

Tree Rings and Mud

An (ongoing) Collaborative Reconstruction of Historical fire regimes in Northern New Hampshire



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What is the future of NE fire?

- What was the fire regime in NE pre-contact?
- What ***will*** the fire regime look like in the future?
- What ***should*** it look like?
- Can we look to the past for context and guidance?

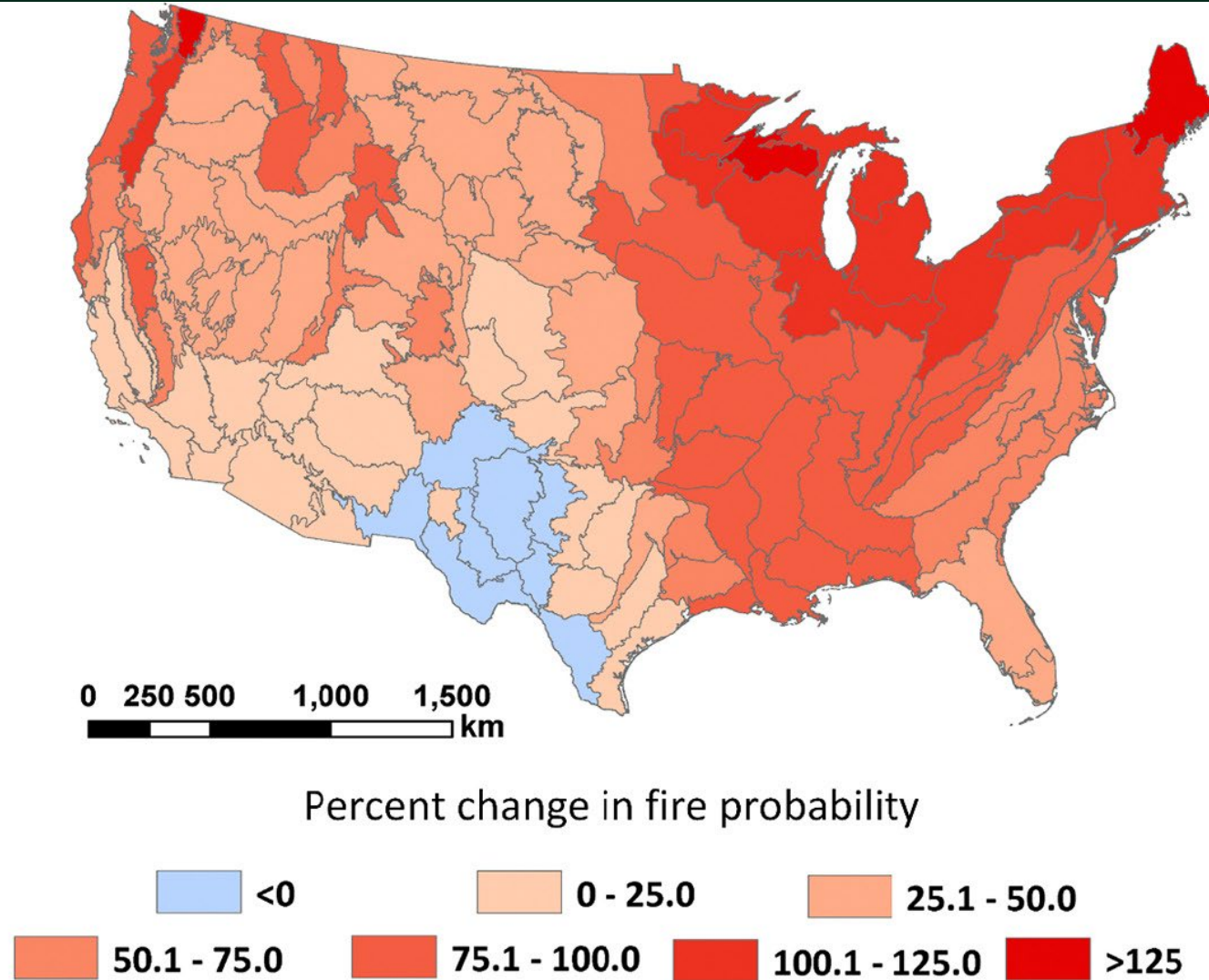


VS



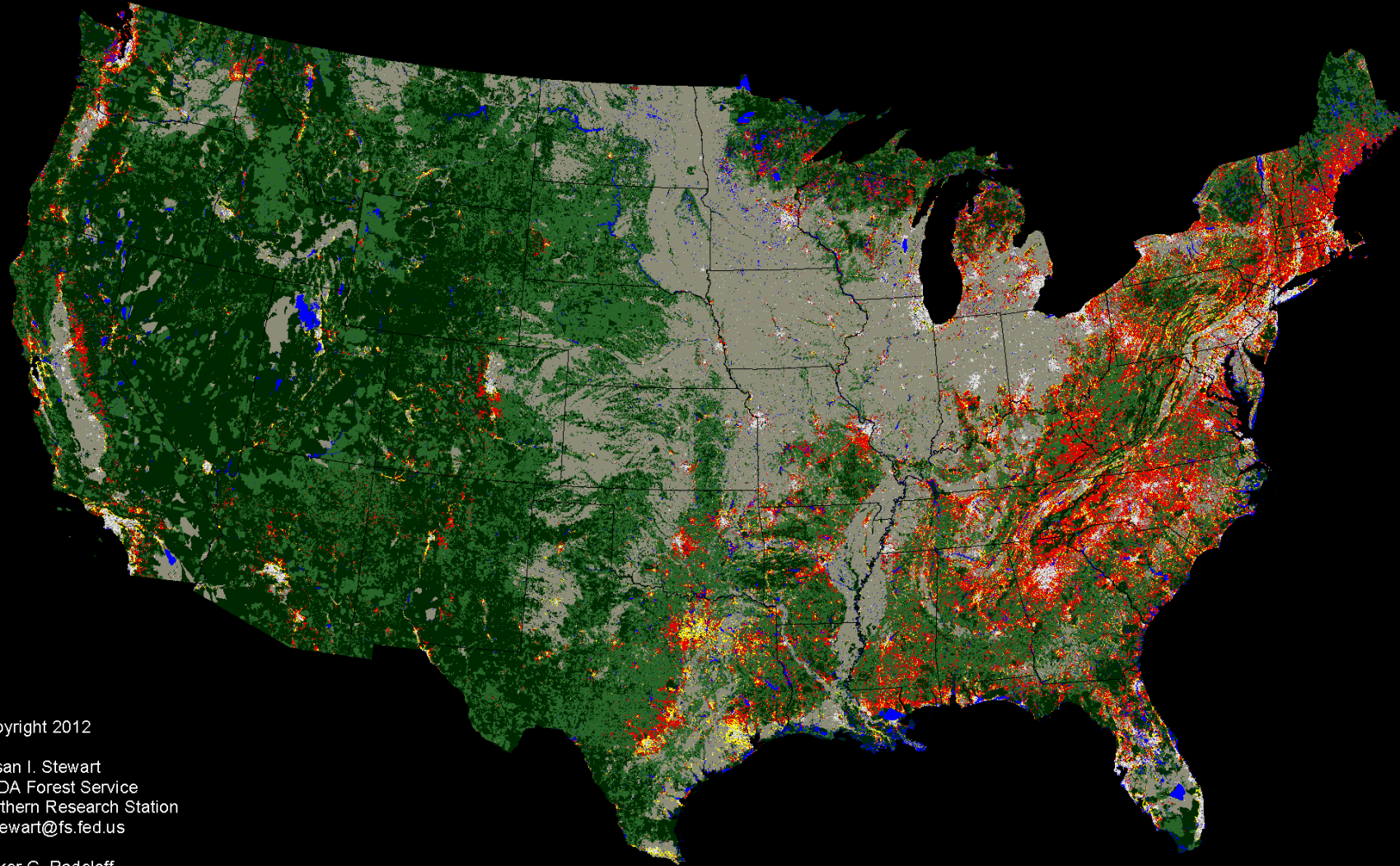
Estimated fire frequency (PC2FM)

Projected Future Fire Probability



Projected changes (%) in annual fire probability from baseline (1971-2000) to late century (2070-2099) based on Greenhouse Gas Emissions Scenario RCP 8.5.

2010 Wildland Urban Interface



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WUI 2010 based on the 2010 Census,
2006 National Land Cover Database (NLCD),
and the Protected Areas Database version 1.1

WUI

- Interface
- Intermix

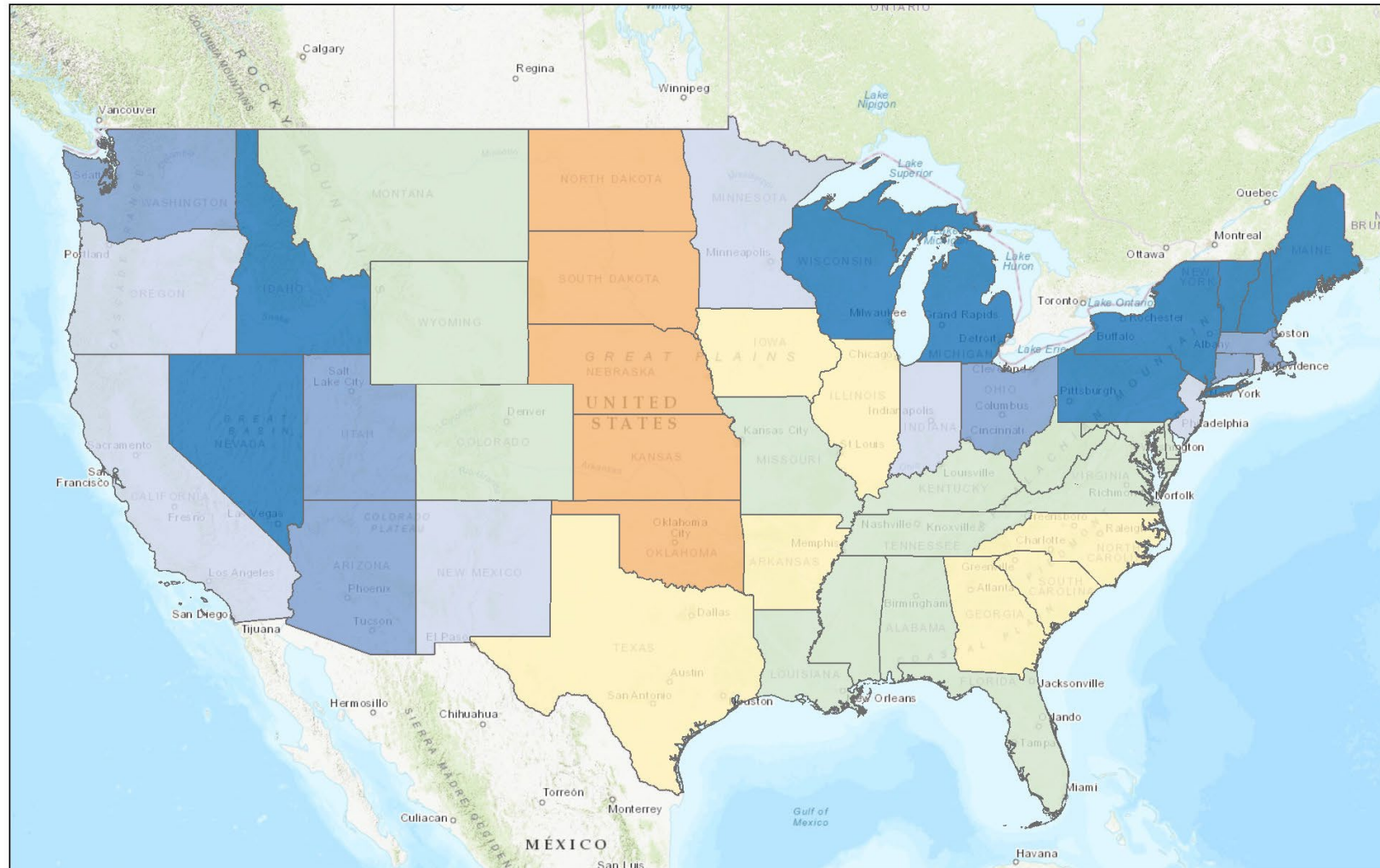
Non-WUI Vegetated

- No Housing
- Very Low Density Housing

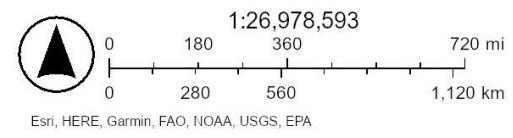
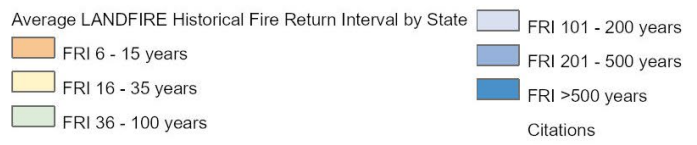
Non-Vegetated or Agriculture

- Medium and High Density Housing
- Low and Very Low Housing Density
- Water

Historical Fire Return Interval

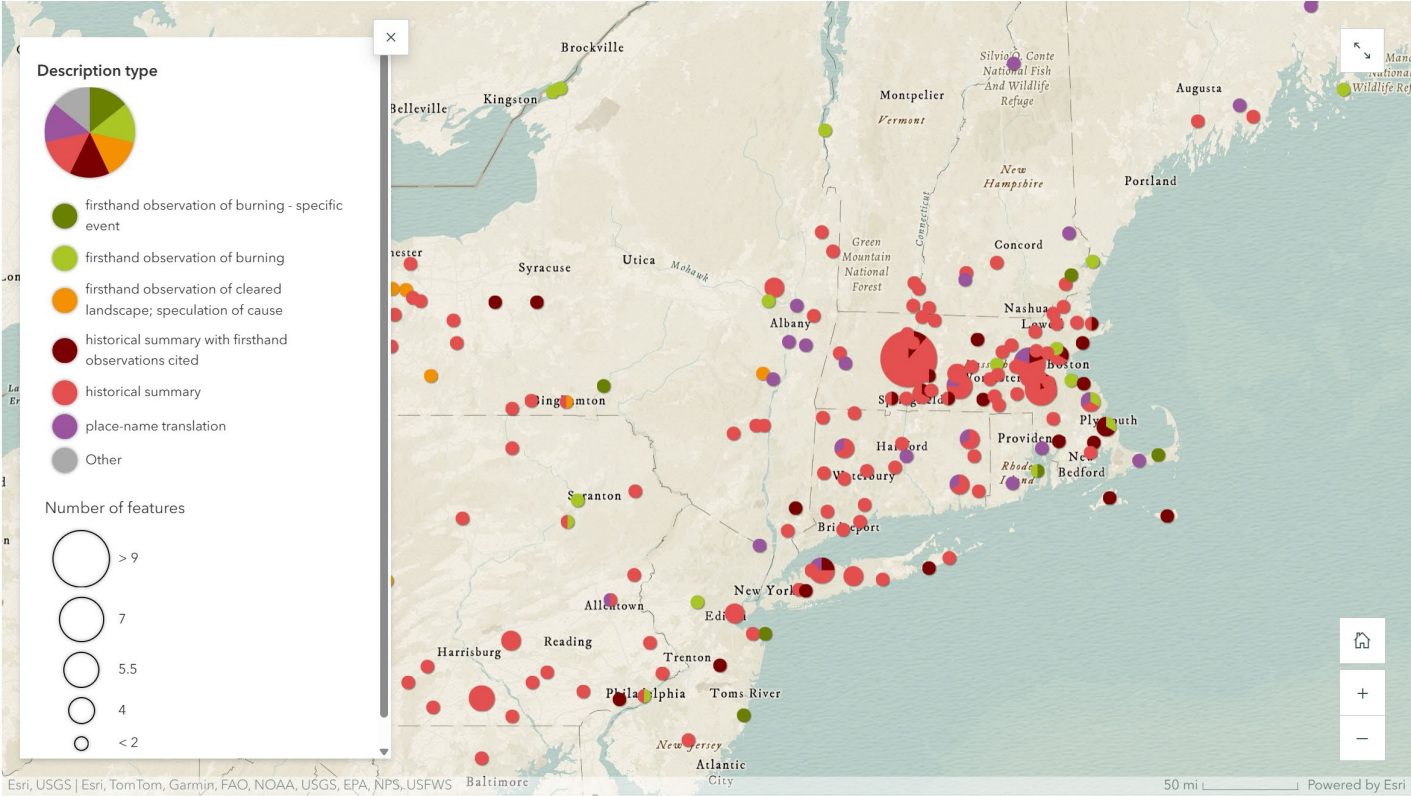


11/15/2025



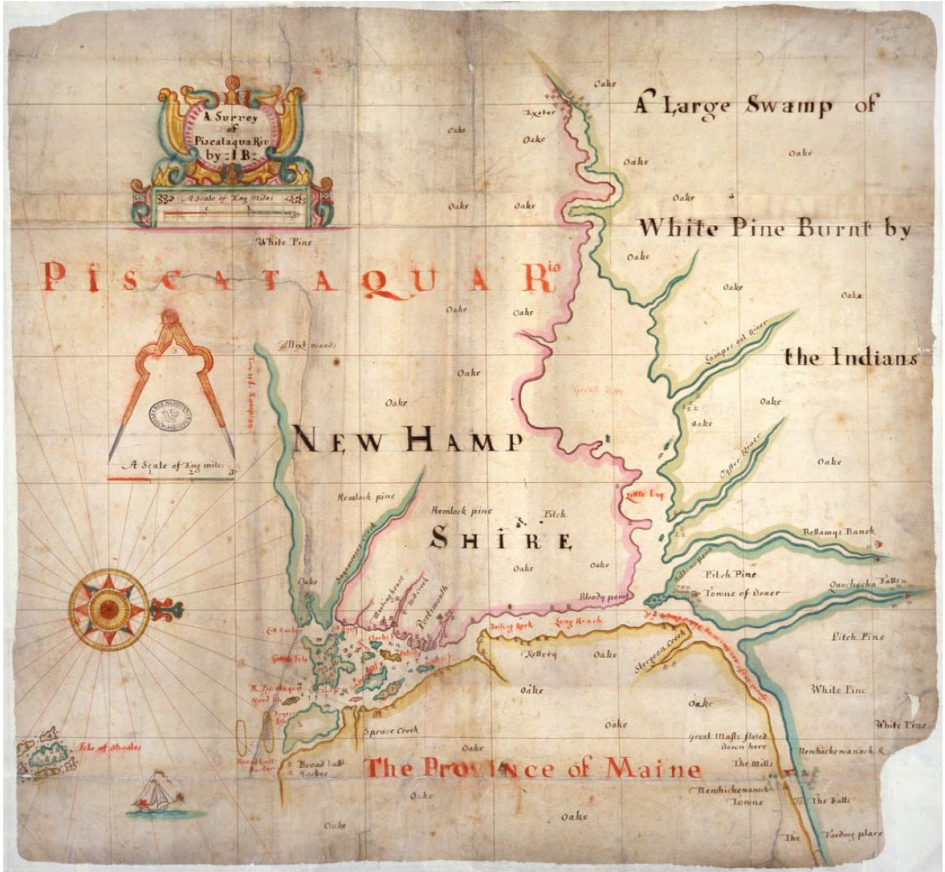
Widespread Indigenous Fire Management

Descriptions of Native burning



Tulowiecki 2024

PISCATAQUA



Map © The National Archives of the UK: ref. CO 700/New Hampshire7 - Survey of the Piscataqua River c.1700

Project Objectives and Outcome

Objective

Expand and combine tree-ring and sedimentary charcoal records to establish fire histories from the Northern Forest landscape prior to and throughout European colonization.

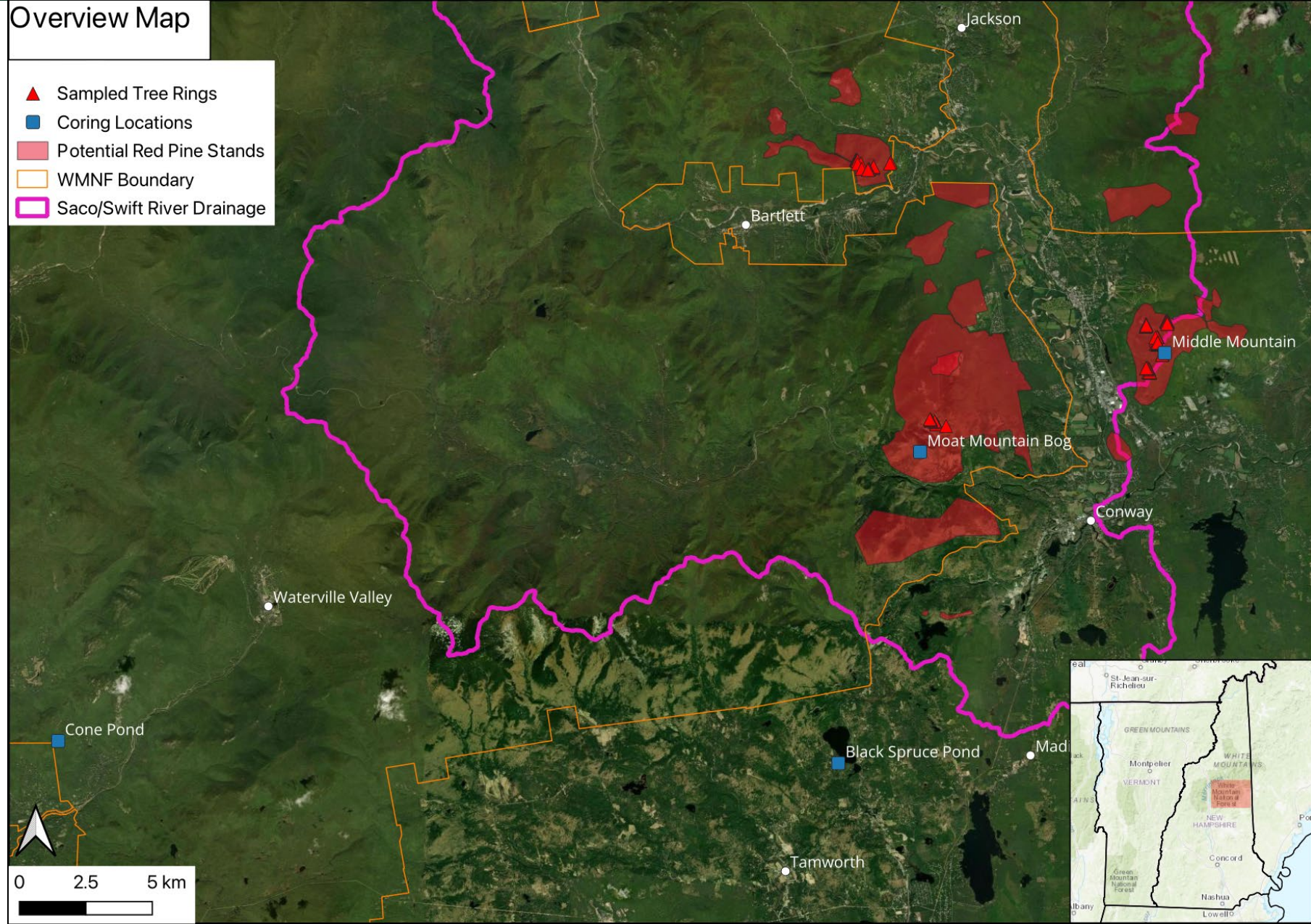
Outcome

These data will be disseminated to the relevant agencies and stakeholder groups, including the Indigenous community, to guide development of evidence-based forest management practices with respect to fire

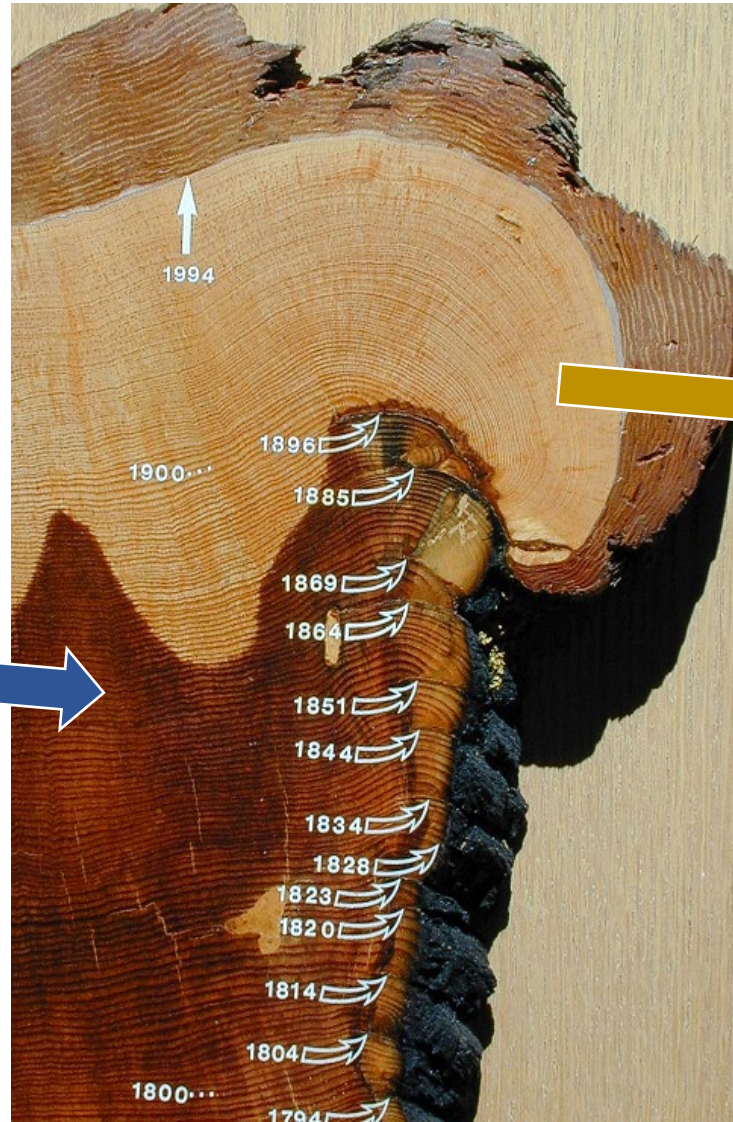
Study Area overview

Overview Map

- ▲ Sampled Tree Rings
- Coring Locations
- Potential Red Pine Stands
- WMNF Boundary
- Saco/Swift River Drainage



Methods – Tree-ring fire scars





Red pine, Green Hills Preserve
North Conway, NH



White pine, Lyme Hill
Lyme, NH

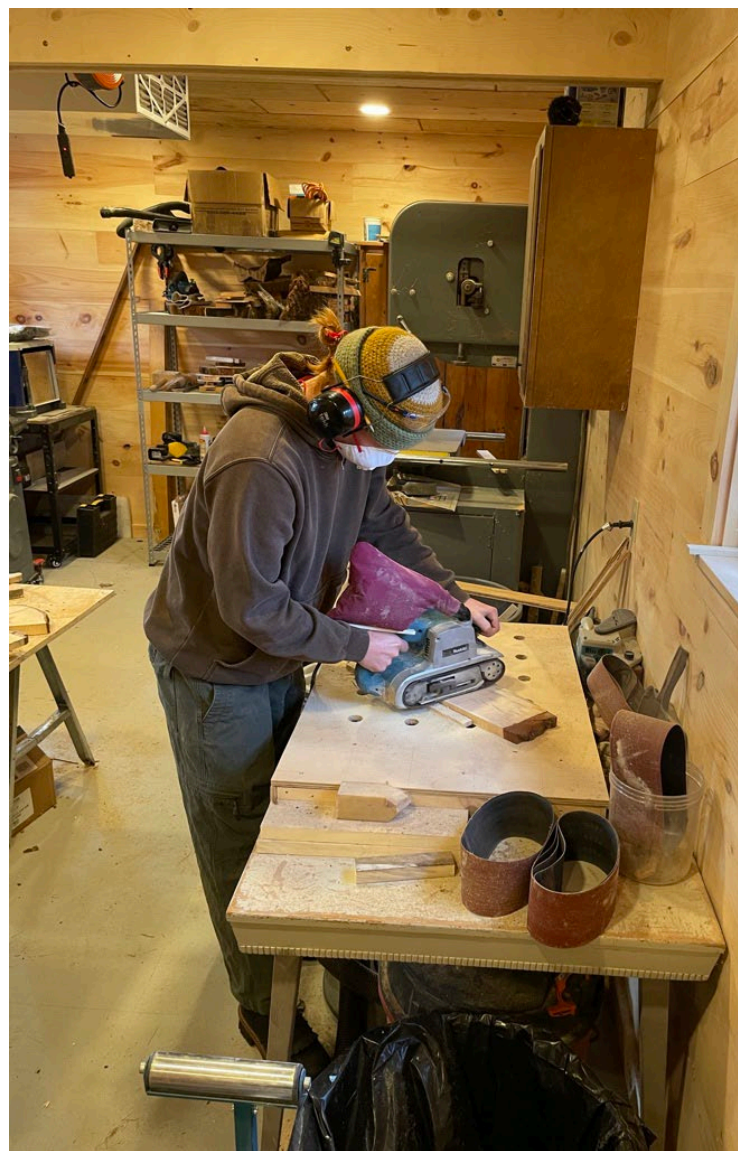


Red pine, Mount Stanton
Bartlett, NH

Tree-ring Fire Scars

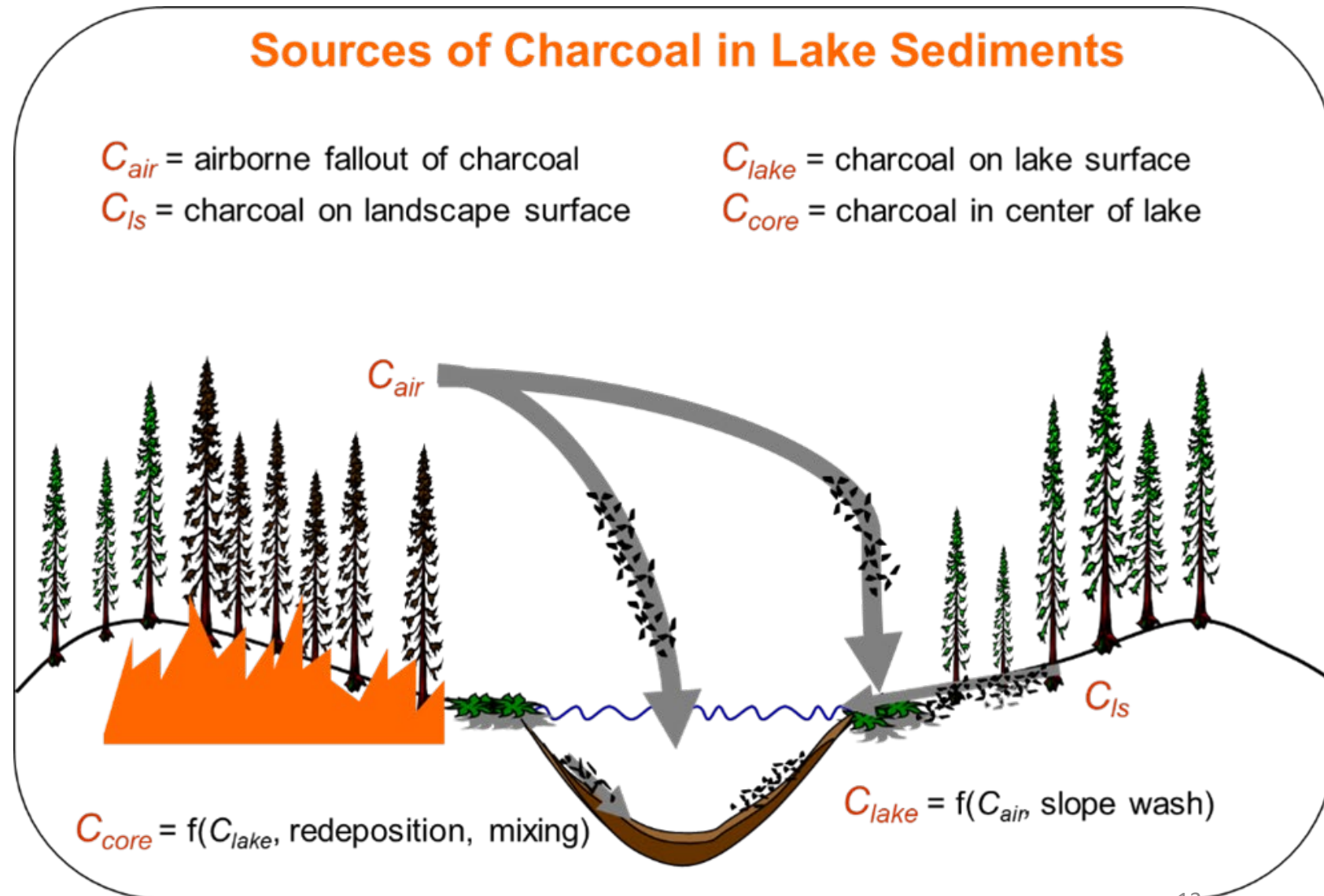


- Collections – increment bores and quarters
- Dead and living trees
- Preparation and analysis by PSU student A. Gifford



Methods – Lake sediment charcoal

- Lakes and bogs act as natural archives of charcoal
- Well dated, high-resolution cores can provide a picture of fire occurrence, frequency, character, and trends from the surrounding landscape
- **not without its complications*

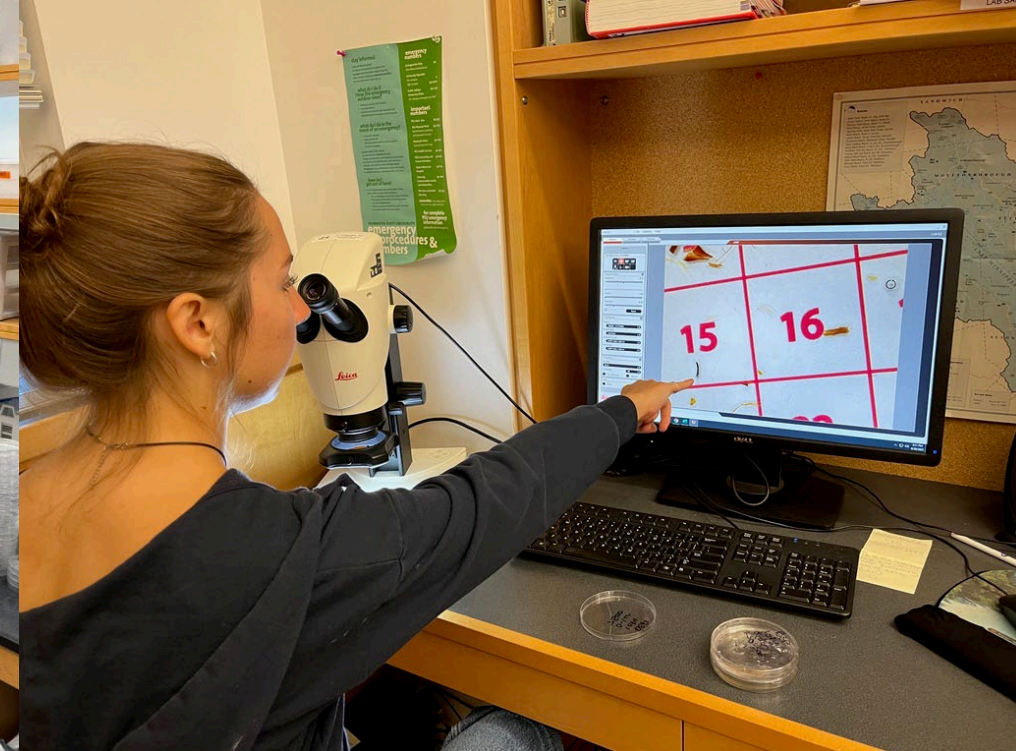


Methods – Lake sediment charcoal



Students involvement

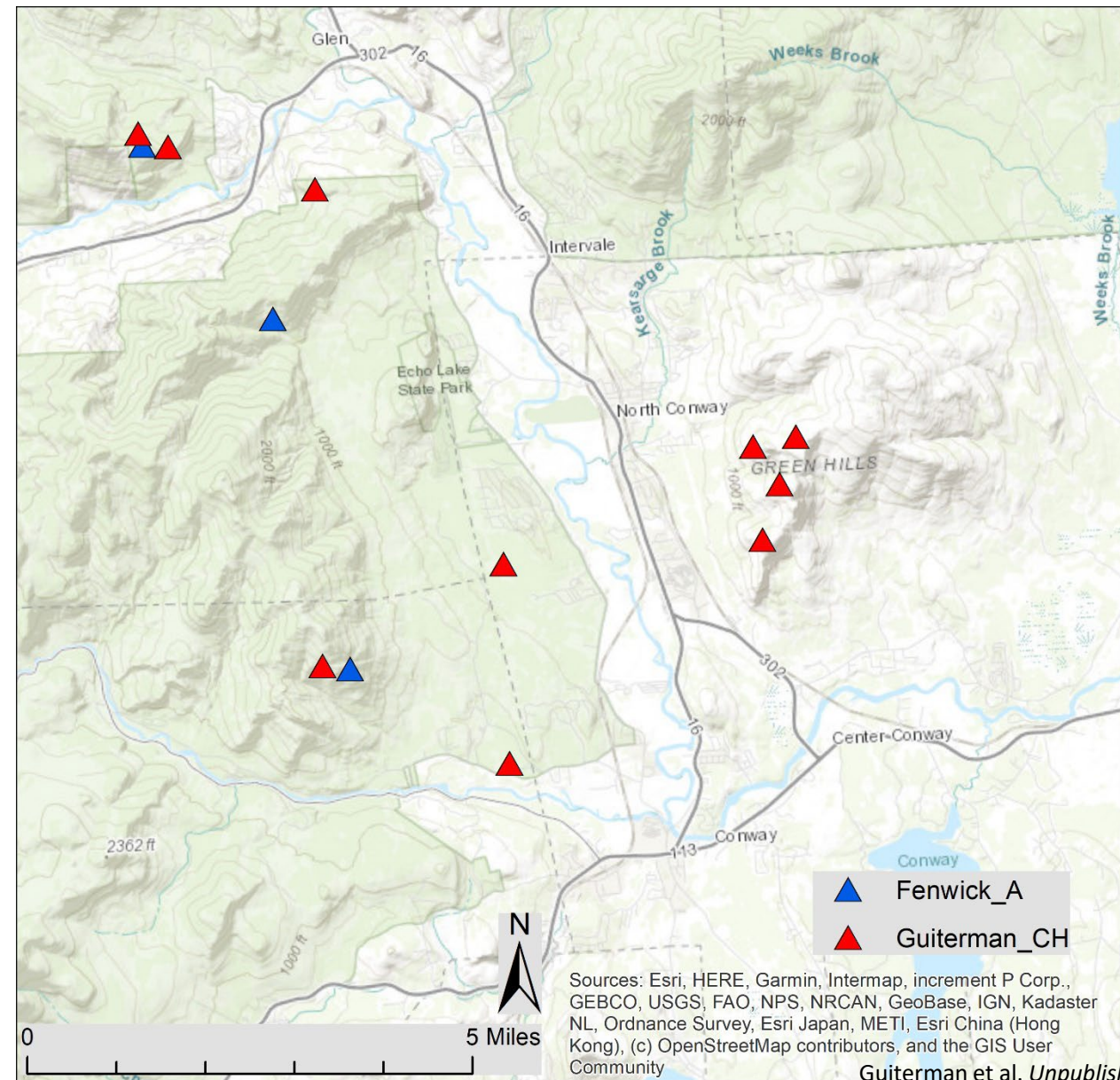
- 6+ students involved in various aspects of the sediment charcoal collection and analysis



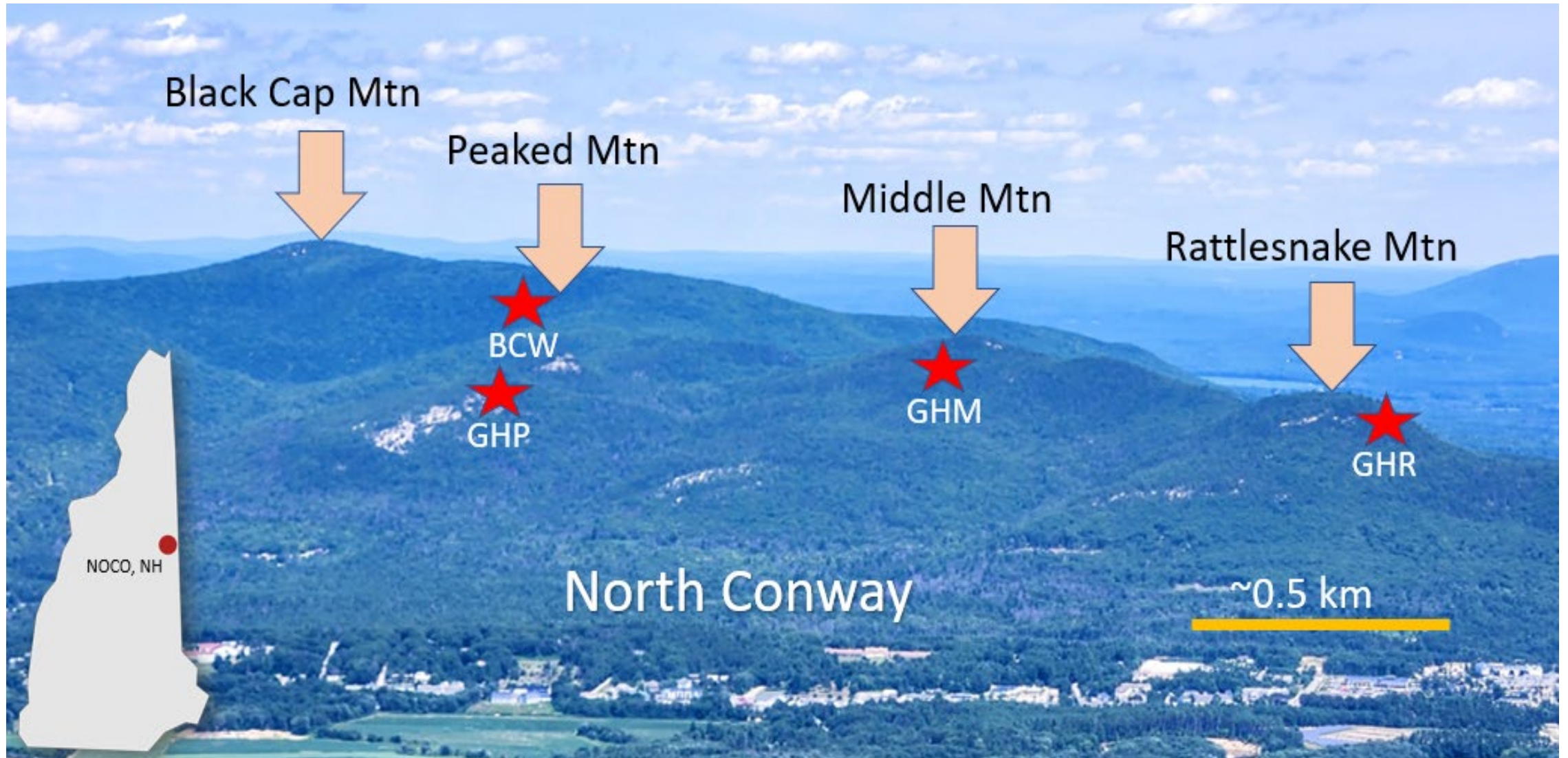
Results thus far – Tree-ring fire scars

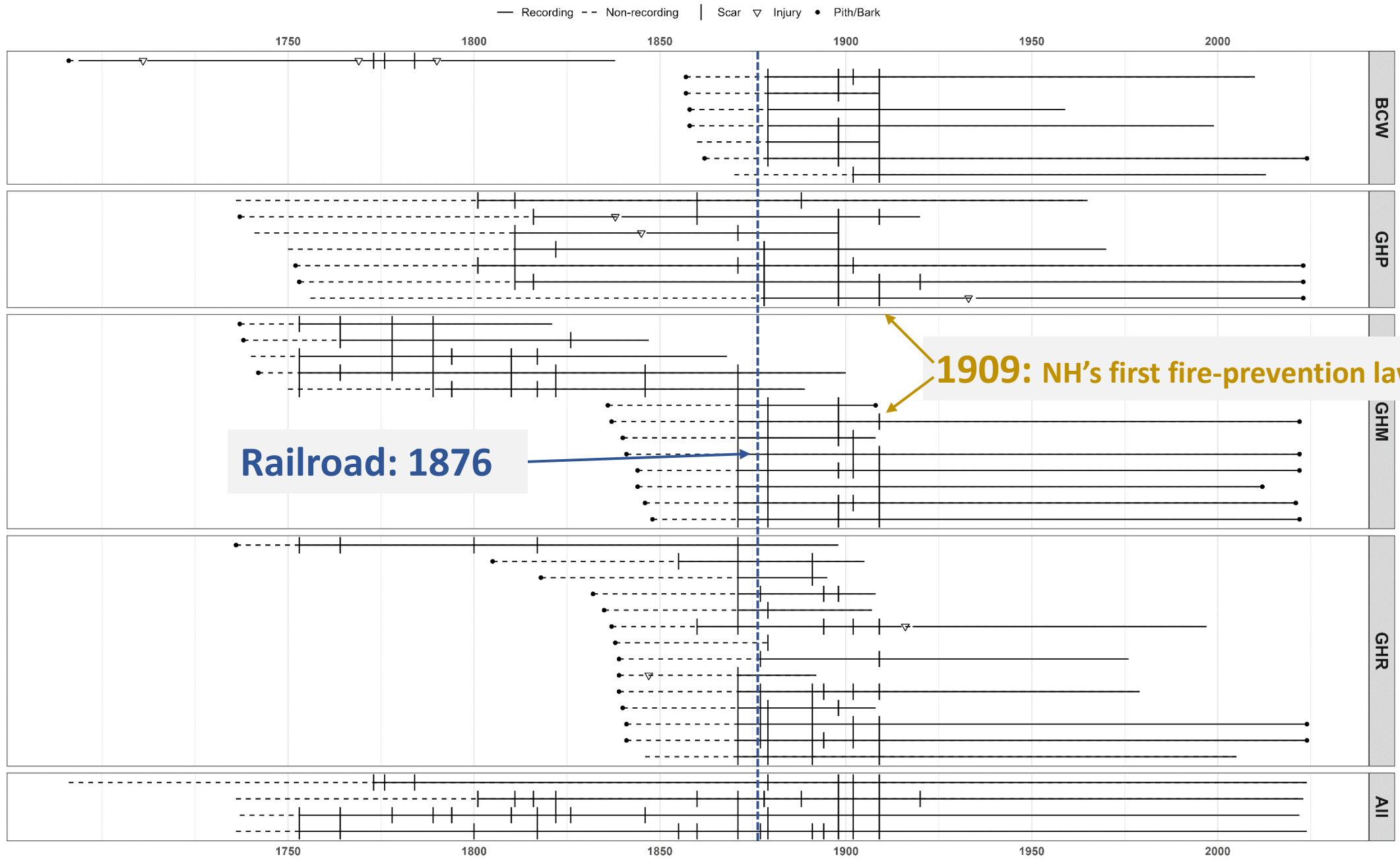


- >10 red pine stands sampled
- Within and beyond the Saco/Swift River catchment

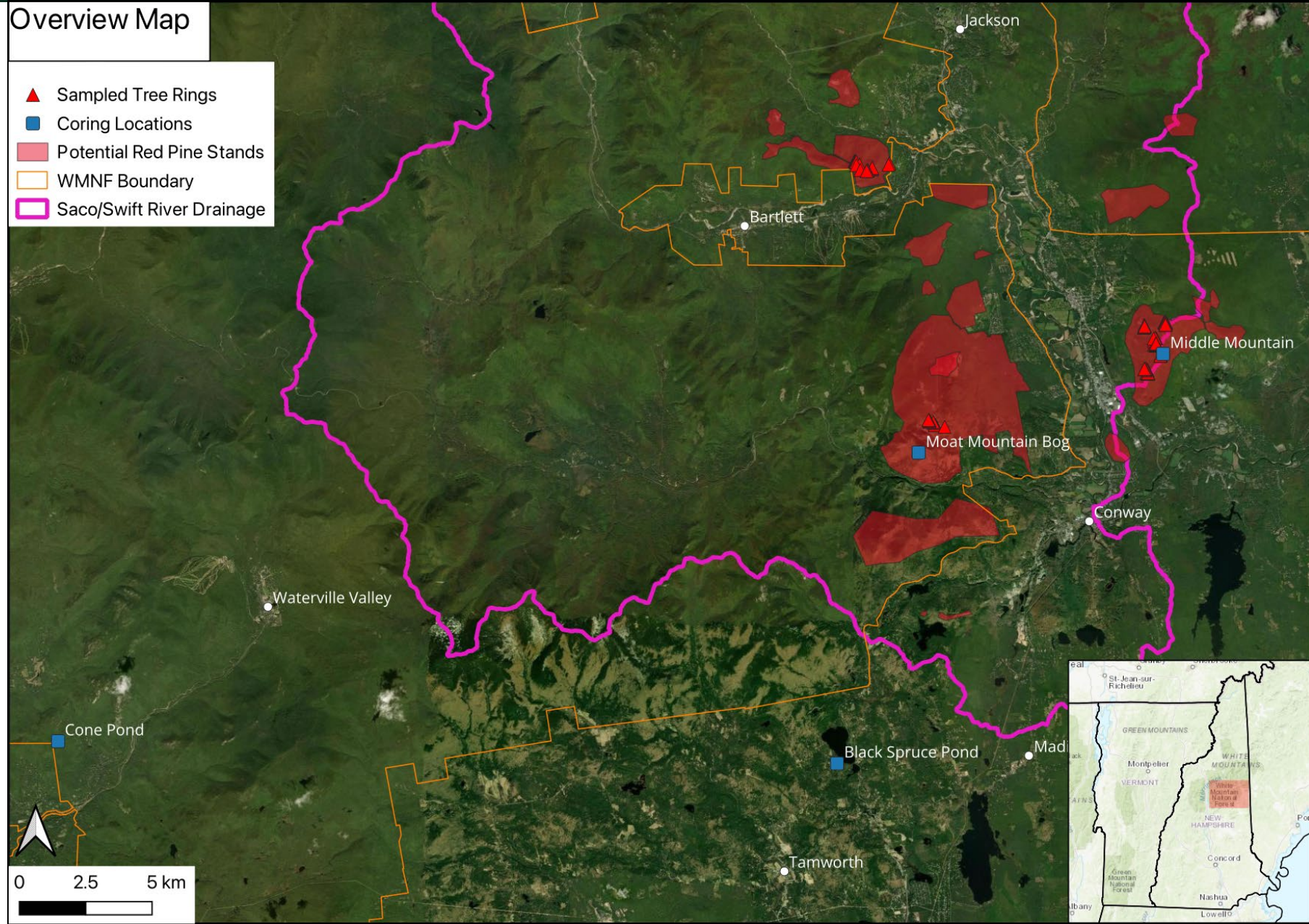


The Nature Conservancy's Green Hills Preserve



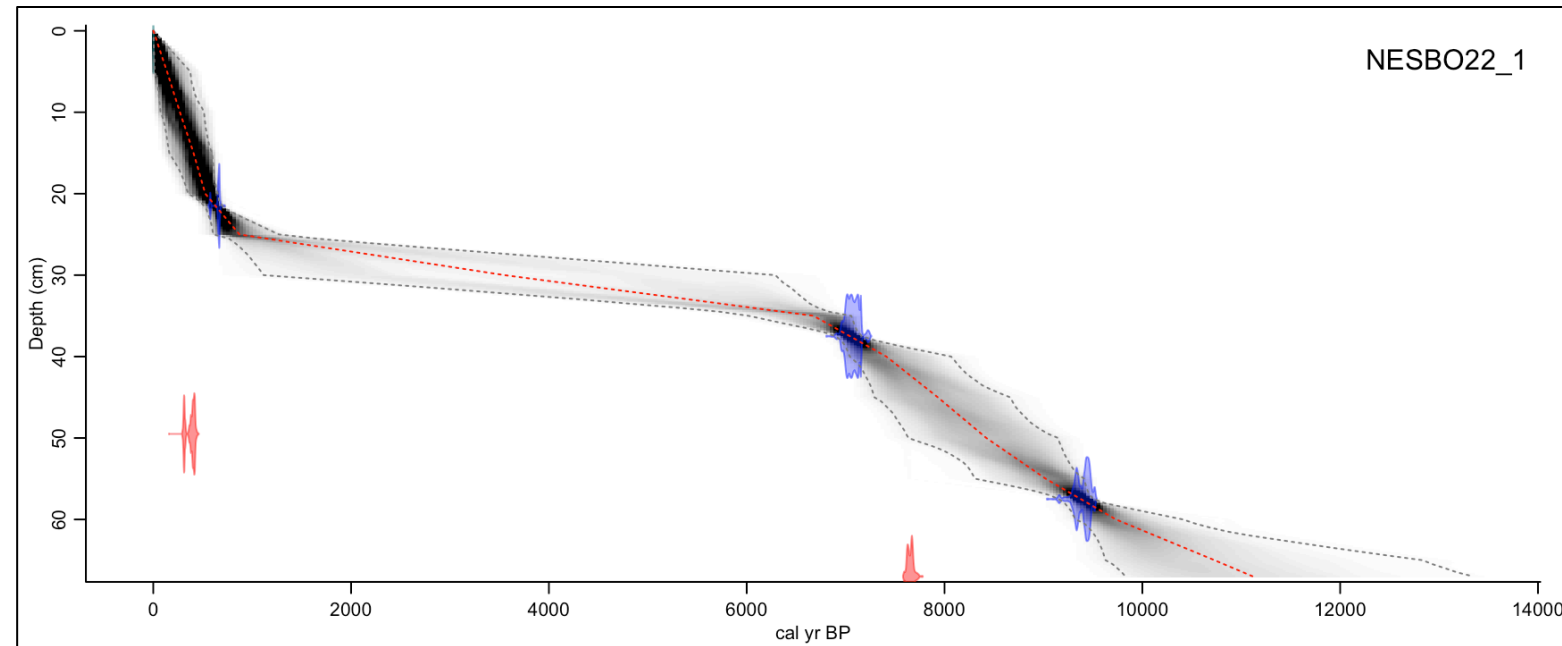
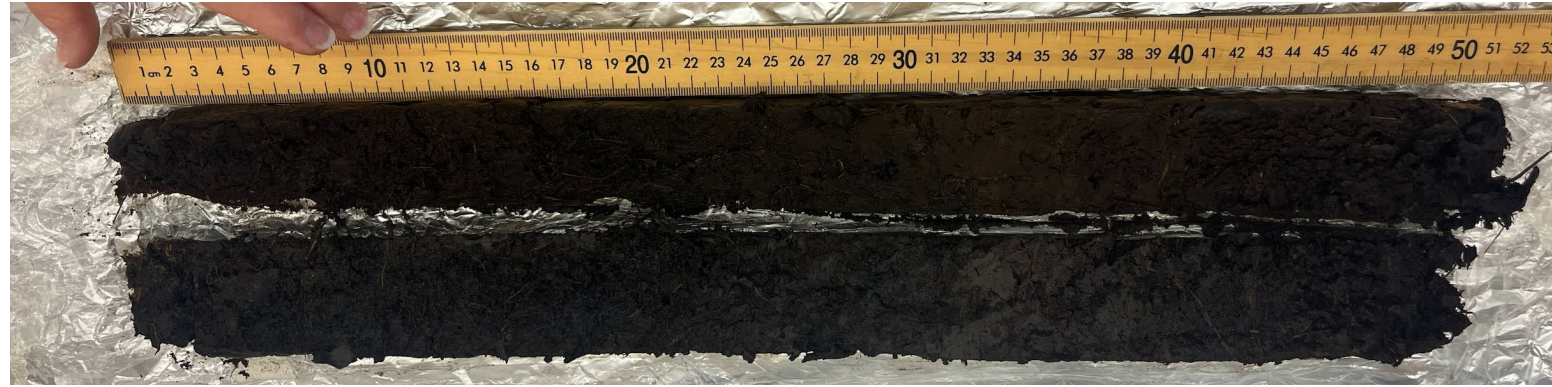


Results thus far – Lake sediment charcoal

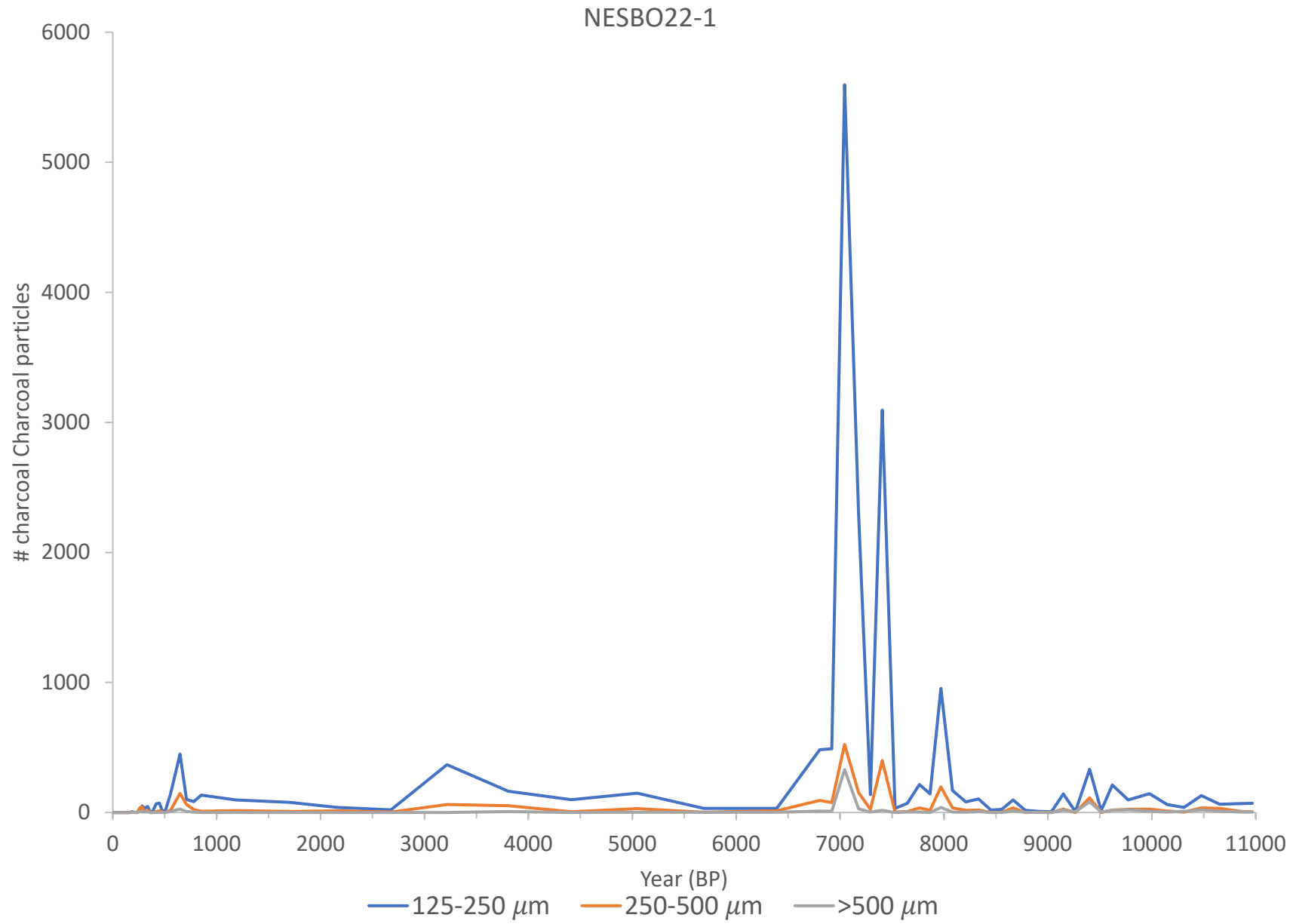


Moat Mountain, Albany, NH

- Preliminary core taken by J. Neely and others
- ~67cm
- Basal age of ~10ka*

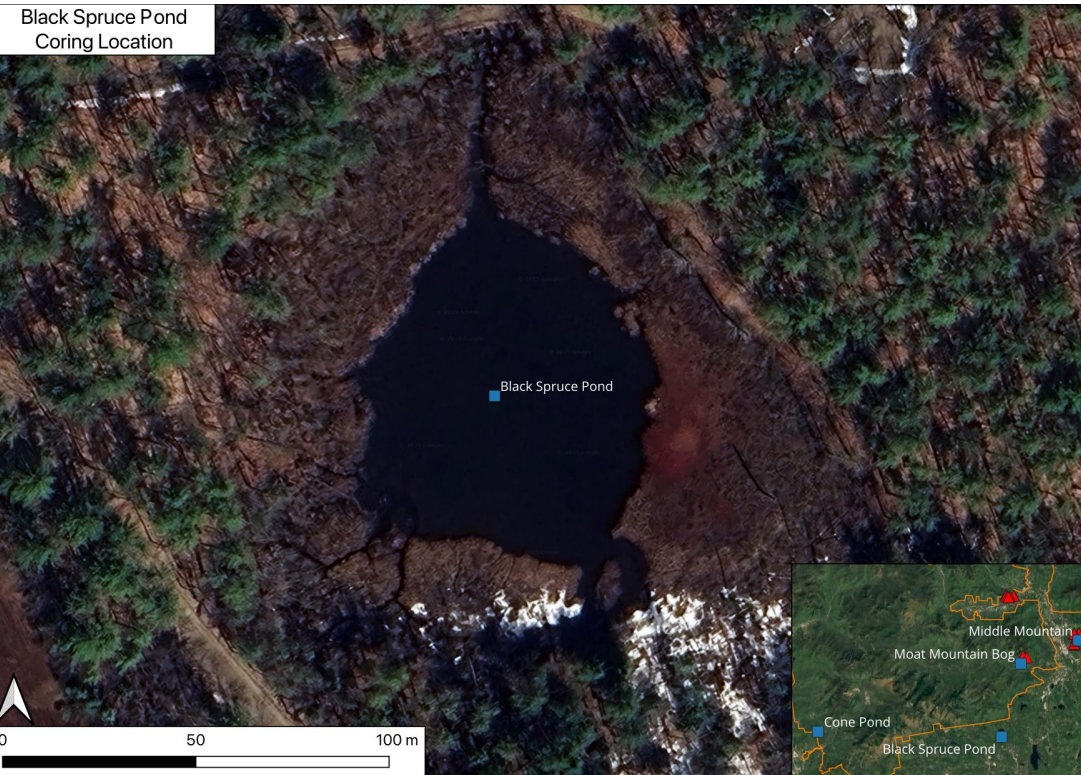
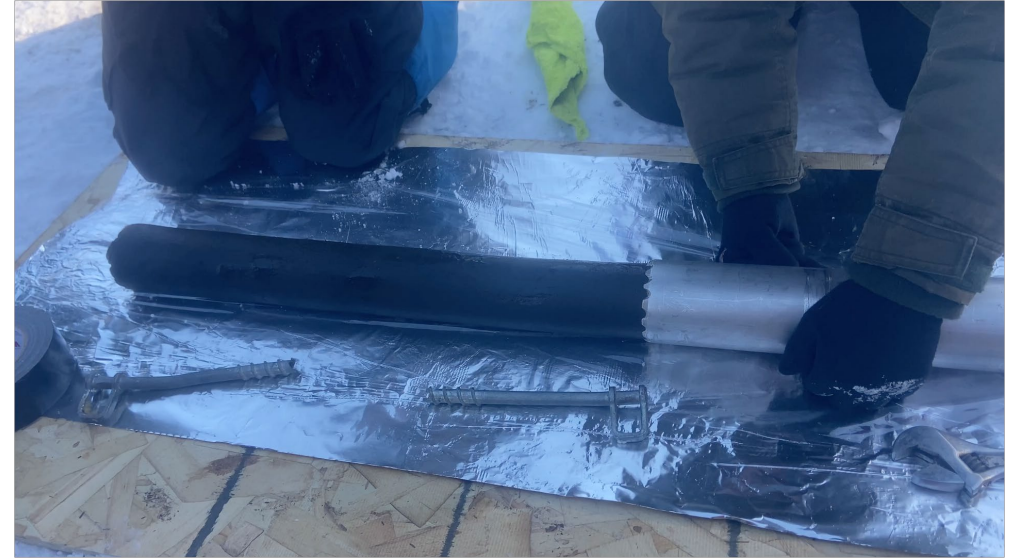


Moat Mountain Charcoal



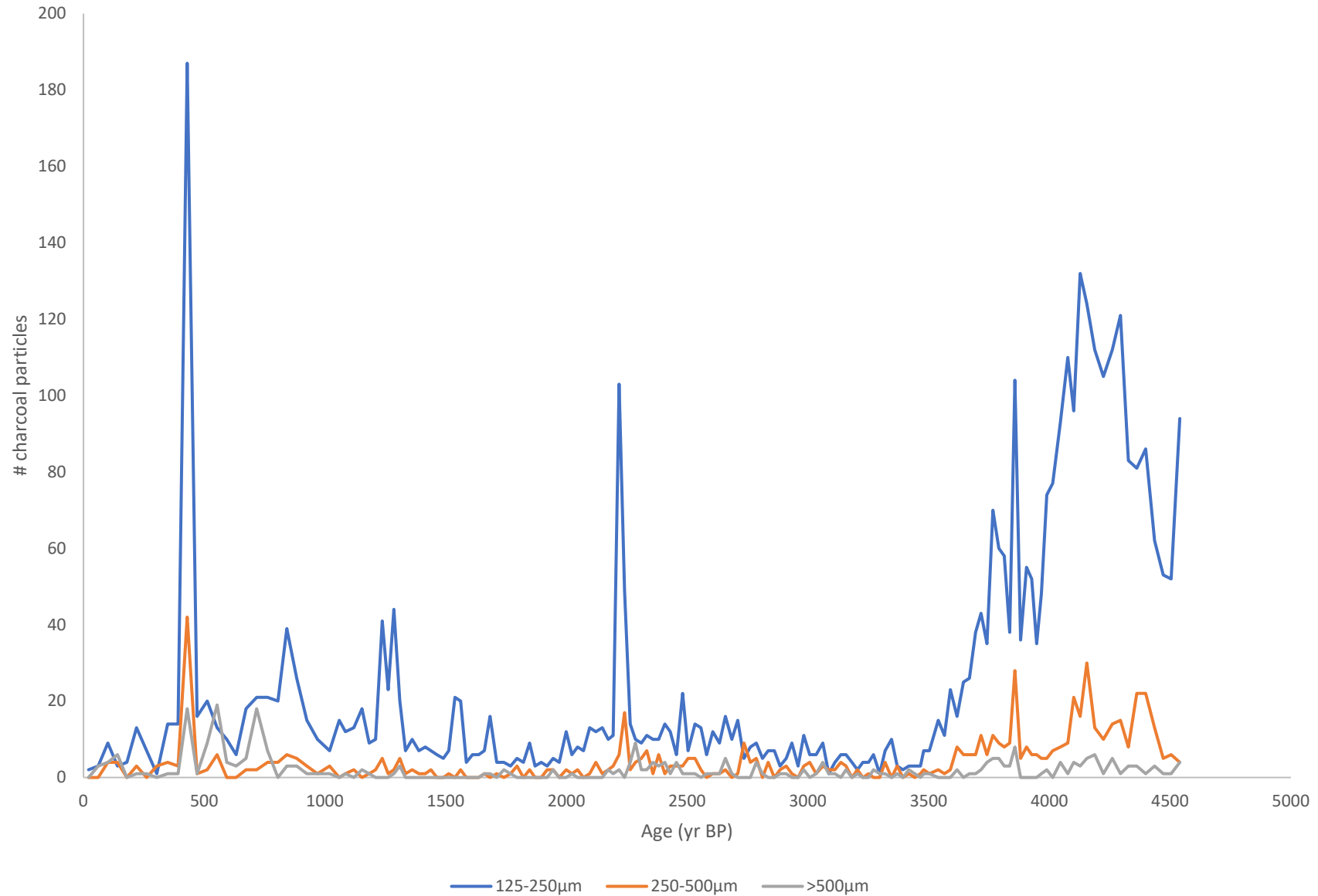
Black Spruce Pond, Tamworth, NH

- Collected January 20, 2025
- 3.6 m retrieved
- Encountered sand – captured deglaciation



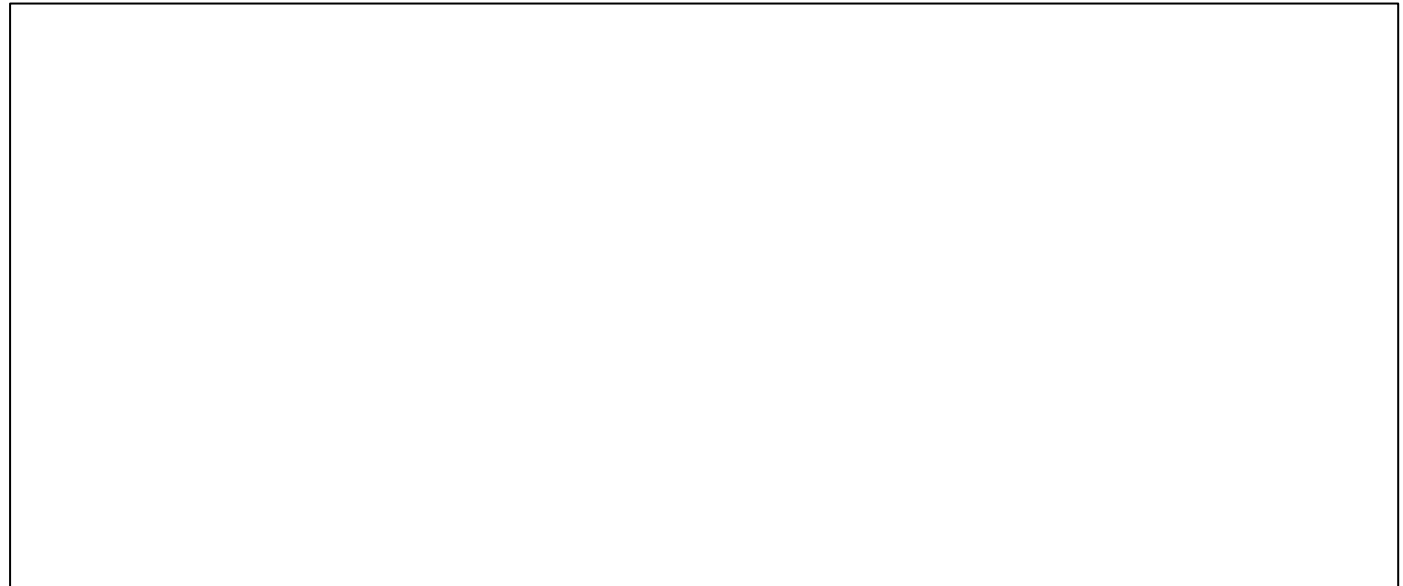
Black spruce pond

Black Spruce Pond, Tamworth, NH

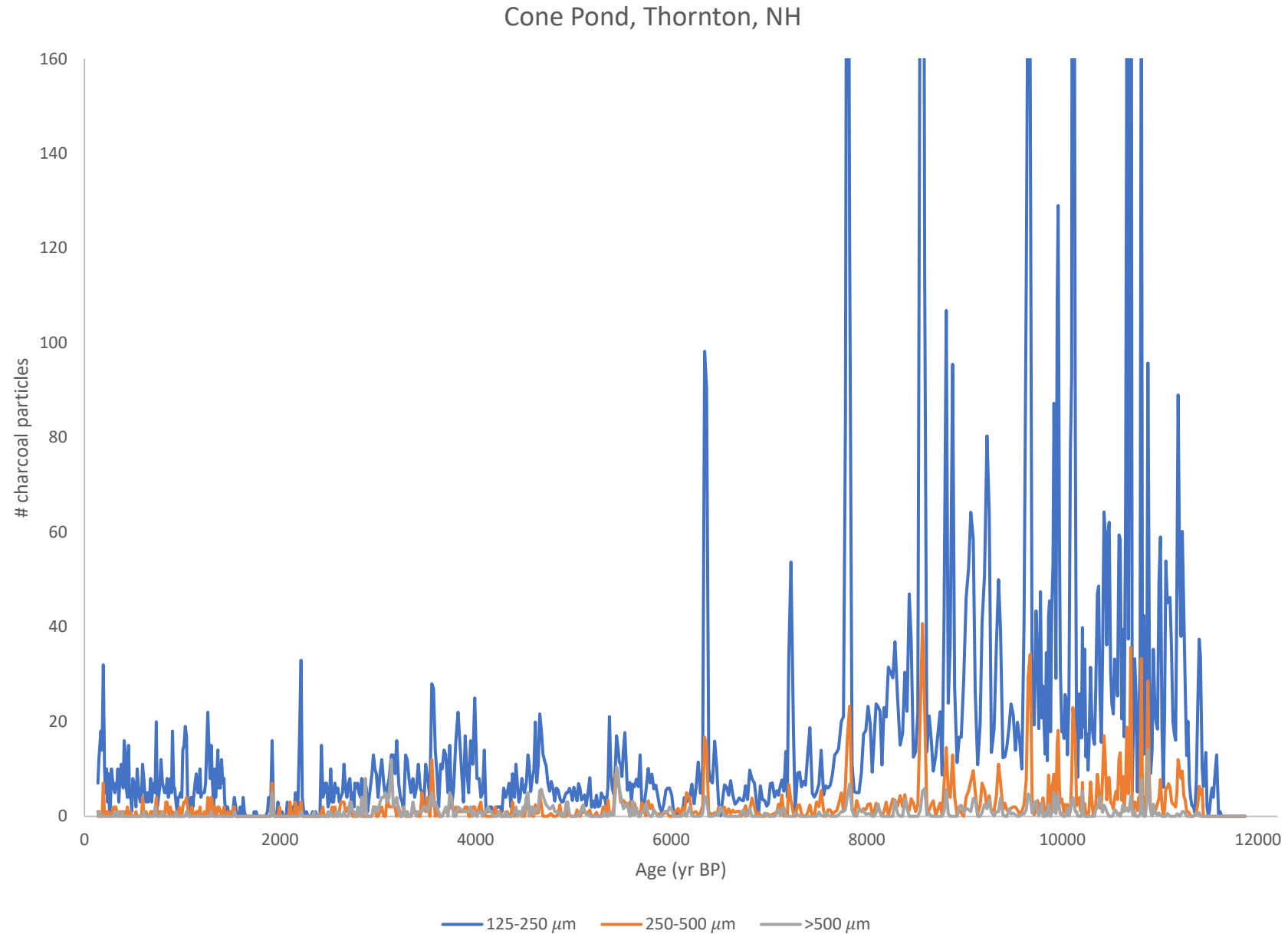


Cone Pond, Thornton, NH

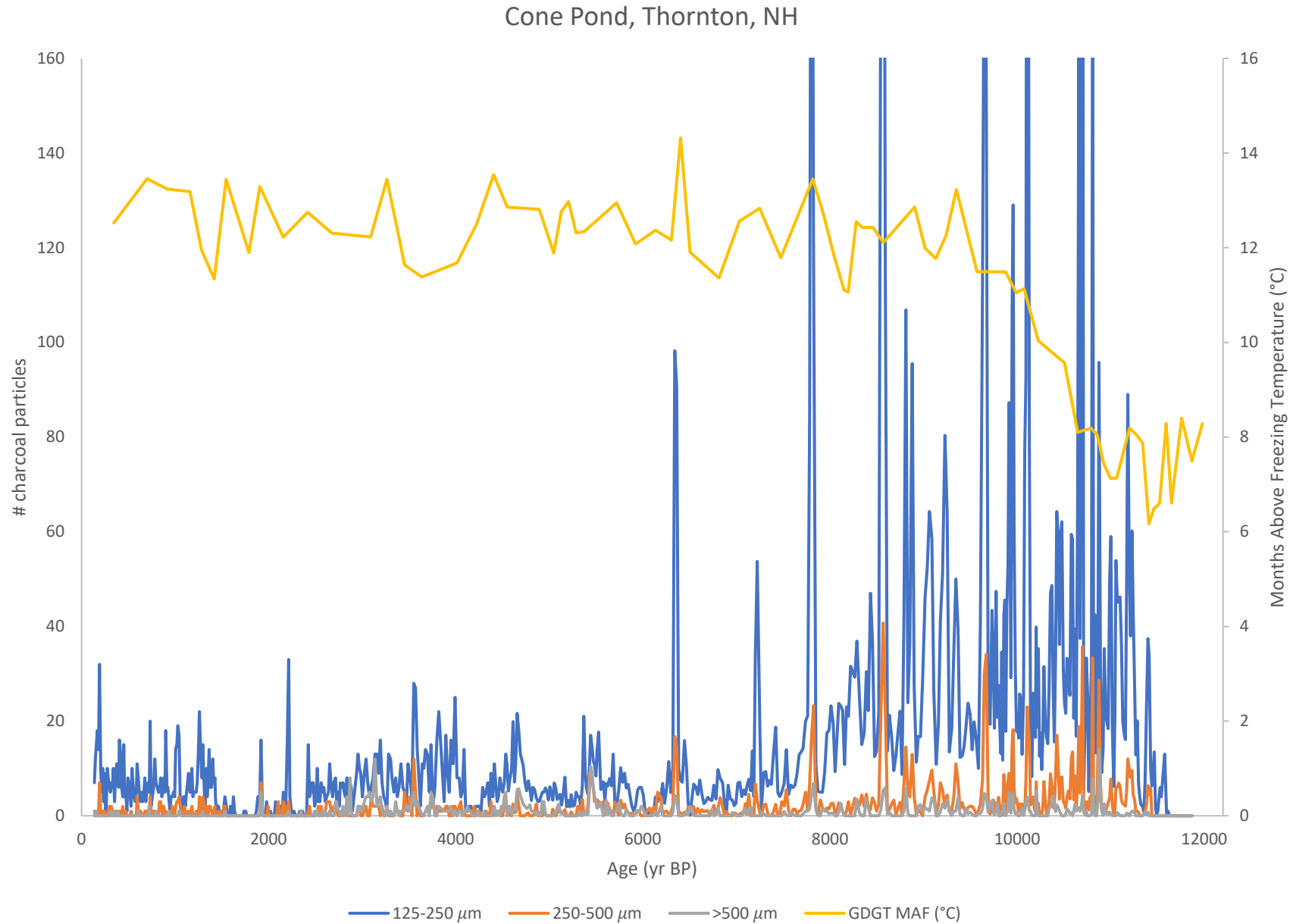
- Composite core collected between 2002 - 2025
- ~6.5 m retrieved
- Pb210, 14C age model; basal age of ~12.6 ka (deglaciation)



Cone Pond Charcoal



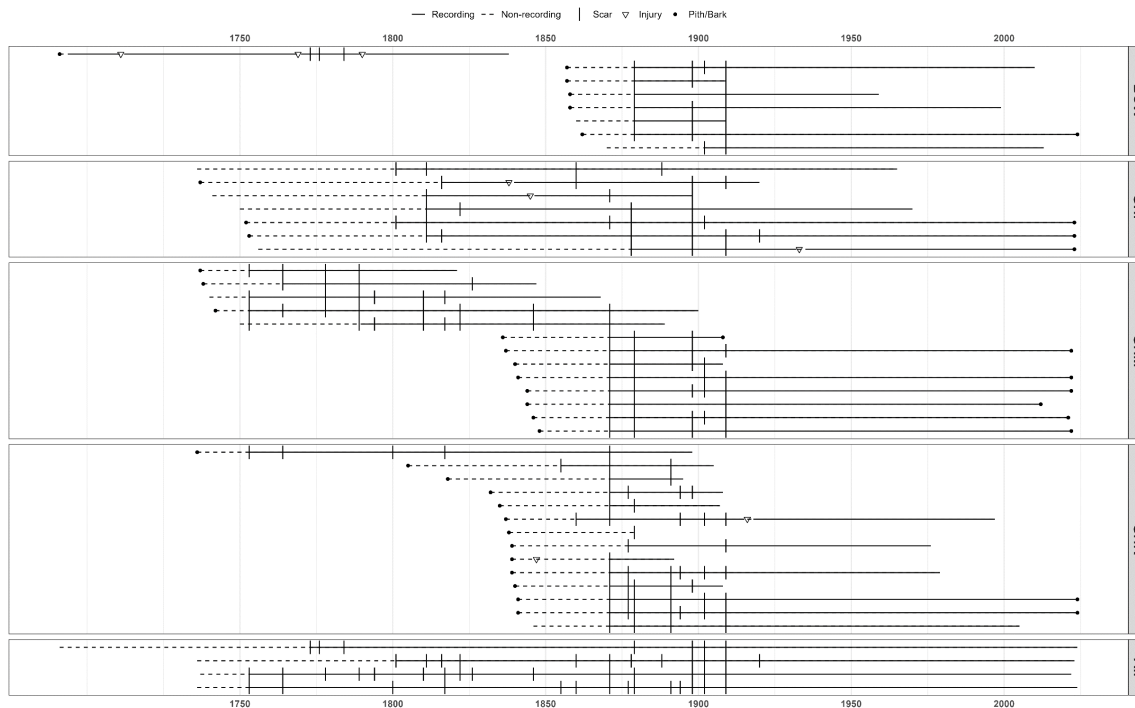
Cone Pond Charcoal



Summary of Charcoal Data

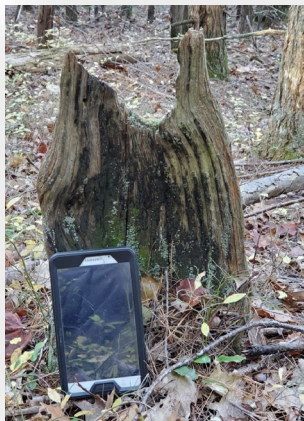
Summary

- Tree-ring records show fire was frequent prior to 20th century suppression
- Thus far, variability in sedimentary charcoal suggests that fire regime is changing from deglaciation through the late Holocene
- However, presence of charcoal throughout the record suggests consistent fire on the landscape throughout the Holocene.



Future Work

- Tree-ring fire scar analysis ongoing and growing
- Lake Sediment Charcoal Analysis
 - Black Spruce Pond
 - Middle Mountain Bog
- Lake Sediment coring (winter 25/26)
 - Red Eagle Pond, Echo Lake
- Overlap of tree-ring and sedimentary records



Red pine, Green Hills
Preserve
North Conway, NH



White pine, Lyme Hill
Lyme, NH



Red pine, Mount
Stanton
Bartlett, NH



Thank you!

- **Acknowledgements**
- We thank the many agencies and land managers for access and support throughout the project: WMNF, TNC, Tamworth Conservation Commission. We also thank Paul and Denise Pouliot and the Indigenous New Hampshire Collaborative Collective for their support and knowledge. We thank NSRC for their support of this work.



WHITMAN COLLEGE



References

- Gao, P., Terando, A. J., Kupfer, J. A., Varner, J. M., Stambaugh, M. C., Lei, T. L., & Hiers, J. K. (2021). Robust projections of future fire probability for the conterminous United States. *Science of the Total Environment*, 789, 14787
- Guyette, R. P., Stambaugh, M. C., Dey, D. C., & Muzika, R. M. (2012). Predicting fire frequency with chemistry and climate. *Ecosystems*, 15(2), 322-335.