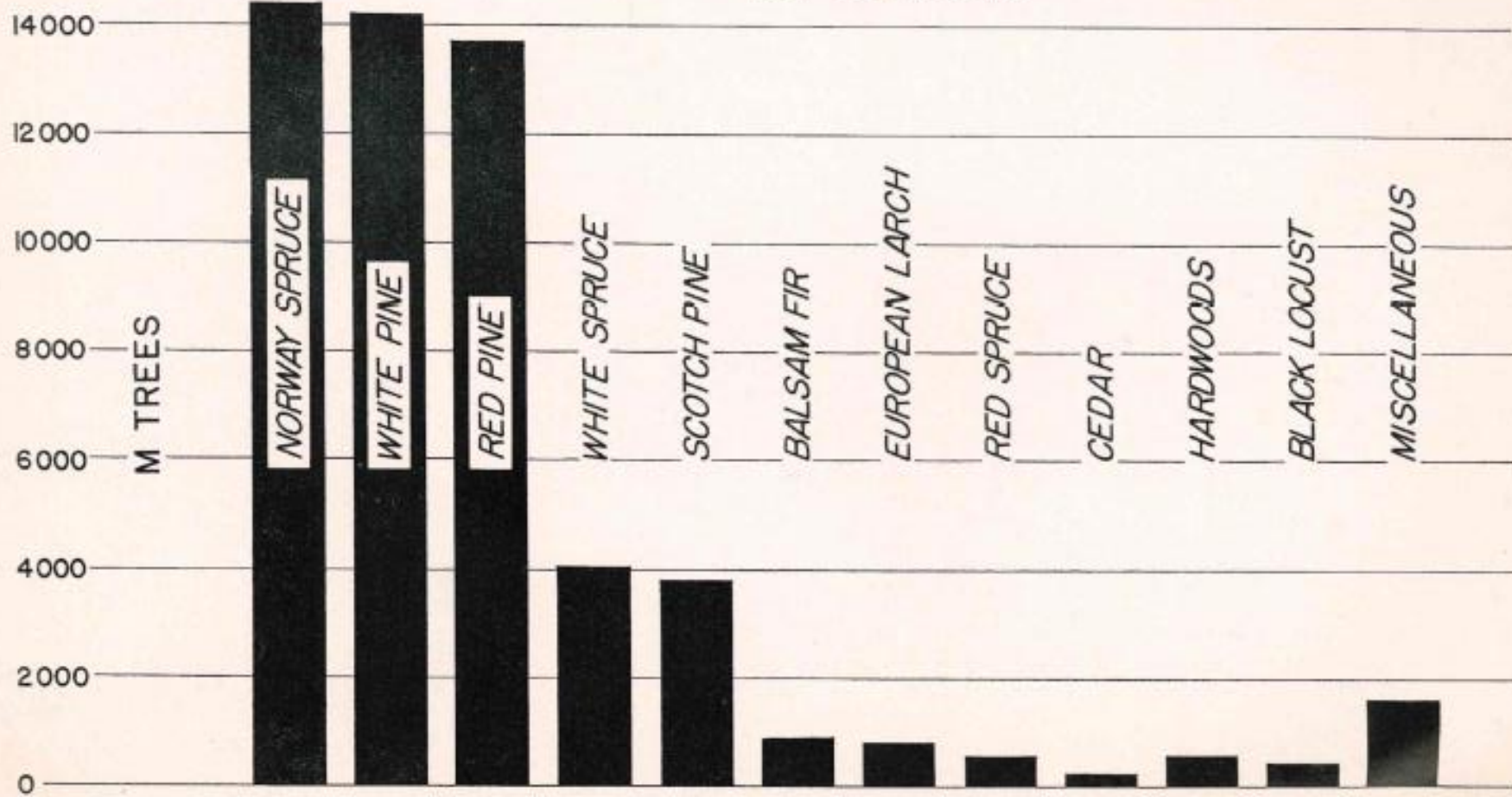
Assisted Species Expansion





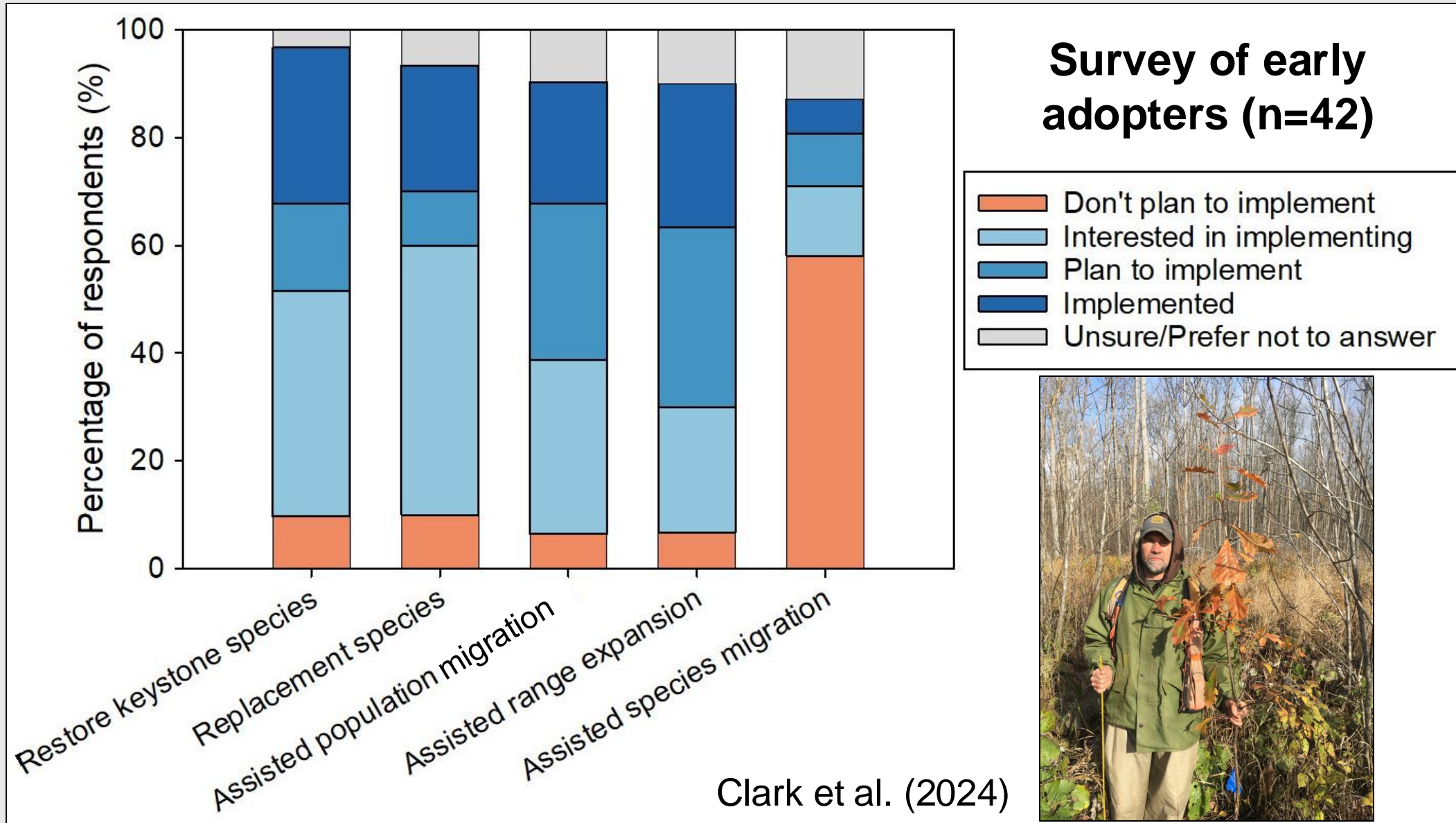
**Merrill (1959)**

TREES PLANTED IN VERMONT  
1909-1959  
BY SPECIES



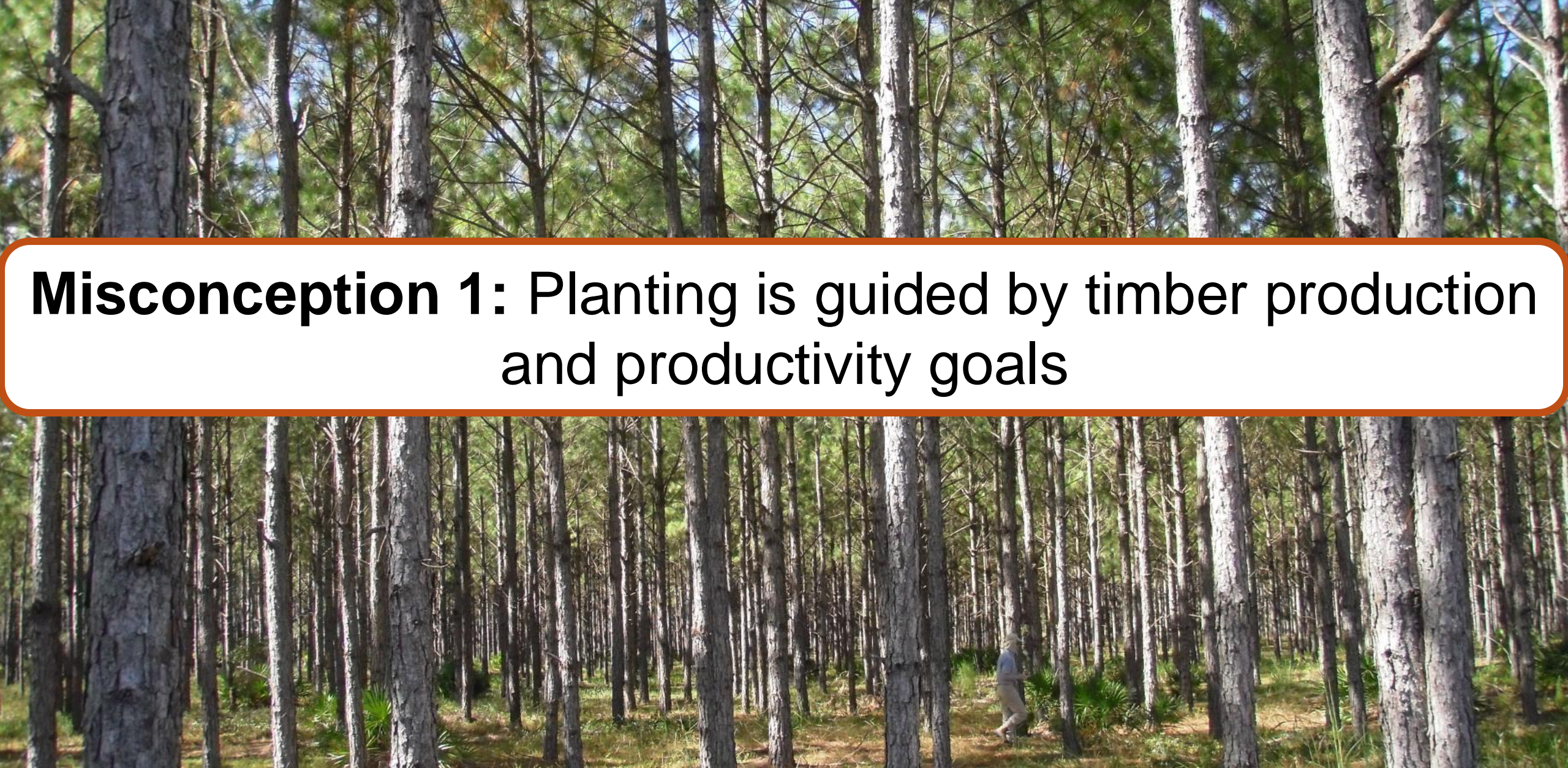


# Primary Applications of Assisted Migration





# A Few Misconceptions

A photograph of a pine forest. The trees are tall and thin, with light-colored bark. The ground is covered in pine needles and some green plants. A person is walking in the distance, providing a sense of scale.

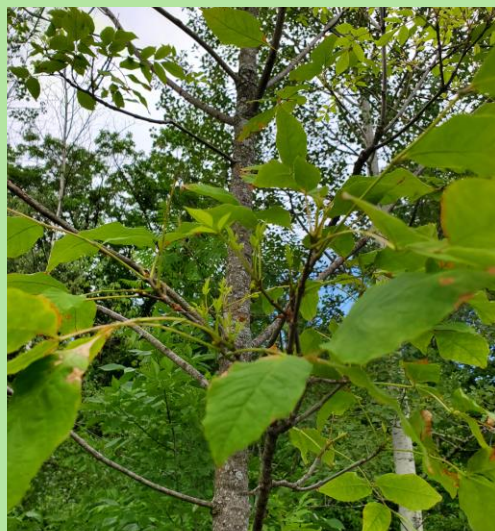
**Misconception 1:** Planting is guided by timber production and productivity goals



# Planting for Functions and Values



Mast production



Litter quality



Sequestration potential

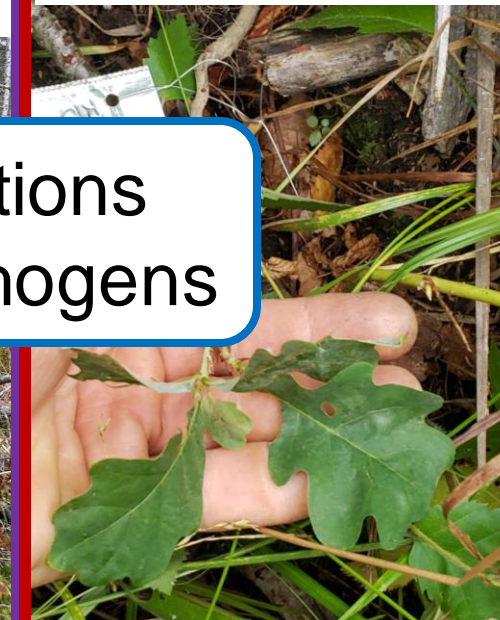
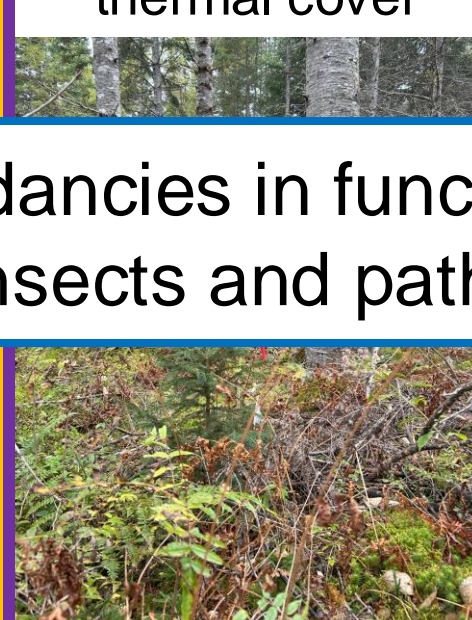
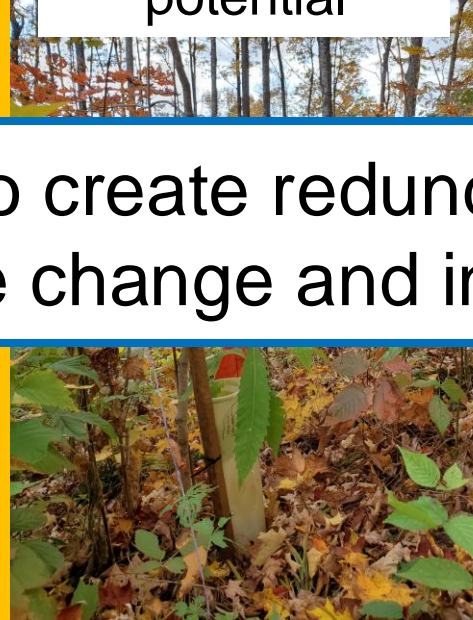


Deep shade and thermal cover




Cultural lifeways

Diverse plantings to create redundancies in functions threatened by climate change and insects and pathogens






# A Few Misconceptions



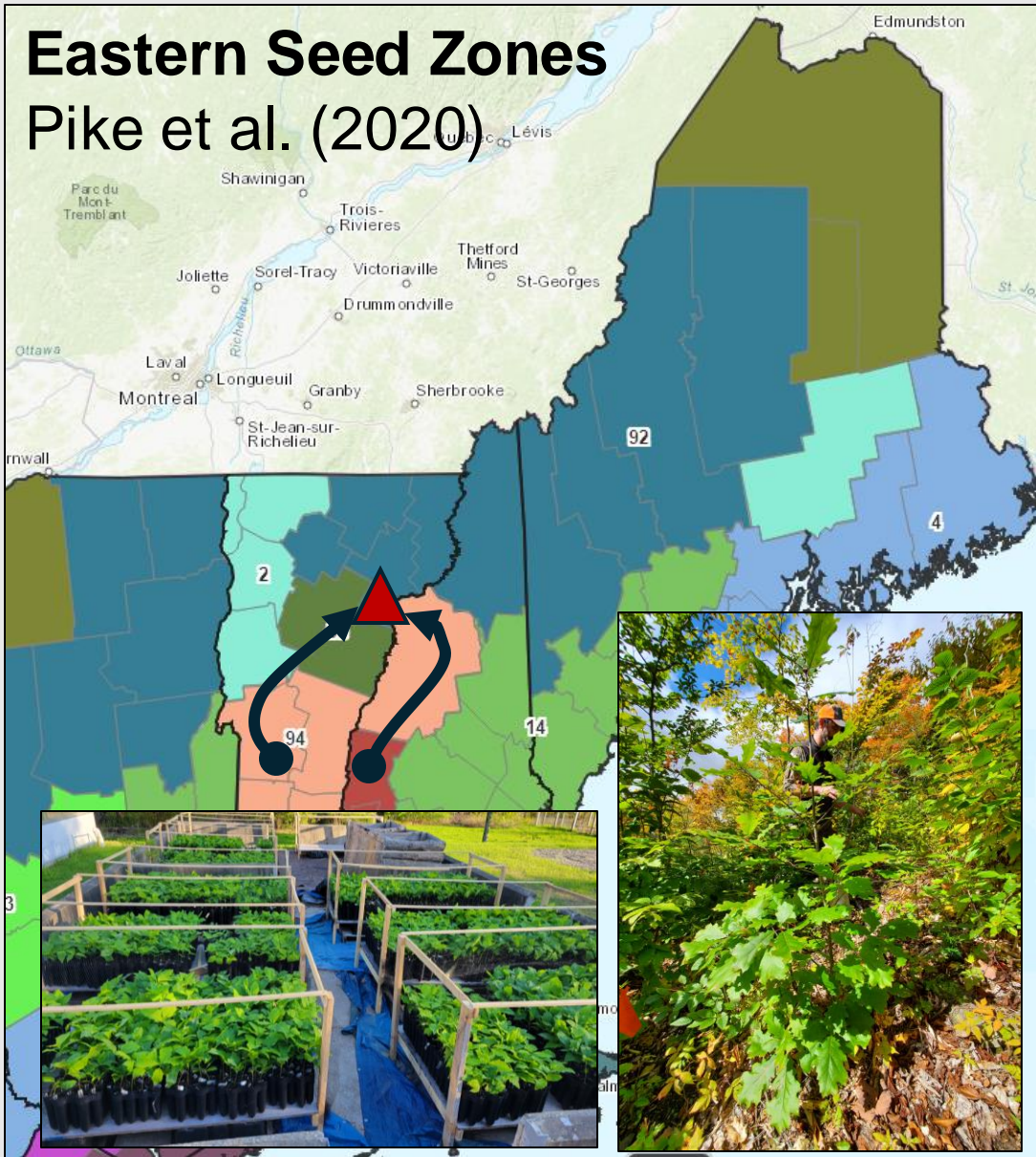
**Misconception 2:** We can do this following current best practices and at scale



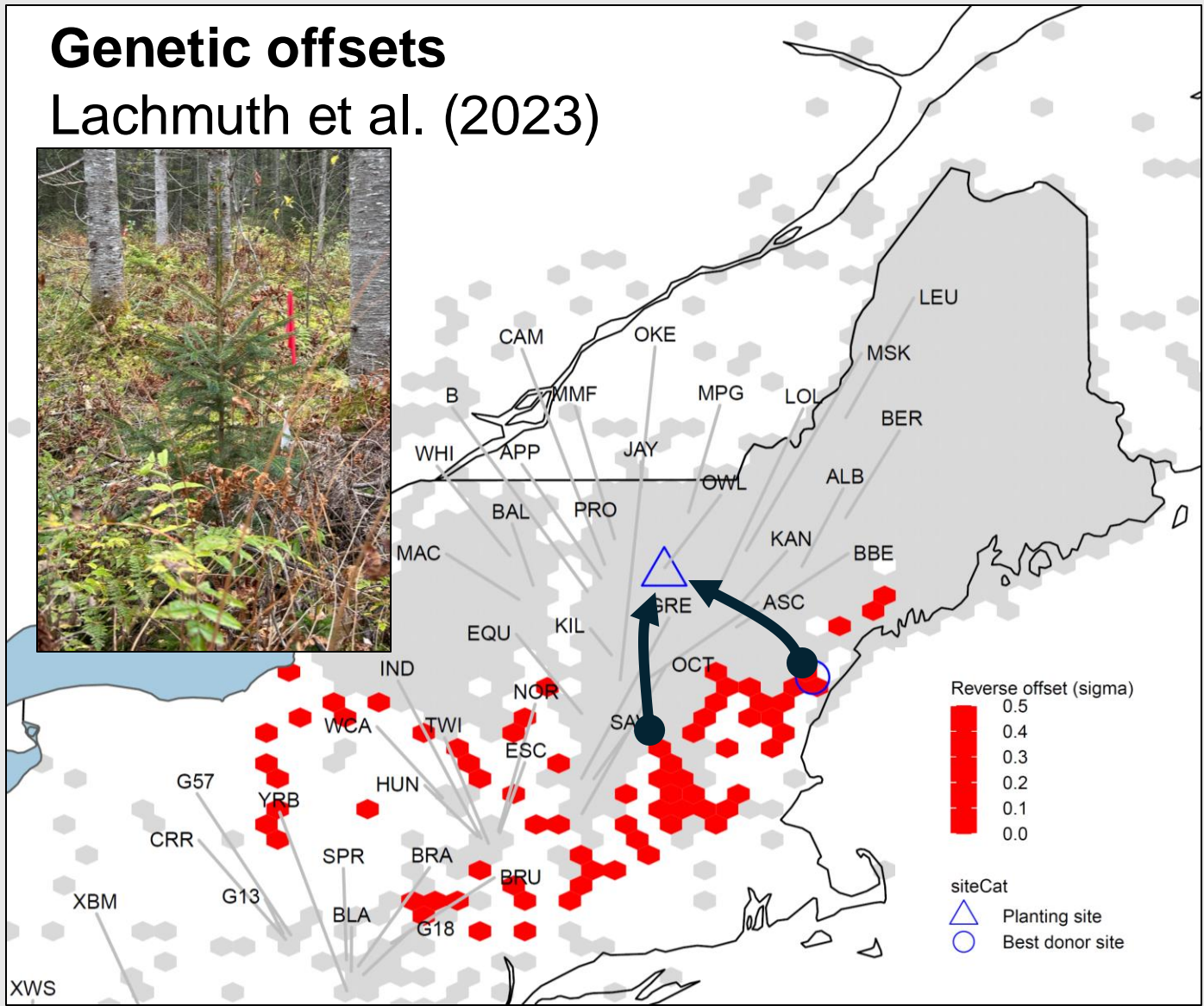


# What we'd like to do

## Eastern Seed Zones Pike et al. (2020)



## Genetic offsets Lachmuth et al. (2023)

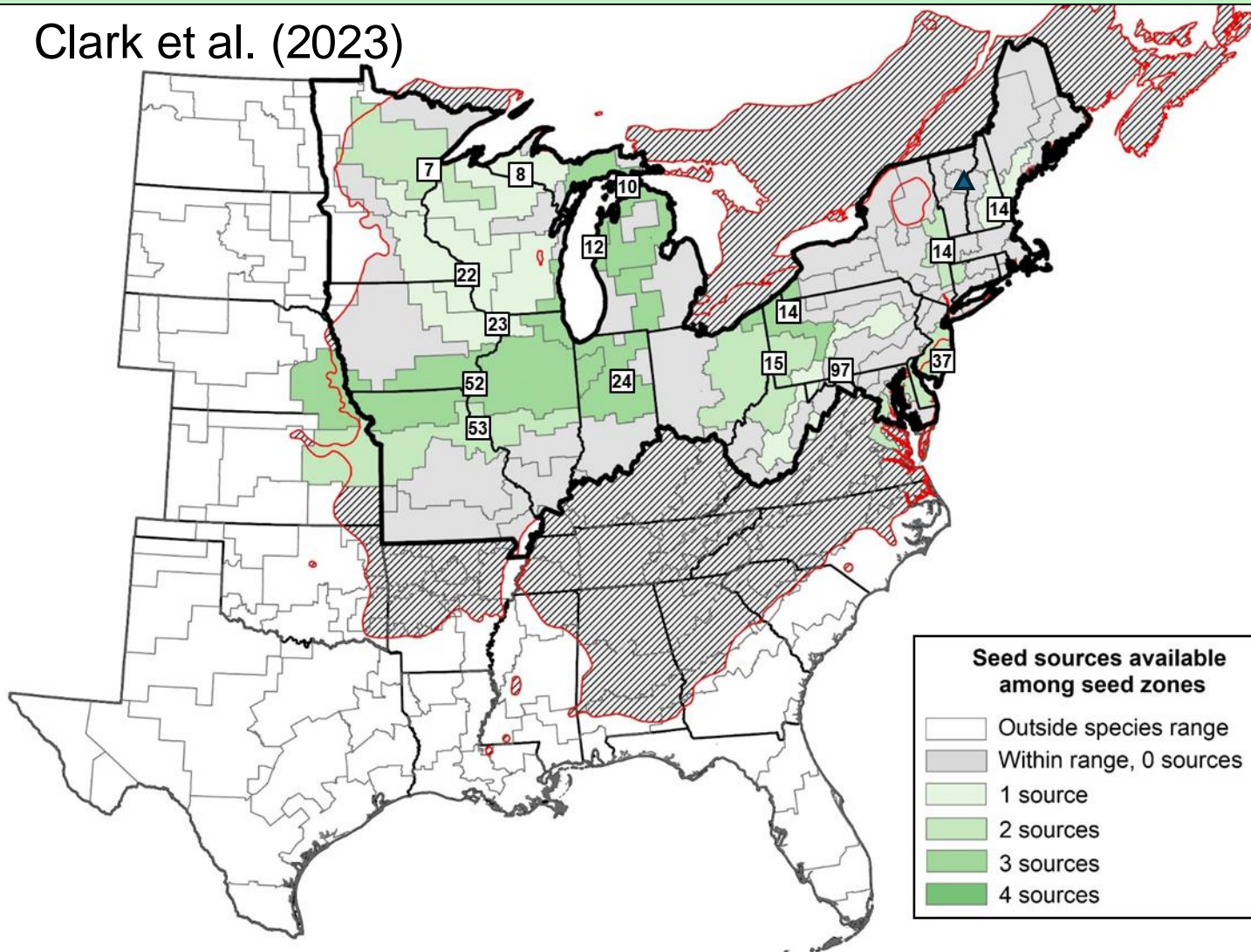




# What we're able to do

Seed source availability within seed zones for northern red oak throughout US portion of range

Clark et al. (2023)



- 15% of potential seed zones are currently represented for common species (e.g., red oak) recommended for adaptation
- Despite widespread interest in planting for the future, we currently lack the nursery capacity, source diversity and labor to do this “correctly” at scale





# A Few Misconceptions



**Misconception 3:** Expect survival rates consistent with “typical” reforestation efforts





# Early Outcomes of Co-Produced Trials

## Testing Forest Adaptation at Operational Scales



- Large-scale adaptive forest management experiments in partnership with NIACS and local managers
- Contain 1-3 different co-produced adaptation strategies reflecting ecological objectives and adaptation considerations
- Typically include ~1k-6k planted seedlings



# Species Most Commonly Being Planted

## 2–7-year Survival: Multiple Sites

Species	% survival (range)
Red spruce	77 (63-86%)
Red oak	76 (58-96%)
Bitternut hickory	59 (32-93%)
American chestnut	58 (42-74%)
White pine	58 (51-67%)
Black cherry	57 (38-96%)
Eastern hemlock	56 (48-65%)
Black birch	49 (33-70%)
Bigtooth aspen	17 (7-28%)

## 2–7-year Survival: Single Site

Species	% survival (SE)
American basswood	92.4 (1.3)
White oak	70.8 (6.4)
N. White cedar	52.1 (3.3)

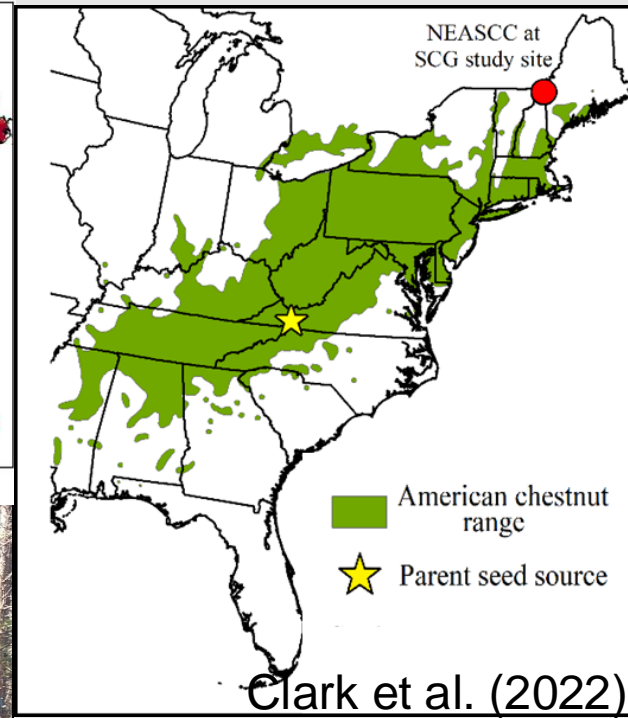
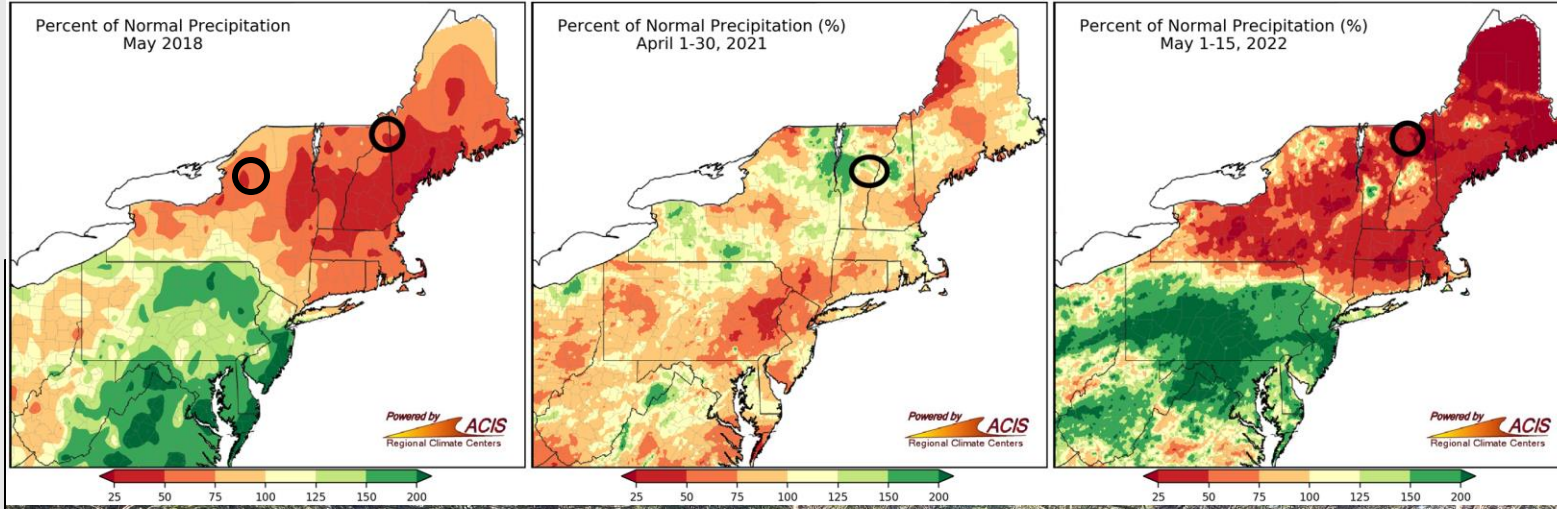




# What is Driving Range in Survival?

Challenging planting conditions + transport distance + pace

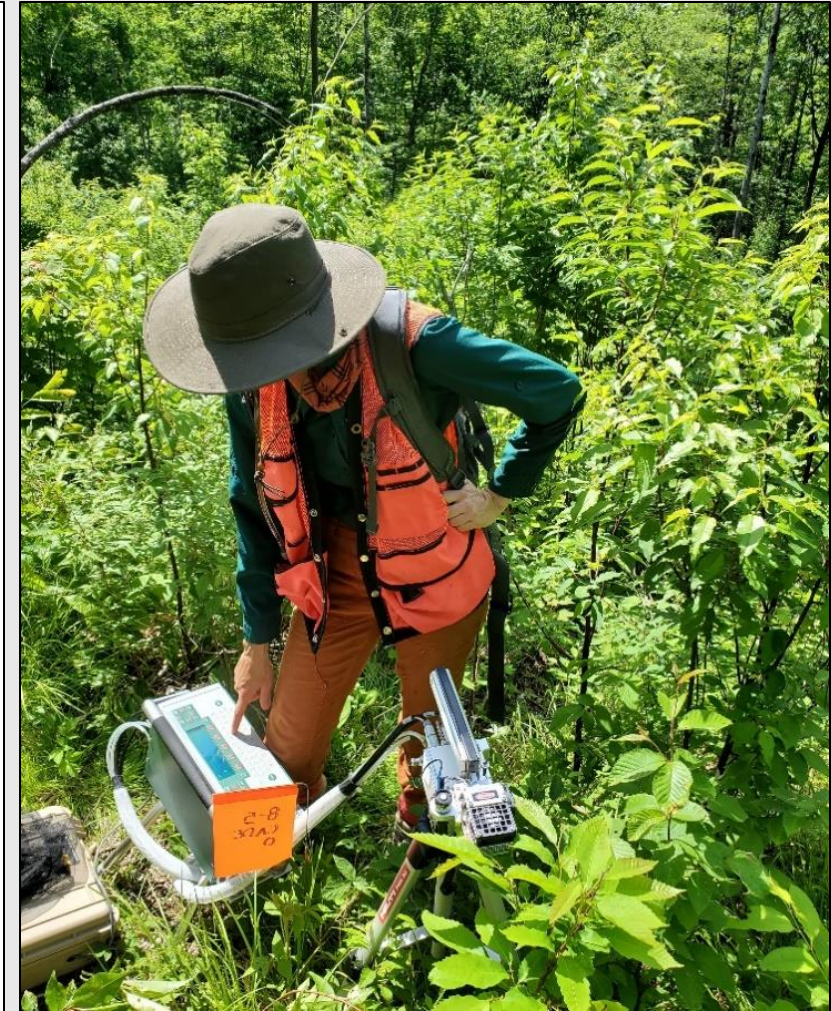
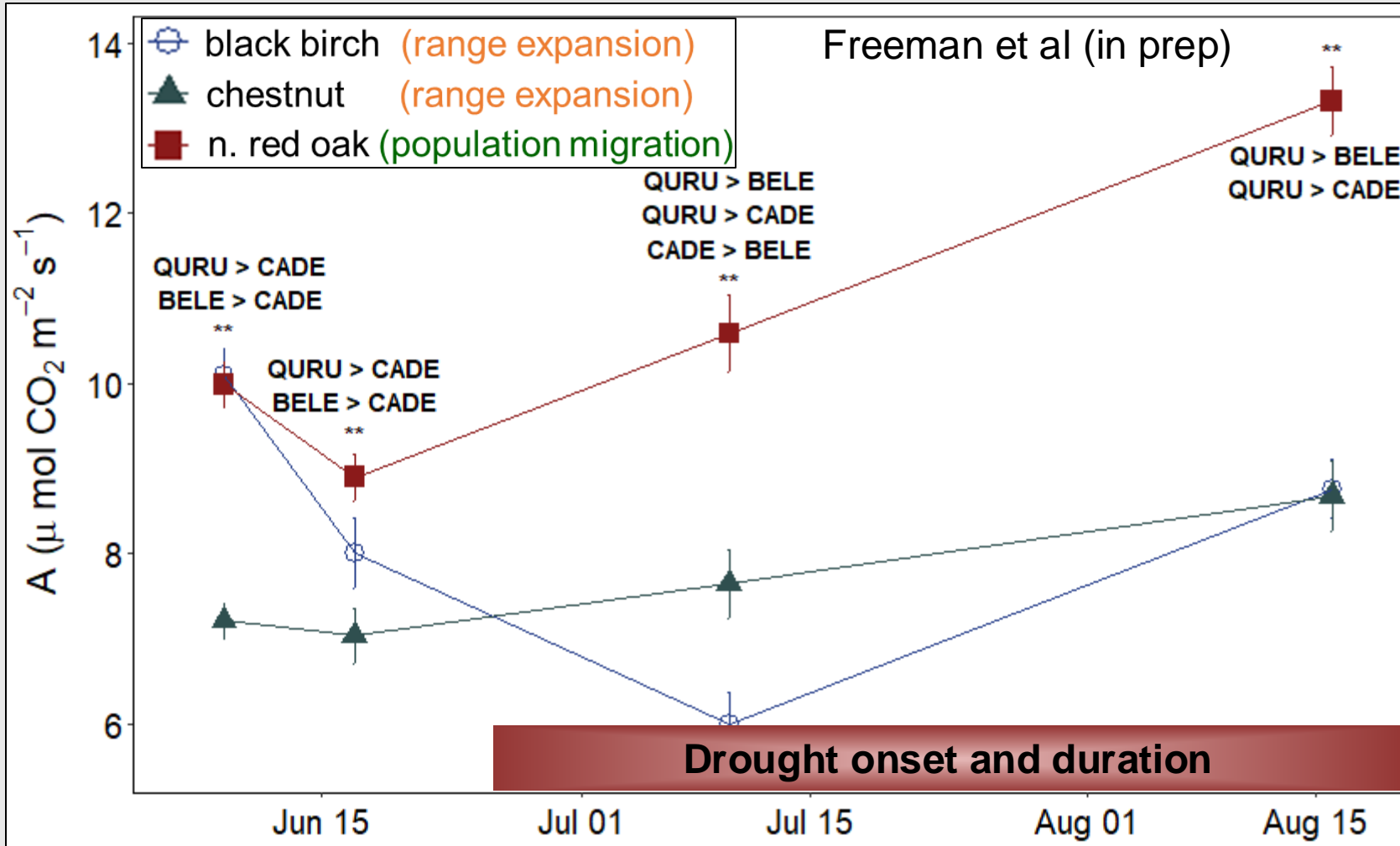
Near-term maladaptation





# What is Driving Range in Survival?

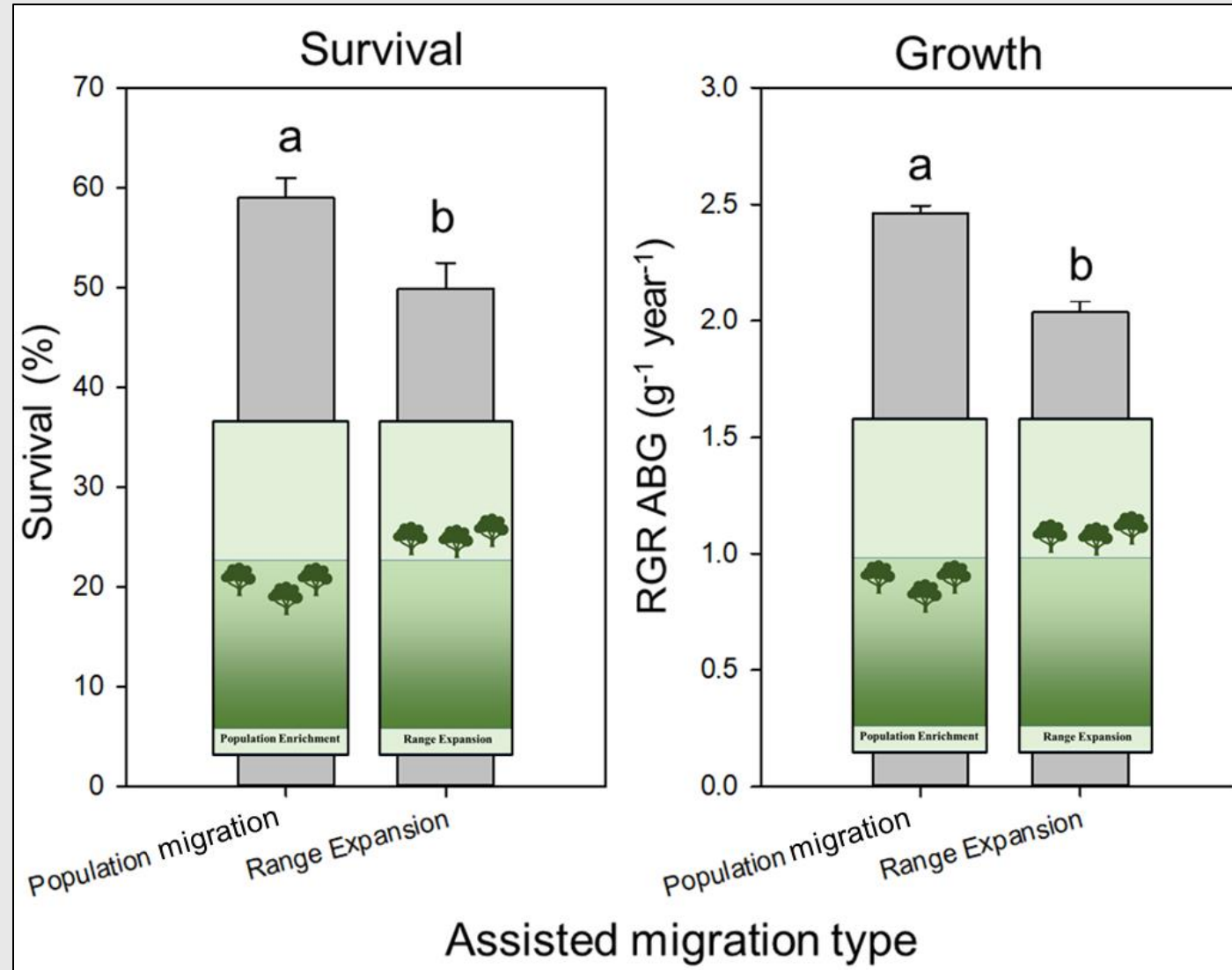
## Differential species performance during drought events



Some aspects of future habitat differentially favor species better adapted to moisture extremes (red oak, red spruce)



# What is Driving Range in Survival?



- Risk of lag in seedling success needs to be weighed against value of future gene flow and functional redundancy
  - Only need a small % to reach sexual maturity to help offset future maladaptation





# Moving Forward with Assisted Migration

- Assisted migration is not a monolith; need to recognize nuances between trees and other lifeforms and tailor best practices accordingly
- We lack capacity for doing this well, particularly in relation to number and species and genotypes available (needs strategic investment and focus)
- Emphasis on assisted migration needs to scale with level of importance as part of adaptation strategies (normally 5-15% of managed areas)→  
Prioritize based on functions and values not supported with other tactics.





# Acknowledgements

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