All about the seedlings:

Three regeneration-focused NSRC projects at UNH

PIs: Matt Vadeboncoeur and Heidi Asbjornsen

Grad students: Sam Zuckerman, Khanh Ton, Holly Wajenberg, Gigi Lish

Three ongoing projects:

- **Assisted migration:** A viable silvicultural technique for facilitating adaptation of Northern Forest tree species to a warmer and drier future world? (2021-24)

- **Oak at the Edge:** Investigating fire as a tool in oak range expansion (2022-25)

- **Supporting Abenaki stewardship** of the ecologically rare and culturally important Atlantic White Cedar Swamp Ecosystem (IFKF; 2023-24)

Assisted migration:

A viable silvicultural technique for facilitating adaptation of Northern Forest tree species to a warmer and drier future world?

Heidi Asbjornsen, Sam Zuckerman, Matt Vadeboncoeur – UNH

Cam McIntire, Chris Woodall – US Forest Service

Tony D'Amato (UVM), Jay Wason (U Maine)

Forestry assisted migration *=*
planting trees well suited for the ***future*** *climate of a region*

Research questions:

When grown together (in controlled greenhouse conditions)…

1. Does seedling ecotype influence seedling success?
2. How do different **species** respond to drought?
3. How do different **ecotypes** respond to drought?

Approach

Setup
- Plant 1-2 y.o. bareroot seedlings
- 7 species, 3 ecotypes

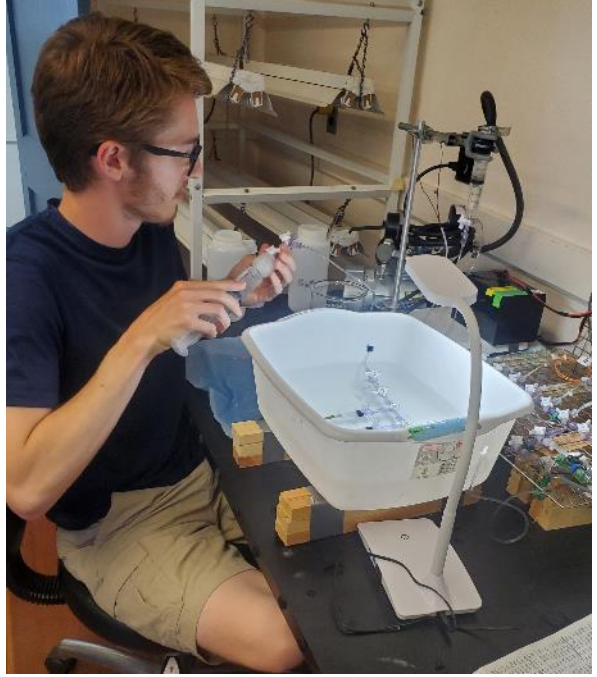
2022
- Control → water to field capacity
- Drought → soil moisture reduced to 5% VWC for 3 weeks

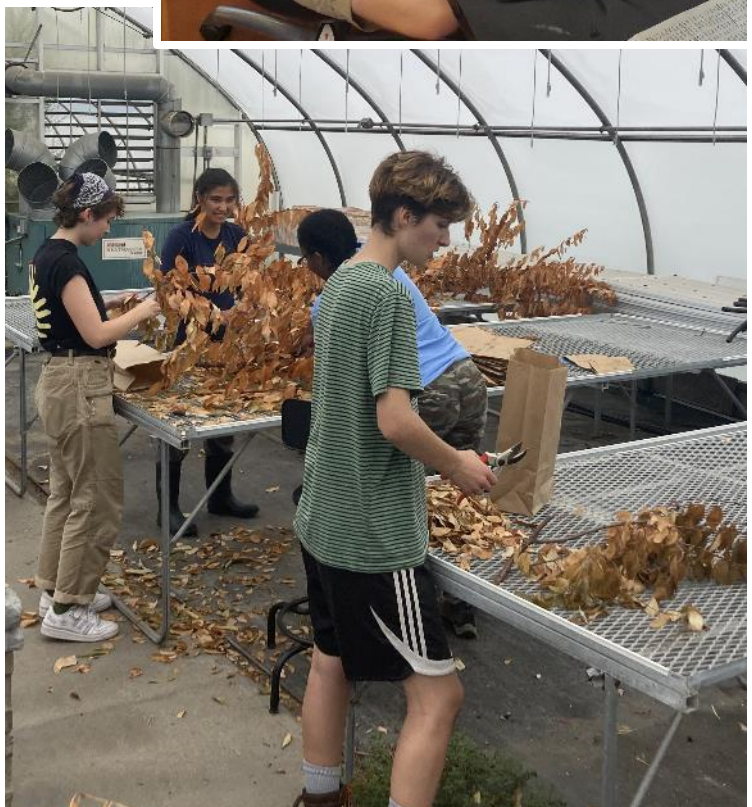
2023
- Control → water to field capacity
- Moderate drought → 5% VWC for 3 weeks
- Extreme drought → withhold water completely.

Species
Northern red oak
Eastern white pine
Black cherry
Sugar maple
White oak
Southern red oak
Black walnut

Ecotypes
New Hampshire
Michigan
Virginia

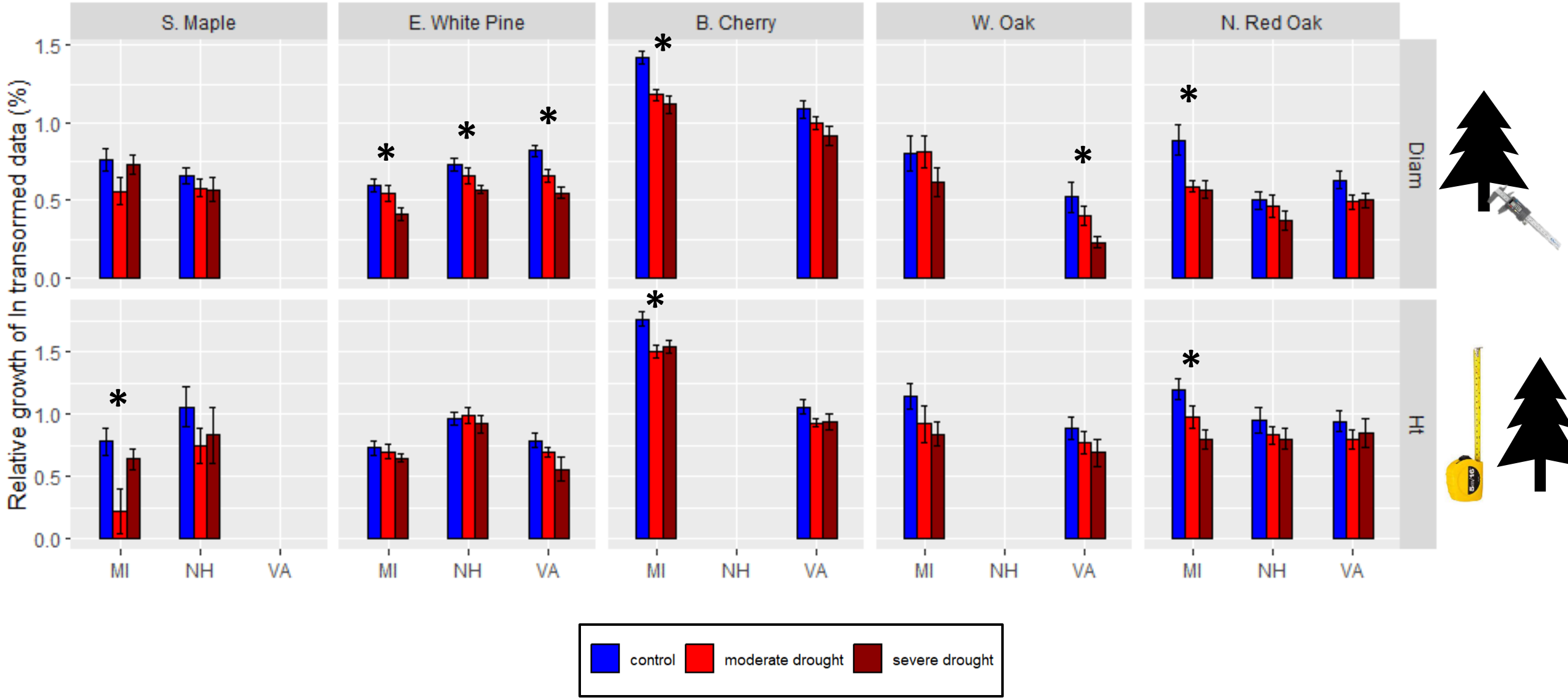

Blocks 1-8
Blocks 9-10
Datalogger for continuous soil moisture readings
Drip irrigation lines: Controls watered daily throughout experiment.
Treatment groups watered daily during acclimation/recovery





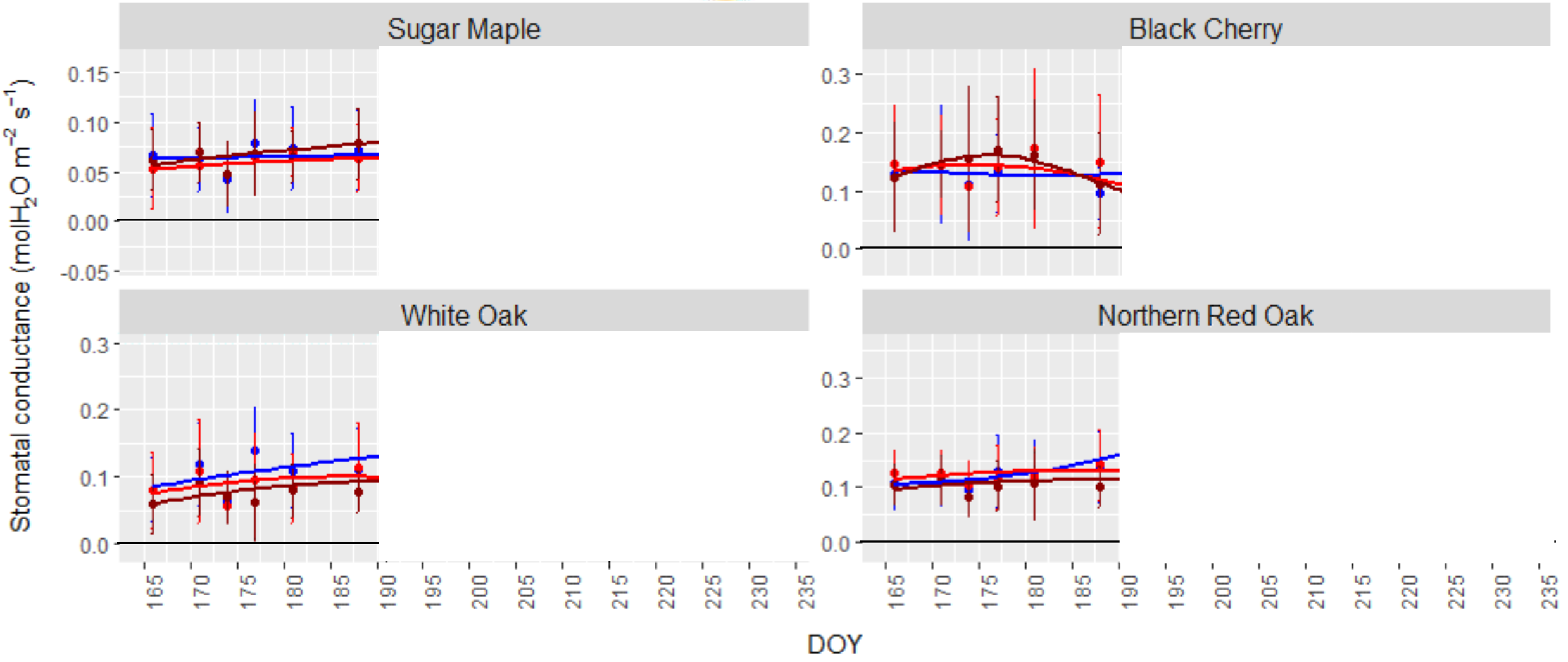
Measurement	2022	2023
Photosynthetic rate	X	X
Stomatal conductance	X	X
Predawn/midday water potential	X	X
Height and diameter	X	X
Soil volumetric water content	X	X
Leaf carbon and nitrogen	X	X
Turgor loss point		X
Specific leaf area		X
Xylem vessel diameter		X
Leaf, stem, and root biomass		X
Chlorophyll fluorescence		X
Phenology (leaf out date)		X
Hydraulic conductance		X

Droughted plants grew less; prioritized height over diameter growth



Asterisks denote significant treatment effect within species and ecotype. Error bars are +/-1 SE

Droughted plants reduced stomatal conductance



vertical dashed lines are start and stop of moderate drought. error bars are 1SD

July 17

1 week into drought

July 24

2 weeks into drought

August 8

4 weeks of drought (extreme)
1 week of recovery (moderate)

Preliminary Findings:

- All species dramatically reduced water use during drought treatment
  - Recovery after moderate drought: cherry > oaks > maple
- Oaks, pine, cherry grew less in drought treatment
  - Little or no growth effect on sugar maple
- Cherry grew the fastest by far, and used the most water
  - Was affected by withholding water more quickly than other species
  - Tolerated moderate drought well; Rapid mortality during extreme drought
- Within species, few clear differences in growth or water use by ecotype
- High *winter* mortality in black walnut (72%), southern red oak (58%), and sugar maple (49%)

Oak at the Edge:
investigating fire as a tool in oak range expansion

Matt Vadeboncoeur, Khanh Ton, Heidi Asbjornsen, Andy Fast – UNH

Nat Cleavitt – Cornell University

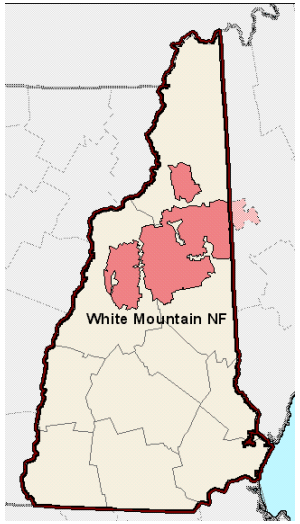
John Neely, Mariko Yamasaki, Erin Lane – US Forest Service

Project components

- **Monitoring oak regeneration** and site conditions in **recent Rx burns** conducted in thinned stands or patch cuts in the WMNF

- **Potted seedling study** with acorns planted in soil collected from inside vs outside a wildfire

- Retrospective (tree-ring) study of oak population age structure in sites known to have burned historically, with limited additional management



unmanaged
CF_Wildfire22

clearcuts
BEF_Burn21

shelterwood
HOG_Burn18

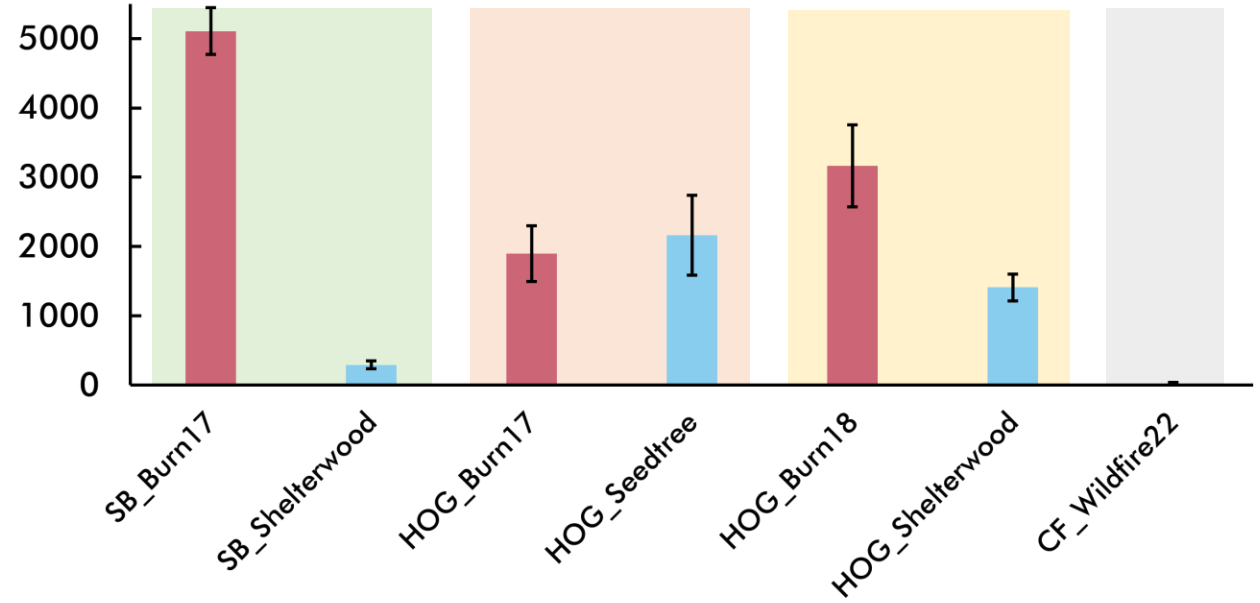
HOG_Burn17
seed tree

White Mountain National Forest

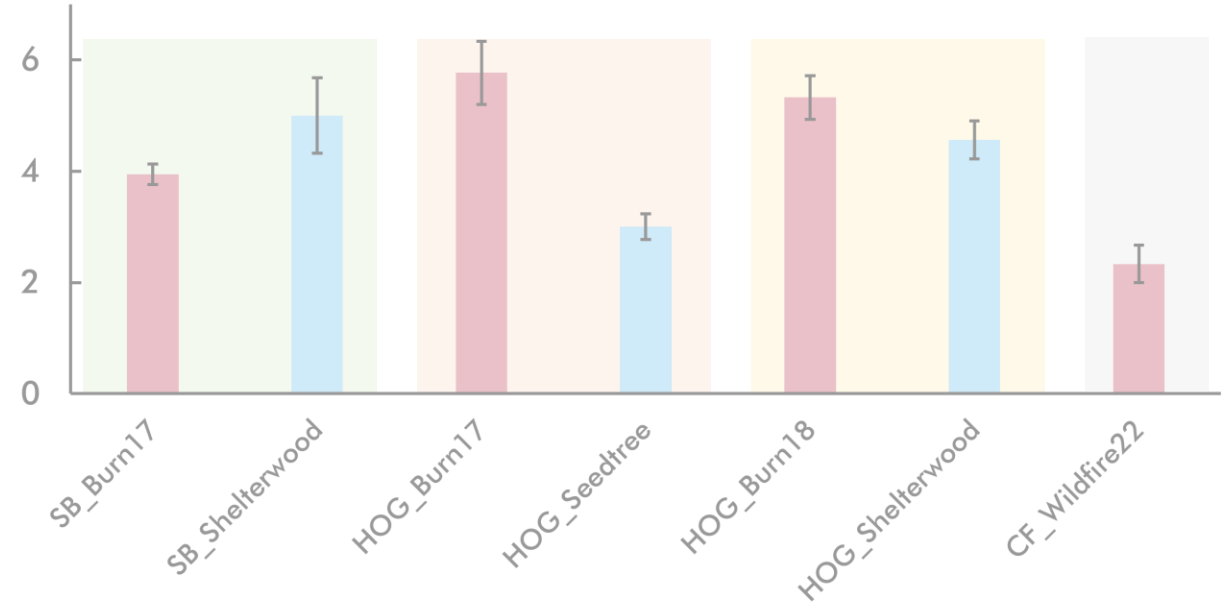
SB_Burn17
shelterwood

0 40 km

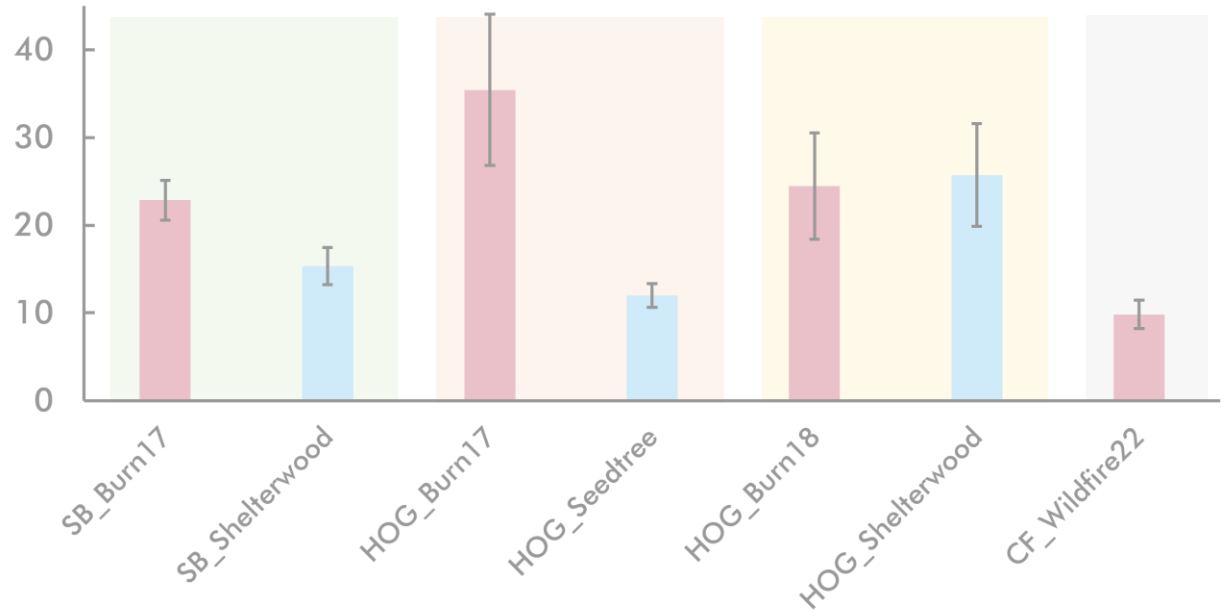
Oak seedling (DBH <2cm) density per ha



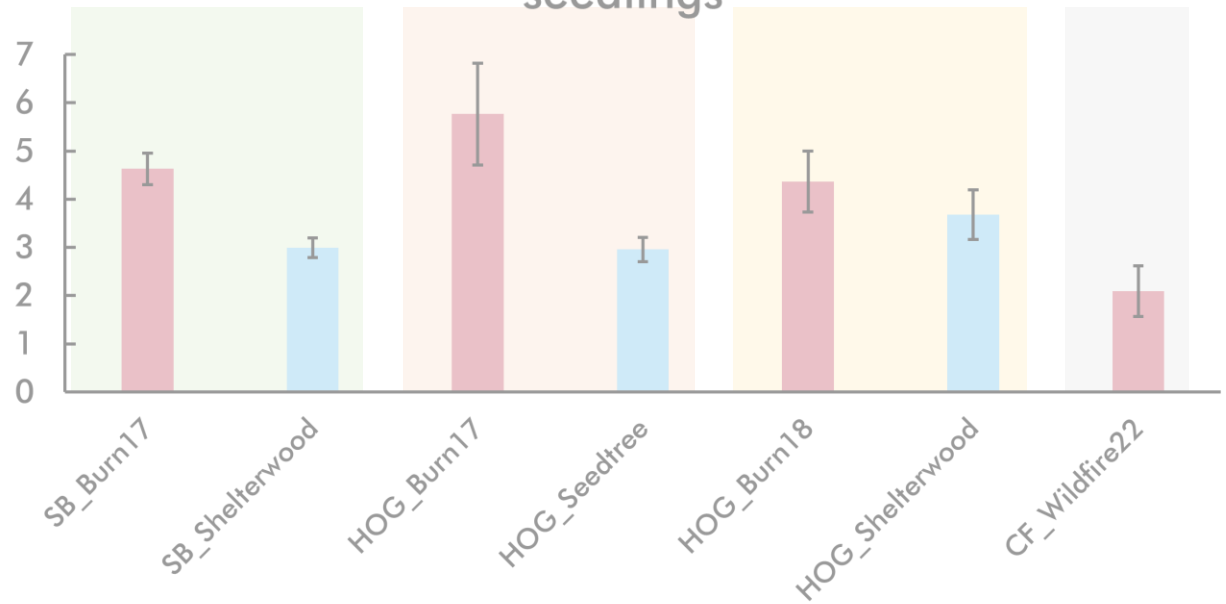
Mean age of oak seedlings

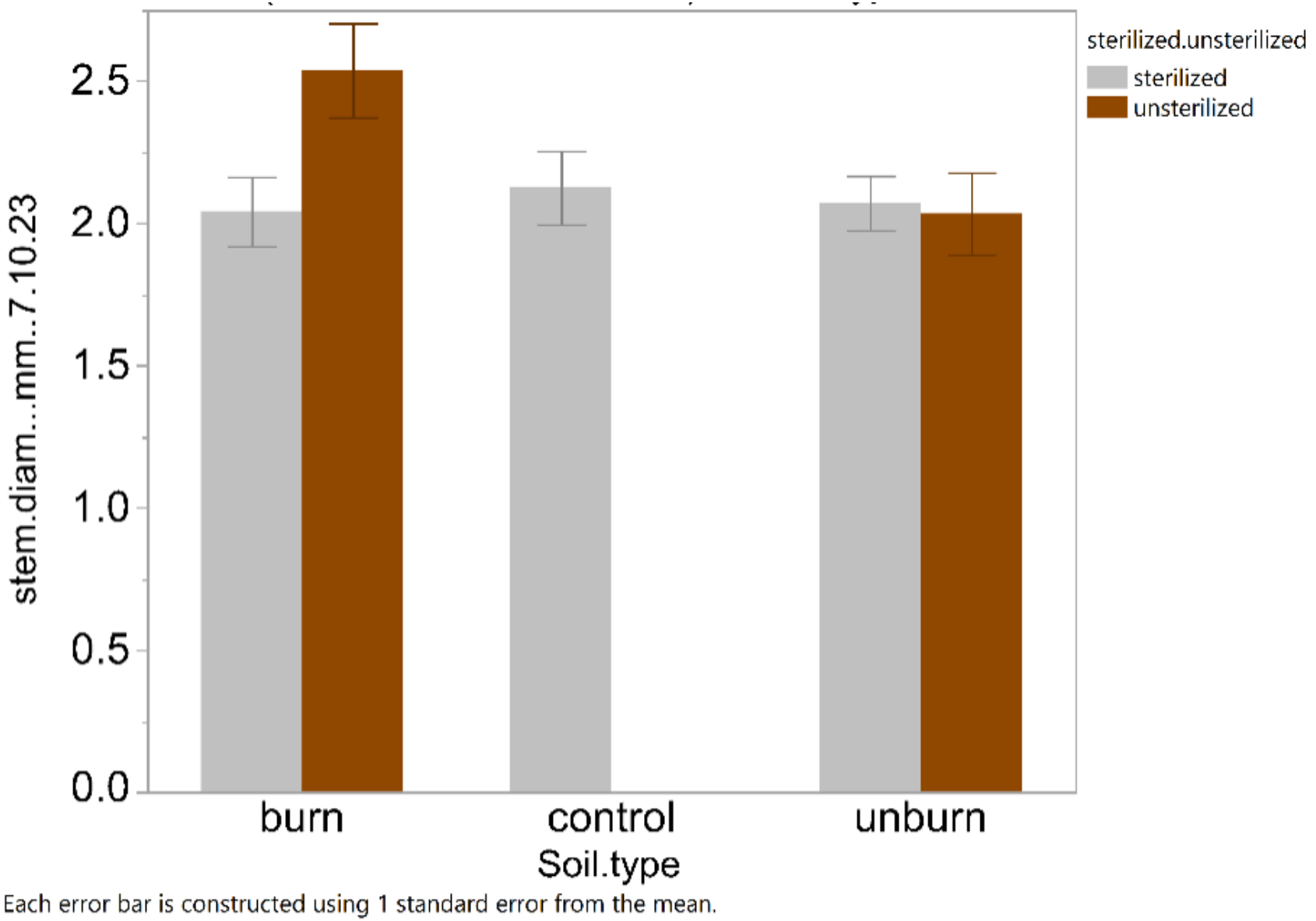


Mean height of oak seedlings



Mean diameter at root collar of oak seedlings




sterilized.unsterilized
sterilized
unsterilized
stem.diam...mm..7.10.23
2.5
2.0
1.5
1.0
0.5
0.0
burn
control
unburn
Soil.type
Each error bar is constructed using 1 standard error from the mean.

Supporting Abenaki stewardship of the ecologically rare and culturally important Atlantic White Cedar Swamp Ecosystem

Heidi Asbjornsen, Teresa Cohn, Holly Wajenberg, Gigi Lish, Matt Vadeboncoeur

in partnership with

Nulhegan Band of the Coosuk Abenaki Nation;
Bradford NH Conservation Commission; Ausbon Sargent Land Preservation Trust

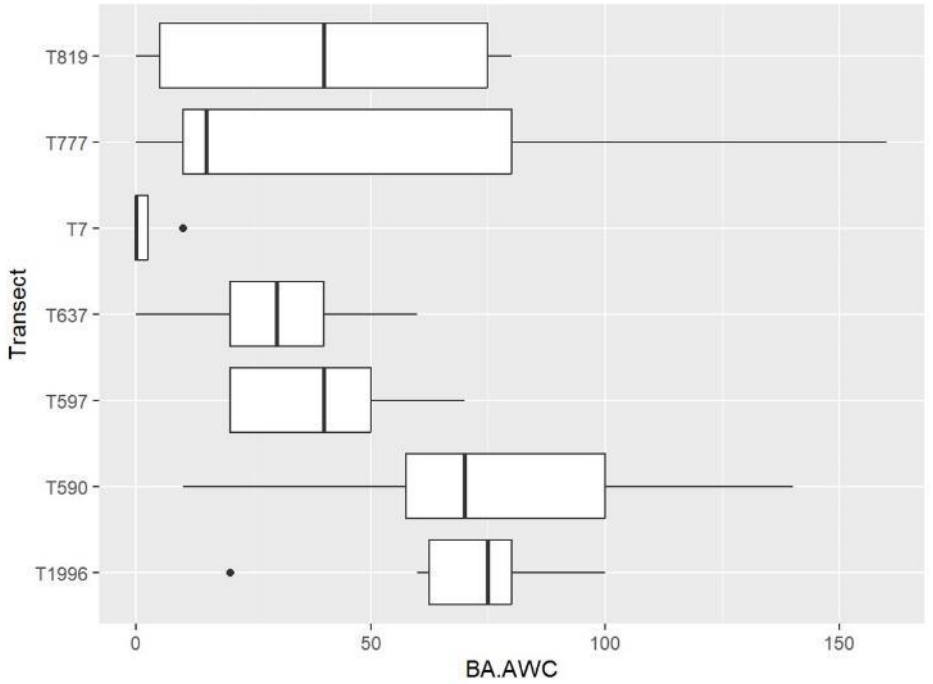
Objectives

1) **Assess AWC natural regeneration** and stand dynamics at **Bradford Bog** in relation to microsite, stand condition, disturbance, management history, and hydrology

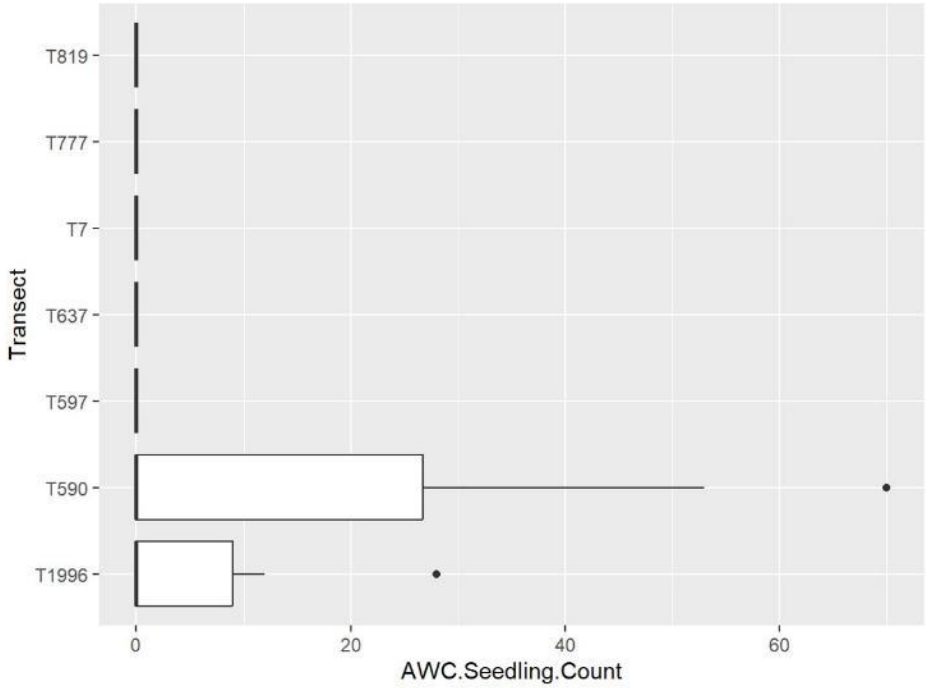
2) Establish **long-term monitoring plots**

3) Document and communicate the **ecological and cultural value** of the ecosystem

4) Co-design an **eco-cultural stewardship plan**, including recommendations for sustainable management and restoration



Transects varied widely in AWC basal area



… but only 2 of 7 transects with mature AWC had any AWC seedlings

Many Thanks

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Emma Flaherty	Nicolas Forestell	Jack Hastings
Zach Hooper	Matt Rozinski	Jason Demers
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