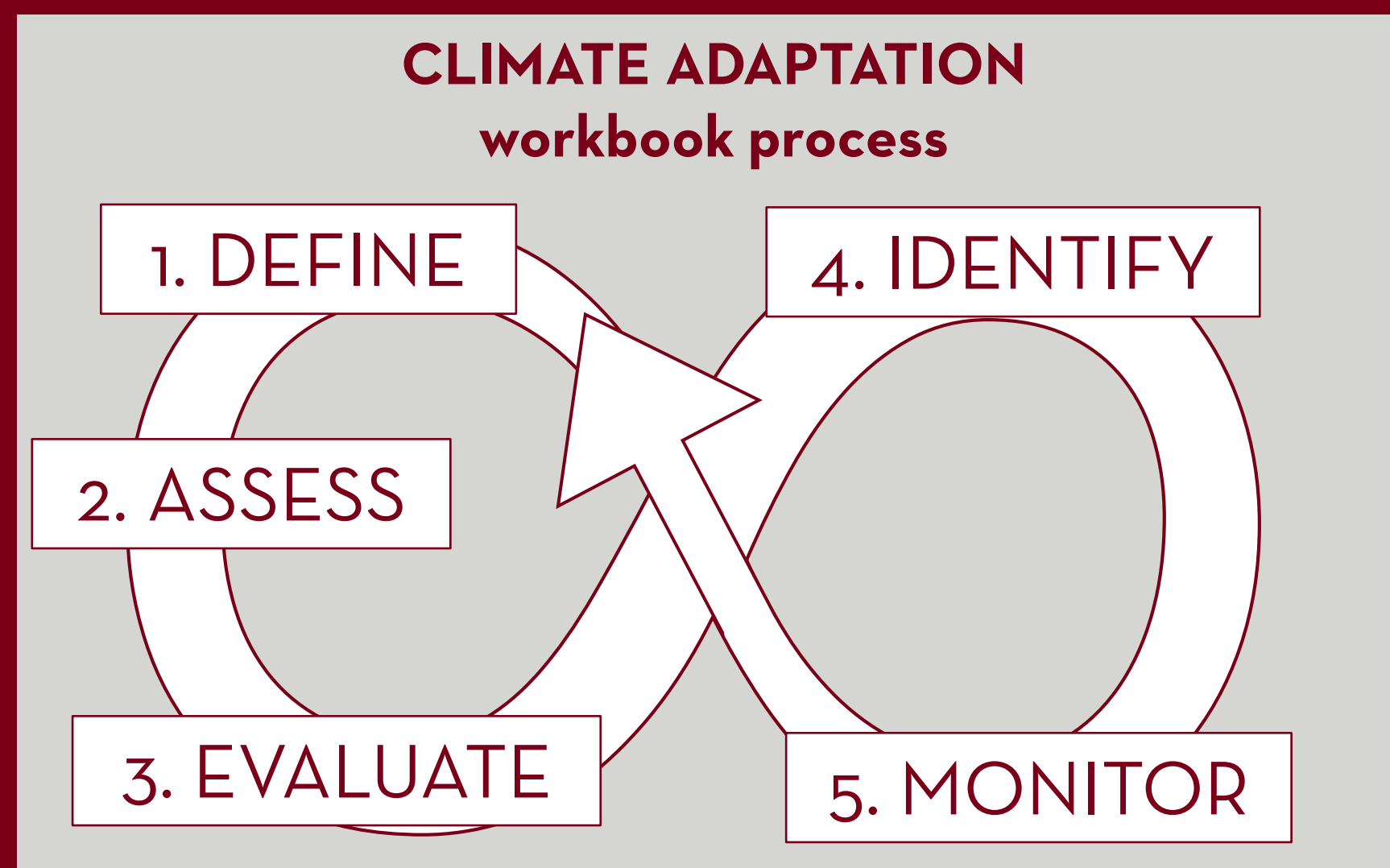


Diversifying STRUCTURE & COMPOSITION in managed red pine using the Climate Change Field Guide for Northern Minnesota Forests



1. DEFINE location, goals, objectives

Location: 46.7033, -92.5346

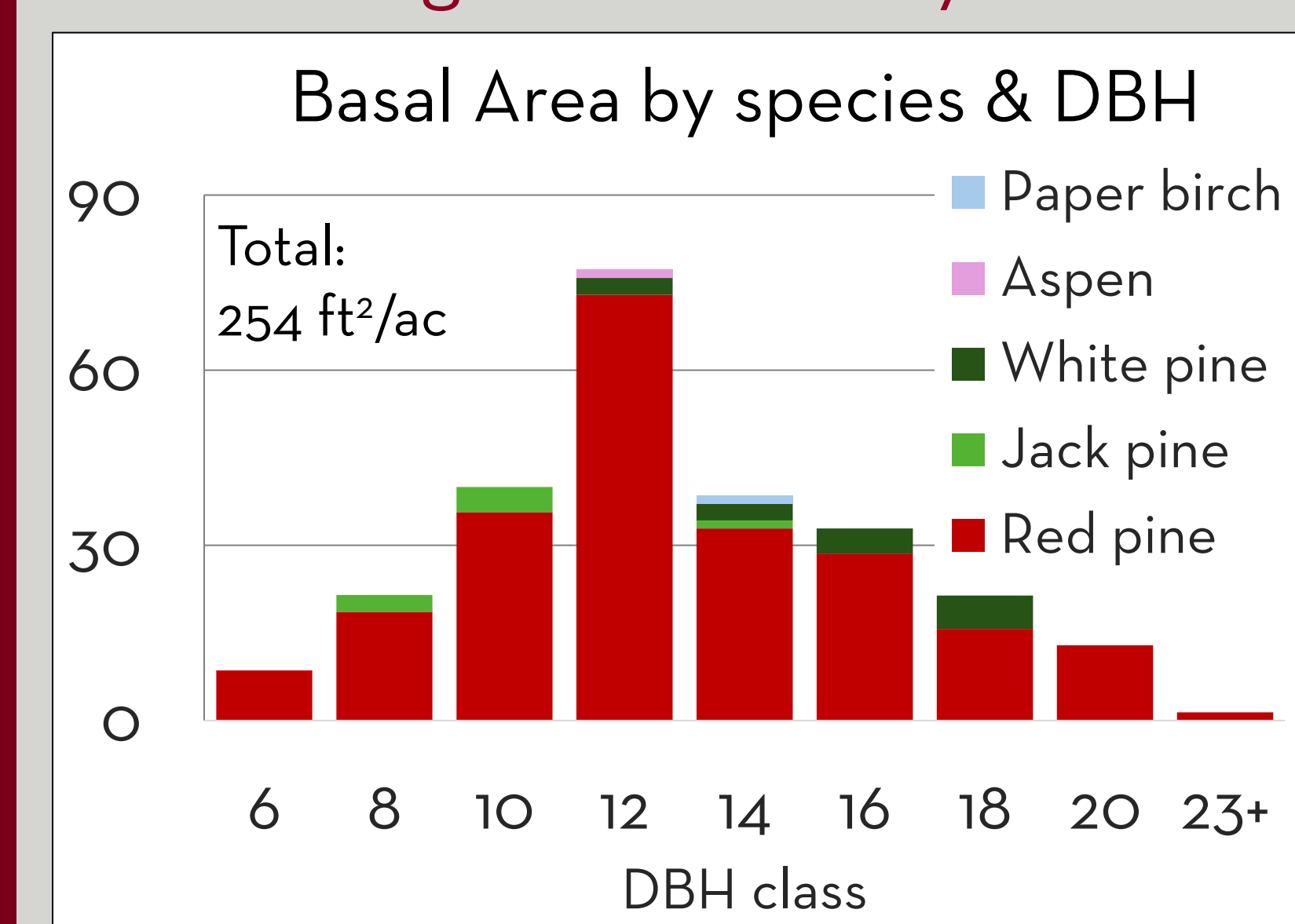
- Cloquet Forestry Center on Nagaajiwanaang
- Stand 57, FDn33, managed red pine

Goal: Improve stand-level resilience to climate and wildfire, wind, and snow disturbances

- Obj 1: DIVERSIFY STRUCTURE to create growing space for two-aged stand through commercial harvest
- Obj 2: DIVERSIFY COMPOSITION using Assisted Natural Regeneration - a blend of natural and artificial regeneration

2. ASSESS site-specific climate change impacts

Managed Red Pine system

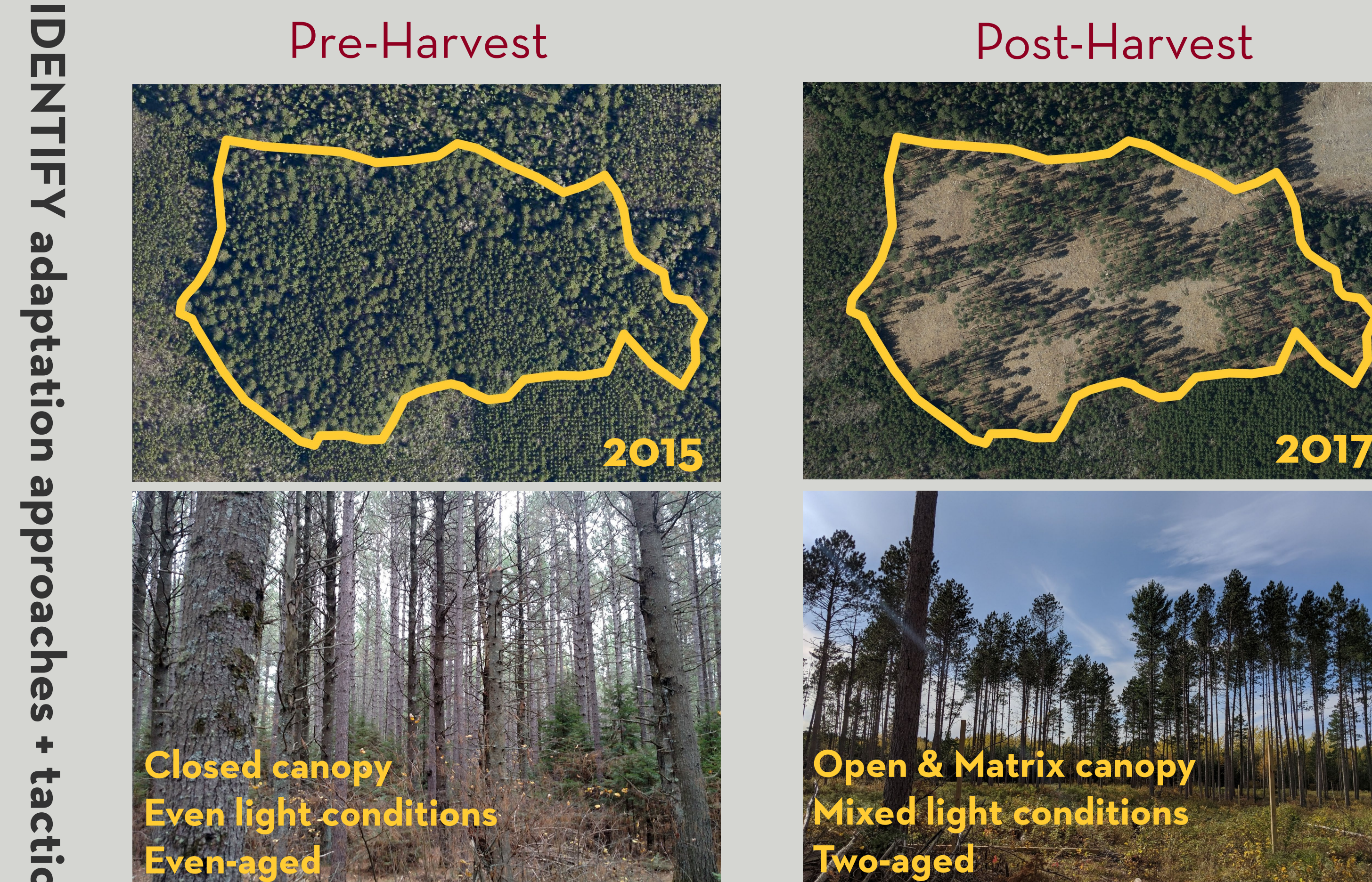


The pre-harvest stand had moderate-to-high climate risk factors associated with being a one-species and even-structured stand

3. EVALUATE management objectives and feasibility

Resilience goal and diversification objectives were assessed to be feasible and income-generating through a commercial timber sale and assisted natural regeneration

4. IDENTIFY adaptation approaches + tactics



LESSONS LEARNED

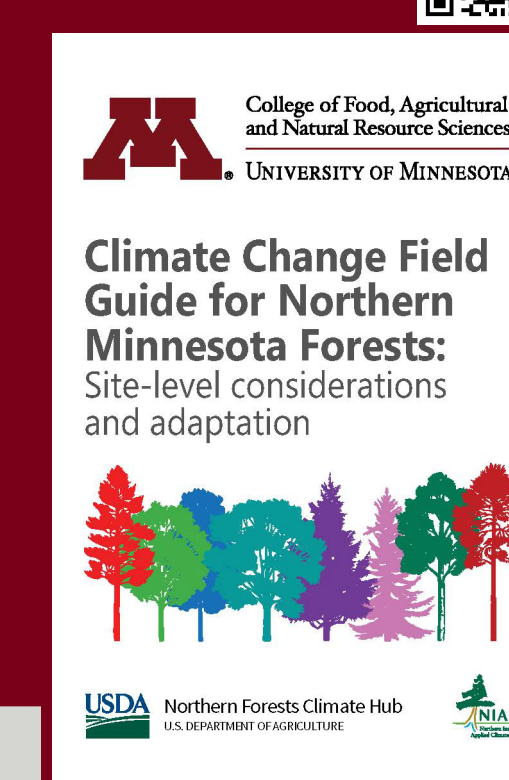
- Field guide + workbook were useful tools for putting climate-adapted stewardship into action but almost too detailed
 - Overall framework was a helpful constraint for turning big ideas into action
 - Strategies and Approaches menu options were detailed but overlapping, caused some confusion of which to prioritize
- Assisted Natural Regeneration has been working well for diversifying tree species composition
 - Red maple, red pine, and paper birch showed solid recruitment
 - Paper birch, white pine, northern red oak, and tamarack preferred the MATRIX light and understory conditions; jack pine demonstrated no preference
- If post-harvest structure is key, be very explicit with marking trees and skid roads

Acknowledgements and Resources

Thank you to the Land on which the project occurred and contributors to the concept and implementation of this project:

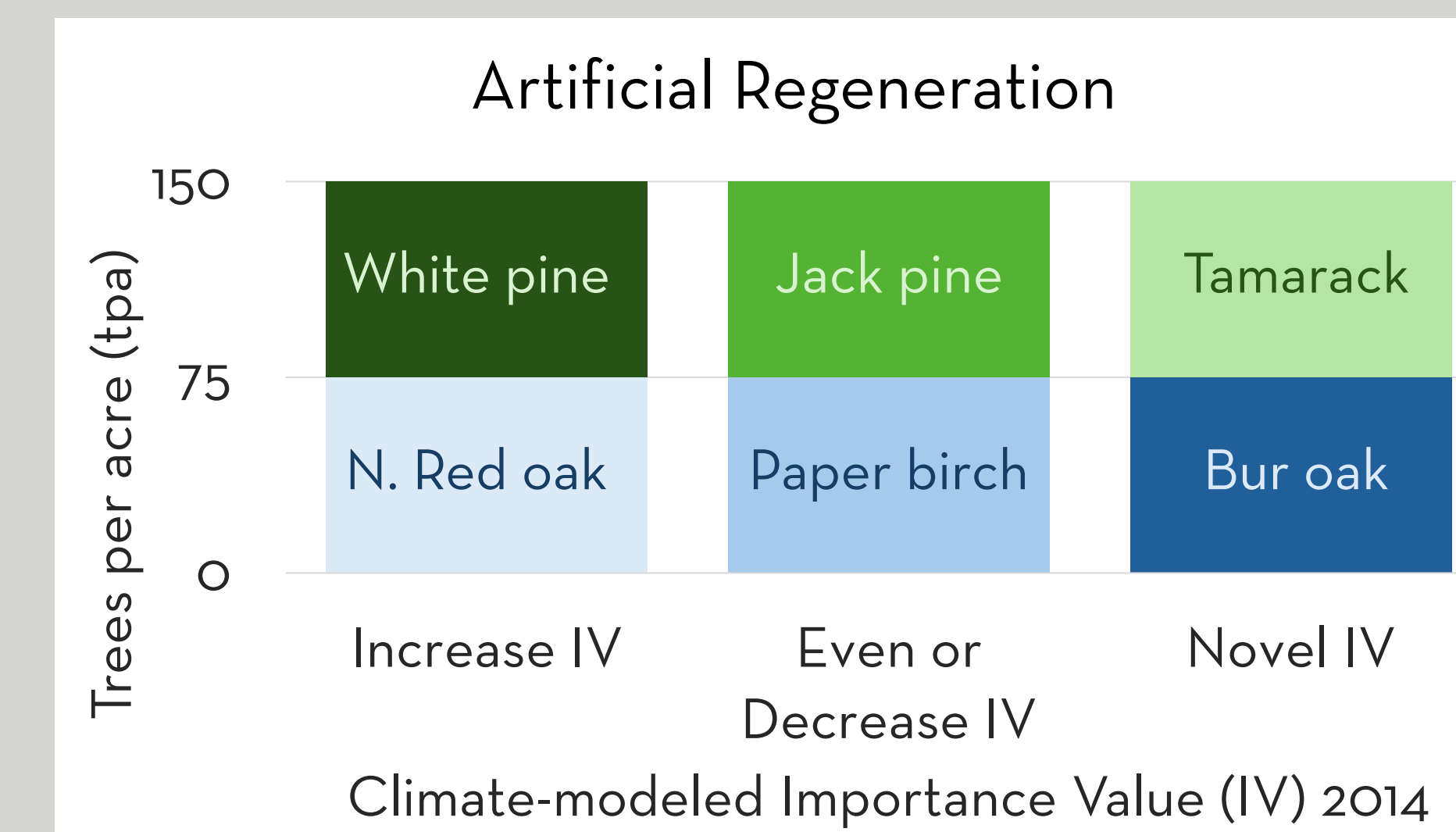
Matthew B Russell, Andrew David, John Zobel, Lane Johnson, Rachael Olesiak, Amanda Preston, Mike Reinikainen, Molly Roske, Benjamin Koenig, Heather Upin, Libby Ring, Lily Thomey, Simon Thill, Garrett Christiansen, Lou McCarthy, Rachel Stepp, Mary Ulrich, Jared Gottlieb, Laura Reuling, Amy Shaunette, Mat Lochner, Lillith Ford, Annie Steuer, Elliot Feldman, Penelope Farrington

z.umn.edu/stand57



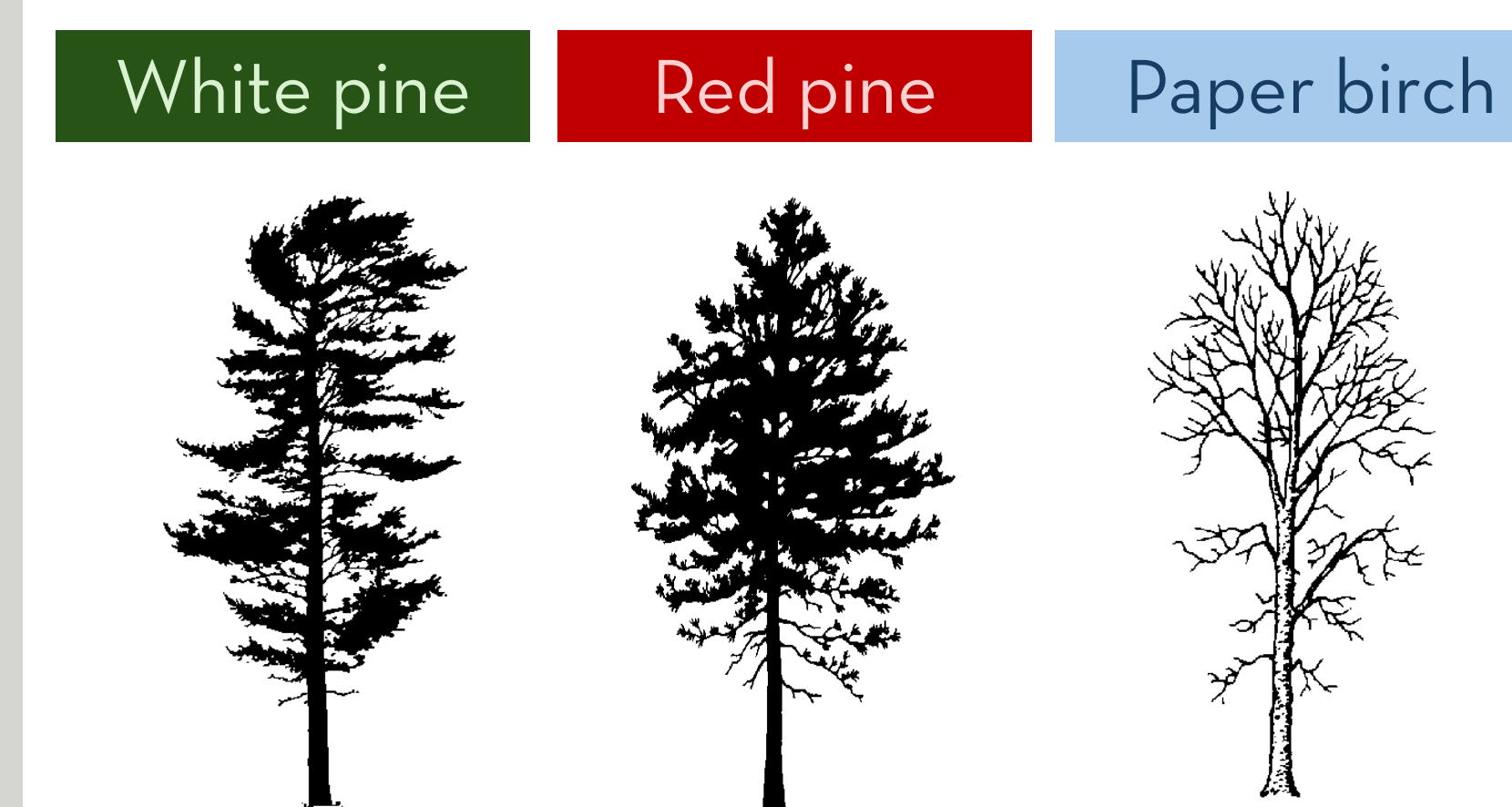
Diversify COMPOSITION

Assisted Natural Regeneration



In May/June 2020, we planted 900 of each of the six species evenly throughout the 12-acre stand at 450 trees per acre, approximately 10' x 10'

Natural Regeneration



Reserved white and red pine, and near-stand paper birch were expected to spread seeds on full-tree-skid-disturbed soil

5. MONITOR and evaluate effectiveness

Standwide

- Mixed structure achieved
- Understory growing conditions different in Open and Matrix areas
- Mix of hardwood and conifer tree regeneration is relatively well distributed across site

Summer 2022 Regeneration Survey

| Species | per acre | Stocking % |
|--------------|-------------|------------|
| Red maple | 786 | 21 |
| Red pine | 643 | 43 |
| Paper birch | 643 | 29 |
| Other | 857 | 57 |
| Total | 2929 | 79 |

Open light conditions

Half-acre clearcut gaps



- Strong raspberry and sweetfern response in clearcut gaps. Above and below ground competition reduction may be helpful

- Jack pine seedlings 83% stocked in both Open and Matrix conditions



Matrix light conditions

Thinned to 115 ft²/ac



- Relatively low understory competition so far
- Significantly higher survival and stocking for Paper birch, White pine, N. Red oak, Tamarack
- Live crown ratios for reserved red pines are increasing