2023 Ecosystem Monitoring Fund Final Report

Project: Continued Long-Term Ecological Monitoring in a Northern Red Oak-White Pine Research Forest Over Five Decades

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Narrative

Abstract

A red oak-white pine ecosystem on Maine's coast, Holt Research Forest (HRF), has filled a key niche of long-term ecosystem monitoring since its establishment in 1983. While many landowners in Maine steward oak-pine forests, HRF is a rare research generator on this critical forest type. A recent harvest at HRF in the fall of 2020 provided a timely opportunity to monitor and distribute data on the impact of disturbance on oak-pine ecosystems, particularly in the context of climate change. With funding provided by the Forest Ecosystem Monitoring Fund through Forest Ecosystem Monitoring Cooperative, we collected, digitized, and distributed pre- and post-harvest data on overstory composition and regeneration at HRF. This effort gave landowners practical data and tools to inform their management while providing researchers with a long-term foundational dataset for future studies. It additionally contributed to an established body of research from HRF, housed by FEMC, tracking ecosystem change on-site as climate change shifts ecological systems across the region. Lastly, the project contributed to workforce development in forestry and forest research by providing students and early-career professionals with practical, applied experience working in the field and with HRF datasets.

Activities

Maine TREE hired a Holt Research Forest Fellow (HRFF) in the winter of 2023 and three technicians for the 2024 summer field season. The technicians came from various educational backgrounds and experiences, including forest ecology, forest management, and bioinformatics. Two technicians were in the final stages of completing their undergraduate degrees, one at the University of Maine studying ecology and environmental sciences with a concentration in forest ecosystems and one at The Pennsylvania State University studying forest ecosystem management with a concentration in forest biology. The third technician was completing their Master's in bioinformatics with a concentration in data analytics at Northeastern University.

Summer 2024 Holt Research Forest technicians at the Maine TREE welcome and end-of-year celebration events.

Under the HRFF's guidance, the technicians collected regeneration and forest composition data, specifically post-harvest seed, seedling, sapling, and overstory

data, following the historical methods outlined in the Holt Research Forest Methods Manual (Witham, 1983). Furthermore, the technicians independently completed a fundamental analysis of pre- and post-harvest datasets. Their studies were summarized in written reports and presented as posters to Maine TREE staff, the Board of Directors, and the HRF Committee on August 1, 2024.

The HRFF digitized pre- and post-harvest regeneration and composition data to make it publicly available on the FEMC data repository. All pre-harvest seed, seedling, sapling, and overstory data have been digitized, cleaned, quality-checked, and published. Datasets collected this summer are being cleaned, digitized, quality-checked, and will be published on the FEMC data repository by the end of summer 2024. A field tour sharing our results and findings will be scheduled for fall 2024.

Data Availability

Project	Years Published	Years Unpublished
Annual Tree Seed Collection	2016, 2017, 2018, 2019, 2020, 2021, 2022	2023
Regeneration Inventory	2022	2024
Timber Inventory	2019 (Partial), 2020 (Complete)	2022-ongoing (Complete)

Results and Impacts

Data Collection and Publication

- **Seed, seedling, sapling, and overstory data**: Summer research technicians collected data for four projects related to regeneration and overstory dynamics at HRF: the Annual Tree Seed Collection, the Regeneration Inventory, S-1 Understory Seedling Releve, and the Complete Timber Inventory. The technicians developed scientific research skills such as field instrument operation and maintenance, navigation, tree and vegetation identification, and teamwork. All three of the students have expressed interest in pursuing graduate studies and working in the fields of ecology or forest management.

Technician Olivia Case (left) taught high school-aged students from Bowdoin College's Upward Bound Program how to identify and measure tree seedlings. Technician Toby

Ouellette (right) investigated harvest impacts on tree mortality.

- **Data availability**: The project successfully cleaned, digitized, and published six datasets to the FEMC data repository. Specifically, we published two datasets for the Annual Tree Seed Collection (seedTraps-S1_2016-2022 and seedTraps-SM_2016-2021), two datasets for the Regeneration Inventory (regen4m2_2022 and regen200m2_2022), and two datasets for the Timber Inventory (TimberInv2019 and TimberInv2020). This effort significantly enhanced the availability and accessibility of long-term ecological monitoring data, especially for the understudied coastal oak-pine ecosystems. The datasets now serve as valuable resources for landowners and researchers, providing practical data and tools for forest management and foundational datasets for current and future studies.

Analysis of Coastal Oak-Pine Ecosystem Response to Harvest

- **Variable Retention Harvest**: The project included comprehensive analyses of the coastal oak-pine ecosystem's response to variable retention harvest conducted by the summer research technicians. These analyses filled critical gaps in understanding the impacts of variable retention harvest on canopy composition and regeneration within a coastal oak-pine forest ecosystem. This work contributed to the broader body of research from HRF and is crucial for informing forest management practices in similar ecosystems. The independent research projects provided the technicians with hands-on experience in applied forestry research, expanding their professional networks and exposing them to various career pathways. The contributions and experiences of our technicians were highlighted in our newsletter, "Seedlings."

Ecological Monitoring and Future Research

- **Foundation for ecological monitoring**: The comprehensive datasets now include pre- and post-harvest data, with future data collection planned for 2024 and beyond. This continuity ensures that the datasets remain relevant and useful for ongoing and future ecological research, providing a valuable resource for investigating various ecosystem components in a managed northern oak-pine forest.
- **Foundation for Ongoing/Future Research**: The project established a robust foundation for continued ecological monitoring and future research at HRF. This year, HRF welcomed a diverse array of regional scientists and research initiatives. Notable examples include a researcher from the Biodiversity Research Institute studying bald eagle nestlings and a PhD student from the University of Maine studying red spruce management and resiliency. This shift towards a collaborative model of hosting diverse research practitioners and projects has expanded HRF’s research scope and capabilities.

Lessons Learned

- **Data management and accessibility**: Ensuring data quality and consistency before publication enhances the utility and reliability of the datasets for various users, including landowners and researchers.

- **Challenges in Data Integration**: Integrating historical data with newly collected data posed challenges, particularly in maintaining consistency and accuracy across different time periods. Developing standardized data collection and management protocols can help mitigate these issues in future projects.

Future Directions

- **Ongoing and Future Data Collection**: The project has set a strong foundation for continued data collection and publication. Future efforts will continue prioritizing forest growth and health, ensuring that these datasets remain up-to-date and comprehensive while expanding research efforts to focus on other priority topics like climate change and wildlife. Furthermore, HRF will strengthen its ecological monitoring programs by incorporating new technologies and methodologies to improve data accuracy and collection efficiency.
- **Workforce development**: HRF will continue prioritizing workforce development by providing more opportunities for students and early-career professionals. This includes expanding technician programs, offering research fellowships, and facilitating mentorship from experienced researchers.
- **Collaboration and networking**: Strengthening collaborations with academic institutions, research organizations, and industry partners will facilitate and host a wider array of regional scientists and research initiatives.

Literature Cited

Witham JW, Moore EH, Hunter ML, Kimball AJ, White AS. (1983). *A Long-Term Study of an Oak Pine Forest Ecosystem: Techniques Manual for the Holt Research Forest*. (Technical Bulletin 153). The University of Maine.

Budget Detail

Item	FEMC Funds	Non-Federal Match	Total
Individual personnel	$22,840.92	$18,740.60	$41,581.52
Personnel fringe benefits		$8,521.65	$8,521.65
Travel		$1,219.52*	$1,219.52
Supplies	$2,159.08	$5,003.48	$7,162.56
Utilities		$4,224.33	$4,224.33
Indirect Costs		$6,270.96**	$6,270.96
Total	**$25,000.00**	**$43,980.54**	**$68,980.54**

**not on the original budget*

***not on the original budget, 10% de minimis, reflected here for match documentation*

Individual Personnel

- FEMC funds for this project supported the Holt Research Forest Fellow responsible for completing the project, our Forest Programs Manager, who managed the project before moving on to a new role with another organization, and a portion of one of three research technicians' time.
- Non-Federal Match for personnel includes the three research technicians, excluding the portion allocated to the FEMC funds, and administrative and supervision support from Maine TREE's Executive Director and Office Manager.

Personnel Fringe Benefits

- All personnel fringe benefits associated with this project were allocated to the project's non-federal match.

Travel

- Not included in the initial budget and documented here as a match includes lodging and registration for conferences Maine TREE staff attended that were relevant to the project.

Supplies

- FEMC Funds supported the purchase of office supplies and research equipment to facilitate the delivery of this project.
- Non-Federal Match was housing provided to personnel at $500/month/person as identified in our initial proposal

Utilities

- All costs allocated as non-federal match for maintaining our facilities throughout the project

Indirect Costs

- Not included in the original project budget, indirect costs were allocated to the non-federal match at the 10% de minimis rate.

See the invoice attachment for more details on the budget breakdown.

Appendix

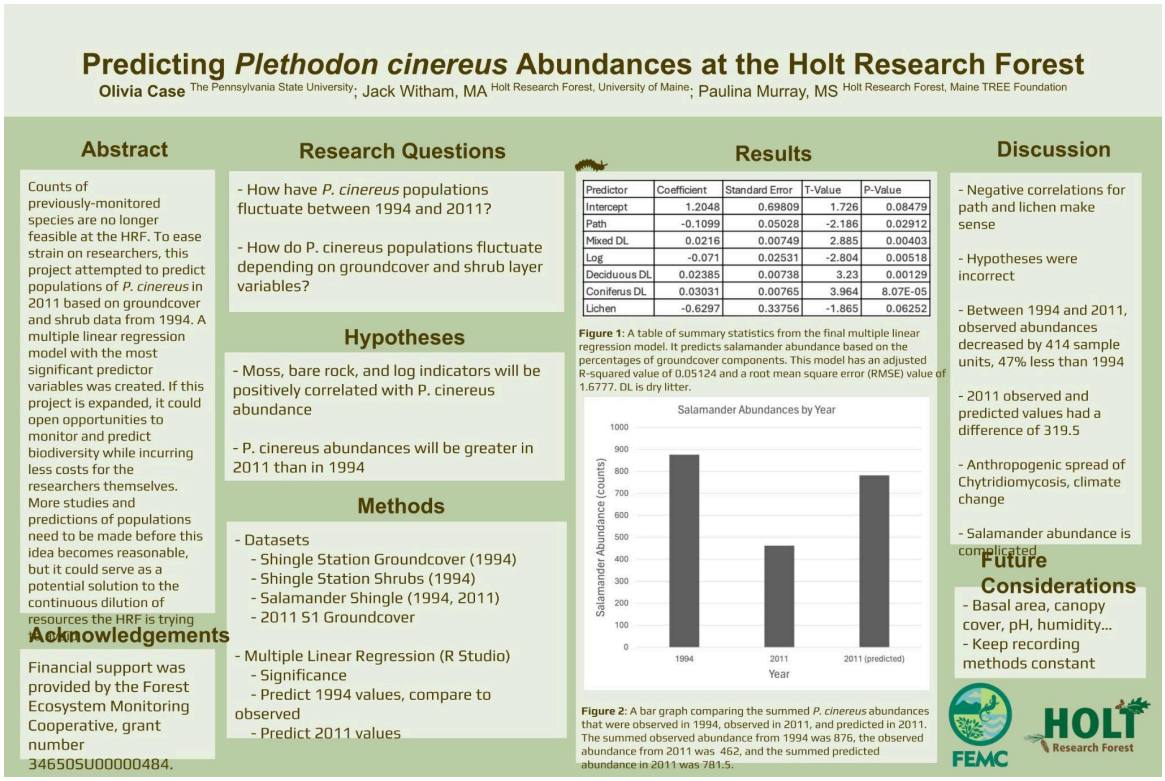

Figure 1. Olivia Case presented "Predicting *Plethodon cinereus* Abundances at the Holt Research Forest."

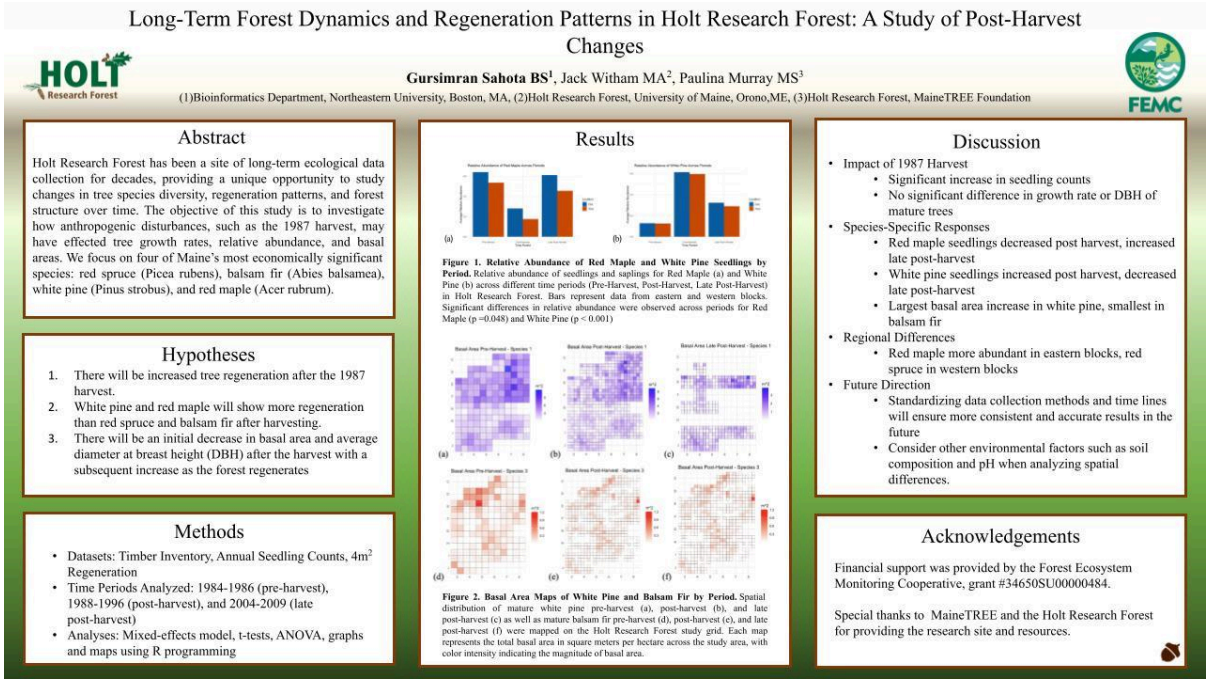

Figure 2. Gursimran Sahota presented "Long-Term Forest Dynamics and Regeneration Patterns in Holt Research Forest: A Study of Post-Harvest Changes."

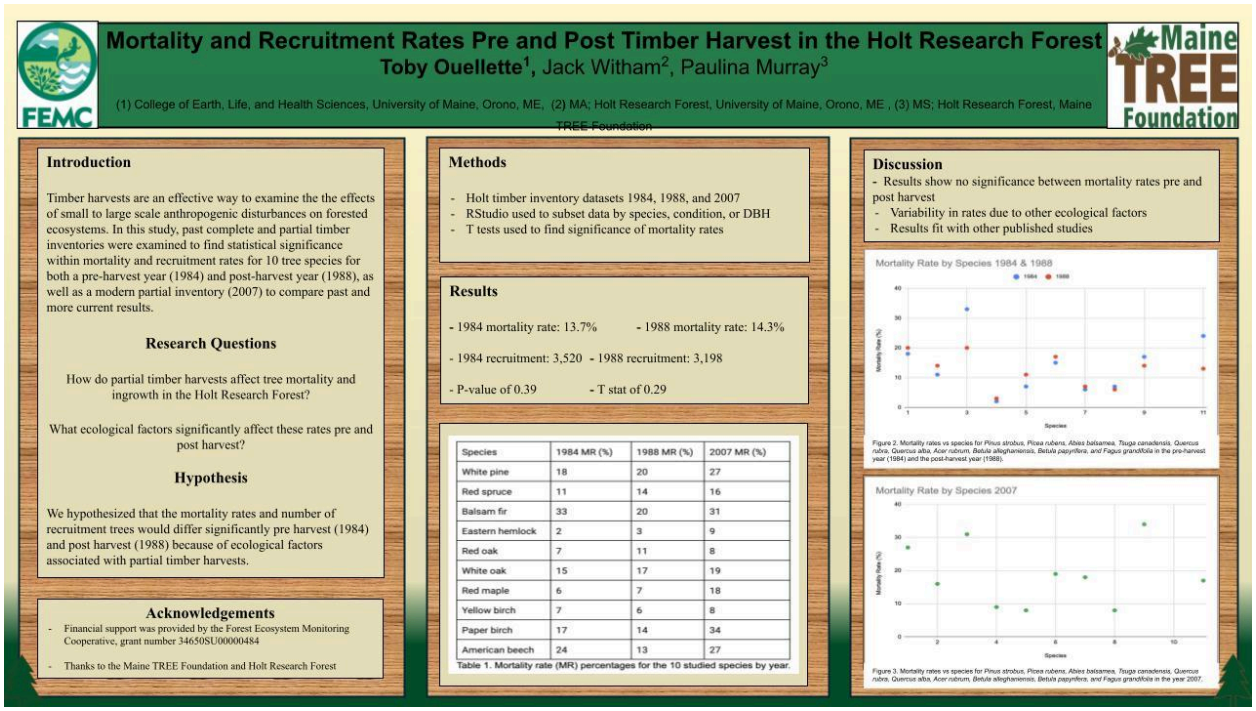

Figure 3. Toby Ouellette presented “Mortality and Recruitment Rates Pre and Post Timber Harvest in the Holt Research Forest.”