Forest Stewards Guild
putting the forest first
Forest Climate Change Initiative
Science and Practice
Addressing Forest Climate Change in Maine
An Interactive Webinar & Field Tour Series for Stakeholders and the Interested Public

SPRUCE-FIR FOREST ON THE PENOBSCOT EXPERIMENTAL FOREST

The Penobscot Experimental Forest (PEF) is home to more than 1,000 acres of forest management research in spruce–fir and associated species.

The PEF is located in the transitional zone between the eastern broadleaf and boreal forests known as the Acadian Region.

The PEF serves as an important and unique source of information about the ecology and silviculture of mixed-species northern conifers.

Forest Service scientists, university partners, and other cooperators maintain long-term silvicultural experiments and conduct short-term observational and manipulative studies at the PEF to better understand the mechanisms of ecosystem change over time.

The PEF is a key research site for Forest Service and UMaine scientists, and provides an ideal location to train students on sustainable forest management, ecosystems and wildlife habitat.
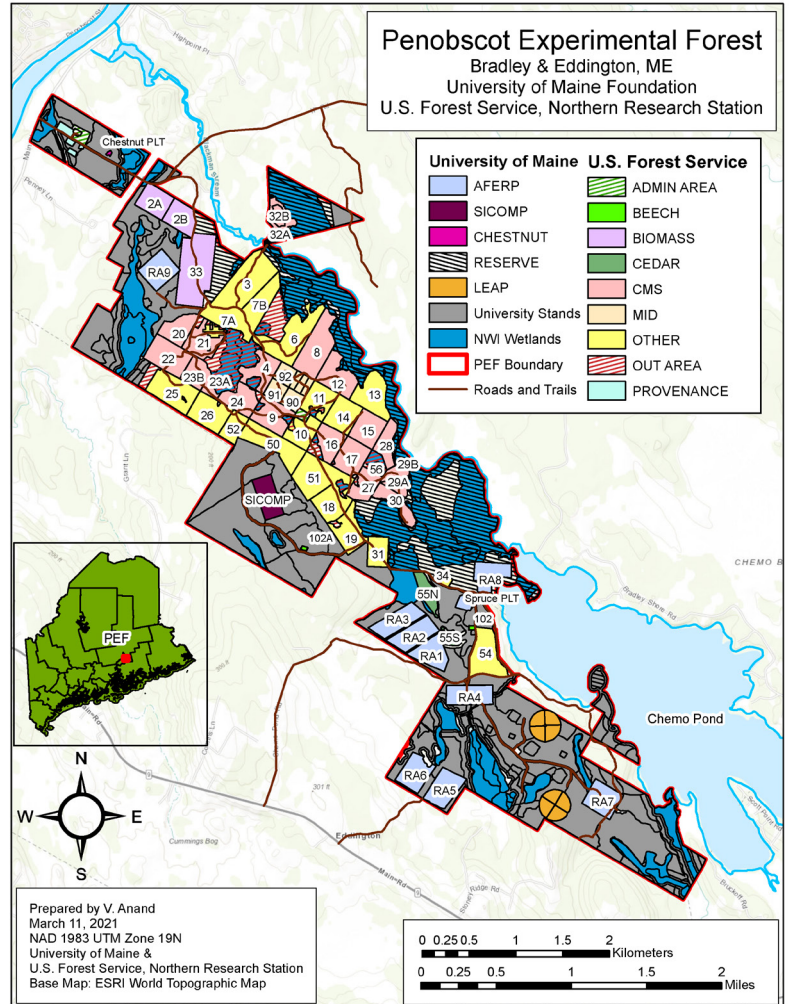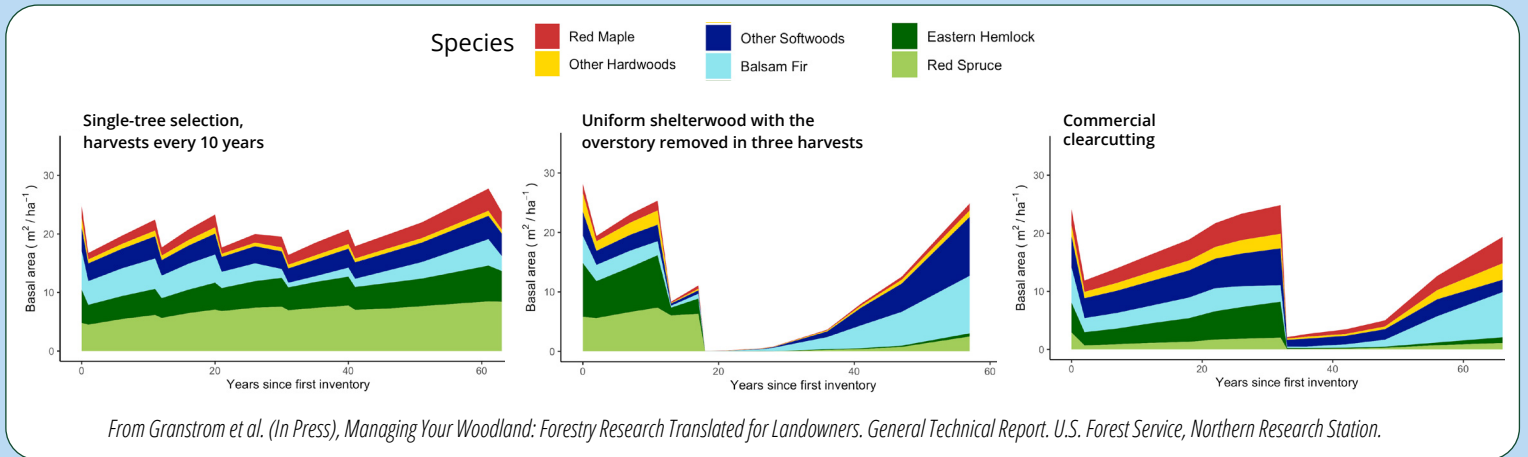

Penobscot Experimental Forest
Bradley & Eddington, ME
University of Maine Foundation
U.S. Forest Service, Northern Research Station

University of Maine
- AFERP
- SICOMP
- CHESTNUT
- RESERVE
- LEAP
- University Stands
- NWI Wetlands
- PEF Boundary
- Roads and Trails

U.S. Forest Service
- ADMIN AREA
- BEECH
- BIOMASS
- CEDAR
- CMS
- MID
- OTHER
- OUT AREA
- PROVENANCE

Prepared by V. Anand
March 11, 2021
NAD 1983 UTM Zone 19N
University of Maine &
U.S. Forest Service, Northern Research Station
Base Map: ESRI World Topographic Map

Figure 1. Future climate outlook for common tree species on the PEF

|	TreeAtlas (SDM)		Linkages (Hybrid)		LANDIS PRO (Process)	
	PCM - B1	GFDL - A1FI	PCM - B1	GFDL - A1FI	PCM - B1	GFDL - A1FI
Balsam fir	4	5	5	5	4	5
Red spruce	4	5	4	5	3	3
Eastern hemlock	3	4	4	2	4	4
Northern white-cedar	4	5	4	5	3	3
White pine	3	4	4	2	3	3
Red maple	3	4	4	3	4	4
Sugar maple	3	4	4	3	3	3
Yellow birch	3	5	5	5	2	2
American beech	3	4	4	3	2	2
Quaking aspen	3	5	4	5	1	1
Northern red oak	2	2	3	2	3	2

Models: TreeAtlas (species distribution model), Linkages (hybrid empirical-process model), LANDIS PRO (process-based landscape model). Climate Scenarios (year 2100): PCM-B1 (mild climate change, low emissions), GFDL-A1FI (harsh climate change, high emissions). Scale: 1=Large Increase in suitable habitat (>2), 2=Small Increase (1.2–2.0), 3=No Change (0.8–1.2), 4=Small Decrease (0.5–0.8), 5=Large Decrease (<0.5). Adapted by V. Anand from Iverson et al. (2017) https://www.fs.usda.gov/treesearch/pubs/52135

Future climate outlook for common PEF tree species varies by modelling approach and emissions scenario (Figure 1). Suitable habitat is generally predicted to decrease for the dominant conifers.

Over 65 years, management on the PEF changed species composition in ways that affected compatibility with future climate. For example, selection cutting maintained spruce and hemlock, shelterwood (unthinned) increased fir and "other softwoods" (mostly white pine), and commercial clearcutting increased fir and hardwoods.

Species: Red Maple, Other Hardwoods, Other Softwoods, Balsam Fir, Eastern Hemlock, Red Spruce

Single-tree selection, harvests every 10 years

Uniform shelterwood with the overstory removed in three harvests

Commercial clearcutting

From Granstrom et al. (In Press), Managing Your Woodland: Forestry Research Translated for Landowners. General Technical Report. U.S. Forest Service, Northern Research Station.

After 65 years, a comparison of some of the management approaches on the PEF showed more carbon stored in the forest in unmanaged stands. In managed stands, selection and shelterwood systems stored more carbon in the forest and wood products than commercial clearcutting.
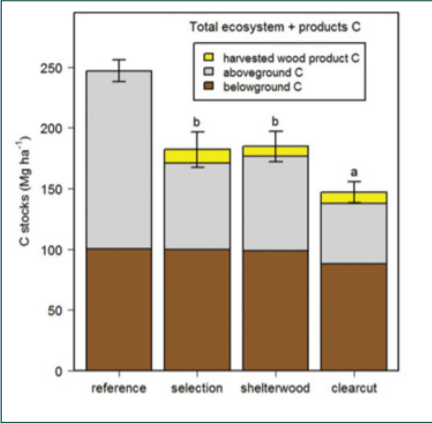
Total Ecosystem Carbon=carbon in soil, forest floor, understory plants, trees, deadwood. Reference=unmanaged. *From Puhlick et al. (2016)* https://www.fs.usda.gov/treesearch/pubs/54052

Long-term data and modelling show that annual net change in carbon (live tree, deadwood, wood products) over 100 years is greatest in unmanaged, selection, and unthinned shelterwood stands.

Codes: UM=unmanaged, S05, S10, and S20=selection cutting on 5-, 10-, and 20-year cycles, SW2=shelterwood with reserves, SW3-T and SW3-N=shelterwood (thinned and unthinned), FDL and GDL=fixed and guiding diameter-limit, CC=commercial clearcut. The boxes show means and variation; there are two examples of each type of management. *From Puhlick et al. (2020) https://www.fs.usda.gov/treesearch/pubs/62735*