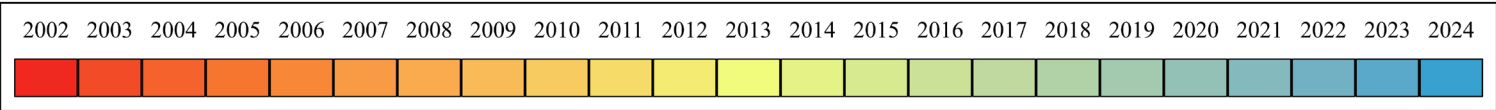
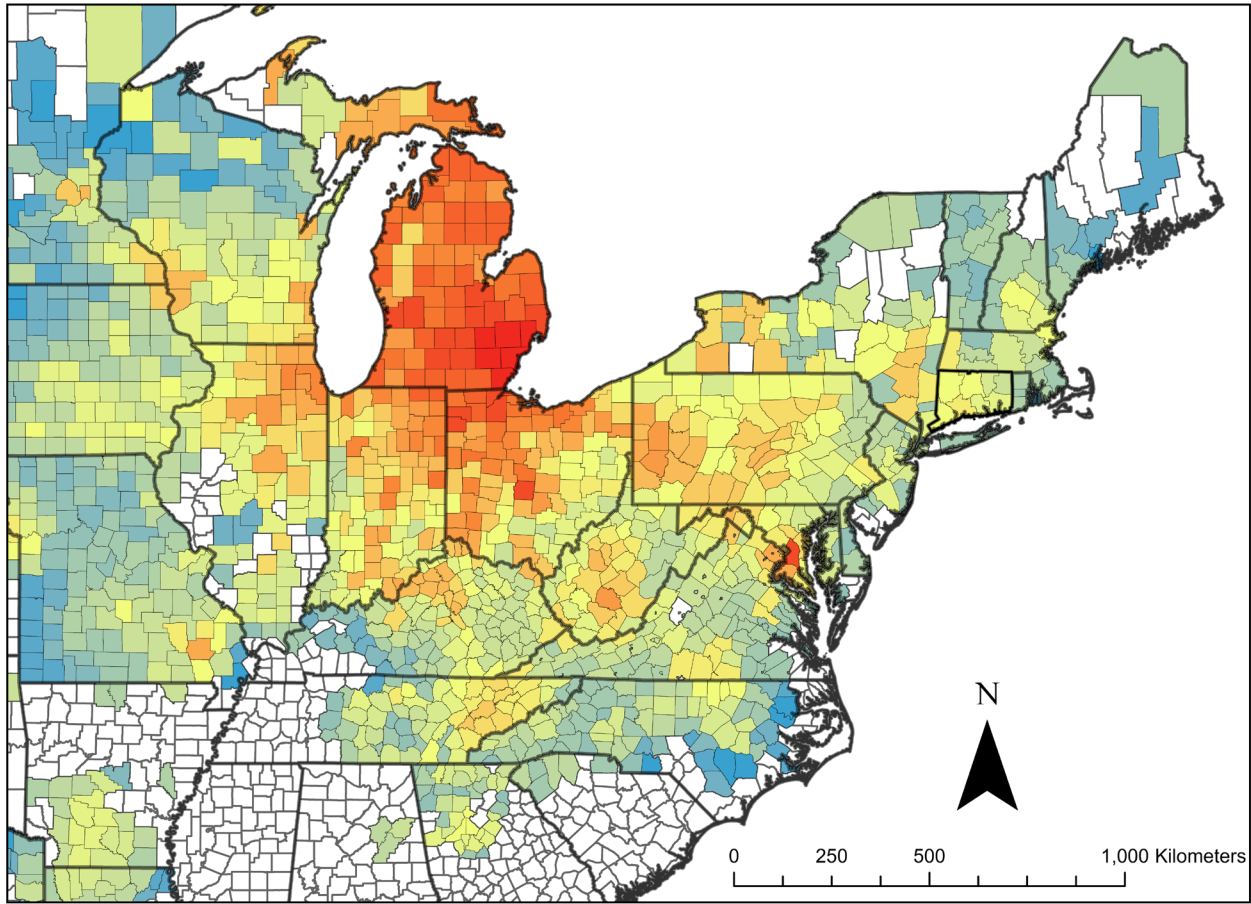


Tree regeneration and understory plant communities in the aftermath of emerald ash borer invasion

Jack E. Hatajik^{1,2}, Marlyse C. Duguid², Mark A. Bradford^{2,3}, Sara E. Kuebbing^{2,3},
Claire E. Rutledge¹, and Elisabeth B. Ward¹

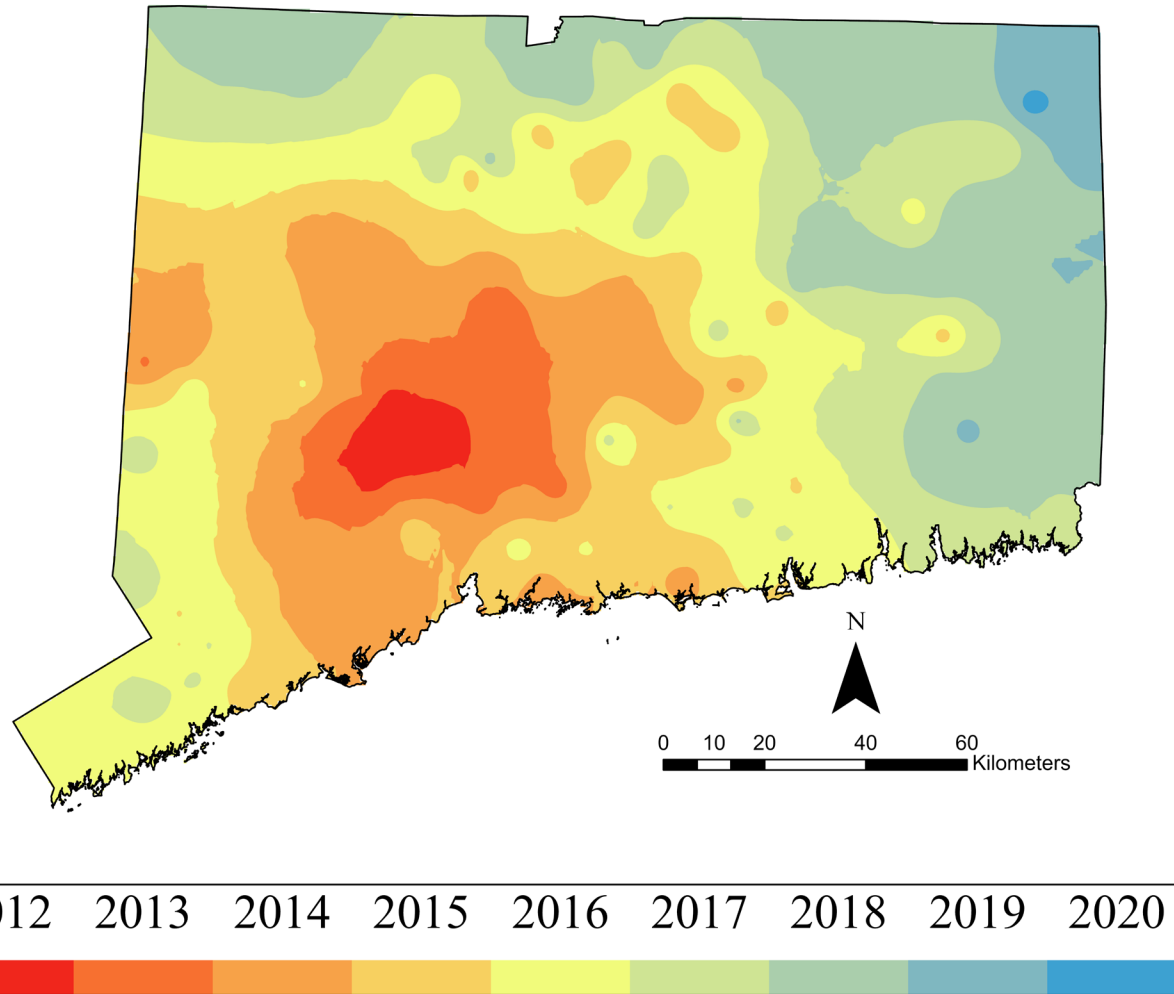
The Connecticut Agricultural Experiment Station¹, The Forest School at the Yale School of the Environment², Yale Center for Natural Carbon Capture³



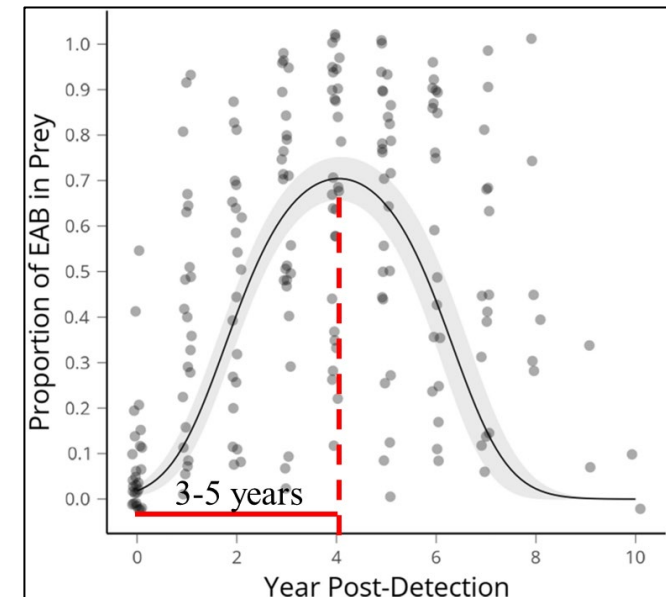


USDA APHIS, 2023
 Debbie Miller, USDA Forest Service

EAB Detection in Connecticut

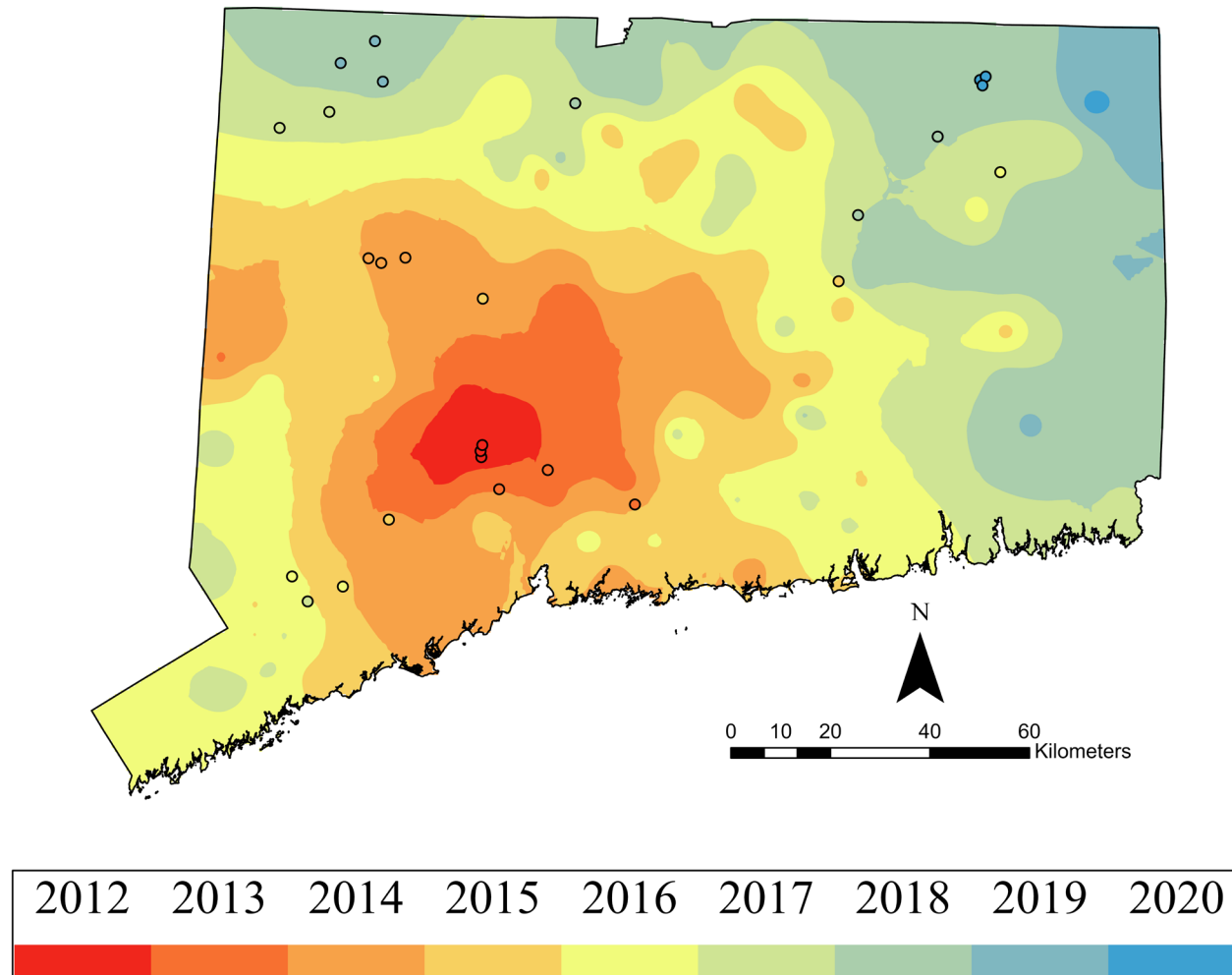


Dr. Claire Rutledge
Department of Entomology
CAES

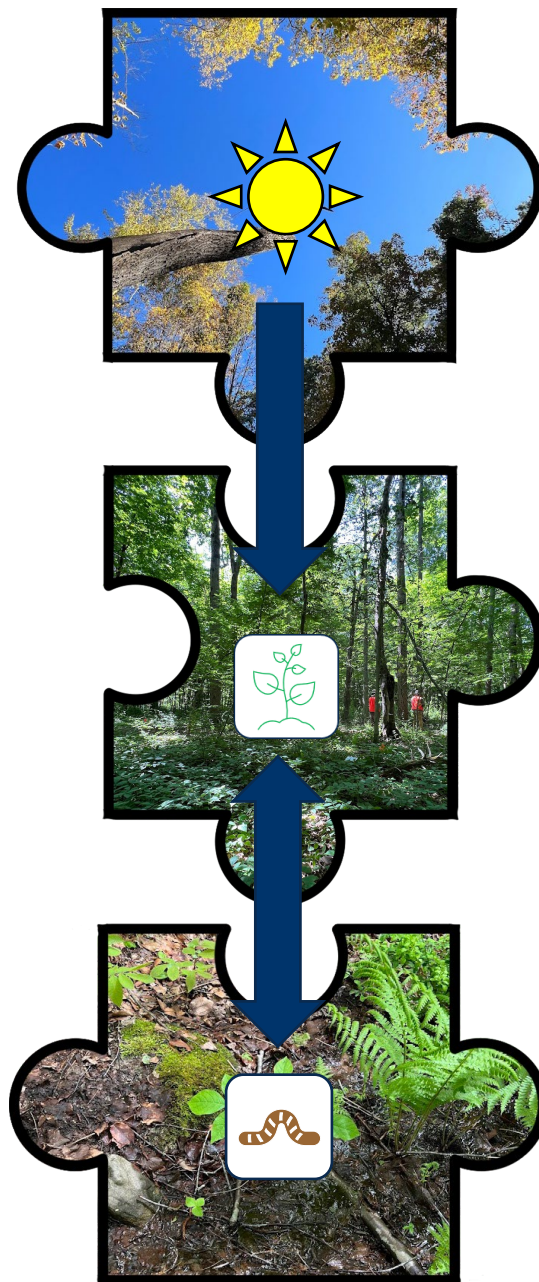


Hatajik et al. In review; Rutledge and Clark, 2023

Selected Passively Managed, Ash-Dominant Sites Across Connecticut



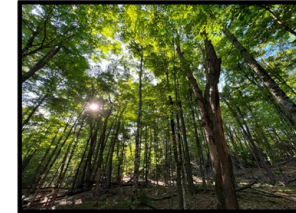
Hatajik et al. In review; Rutledge and Clark, 2023



Hypotheses

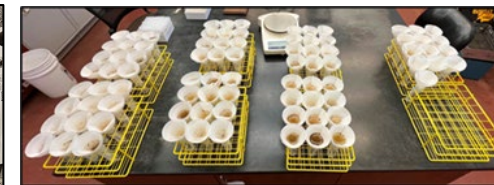
1) +Dead Ash → +Light = ±Plants

Canopy Openness → Relative Proportion of Dead Ash



2) ±Soil Nutrients → ±Plants

Nitrogen Availability → Nitrification

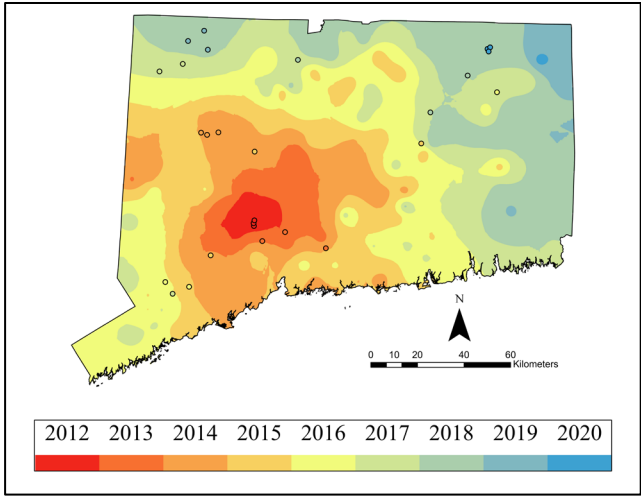
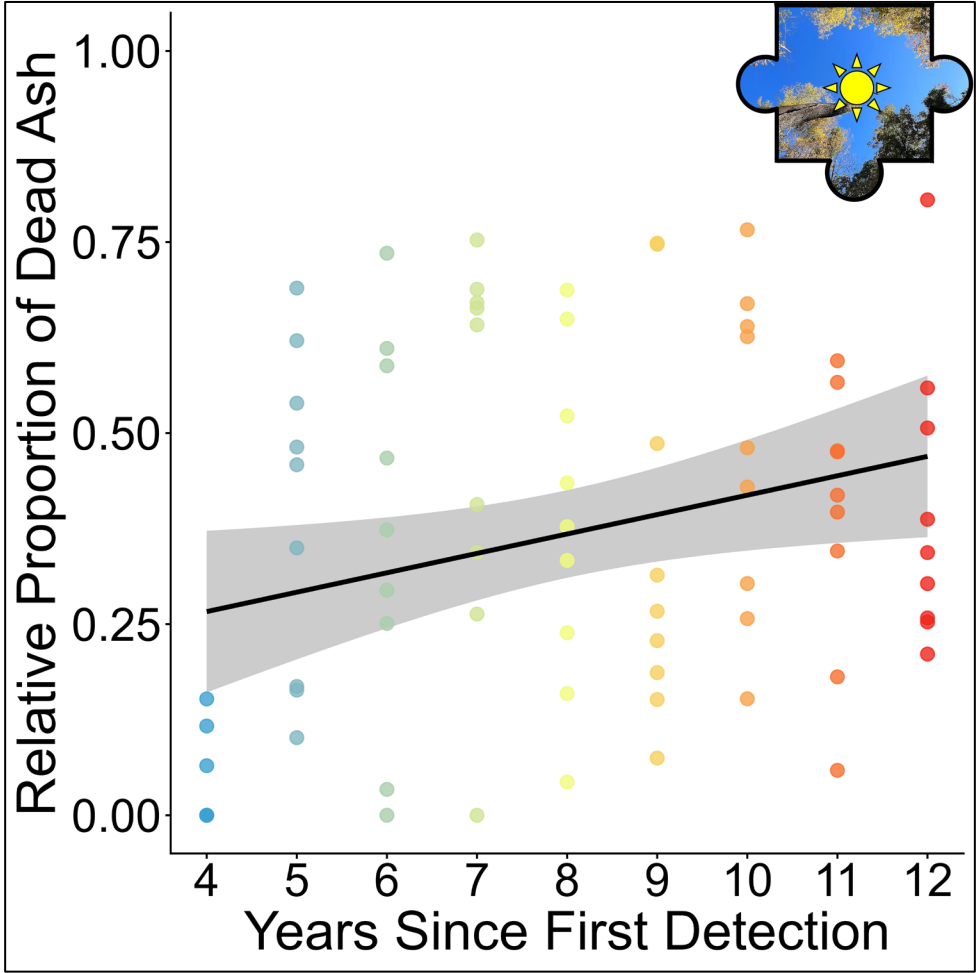


Response = Understory Plants

Plant Cover and Tree Regeneration

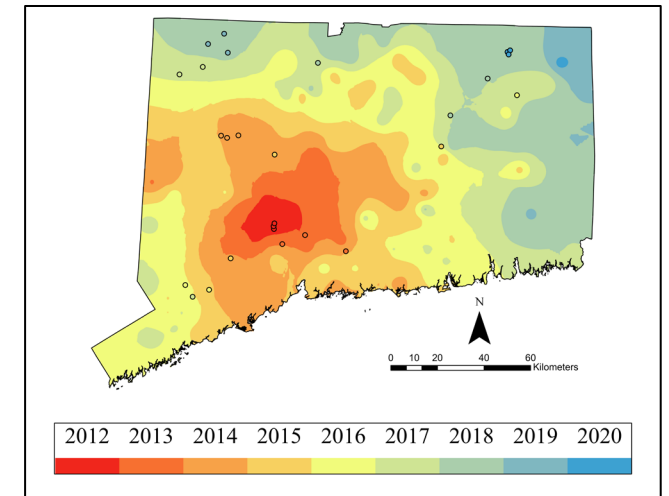
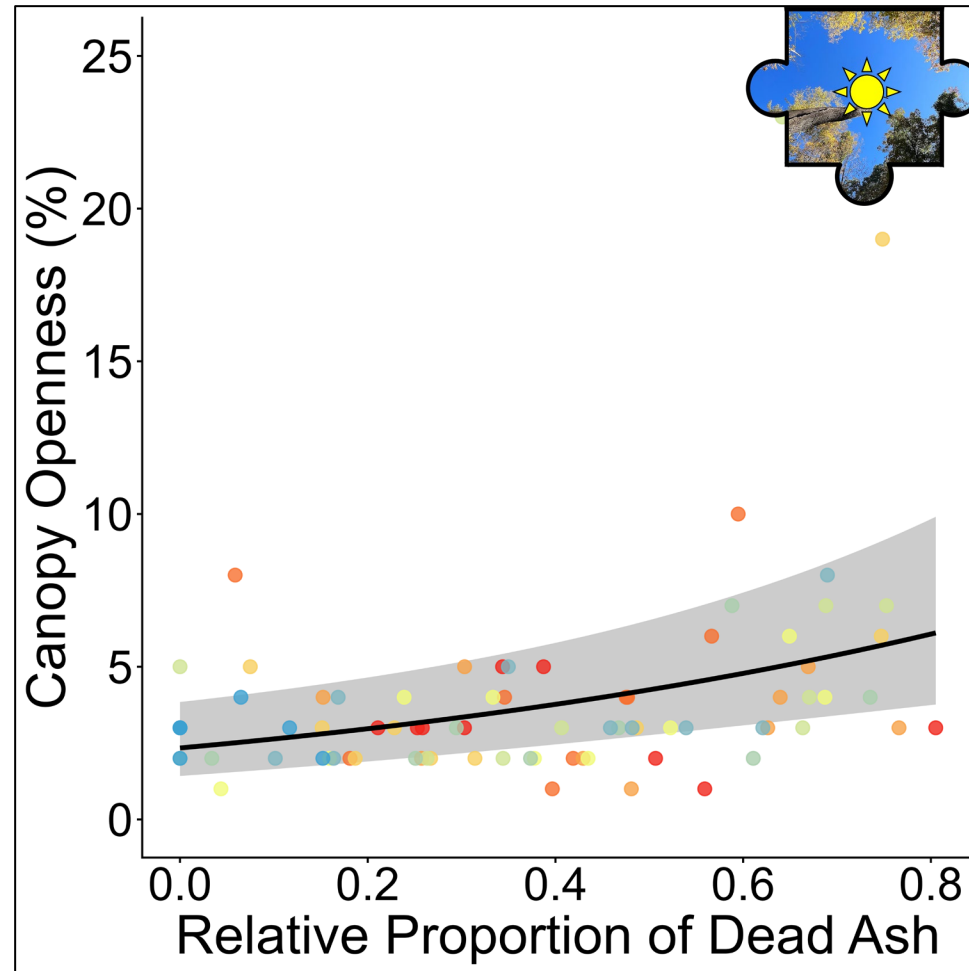
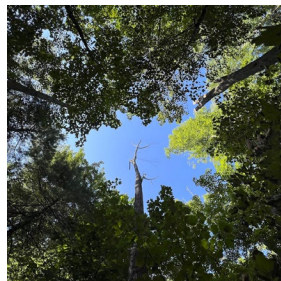
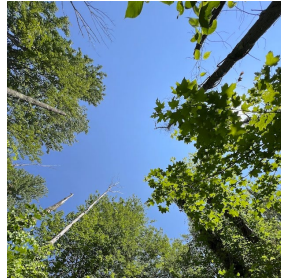


Ash Mortality is Greater Over Time

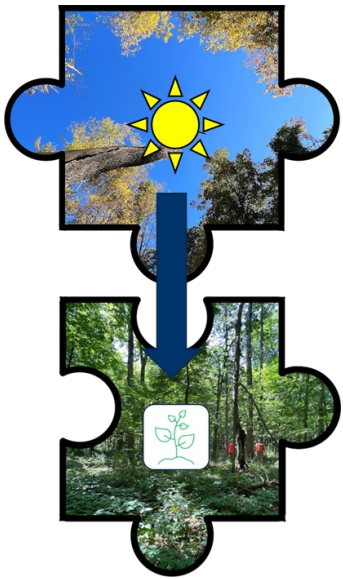


Hatajik et al. In review

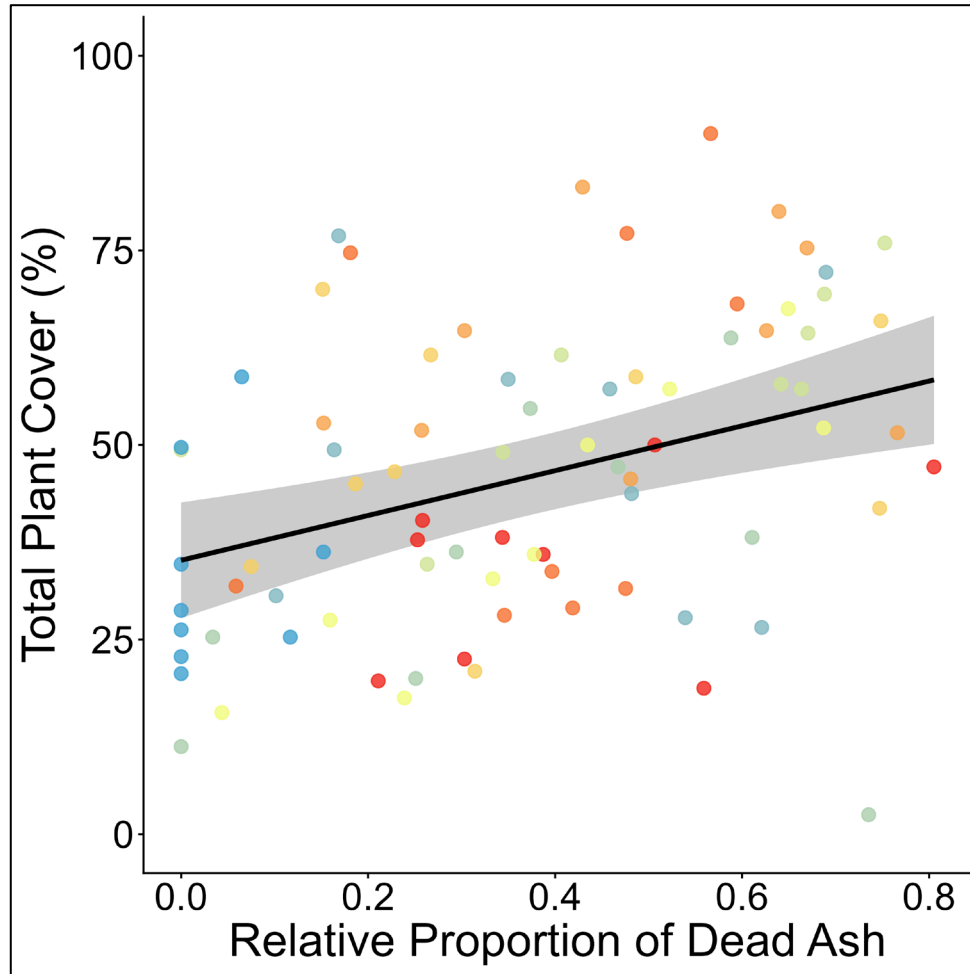
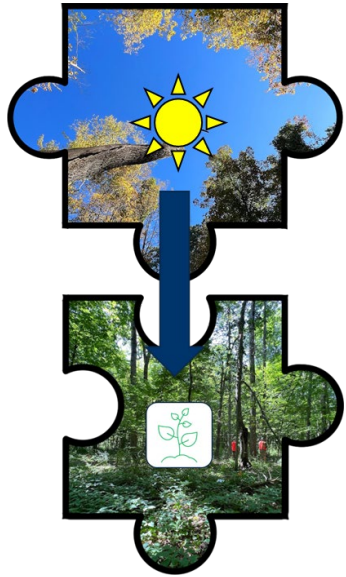
Canopy Openness is **Positively** Associated with **Ash Mortality**



Hatajik et al. In review

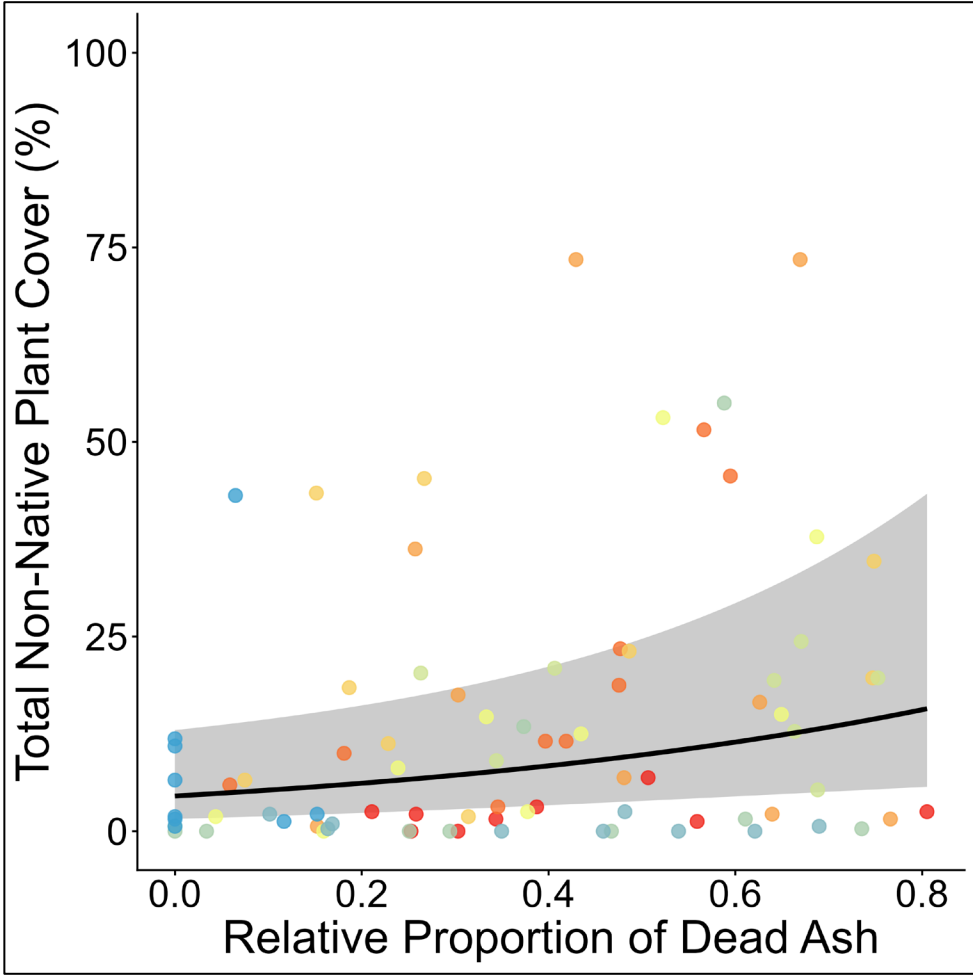
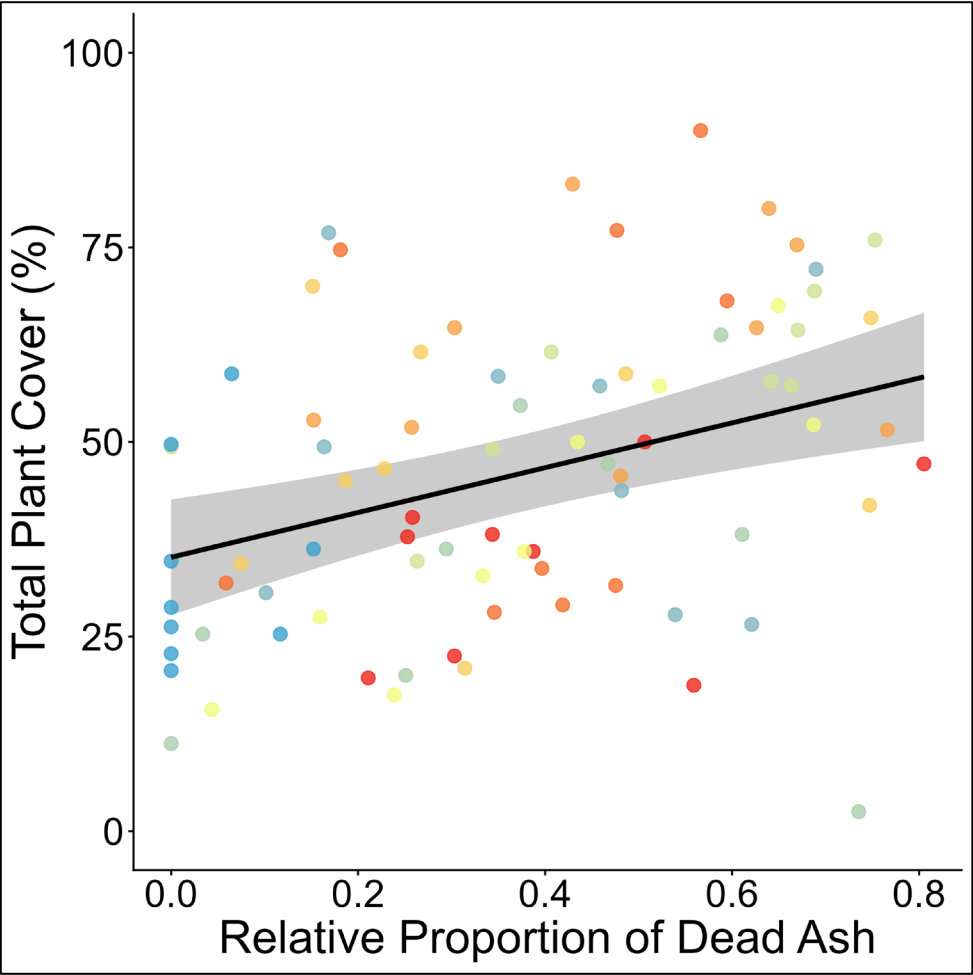
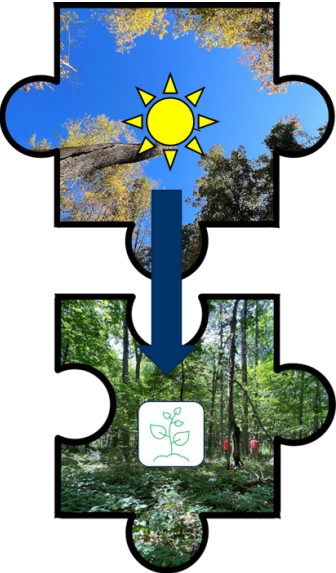


Total Plant Cover is **Positively** Associated with Ash Mortality

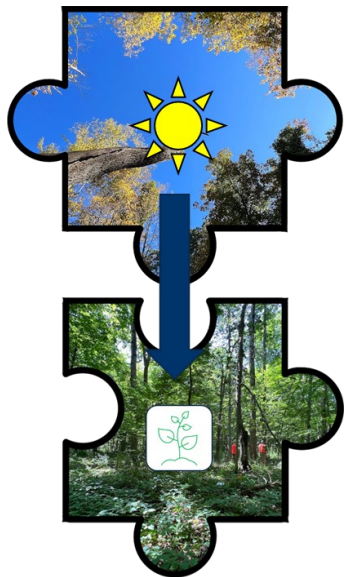


Hatajik et al. In review

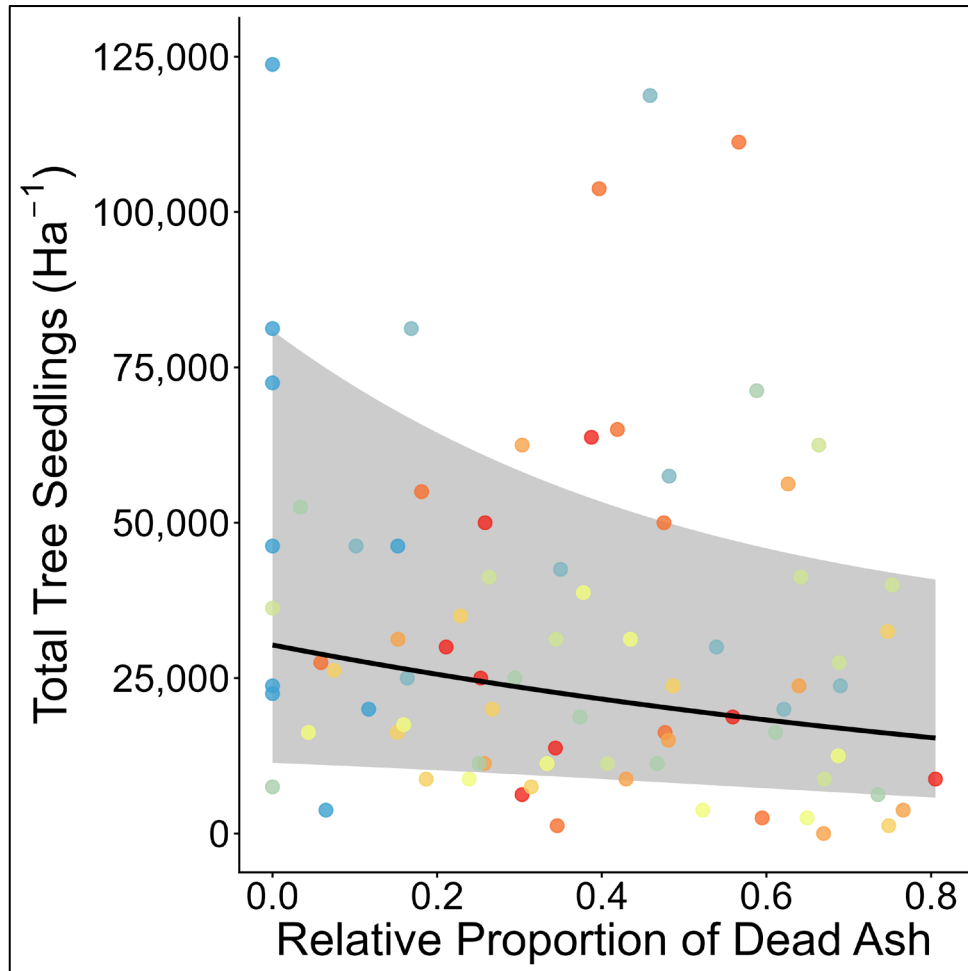
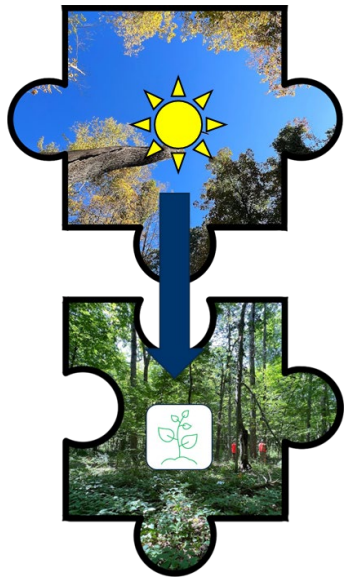
Non-Native Plant Cover is **Positively** Associated with Ash Mortality



Hatajik et al. In review

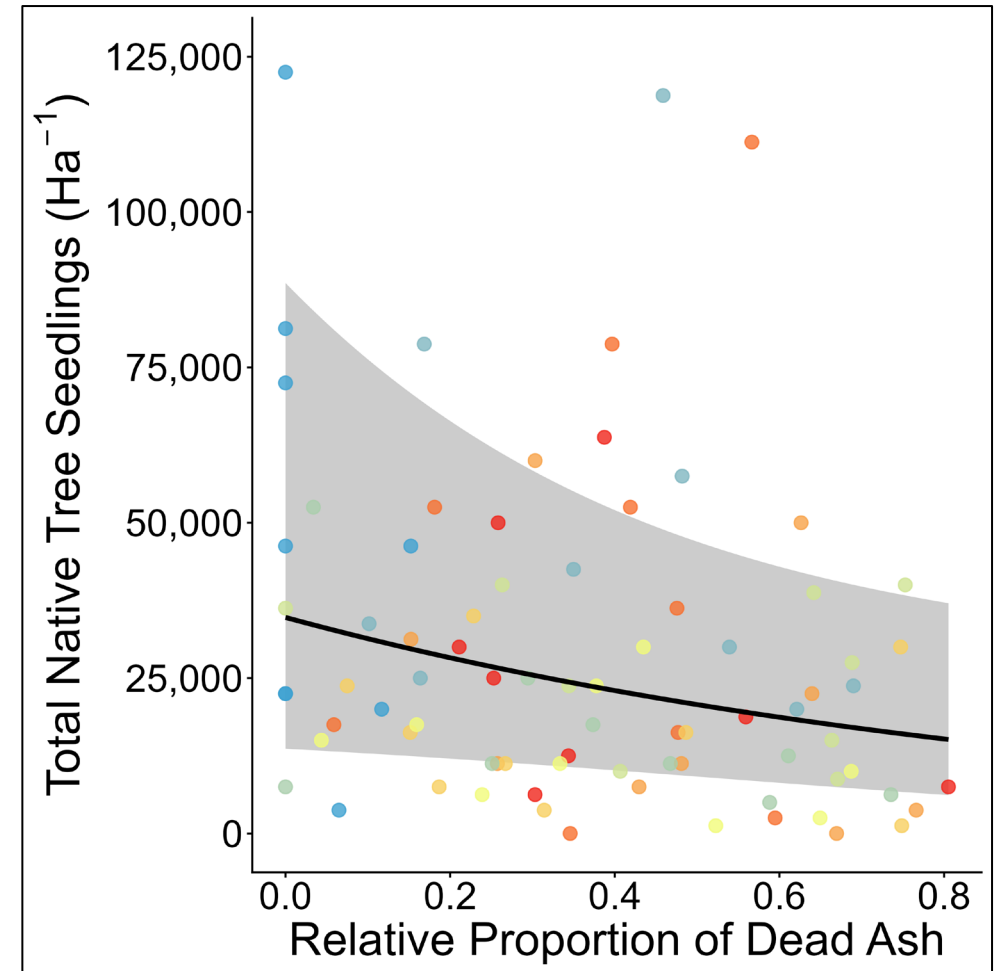
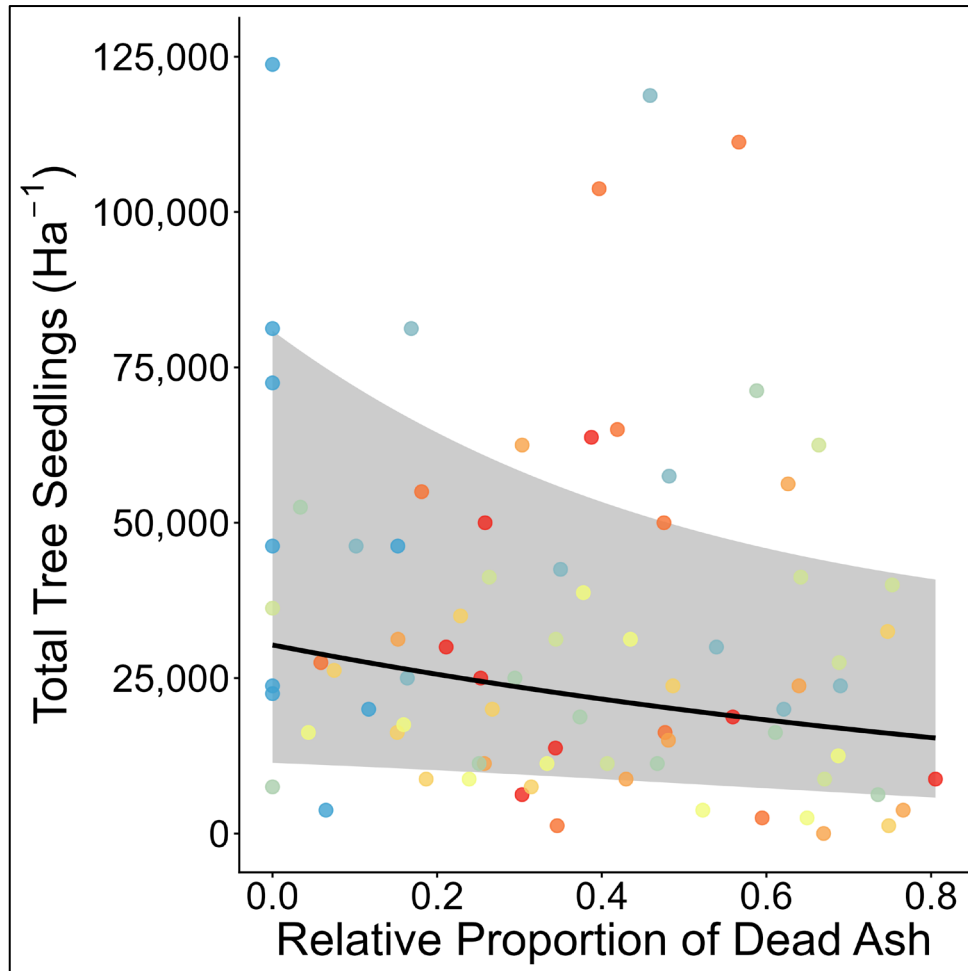
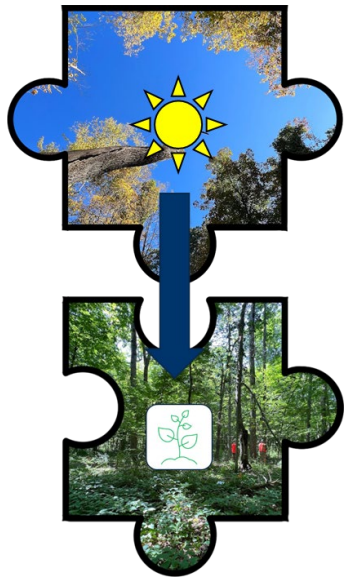


Total Tree Regeneration is **Negatively** Associated with **Ash Mortality**

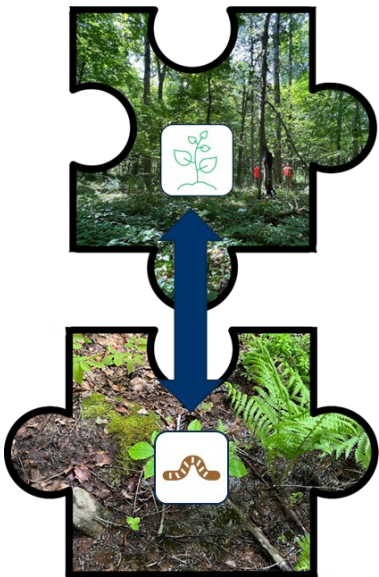


Hatajik et al. In review

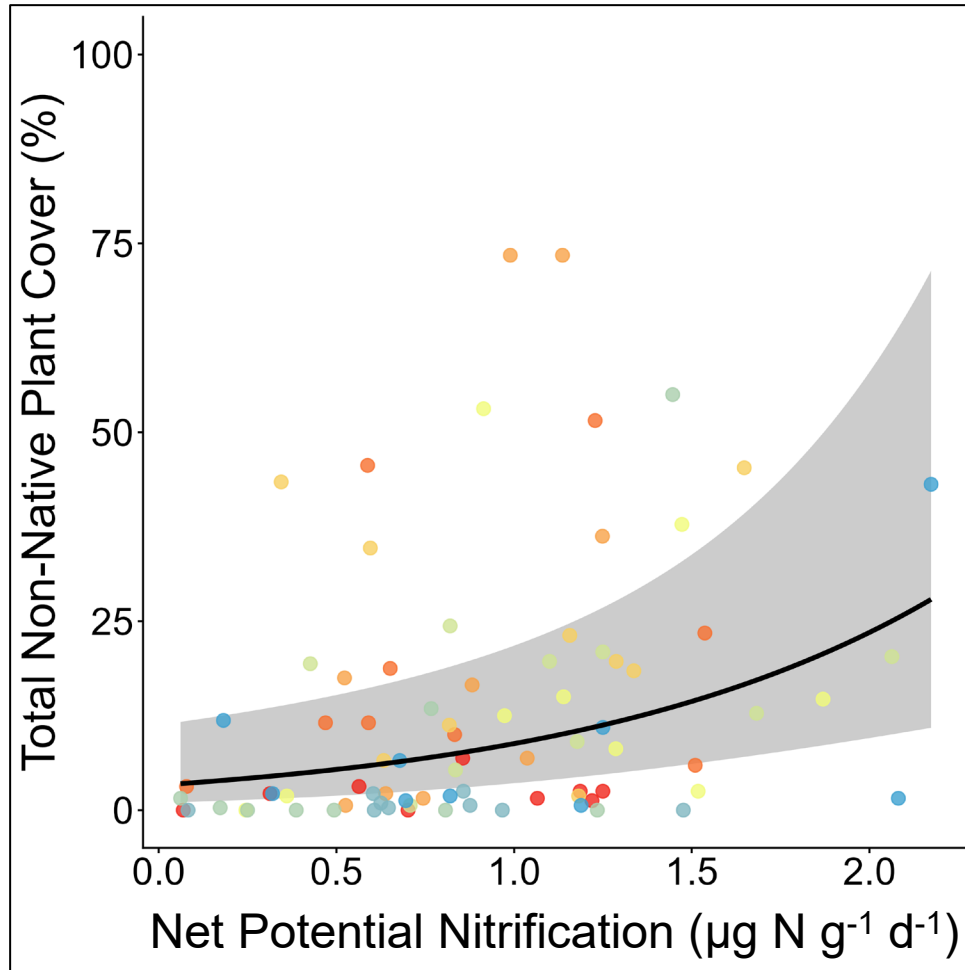
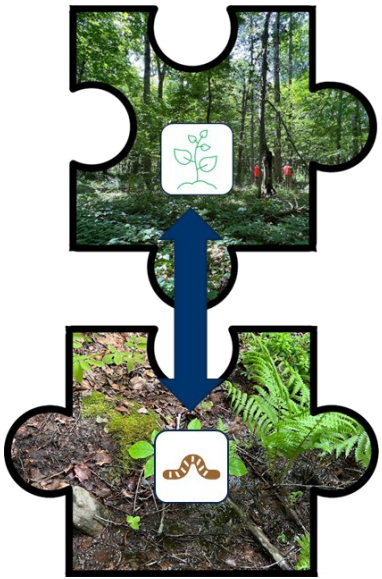
Native Tree Regeneration is **Negatively** Associated with **Ash Mortality**



Hatajik et al. In review

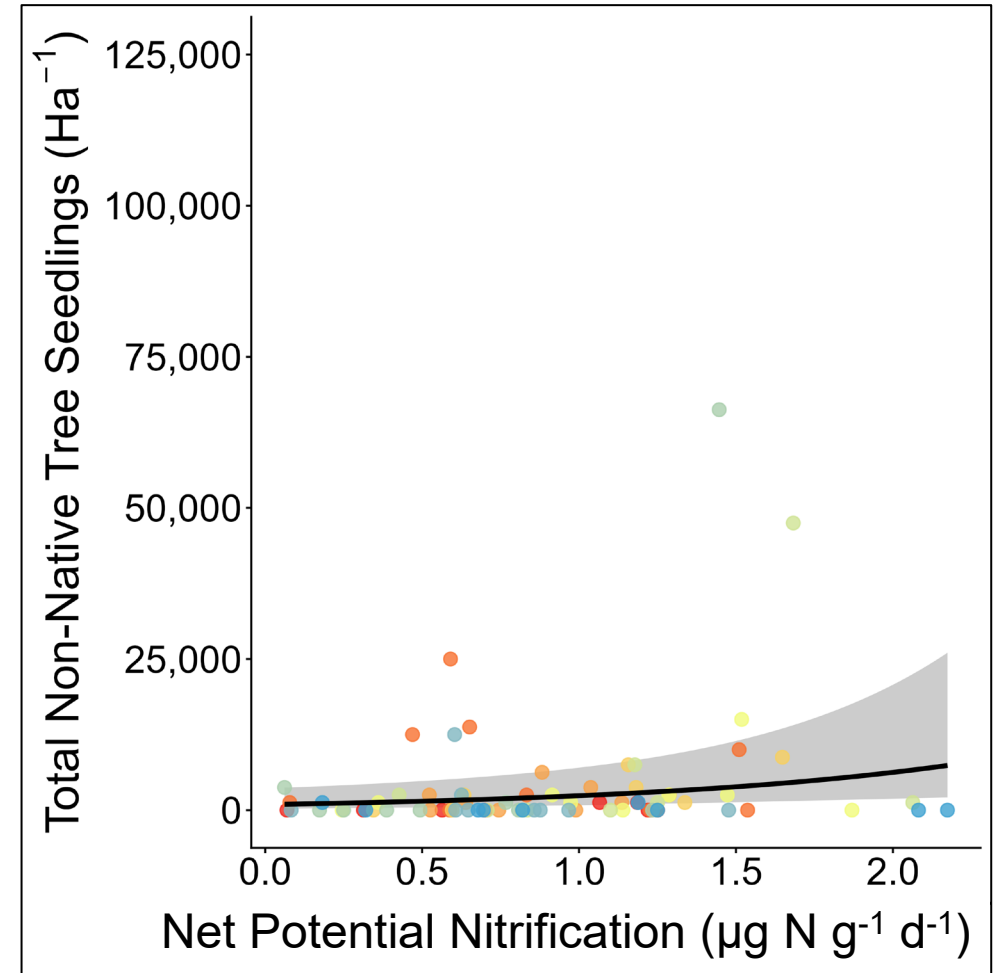
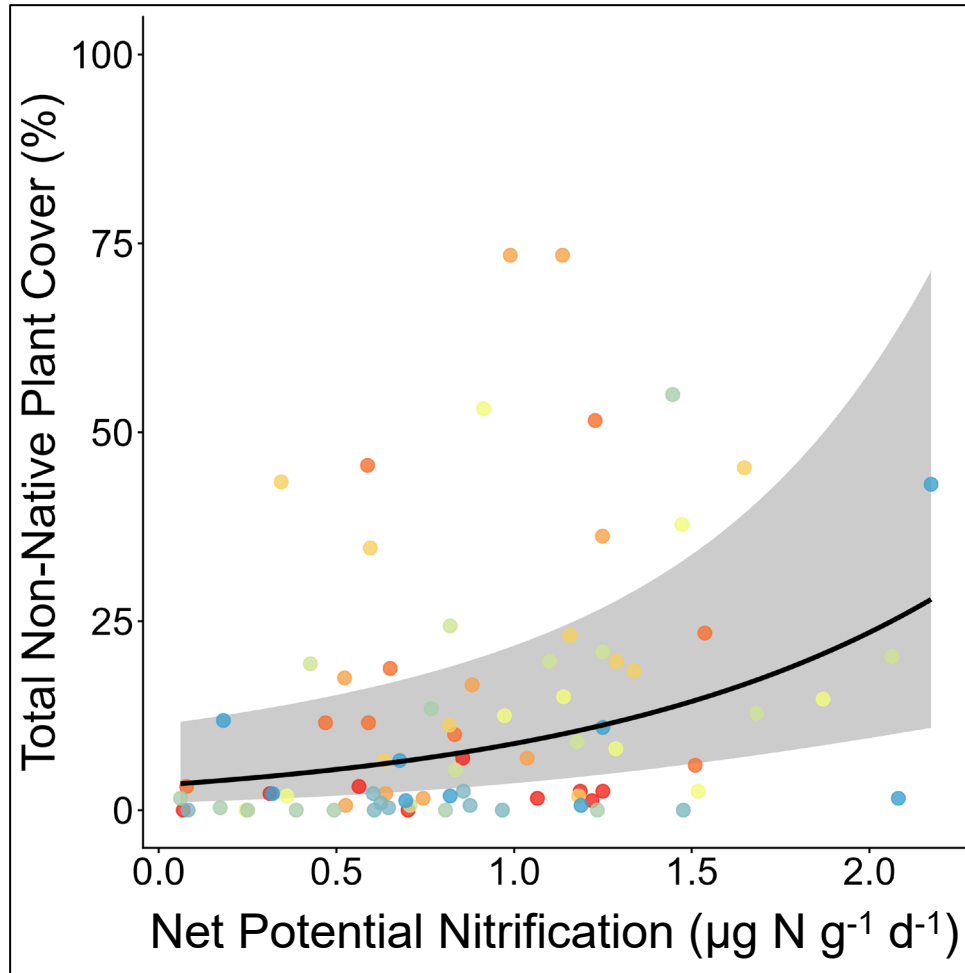
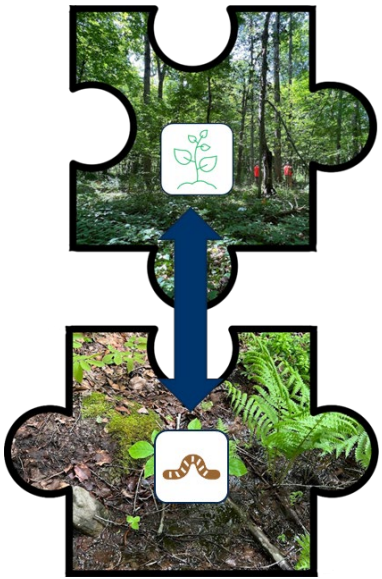


Non-Native Plants are Positively Associated with Nitrogen Availability



Hatajik et al. In review

Non-Native Plants are Positively Associated with Nitrogen Availability



Hatajick et al. In review



Non-native plants



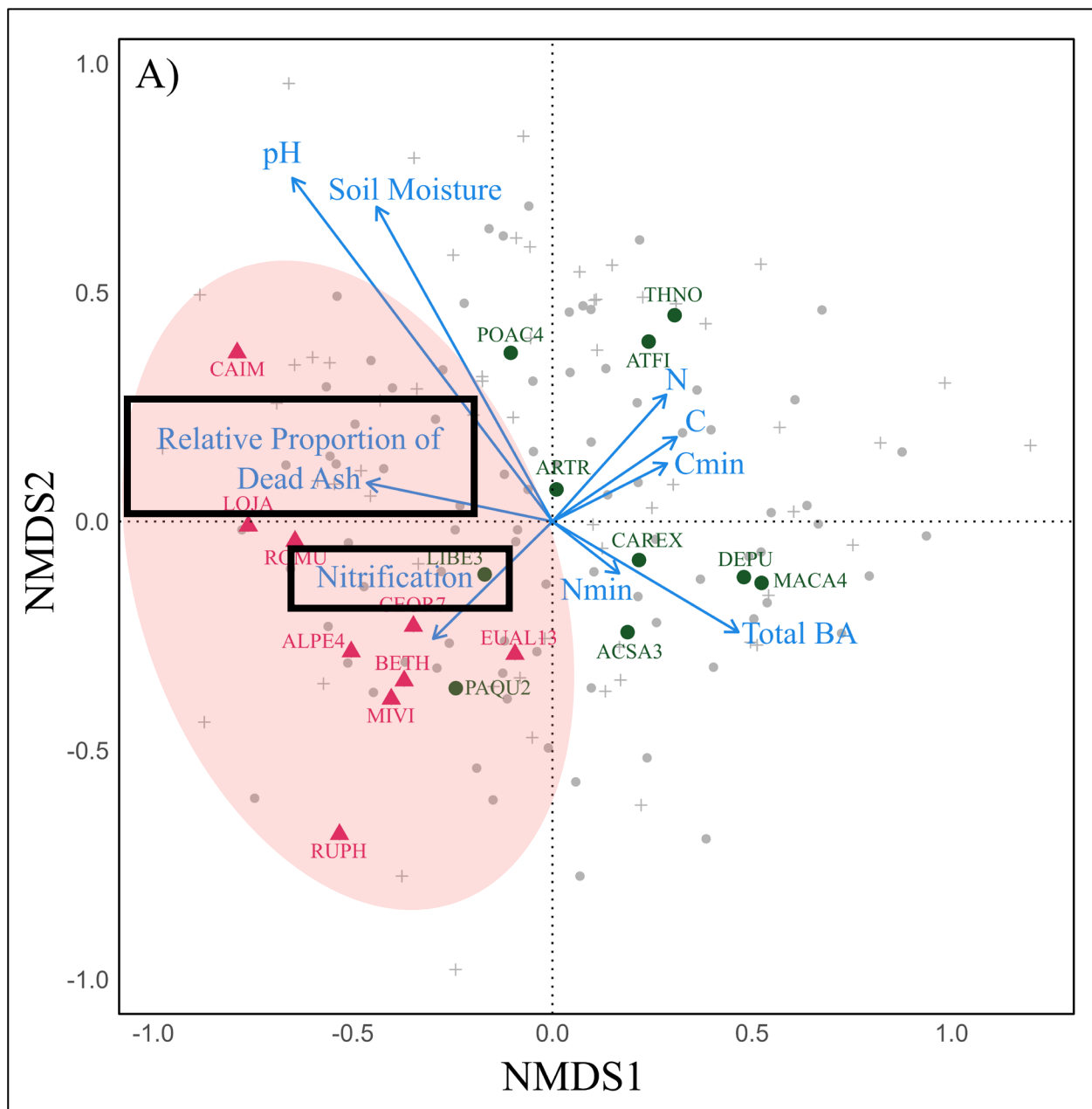
Japanese barberry



Asiatic bittersweet



Multiflora rose



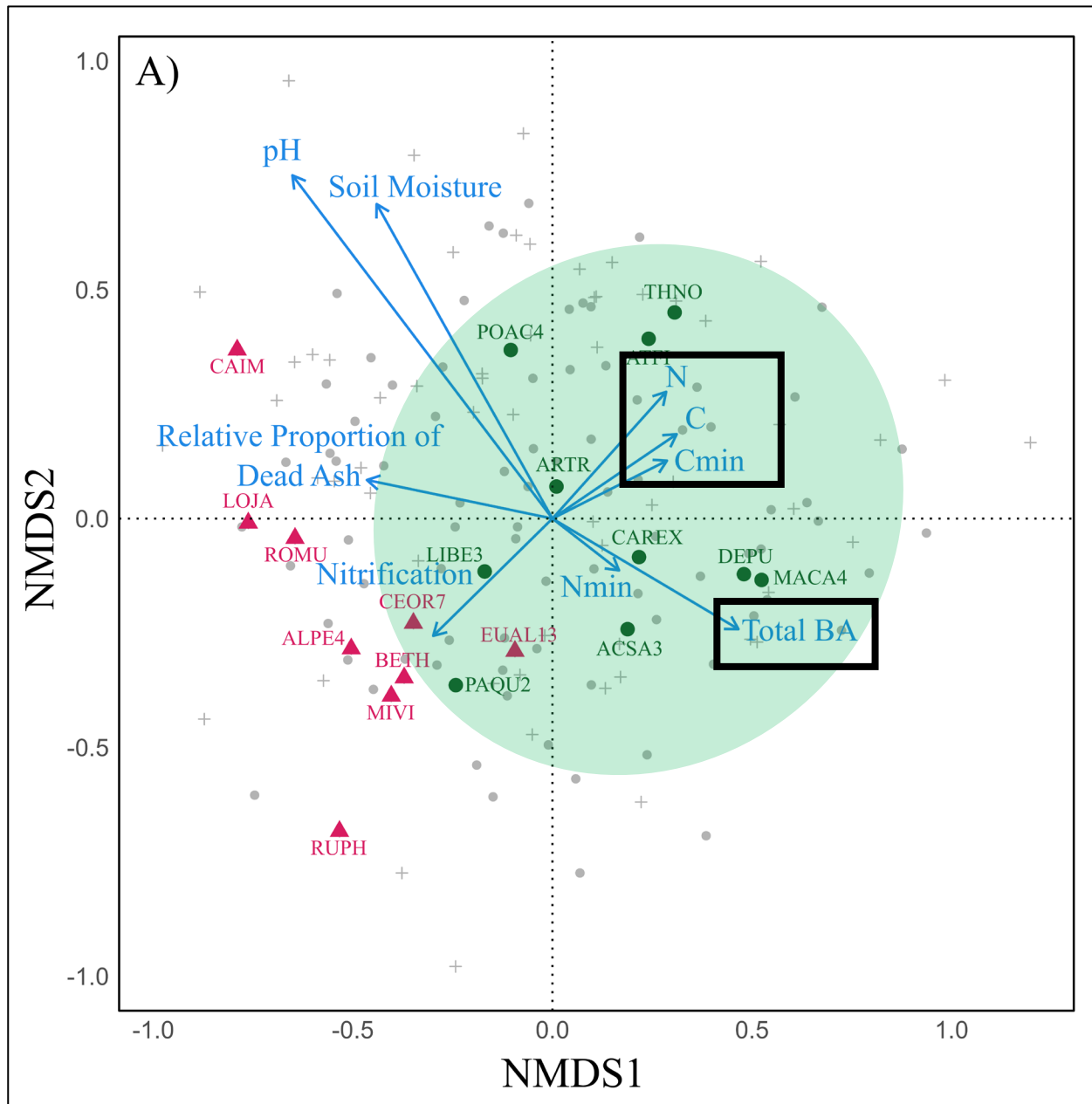
Relative Proportion of
Dead Ash =
Greater Light

Nitrification =
Greater Nitrogen
Availability

Hatajik et al. In review

Total BA/Basal Area =
Less Light

C/N/Cmin =
Less Nitrogen
Availability



Native plants



Hayscented fern



Sedges



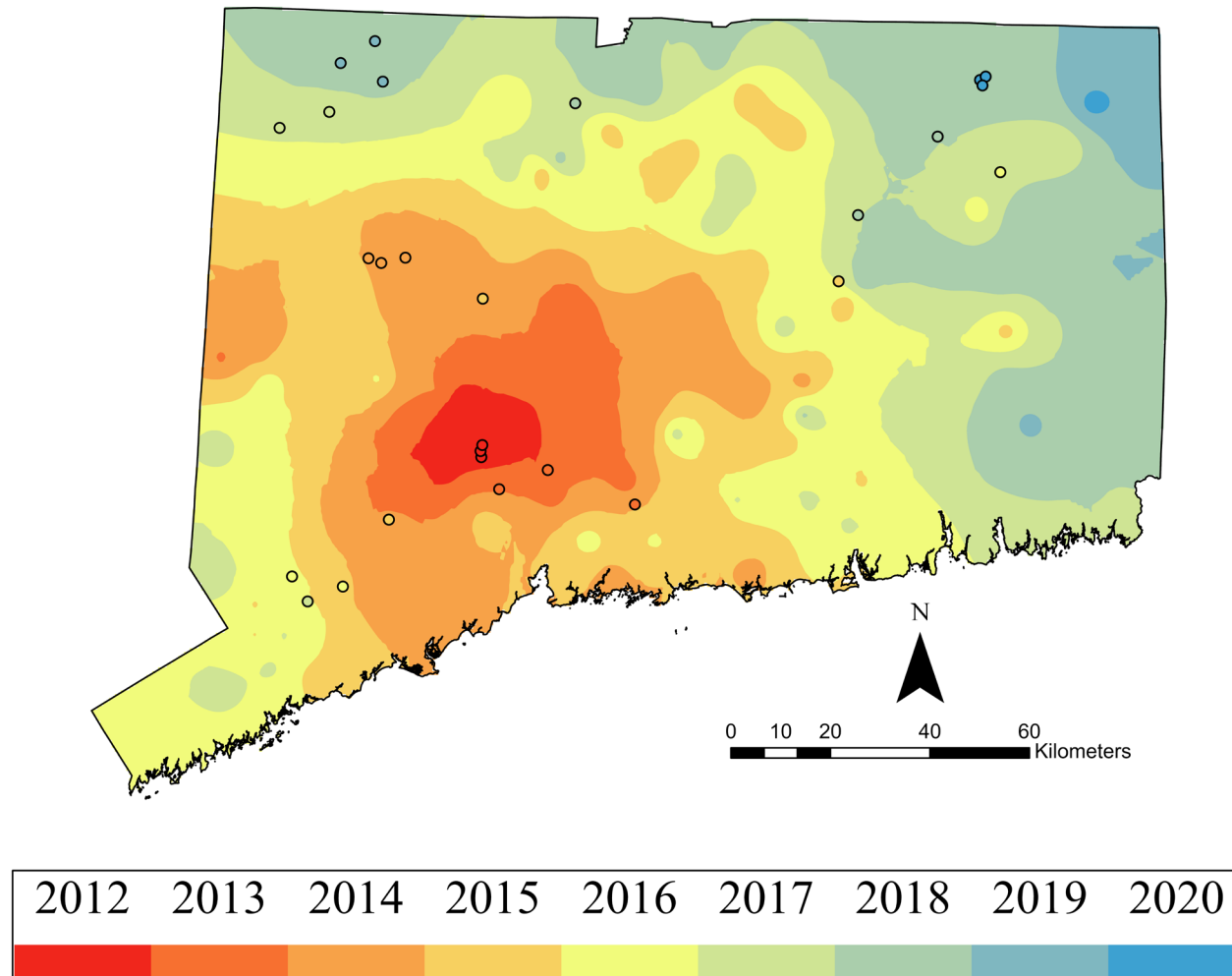
Northern spicebush

Hatajik et al. In review



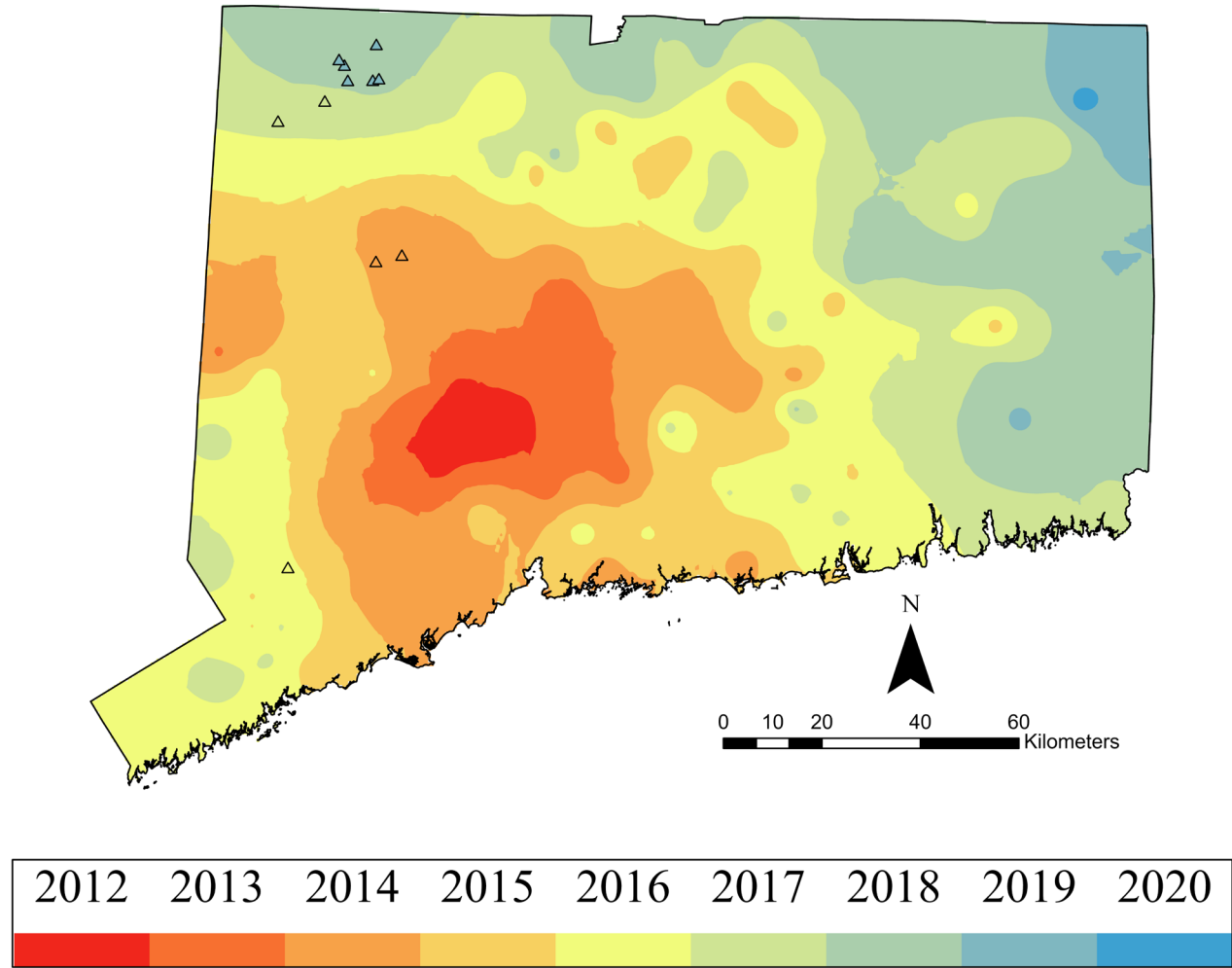


Selected Passively Managed, Ash-Dominant Sites Across Connecticut



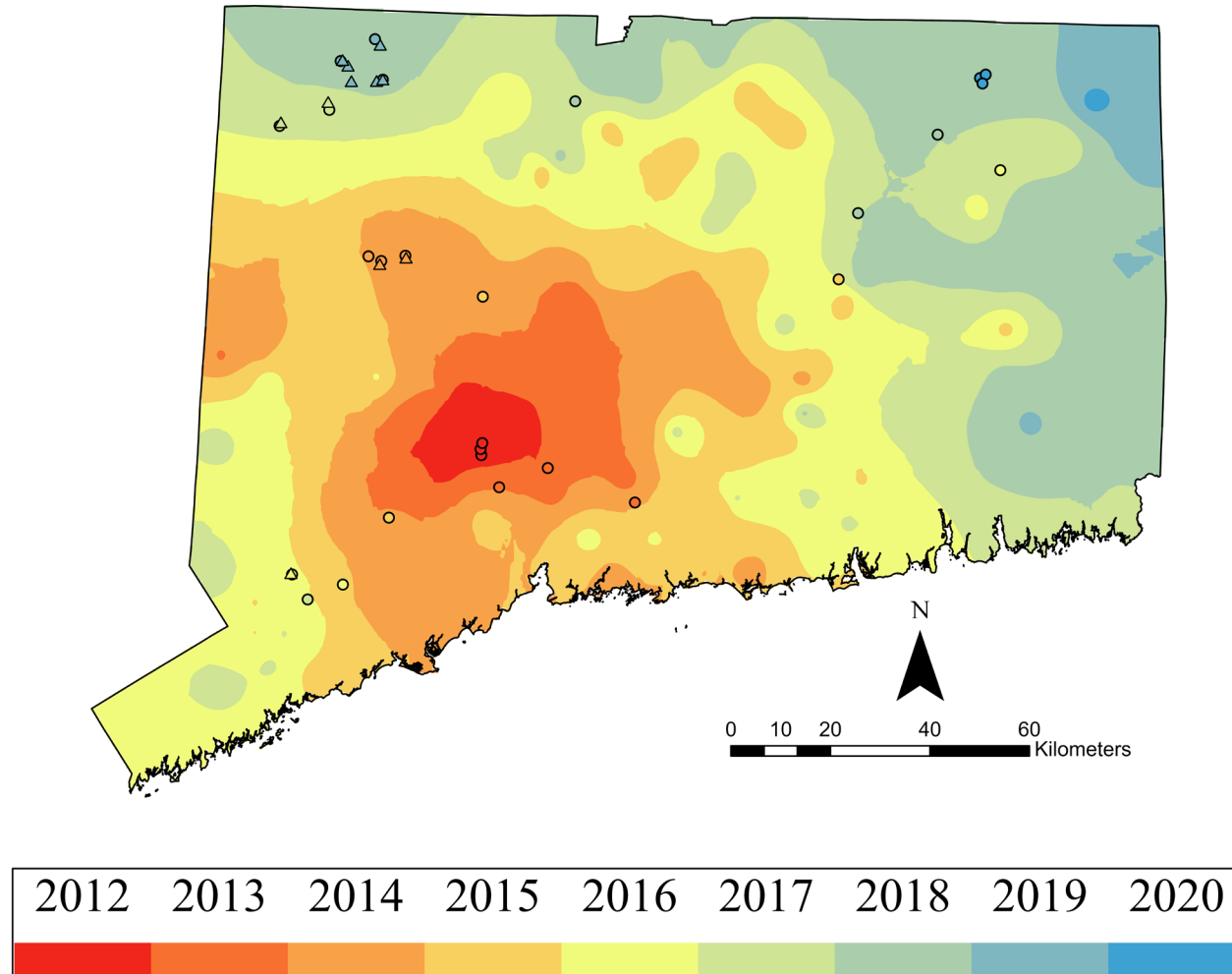
Hatajik et al. In review; Rutledge and Clark, 2023

Selected Actively Managed, Ash-Dominant Sites



Hatajik et al. In review; Rutledge and Clark, 2023

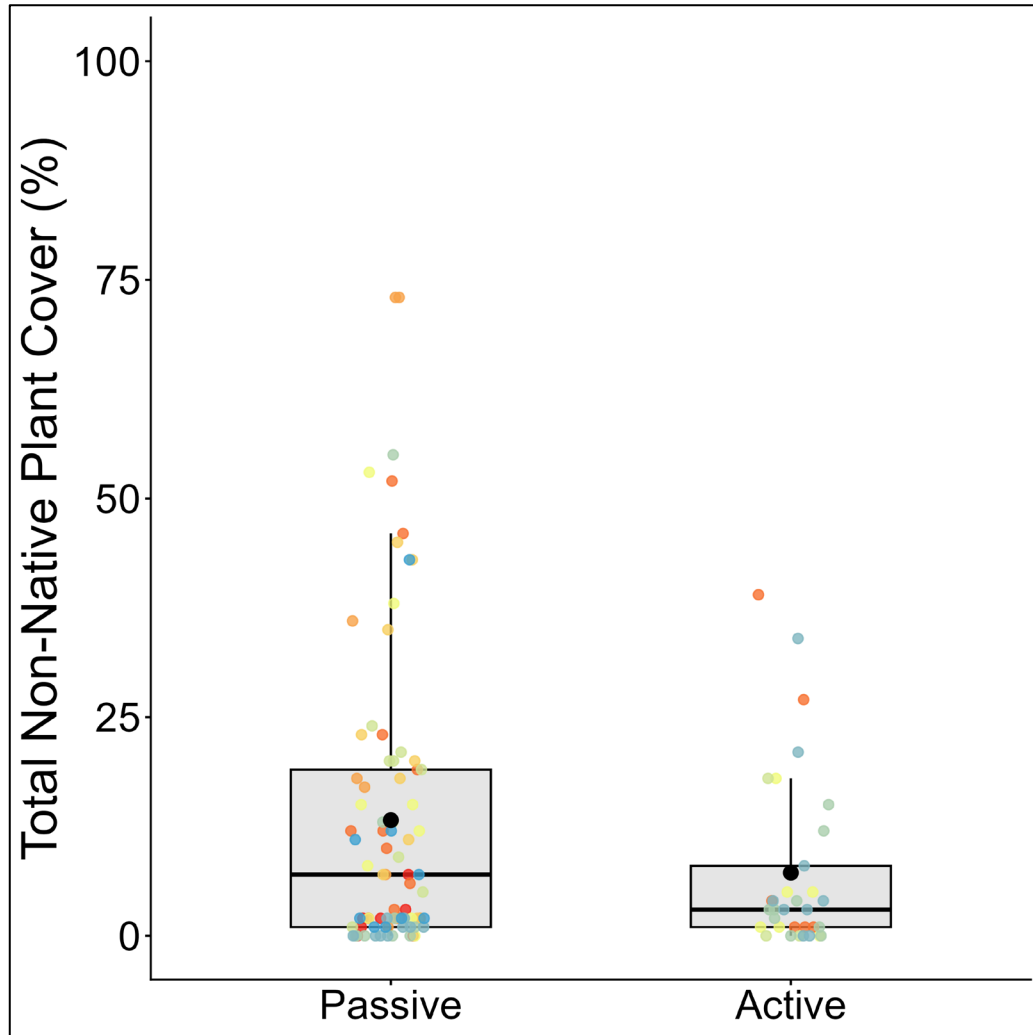
Compared Passively vs. Actively Managed Sites



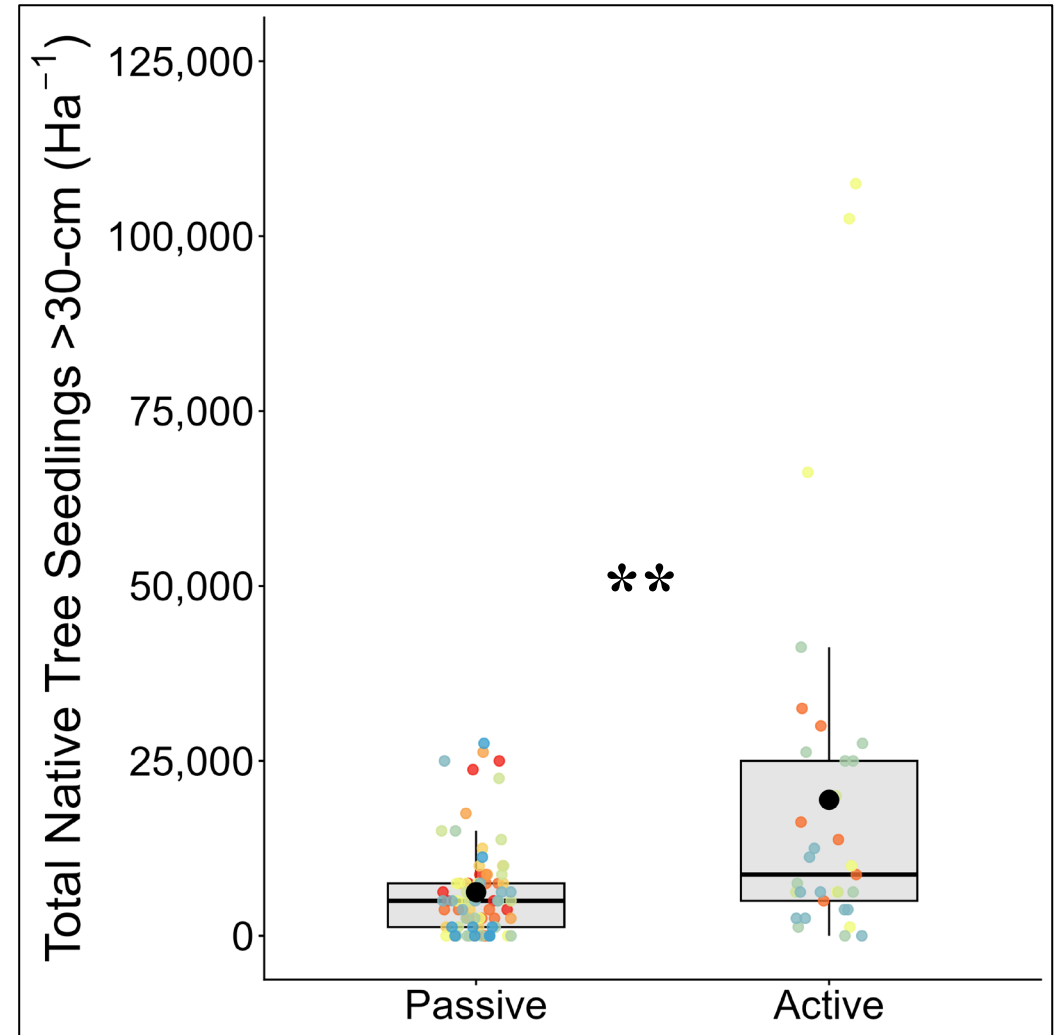
Hatajik et al. In review; Rutledge and Clark, 2023

Preliminary Results: Passive vs. Active

Understory Plants

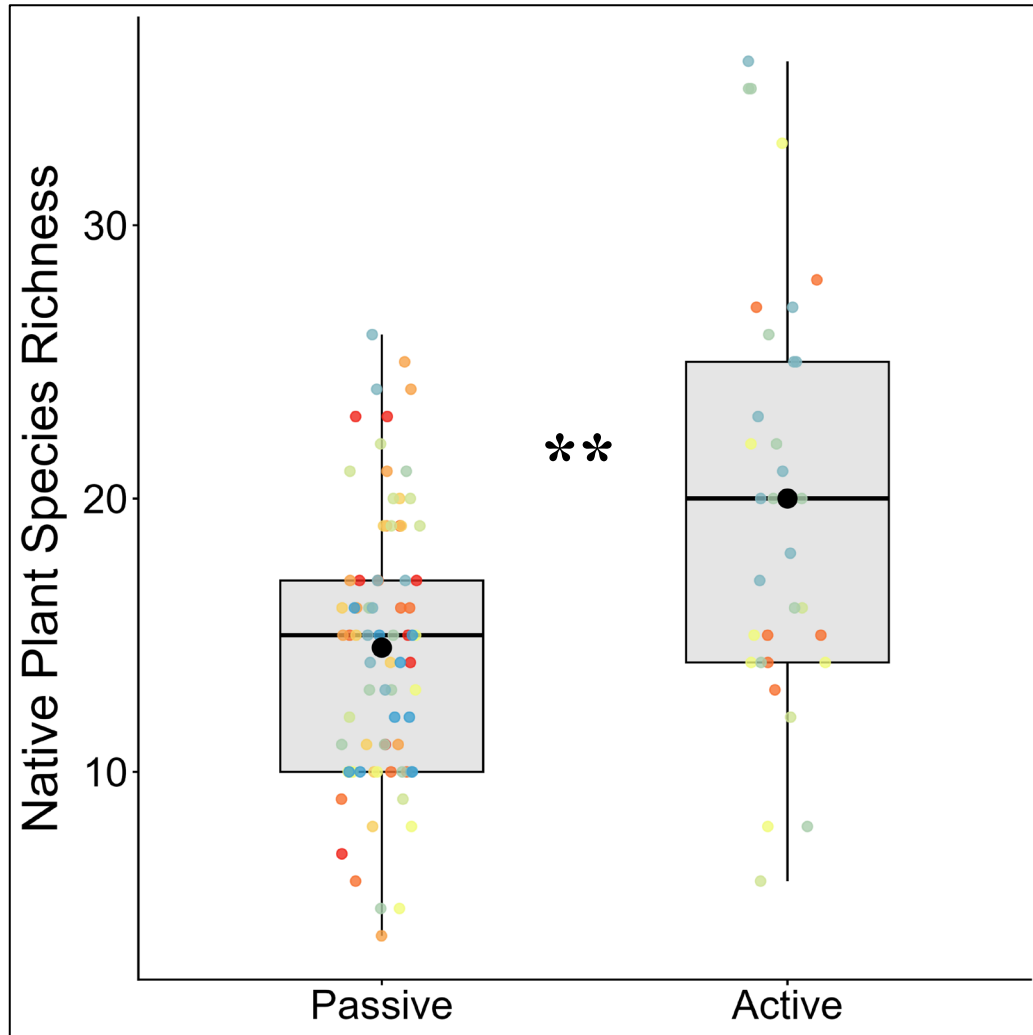


Tree Regeneration > 30-cm

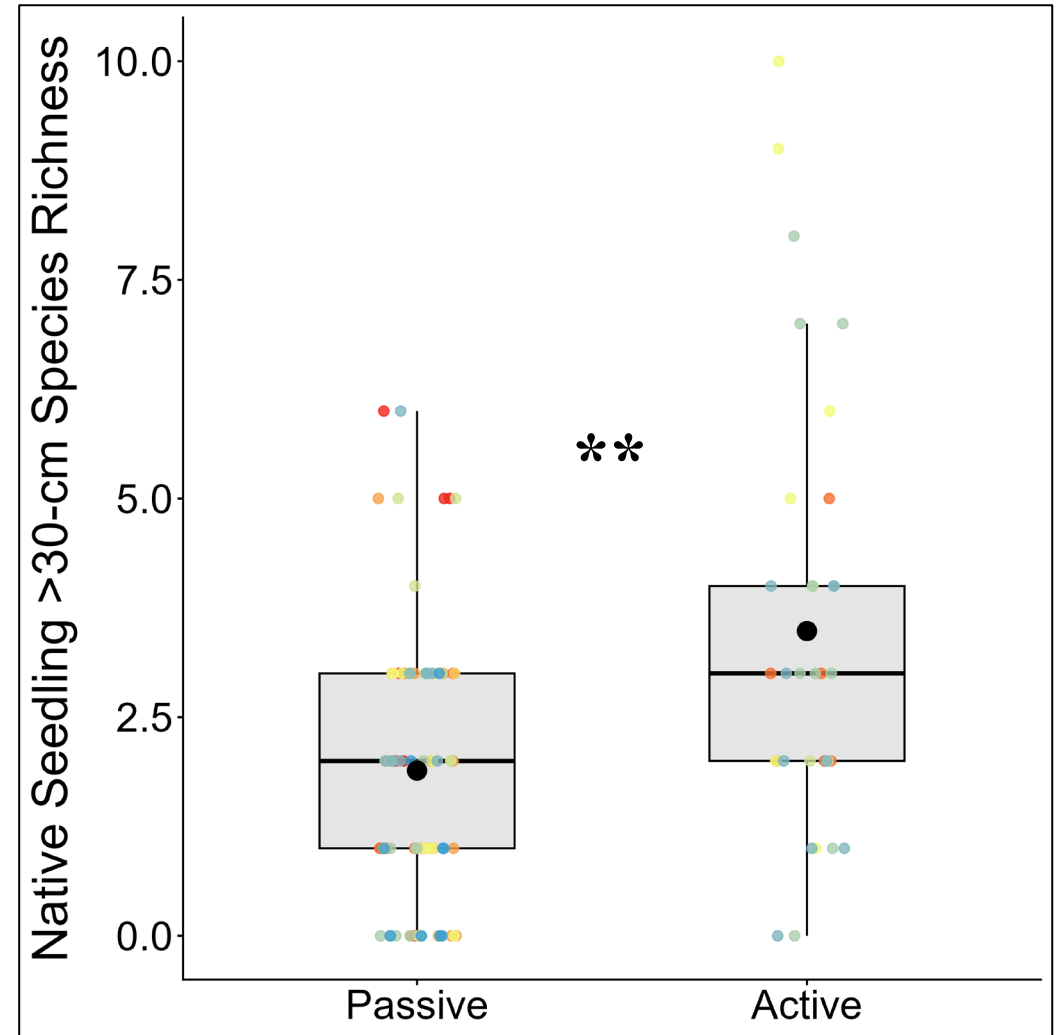


Preliminary Results: Passive vs. Active

Understory Plants

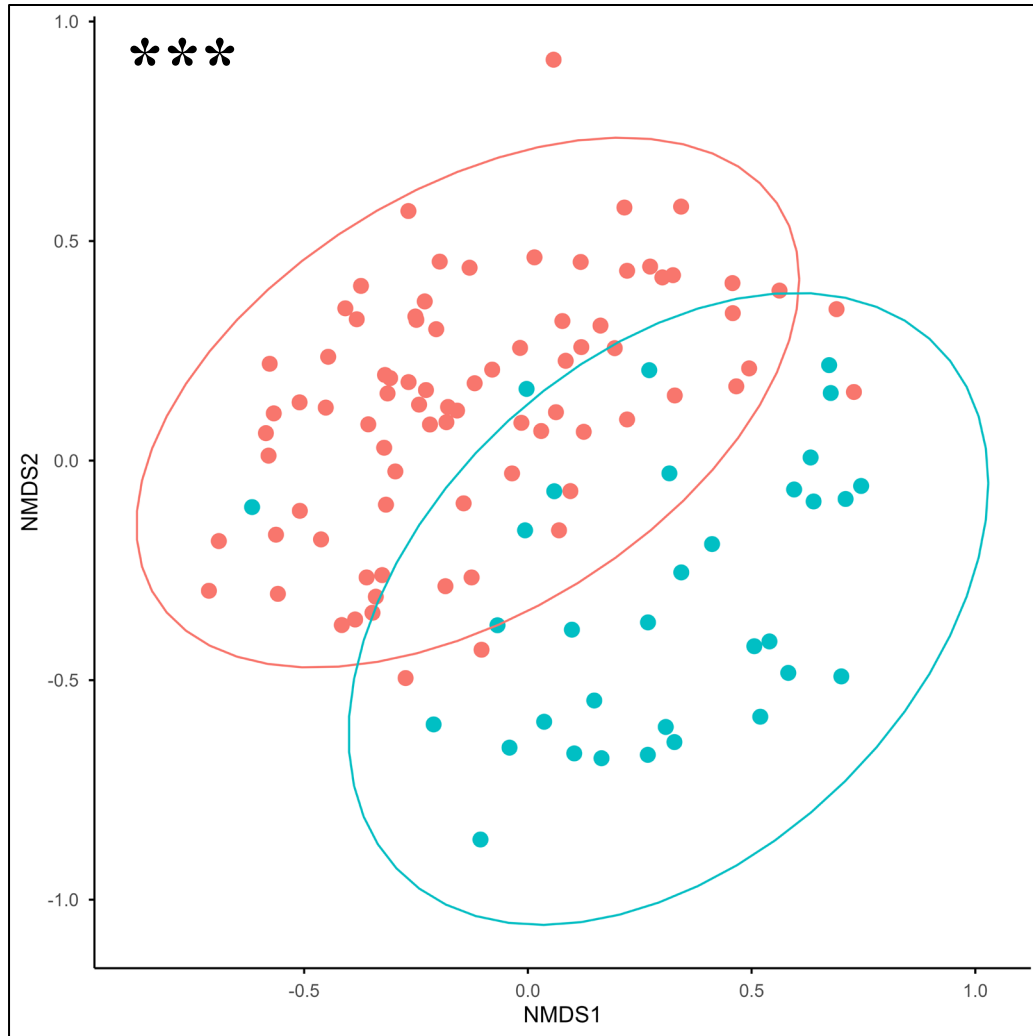


Tree Regeneration > 30-cm

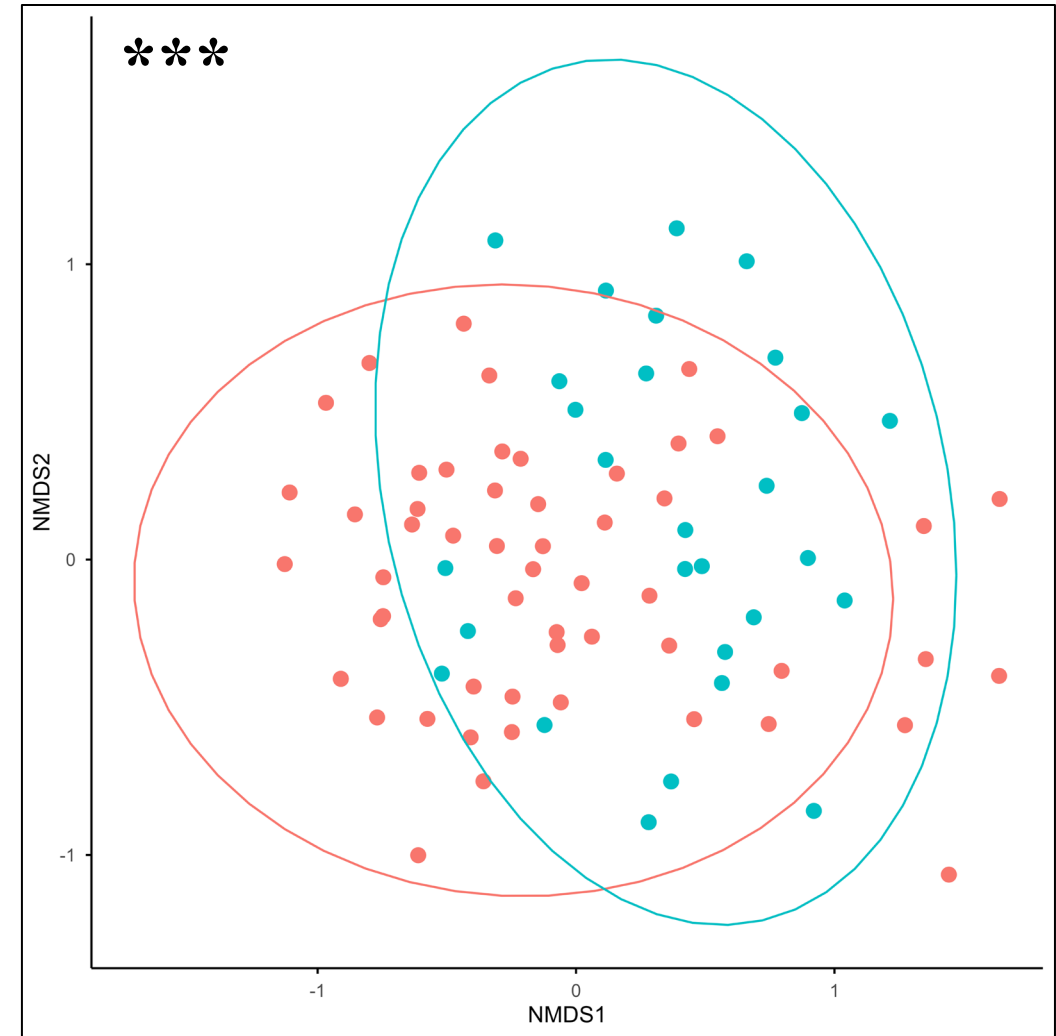


Preliminary Results: Passive vs. Active

Understory Plants



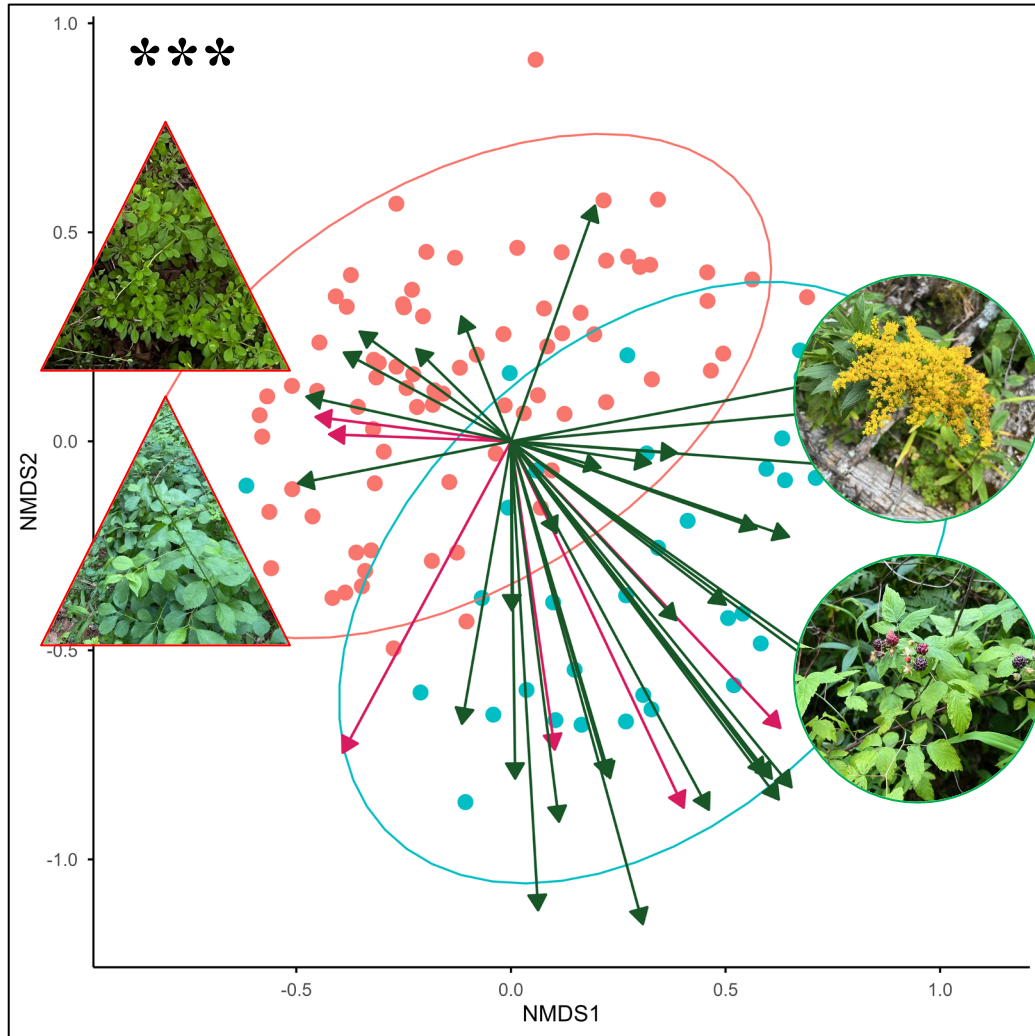
Tree Regeneration > 30-cm



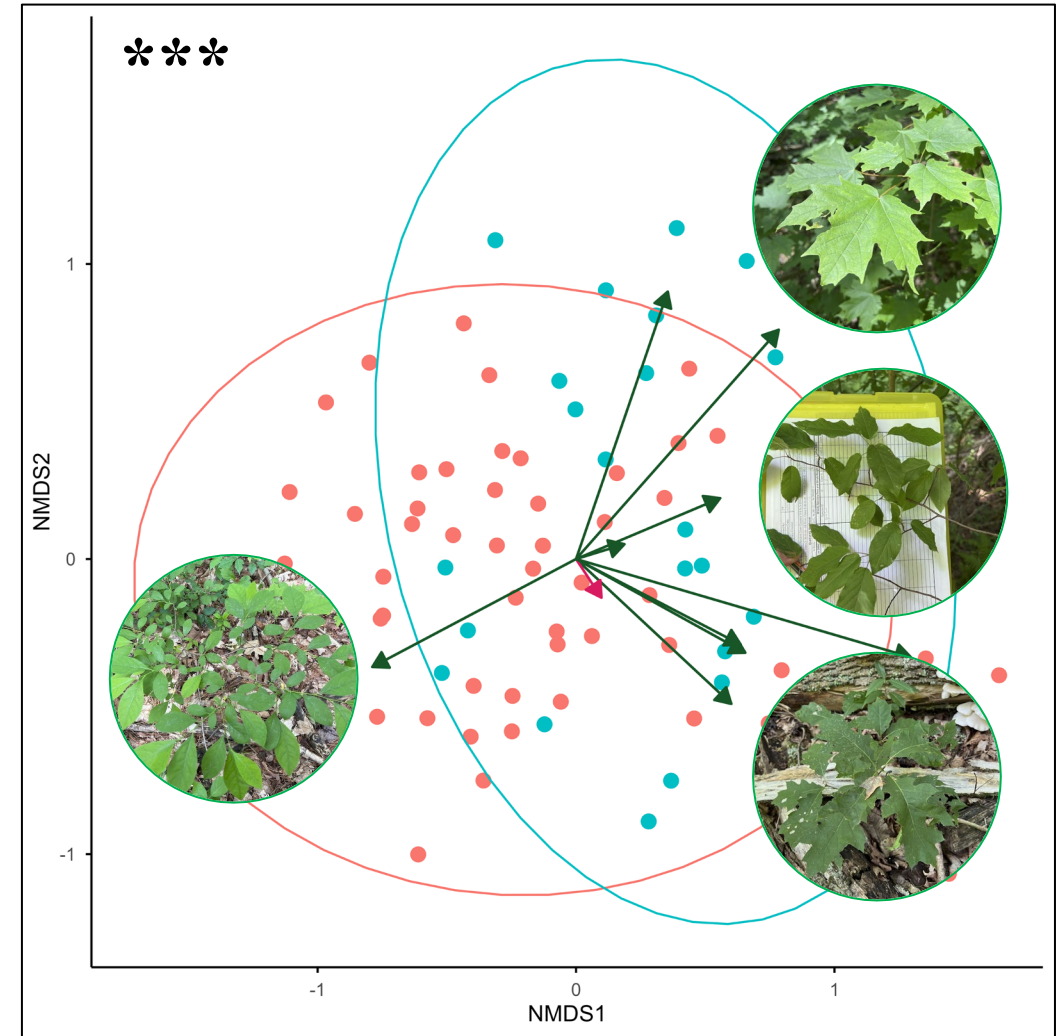
● Passive
● Active

Preliminary Results: Passive vs. Active

Understory Plants

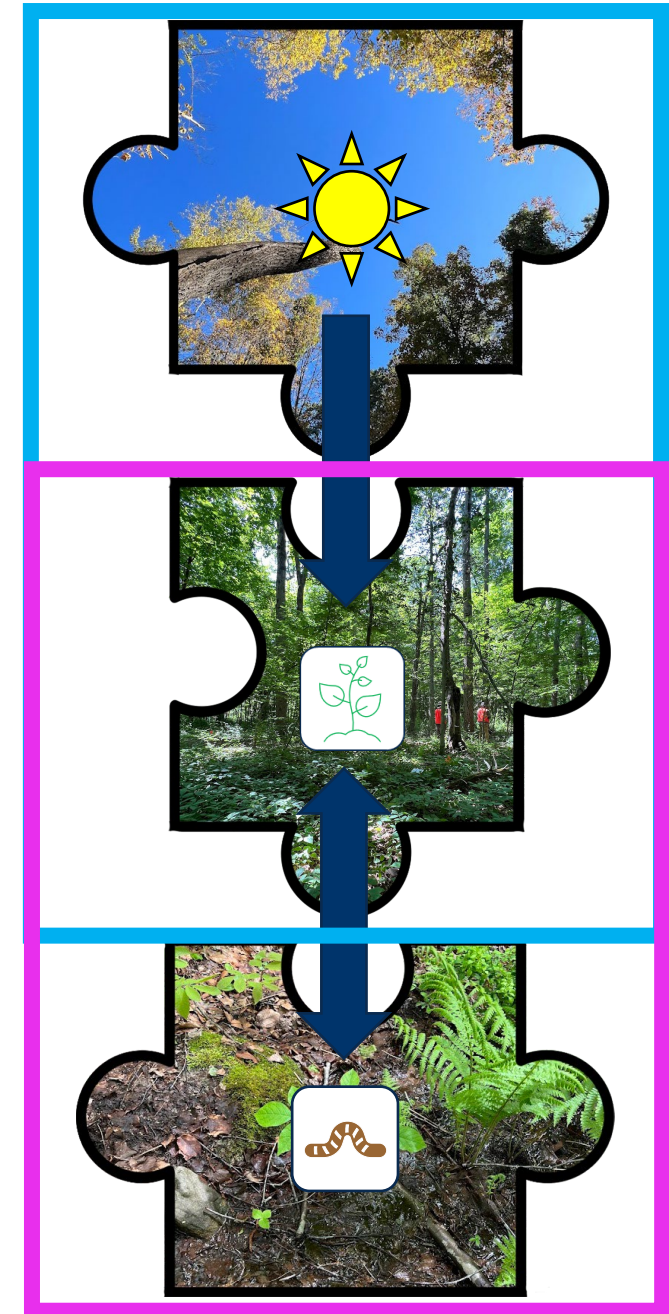


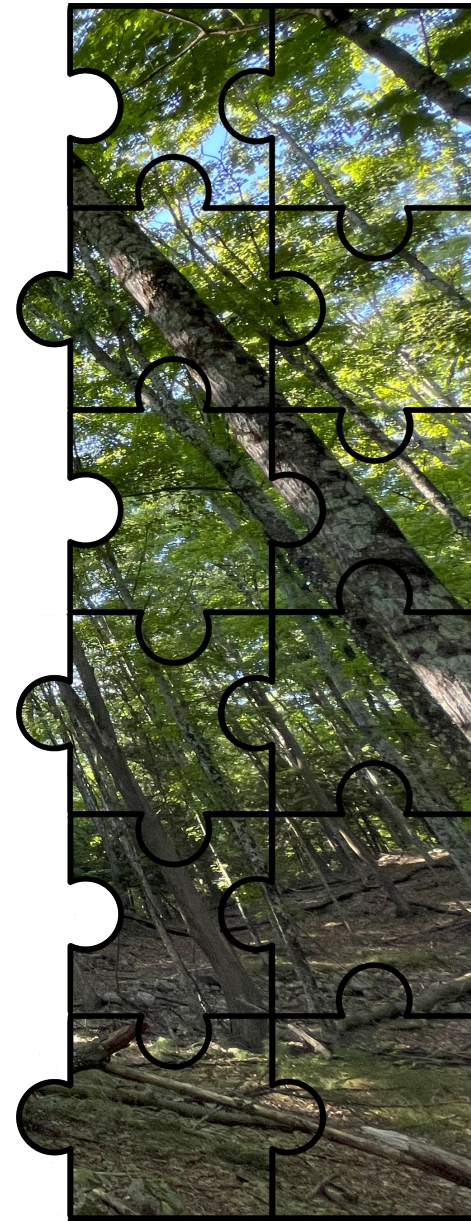
Tree Regeneration > 30-cm



Takeaways

- Greater EAB-induced ash mortality is disproportionately associated with non-native species
 - 1) **Light – Ash Mortality**
 - **+Non-Native Plant Cover**
 - **-Native Tree Seedlings**
 - 2) **Soil – Nitrogen Availability**
 - **+Non-Native Plant Cover**
 - **+Non-Native Tree Seedlings**
- Significant differences between Passive vs. Active
 - Higher abundance and diversity of native tree regeneration in actively managed sites
- Continued monitoring is needed





Thank you! Questions?

Jack E. Hatajik

Email: jack.hatajik@ct.gov



Acknowledgments:

Collaborators: Eli Ward, Claire Rutledge, Marlyse Duguid, Mark Bradford, Sara Kuebbing, and J.P. Barsky

Field assistants: J.P. Barsky, Xavier Murrell, Kaleb Diaz Alvarez, Ana DiMauro, Jose Ayala, Christian Filtreau

Foresters and land managers: Great Mountain Forest, Bethany Land Trust, Aspetuck Land Trust, CT Department of Energy and Environmental Protection, South Central CT Regional Water Authority, White Memorial Foundation, Inc., Aquarion Water Company, McLean Game Refuge, and Yale Forests for assistance in establishing field sites, especially Mike Zarfos, Kate Regan-Loomis, Rob Turnbull, Jamie Fisher, Mike Berry, Lukas Hyder, Will Hochholzer, Nate Piche, Dan Evans, Jerry Milne, Jeremy Clark, Connor Hogan, Casey Cordes, Josh Tracey, Nicole Smith, Joe Schnierlein, and Lou Bacchiocchi.

Funding: Yale Forests (Kohlberg-Donohoe Research Fellowship), Yale School of the Environment (Child's Family Research Fund and Armbrecht Edward C. Jr. Family Fund), USDA NIFA McIntire-Stennis Capacity Grant (project award no. CONH793), USDA Forest Service Forest Health Protection and Infrastructure Investment and Jobs Act

Special thanks to:



Dr. Eli Ward

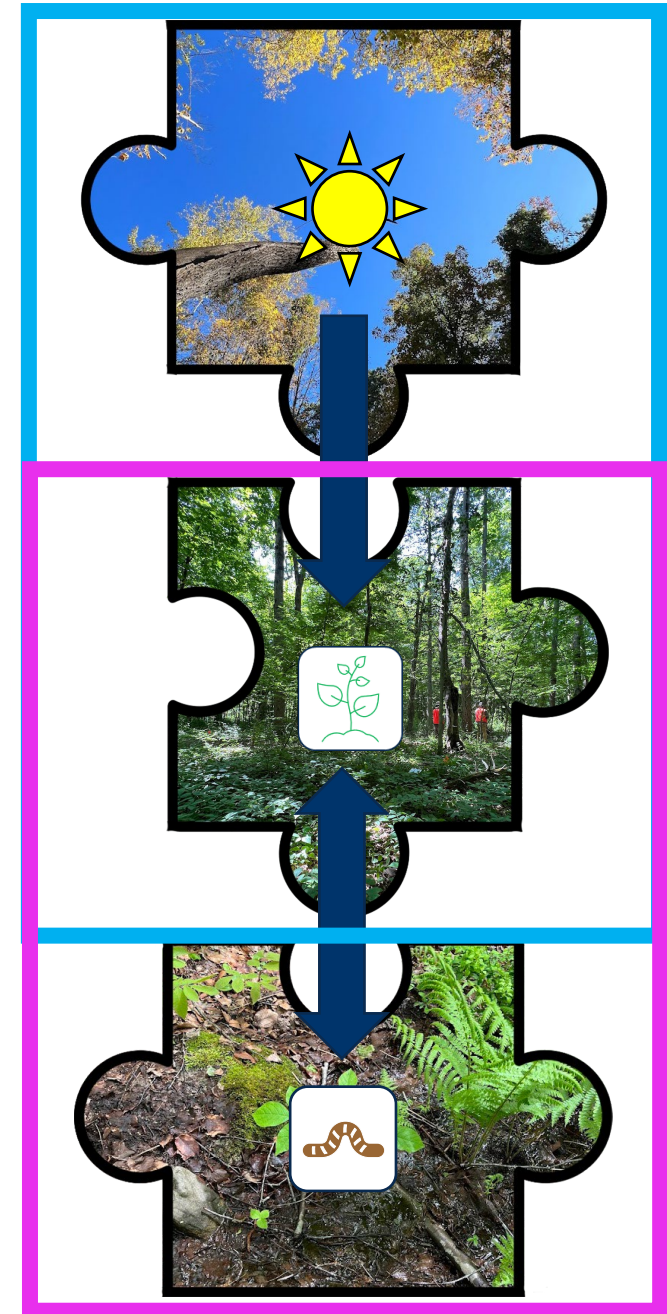


Dr. Claire Rutledge



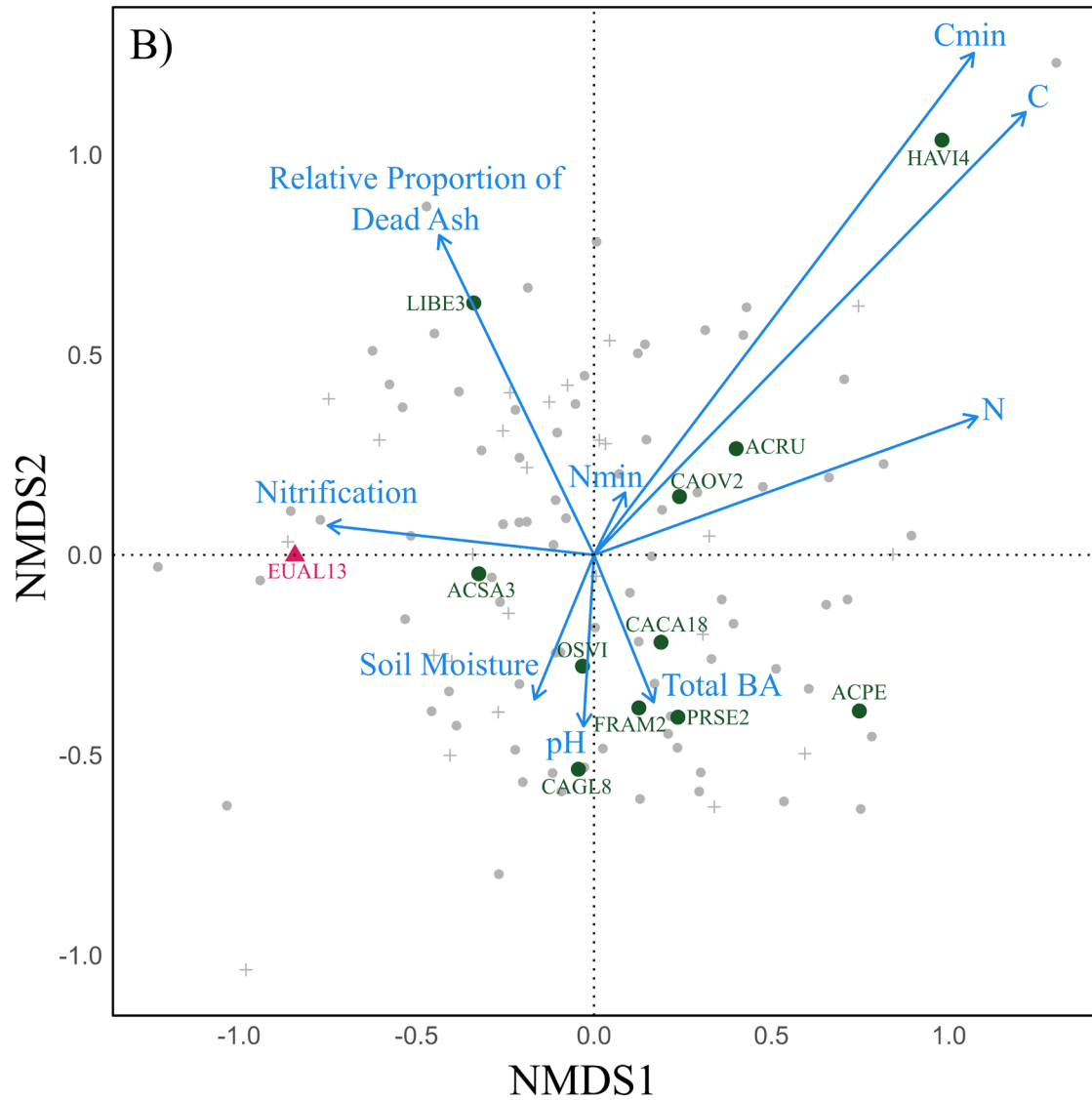
Takeaways

- Greater EAB-induced ash mortality is disproportionately associated with non-native species
 - 1) **Light – Ash Mortality**
 - **+Non-Native Plant Cover**
 - **-Native Tree Seedlings**
 - 2) **Soil – Nitrogen Availability**
 - **+Non-Native Plant Cover**
 - **+Non-Native Tree Seedlings**
- Significant differences between Passive vs. Active
 - Higher abundance and diversity of native tree regeneration in actively managed sites
- Continued monitoring is needed



Passively Managed Site Table

Site, Ownership + Actively Managed PAIR (if applicable)	Year of First EAB Detection
Mendell's Folly, Bethany Land Trust	2012
Van Epps Preserve, Bethany Land Trust	2012
Naugatuck State Forest, CT DEEP	2012
Lake Chamberlain, South Central CT Regional Water Authority	2013
Sleeping Giant State Park, CT DEEP	2013
Lake Gaillard, South Central CT Regional Water Authority	2013
Chestnut Hill Road, White Memorial Foundation Inc. + PAIR	2014
East Shore Road, White Memorial Foundation Inc. + PAIR	2014
Wheeler Hill, White Memorial Foundation Inc.	2014
Centennial Watershed State Forest – Barn Hill Road, CT DEEP & Aquarion Water Company	2015
Mattatuck State Forest, CT DEEP	2015
Salmon River State Forest, CT DEEP	2015
Centennial Watershed State Forest – Andrews Road, CT DEEP & Aquarion Water Company	2016
Centennial Watershed State Forest – Greenbush Road, CT DEEP & Aquarion Water Company + PAIR	2016
Natchaug State Forest – Kingsbury Road, CT DEEP	2016
Housatonic State Forest – Sharon Mountain Block, CT DEEP + PAIR	2017
Trout Brook Valley Preserve, Aspetuck Land Trust	2017
Housatonic State Forest – Cream Hill Block, CT DEEP + PAIR	2017
Natchaug State Forest – Perry Hill Road, CT DEEP	2018
Nathan Hale State Forest, CT DEEP	2018
McLean Game Refuge, McLean Game Refuge Inc.	2018
Housatonic State Forest/Centennial Watershed State Forest – Wangum Lake, CT DEEP and Aquarion Water Company + PAIR	2019
Haystack Mountain State Park, CT DEEP + PAIR	2019
Dennis Hill State Park, CT DEEP + PAIR	2019
Morse House – Yale-Myers Forest, Yale University	2020
Christmas Tree Farm – Yale-Myers Forest, Yale University	2020
Laboratory – Yale-Myers Forest, Yale University	2020



Hatajik et al. In review