Planning and Incentives for Climate-Smart Forestry

Josh Rapp, Jennifer Fish, Jennifer Shakun

3/25/2023

Mass Audubon

dcr Massachusetts

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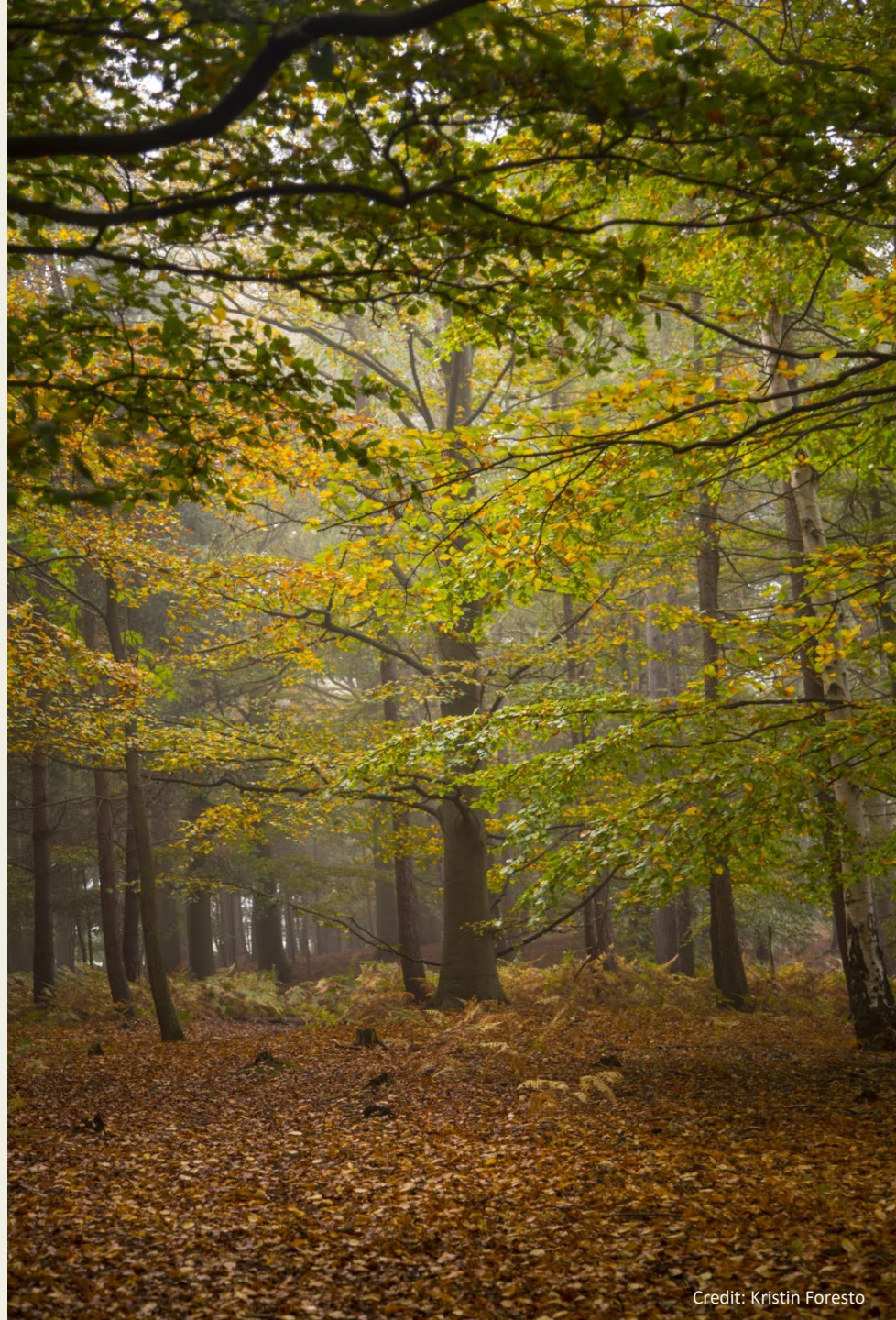

Credit: Kristin Foresto

Partners

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Massachusetts Woodlands Institute
A SUBSIDIARY OF FRANKLIN LAND TRUST

The Nature Conservancy

NIACS
Northern Institute of Applied Climate Science

frcog Franklin Regional Council of Governments

BRPC
Berkshire Regional Planning Commission

OHKETEAU

Climate-Smart Forestry

1. **Introduction to Climate-Smart Forestry**
2. **Climate Stewardship Planning**
3. **New England Climate-Smart Forest Partnership**
4. **Climate-Smart Forestry Case Study: Pelham Lake Park, Rowe, MA**

What is a Forest?

Forests are large, dynamic systems that vary in age, structure, and composition.

- **Ecological value**
  - Diverse forest types and ages provide crucial wildlife habitats
  - Buffer against the impacts of climate change
  - Support clean air and water
- **Social & Cultural Value**
  - Provide respite and recreational opportunities
  - Are essential to human health
  - Support local economies
  - Supply wood products, medicine, and food

What is Forestry?

- the science of developing, caring for, or cultivating forests (Merriam–Webster)
- the science, art, and business of creating, managing, and conserving forests and associated resources in a sustainable manner to meet desired goals, needs, and values (Society of American Foresters)

What is Climate-Smart Forestry?

Adaptation

Maintaining forest health in a changing climate

- Addressing threats/vulnerabilities
- Adaptation pathways – Resistance-Resilience-Transition

Mitigation

Sequestering and Storing carbon

- Maximizing carbon storage on some lands – reserves
- Maintaining carbon storage while enhancing sequestration on managed lands

❖**Both occur in the context of multiple forest management goals, benefits, and values**



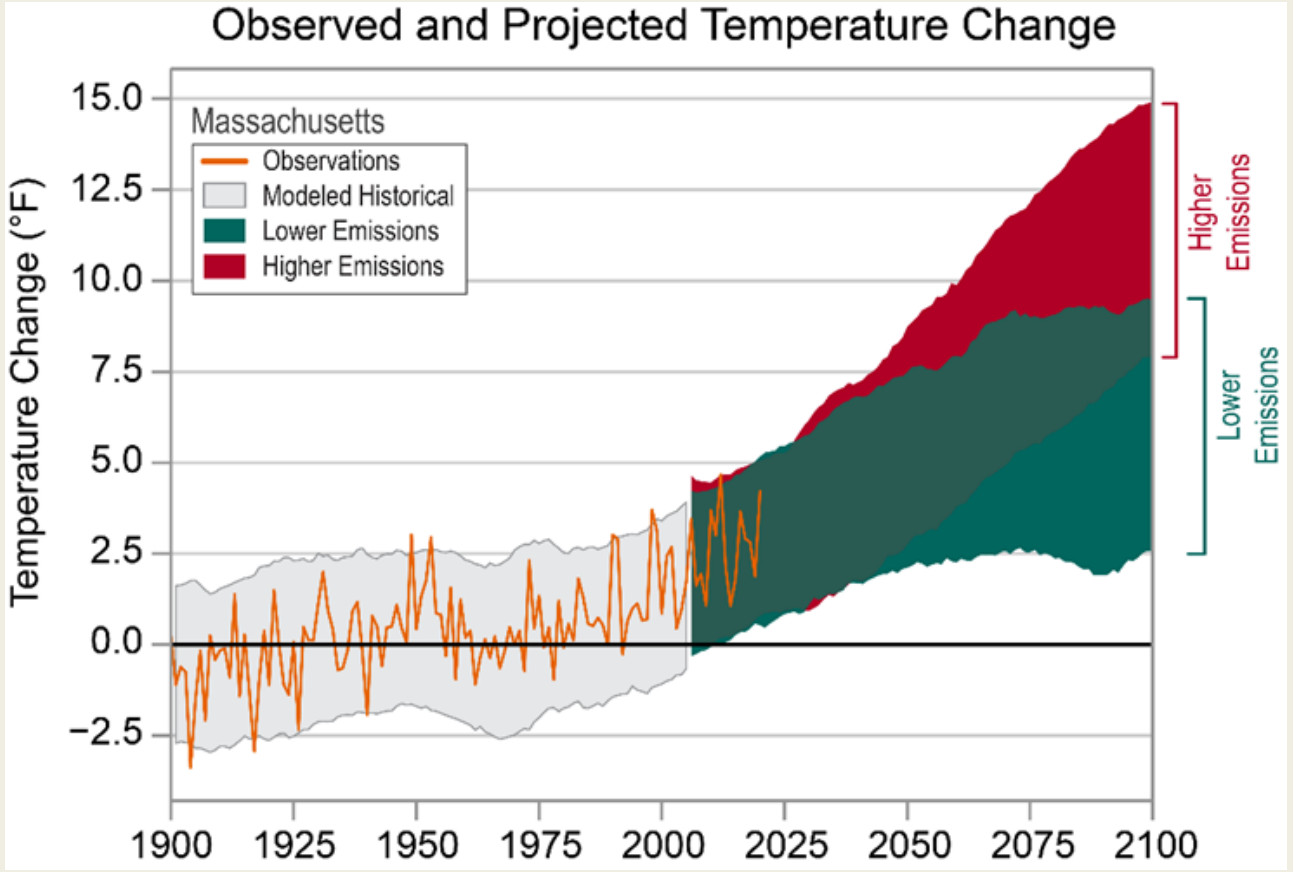


Why Practice Climate-Smart Forestry?

- **Climate change is impacting forests now**
- **Forests can be part of the climate change solution**
- **Forest stewardship can help forests adapt to climate change**

Climate Change is Impacting Forests Now

- Burning fossil fuels releases greenhouse gases that cause climate change
- Climate change is happening now and will intensify through the end of the century

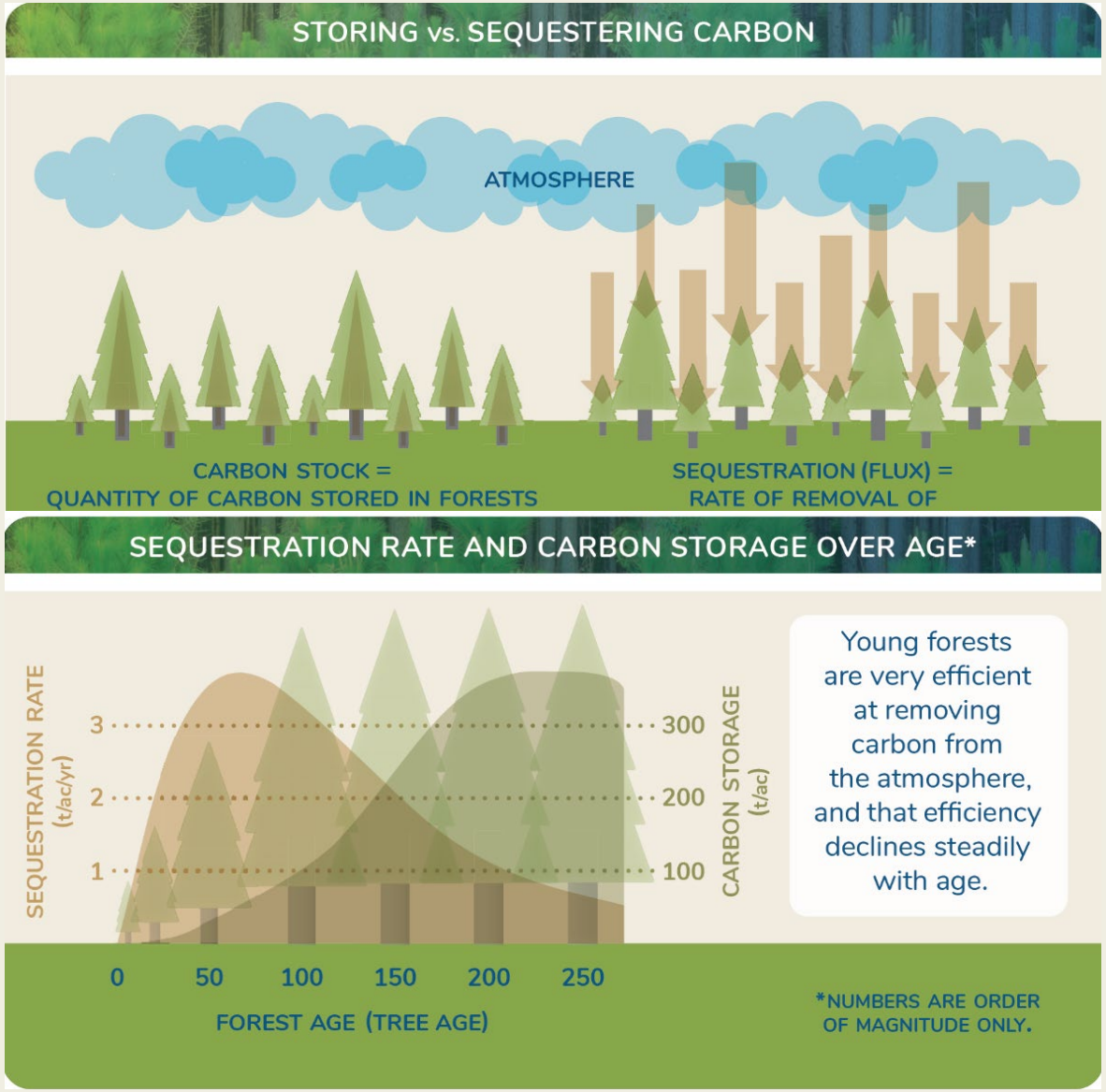


See ‘Caring for Your Woods: Adapting to Changing Conditions’ – Available from MA DCR and Mass Audubon

Climate Change is Impacting Forests Now

- More extreme precipitation events
- Increased storm frequency & intensity
- Elevated drought risk
- Less snow & frozen ground
- Rising sea levels
- More forest pests & pathogens
- Increases in invasive plants
- Reduction in tree species habitat

Forests are a Solution to Climate Change



Credit: NCASI

- **Carbon sequestration**
  - The process of plants using sunlight to capture CO_2 from the air and convert it into biomass, including wood and roots.
- **Carbon storage**
  - The amount of carbon retained long-term within the forest.

What does Climate-Smart Forestry look like?

Defining Climate-Smart Forestry Practices

ONE
Scientific Literature Review

TWO
Consideration of Regional Context of Forest Management Practices

THREE
Evaluation & Refinement by a Team of Experts

Stakeholders: Massachusetts & Vermont

- Northern Institute of Applied Climate Science
- MA Executive Office of Energy & Env. Affairs
- MA Dept. Conservation & Recreation
- VT Forests, Parks, & Recreation
- Private foresters
- Sawmill operator/ logger
- Family forest owner
- Carbon project verifier
- Harvard Forest
- University of Massachusetts Amherst
- University of Vermont
- US Fish and Wildlife Service
- MA Forest Alliance
- VT Woodlands Association
- Massachusetts Woodland Institute
- Franklin County Regional Council of Governments
- Berkshire Regional Planning Commission
- Mass Audubon
- Audubon Vermont
- New England Forestry Foundation
- The Nature Conservancy
- Forest Stewards Guild

Climate-Smart Forestry Practices

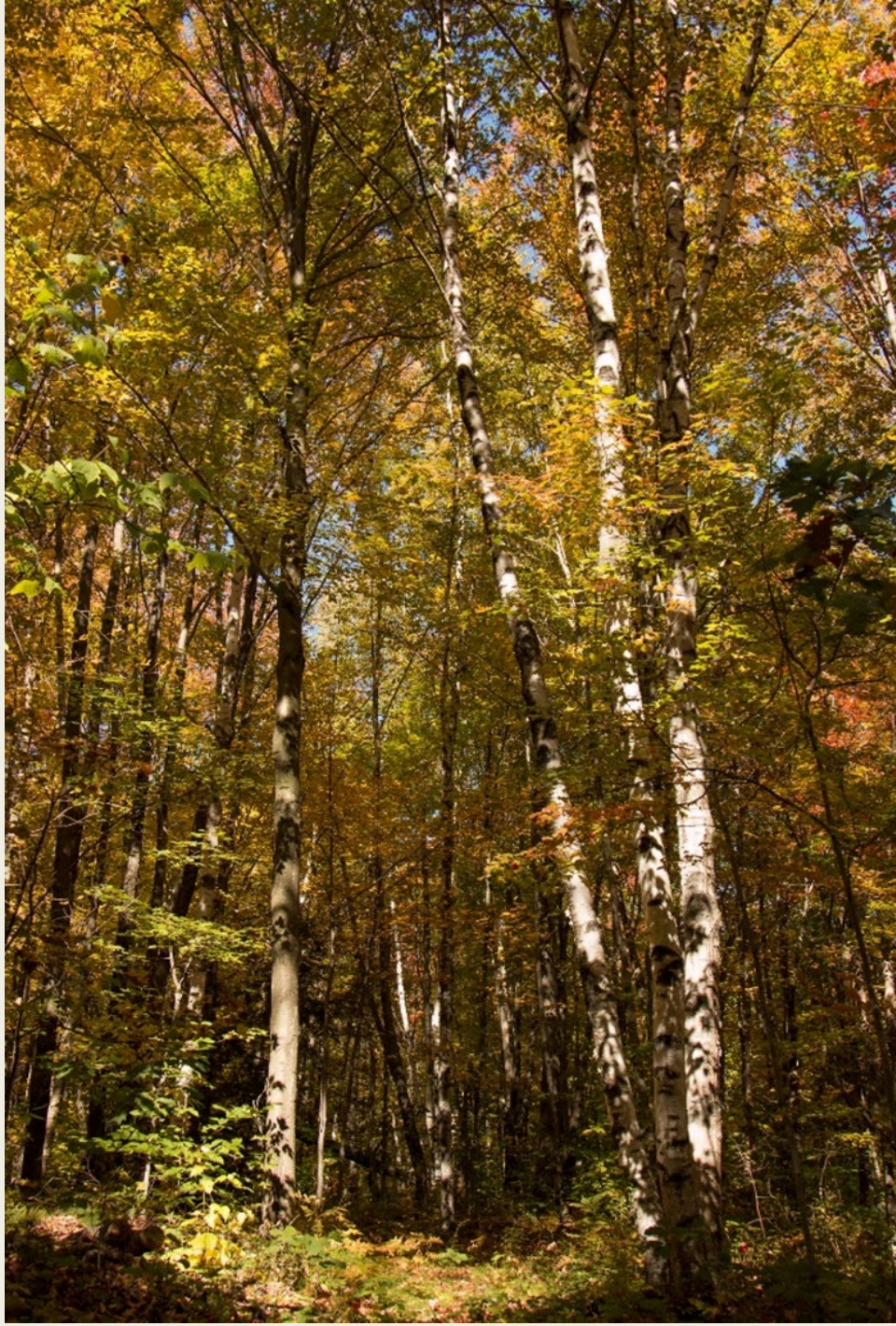
- Keep Forests We Have
- Grow New Forests and Trees
- Reduce Stressors
- Let Trees Grow
- Shape the Future Forest

Grow New Forests and Trees

- **Reforestation** – Create new forests
- **Green developed areas** – Plant trees along streets and in yards
- **Underplant climate-adapted trees** – plant trees to increase forest stocking

Keeping the Forests we Have

- **Avoid forest loss** – Reduce or eliminate the conversion of forest to non-forest land types.
- **Respond to disturbance** – Restore forests following a disturbance.



Reduce Stressors

- **Climate-informed forest access and forestry operations** – best management practices
- **Removing invasive vegetation** - remove and control non-native and competing vegetation
- **Protecting seedlings from animal browse** - protect regeneration from deer and moose browsing

Let Trees Grow

- **Establish forest reserves** – protect refugia and rare and sensitive sites
- I**ncrease time between harvests** – extend cutting cycles

Shape the Future Forest

- **Enhance adaptive capacity in forests (Resilience)**
- **Facilitate forest transition to better match future conditions**
- **Create gaps to promote regeneration**
- **Retain more carbon in a thinning**


Questions?
climateforestry@massaudubon.org
massaudubon.org/csf

Climate Stewardship Planning

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dcr Massachusetts

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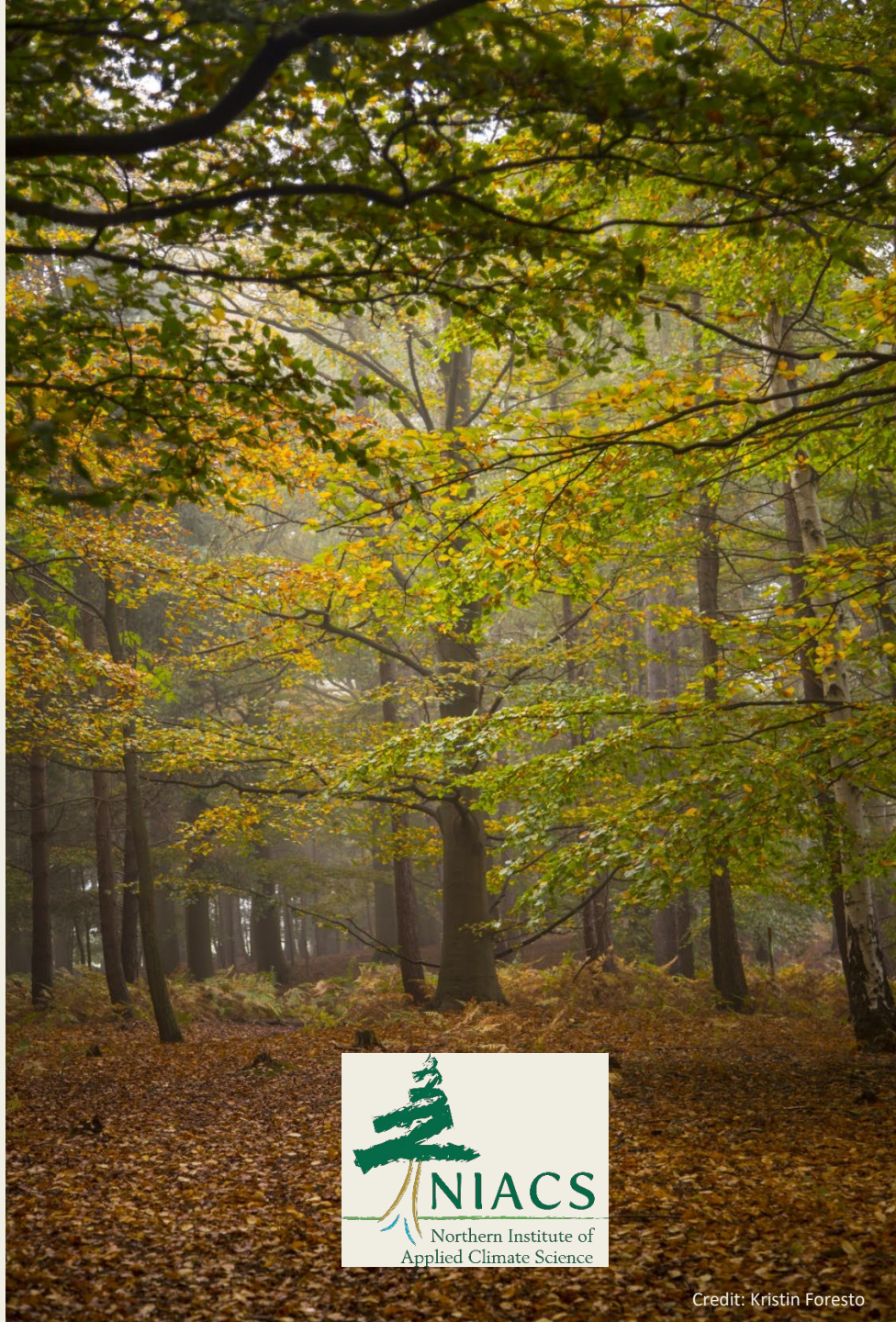


Credit: Kristin Foresto

Climate Forestry

- Forest Stewardship Program Climate **Planning**
  - Private landowners, municipal forest lands, and NGO lands
  - **Training** private foresters to
    - increase their knowledge regarding climate change and anticipated effects on our forests
    - aid them in communication
    - write climate informed Forest Stewardship plans
  - Providing forest landowners with **resources**

Climate Stewardship Forester Trainings

- **Held forester trainings spring of 2022 and 2023**
  - Pilot trainings 11 attendees during the 2022
  - 42 attendees in 2023
  - Planning field assessment training for April

- Certificate Program

Certification

- **Similar to Foresters for the Birds**
- **Training ✓**
- **Write plan with help**
- **Write plan on own with review**
- **Climate smart people always there to answer questions**
- **Follow up trainings as the landscape changes**

Why create a Forest Stewardship Plan?

- Primarily educational
  - “…supports and encourages private forest landowners' efforts to manage, enjoy, and care for their land using a long-term goal oriented approach.”
- Can be regulatory – meet Chapter 61 requirements forest management plan
- May meet requirements of CR
- We’ve created the directions so that any format can be combined
  - stew, stew/ch61, stew/birds, stew/climate, stew/climate/birds

Why create a Forest Stewardship Plan?

- Encourage landowners to act
  - “The plan recommends actions that will protect or increase the environmental values of your forest while providing social or economic benefits”
- Provide sufficient detail on forest condition and management recommendations for DCR review

Why create a Forest Stewardship *Climate* Plan?

- Identify site-specific climate change impacts, challenges and opportunities, and adaptation actions

- ***"Climate-informed forest management plans intentionally consider climate change and make linkages between potential climate change impacts and the associated management actions."***

Managing for Climate Change in Massachusetts (2022)

- **Tweaks to management**
- **Climate forward**
- ***Can be active***

It’s Complicated

Some of the variables…

Shifting seasonality

Extreme Events

Disturbance

Sea-level rise

Wildfire Risk

Interacting stressors

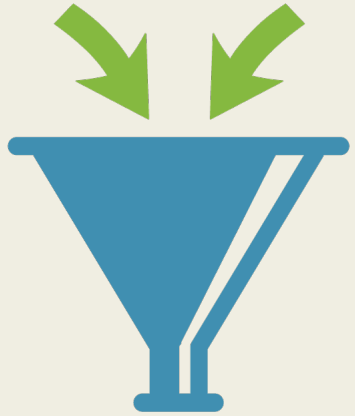
Forest pests and disease

Altered precipitation

Invasive Plants

Tree species changes

To think about…



What’s at risk in YOUR forest?

Interactions are Critical

Climate change is a “threat multiplier”

- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species

Interactions make all the difference.

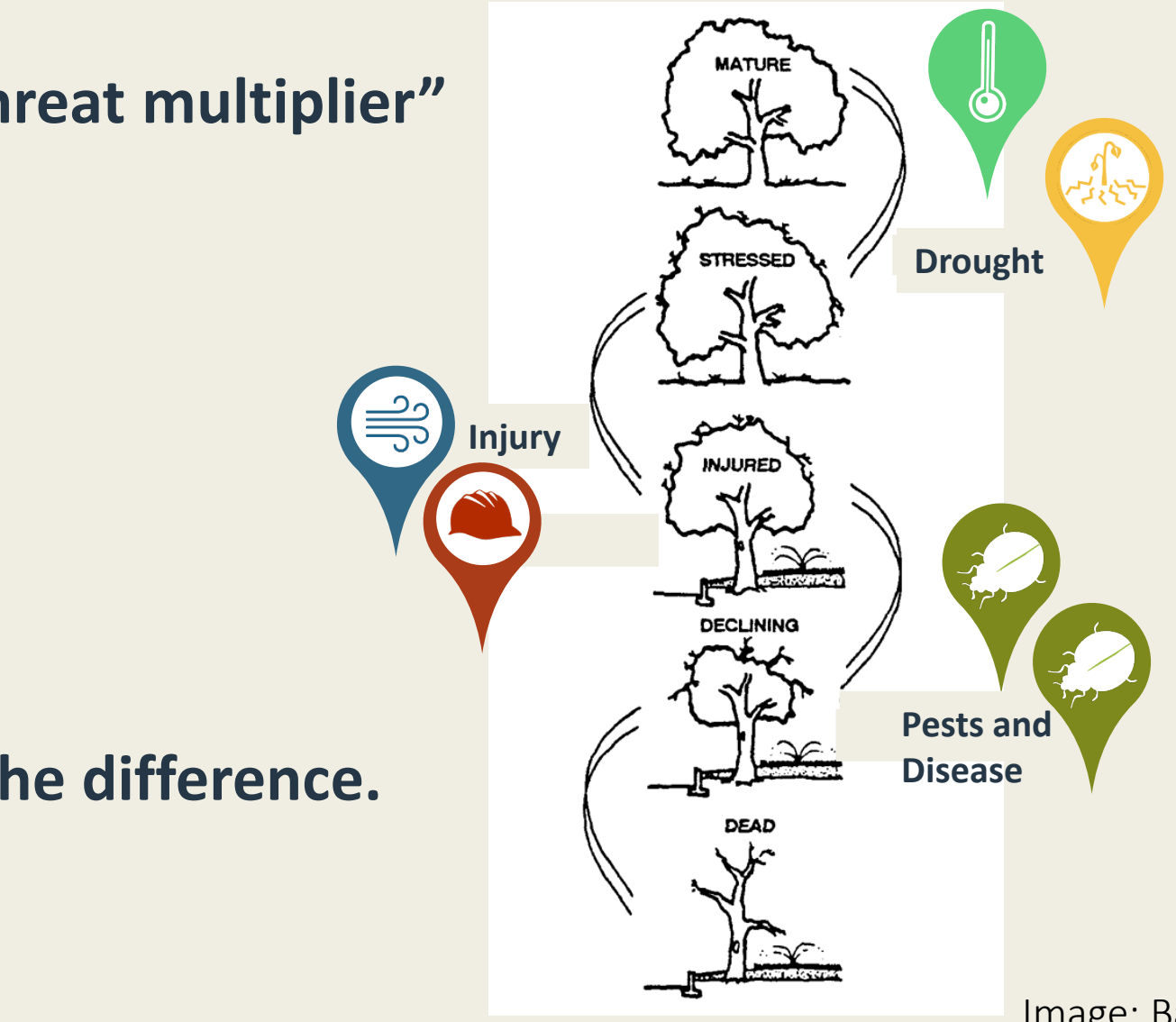


Image: Bartlett Tree Experts

FUTURE CHANGES IN CLIMATE

Anticipated Change in Climate	Evidence	Confidence
Warmer temperatures increasing another 5.3 to 9.1 °F	●●●	●●●
Longer growing season increasing another 20+ days	●●●	●●●
Shorter, warmer winters with less snow fall and snow cover	●●●	●●●
Sea levels rising by another 2 to 4.5 feet	●●●	●●●
Altered precipitation patterns with increased annual rainfall	●●●	●●●
Intense precipitation events that are more frequent and severe	●●●	●●●
Altered soil moisture potentially both wetter and drier	●●	●●●
Increased risk of drought stress during the growing season	●●	●●

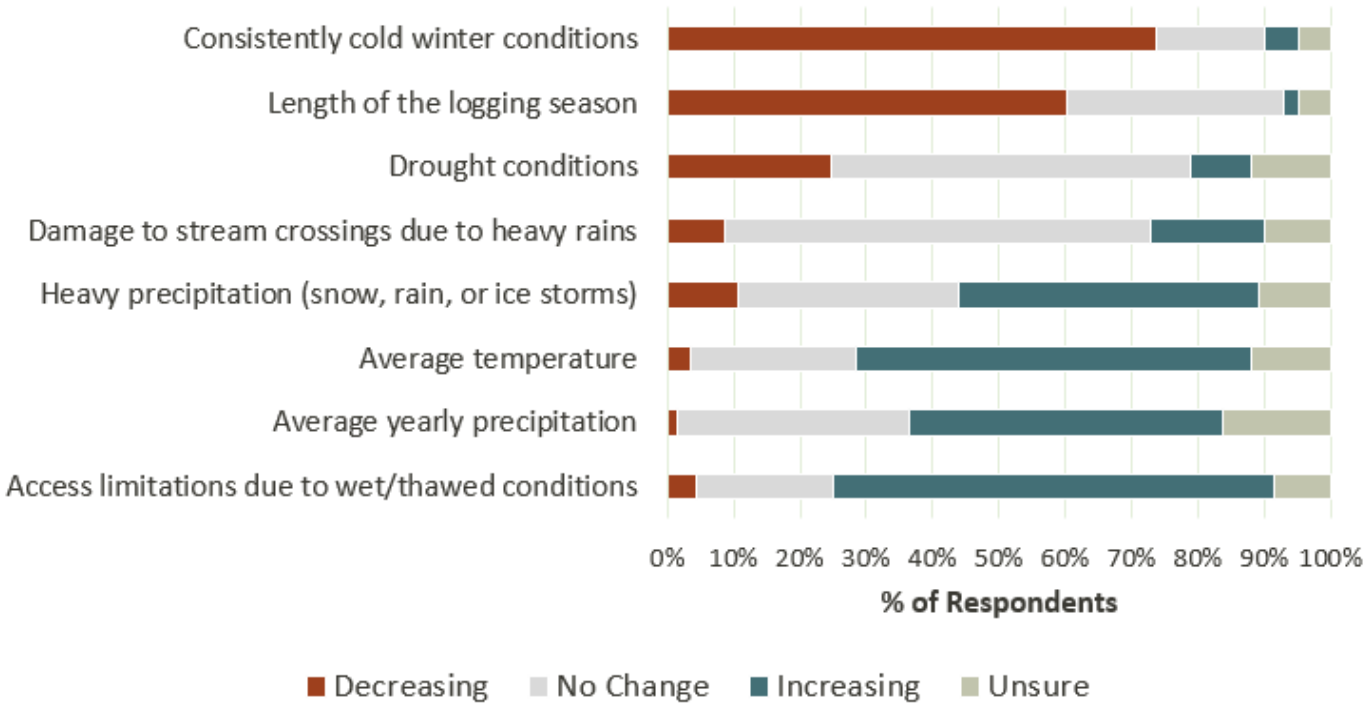
●●● = *robust/high*
●● = *medium*

LOGGERS AND LANDOWNERS

2020 Massachusetts Timber Harvester Survey

Harvesting Conditions

19. In your experience, have you encountered changes in any of the following conditions?



Family Forest Research Center
Woodland Owners Survey

TOP 5 CONCERNS

- Keeping land intact
- Property taxes
- Insects or diseases
- Invasive plants
- Climate change

Percentage of ownerships by landowners' level of concern about climate change (10+ acres)

Category	Value
Great Concern	34%
Concern	22%
Moderate Concern	21%
Of Little Concern	12%
No Concern	10%
Not Applicable	<1%

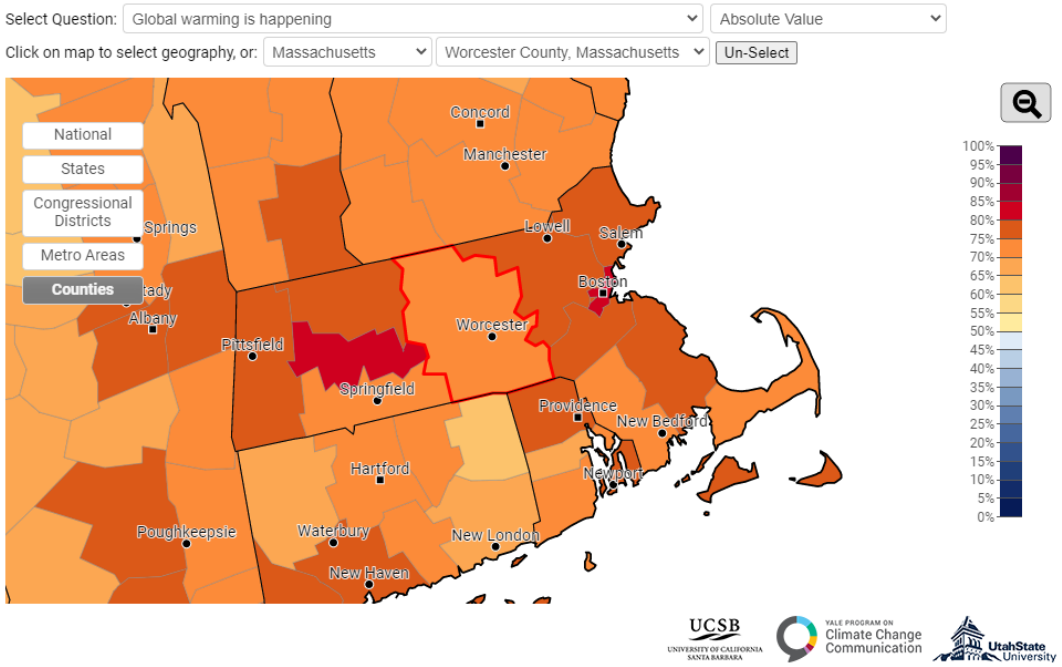
Massachusetts
(2018)

Category	Value
Great Concern	20%
Concern	20%
Moderate Concern	21%
Of Little Concern	15%
No Concern	21%
Not Applicable	2%

United States
(2018)

CURRENT PERCEPTIONS ON CLIMATE CHANGE

Estimated % of adults who think global warming is happening (nat'l avg. 72%), 2021



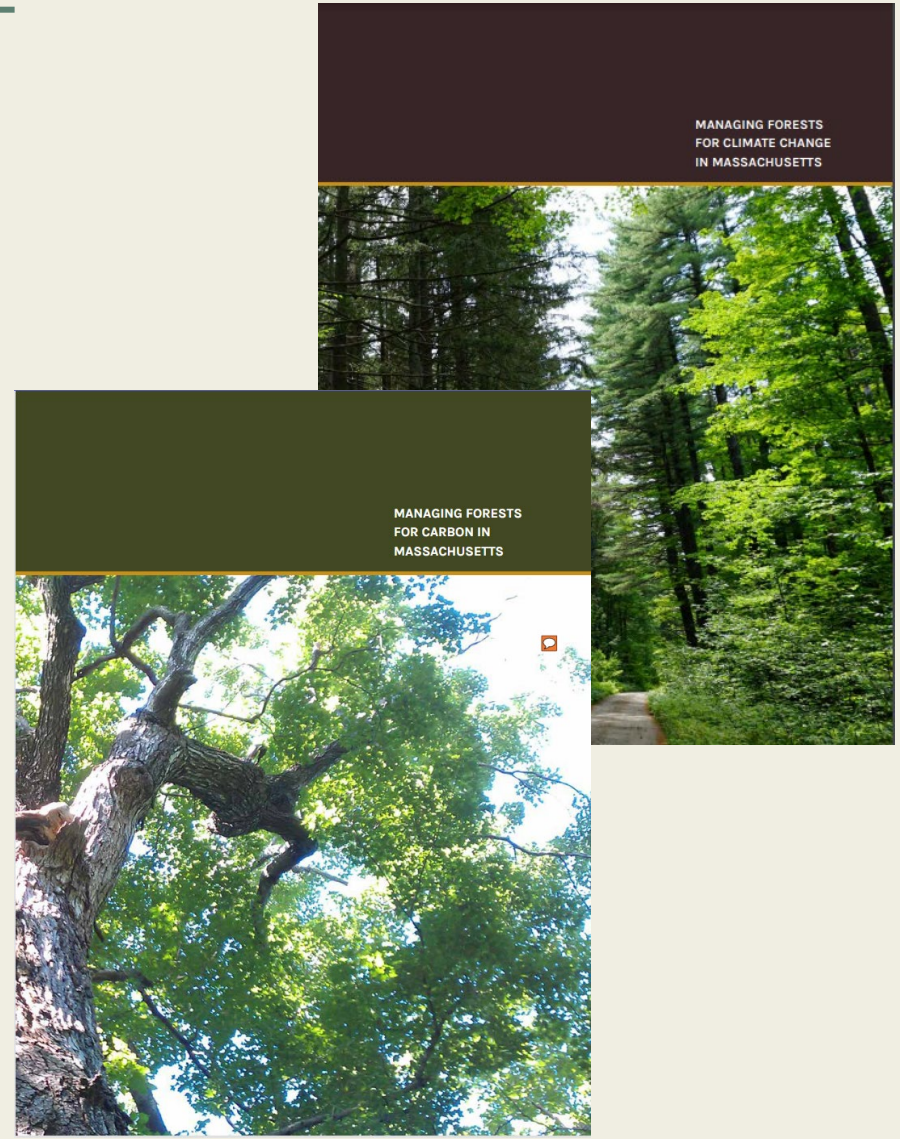
YALE PROGRAM ON
Climate Change
Communication

Supporting Landowner documents

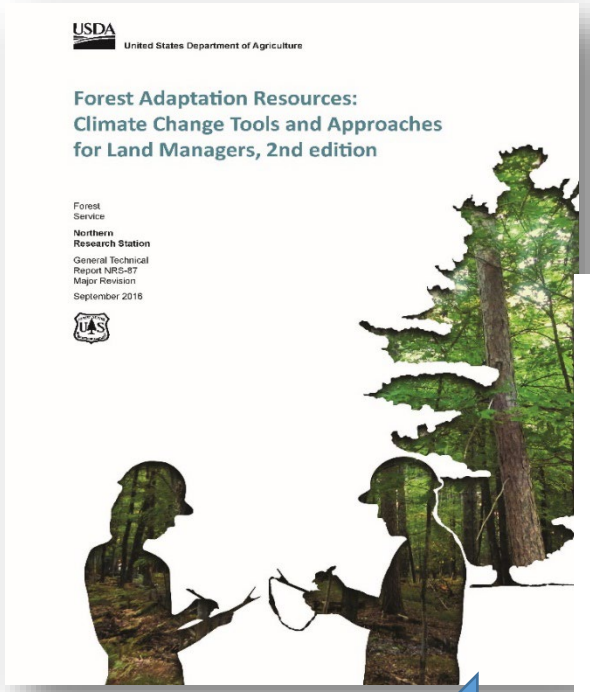
- Caring for your Woods - Setting Goals landowner guide—the items in this goals booklet are also part of a checklist in the FSP template and include checkboxes for both climate change and carbon, which provides a potential avenue for monitoring.
- Caring for your Woods - Adapting to Changing Conditions landowner guide – led by NIACS and summarizing best practices and no-regrets practices; could be adapted to other states/regions
- Caring for your Woods - Managing for Forest Carbon landowner guide – also led by NIACS broadly applicable to other states/regions

Supporting Forester Documents

- Forester Guide – Adaptation
  - ***Managing Forests for Climate Change Adaptation in Massachusetts*** **forester guide, that is parallel to a guide developed for the Forestry for the Birds program. The guide summarizes climate change impacts on forests in MA and provides an overview of how to integrate climate change consideration into developing management plans (broadly, not just FSPs) based on the NIACS Adaptation Workbook process.**



- Forester Guide – Carbon
  - Final draft



Executive Summary, Property Overview, Stand Descriptions, Management Practices

Conduct Forest Inventory and Habitat and Resilience Assessment

1. Management Goals

2. Climate Change Impacts and Vulnerabilities

Executive Summary, Property Overview, Stand Descriptions

3.Management Considerations for Climate Change

Property Overview

4. Management Actions for Climate Change

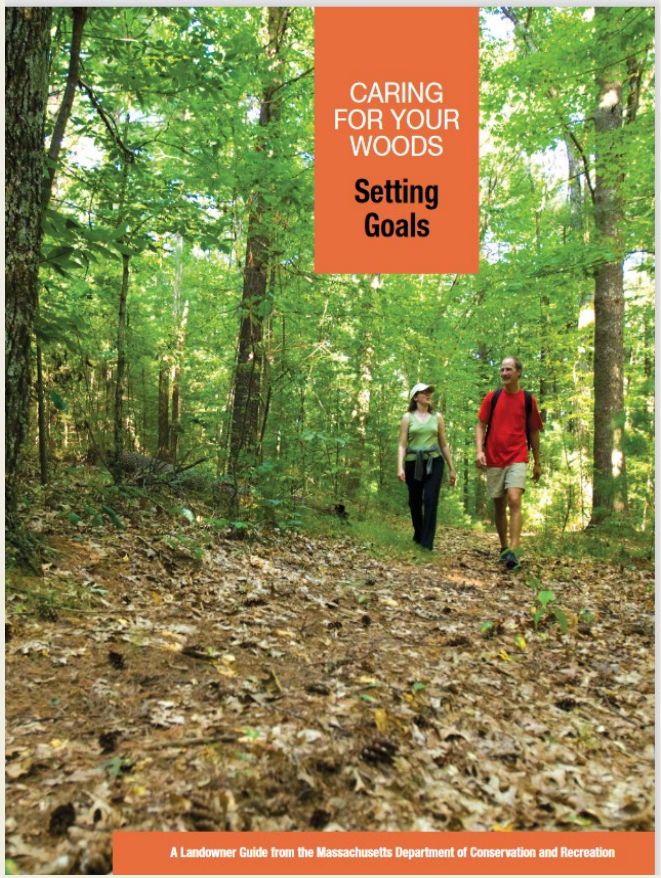
Executive Summary, Property Overview, Management Practices

5.Monitoring and Adaptive Management

Management Practices

Original Adaptation Diagram: Swanston et al. 2016 (2nd edition) www.nrs.fs.fed.us/pubs/52760
Modified by MA DCR for 2022 Forester Training

Landowner Goals Form



Landowner Goals

Please **check** the column that best reflects the importance of the following goals:

(goals may change over time and this table may be updated to reflect any changes)

Goal	Importance to Me			
	HIGH	MED	LOW	N/A, Don't Know
Improve access for walking/skiing/recreation				
Improve hunting or fishing				
Maintain or enhance privacy				
Preserve or improve scenic beauty	✖			
Protect special features, including those of historical or person significance				
Enhance the quality and/or quantity of forest products*	✖			
Practice agroforestry				
Produce income from timber products, or other products and services				
Produce firewood for personal use				
Enhance habitat for birds				
Enhance aquatic habitat in streams, ponds, and other wetlands				
Enhance habitat for wildlife				
Promote diversity of plant species and habitat types	✖			
Increase forest resiliency	✖			
Minimize damage from forest pests	✖			
Protect water quality				
Sequester and/or store carbon to mitigate climate change	✖			
Suppress or eradicate invasive plants	✖			
Lower property taxes				
Protect land from development				

*** This goal must be checked "HIGH" if you are interested in classifying your land under Chapter 61/61A.**

Owner(s) (print) _____ (This page will be included with the completed plan.)

Page ____ of ____

Stewardship climate plan

- Climate Change Impacts and Vulnerabilities
  - Property-level vulnerabilities
  - Near-term and long-term
- Climate Change Challenges and Opportunities for Management
  - Potential effects, positive or negative, of climate change impacts on forest carbon
- The general management approach –
  - Resist climate change, build ecosystem resilience, and/or help transition forests toward future conditions

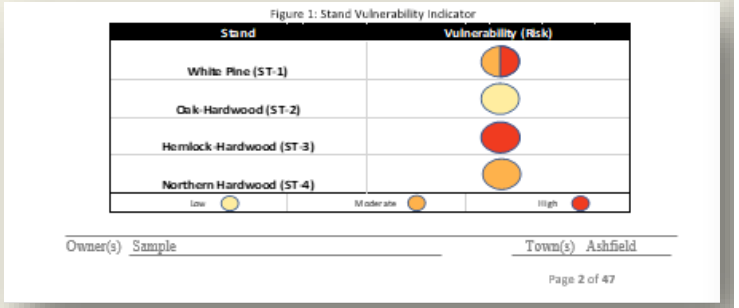


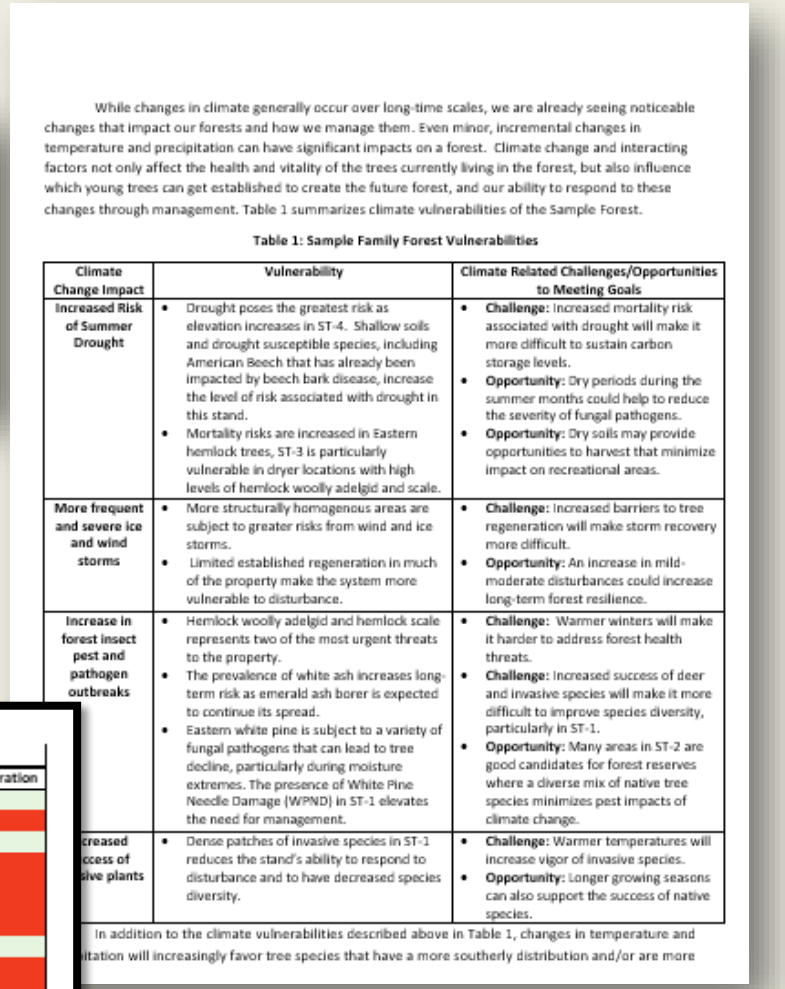
Figure 1: Stand Vulnerability Indicator

Stand	Vulnerability (Risk)
White Pine (ST-1)	
Oak-Hardwood (ST-2)	
Hemlock-Hardwood (ST-3)	
Northern Hardwood (ST-4)	

Low · Moderate · High

Owner(s) Sample Town(s) Ashfield

Page 2 of 47



While changes in climate generally occur over long-time scales, we are already seeing noticeable changes that impact our forests and how we manage them. Even minor, incremental changes in temperature and precipitation can have significant impacts on a forest. Climate change and interacting factors not only affect the health and vitality of the trees currently living in the forest, but also influence which young trees can get established to create the future forest, and our ability to respond to these changes through management. Table 1 summarizes climate vulnerabilities of the Sample Forest.

Table 1: Sample Family Forest Vulnerabilities

Climate Change Impact	Vulnerability	Climate Related Challenges/Opportunities to Meeting Goals
Increased Risk of Summer Drought	• Drought poses the greatest risk as elevation increases in ST-4. Shallow soils and drought susceptible species, including American Beech that has already been impacted by beech bark disease, increase the level of risk associated with drought in this stand. • Mortality risks are increased in Eastern hemlock trees, ST-3 is particularly vulnerable in dryer locations with high levels of hemlock woolly adelgid and scale.	• **Challenge:** Increased mortality risk associated with drought will make it more difficult to sustain carbon storage levels. • **Opportunity:** Dry periods during the summer months could help to reduce the severity of fungal pathogens. • **Opportunity:** Dry soils may provide opportunities to harvest that minimize impact on recreational areas.
More frequent and severe ice and wind storms	• More structurally homogenous areas are subject to greater risks from wind and ice storms. • Limited established regeneration in much of the property make the system more vulnerable to disturbance.	• **Challenge:** Increased barriers to tree regeneration will make storm recovery more difficult. • **Opportunity:** An increase in mild-moderate disturbances could increase long-term forest resilience.
Increase in forest insect pest and pathogen outbreaks	• Hemlock woolly adelgid and hemlock scale represents two of the most urgent threats to the property. • The prevalence of white ash increases long-term risk as emerald ash borer is expected to continue its spread. • Eastern white pine is subject to a variety of fungal pathogens that can lead to tree decline, particularly during moisture extremes. The presence of White Pine Needle Damage (WPND) in ST-1 elevates the need for management.	• **Challenge:** Warmer winters will make it harder to address forest health threats. • **Challenge:** Increased success of deer and invasive species will make it more difficult to improve species diversity, particularly in ST-1. • **Opportunity:** Many areas in ST-2 are good candidates for forest reserves where a diverse mix of native tree species minimizes pest impacts of climate change.
…creased …cess of …ive plants	• Dense patches of invasive species in ST-1 reduces the stand's ability to respond to disturbance and to have decreased species diversity.	• **Challenge:** Warmer temperatures will increase vigor of invasive species. • **Opportunity:** Longer growing seasons can also support the success of native species.

In addition to the climate vulnerabilities described above in Table 1, changes in temperature and …itation will increasingly favor tree species that have a more southerly distribution and/or are more

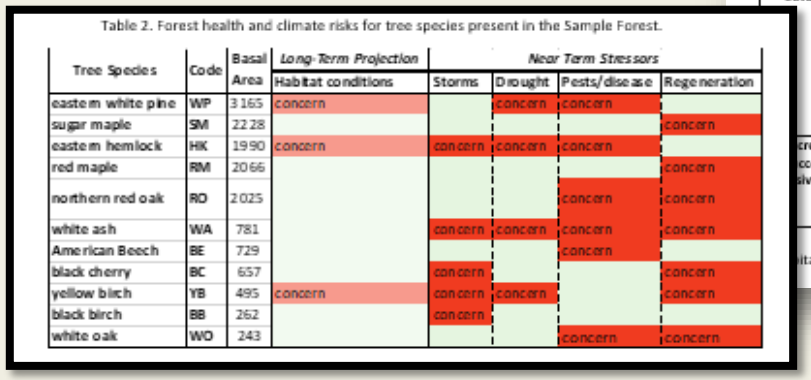


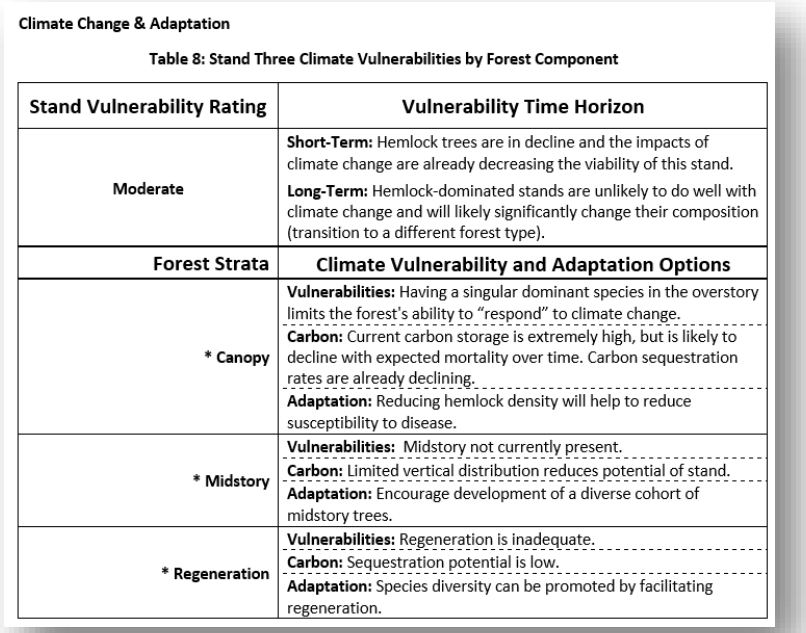
Table 2. Forest health and climate risks for tree species present in the Sample Forest.

Tree Species	Code	Basal Area	*Long-Term Projection*	*Near Term Stressors*			
			Habitat conditions	Storms	Drought	Pests/disease	Regeneration
eastern white pine	WP	3165	concern		concern	concern	
sugar maple	SM	2228					concern
eastern hemlock	HK	1990	concern	concern	concern	concern	
red maple	RM	2066					concern
northern red oak	RO	2025				concern	concern
white ash	WA	781		concern	concern	concern	concern
American Beech	BE	729				concern	
black cherry	BC	657		concern			concern
yellow birch	YB	495	concern	concern	concern		concern
black birch	BB	262		concern			
white oak	WO	243				concern	concern

THE LANDOWNER SHOULD BE LEFT WITH A SENSE OF HOW VULNERABLE VARIOUS STAND COMPONENTS ARE TO CLIMATE CHANGE AND WHETHER TO TAKE ACTION.

- Climate Change Adaptation – Describe how the management actions reduce climate risks, enhance resilience, and/or enable forests to adapt to anticipated future conditions.

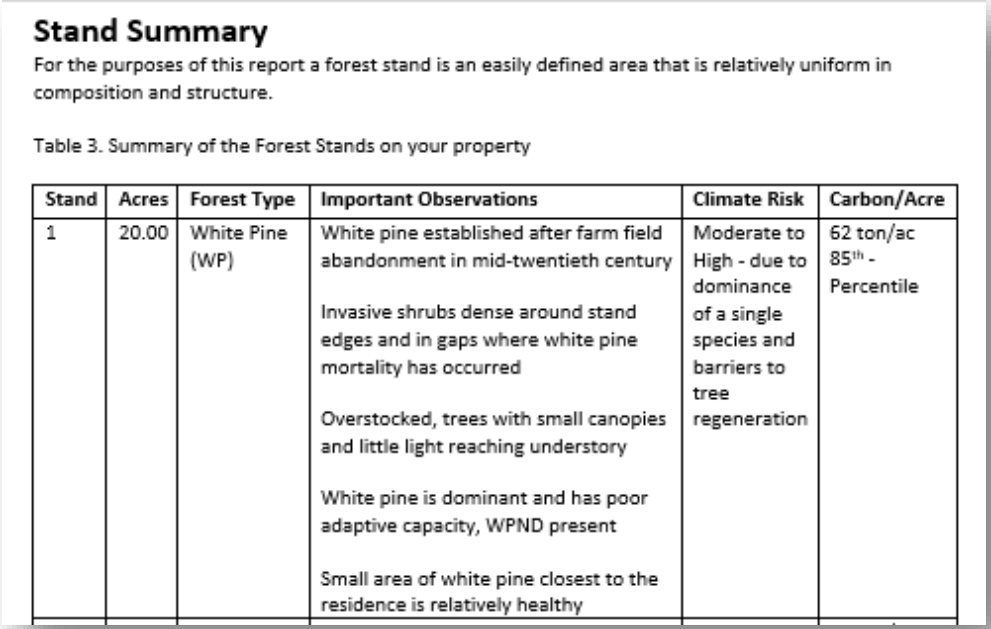
- Forest Carbon – Identify how management influences short- and long-term carbon sequestration and storage, including both enhancement of carbon and/or reducing the risk of carbon loss.



Climate Change & Adaptation

Table 8: Stand Three Climate Vulnerabilities by Forest Component

Stand Vulnerability Rating	Vulnerability Time Horizon
Moderate	**Short-Term:** Hemlock trees are in decline and the impacts of climate change are already decreasing the viability of this stand. **Long-Term:** Hemlock-dominated stands are unlikely to do well with climate change and will likely significantly change their composition (transition to a different forest type).
Forest Strata	**Climate Vulnerability and Adaptation Options**
* Canopy	**Vulnerabilities:** Having a singular dominant species in the overstory limits the forest's ability to "respond" to climate change. **Carbon:** Current carbon storage is extremely high, but is likely to decline with expected mortality over time. Carbon sequestration rates are already declining. **Adaptation:** Reducing hemlock density will help to reduce susceptibility to disease.
* Midstory	**Vulnerabilities:** Midstory not currently present. **Carbon:** Limited vertical distribution reduces potential of stand. **Adaptation:** Encourage development of a diverse cohort of midstory trees.
* Regeneration	**Vulnerabilities:** Regeneration is inadequate. **Carbon:** Sequestration potential is low. **Adaptation:** Species diversity can be promoted by facilitating regeneration.



Stand Summary

For the purposes of this report a forest stand is an easily defined area that is relatively uniform in composition and structure.

Table 3. Summary of the Forest Stands on your property

Stand	Acres	Forest Type	Important Observations	Climate Risk	Carbon/Acre
1	20.00	White Pine (WP)	White pine established after farm field abandonment in mid-twentieth century Invasive shrubs dense around stand edges and in gaps where white pine mortality has occurred Overstocked, trees with small canopies and little light reaching understory White pine is dominant and has poor adaptive capacity, WPND present Small area of white pine closest to the residence is relatively healthy	Moderate to High - due to dominance of a single species and barriers to tree regeneration	62 ton/ac 85th - Percentile

Estimating Forest Carbon

- **Purpose** – provide landowners with a general sense of how much carbon their forest stores and sequesters
- **Approach** –
  - Storage: relate to basal area
  - Sequestration: relate to stand age
- **Limitations** – not precise enough for carbon offset sales

Stand Descriptions

Carbon

Described broad strategies and actions to maintain or increase carbon benefit. These can include strategies that benefit sequestration, storage, or both, with specific actions detailed in stand descriptions.

Enhancing buffers around sensitive areas such as riparian zones preserves more carbon.

Creating gaps can increase species and age class diversity in your forest.

Management Recommendations

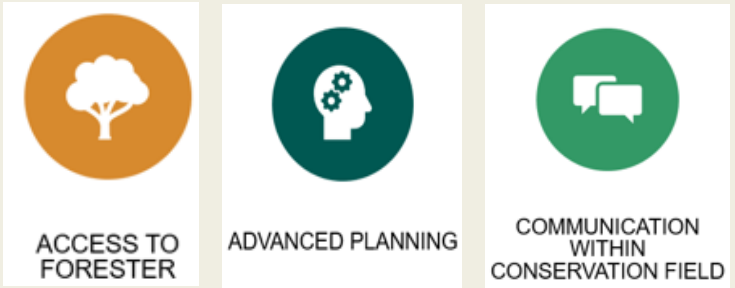
For the purposes of this report, management practices with an object code of 'CH61' are required to be accomplished as a commitment to the Massachusetts Current Use Program. Practices with object codes of 'STEW' are voluntary and are provided as suggestions of activities that can help you achieve your woodland objectives.

Stand(s)	Obj Code	Goal	Practice	Timing	Climate Benefits		Value/Cost/Cost Share
					Resilience	Carbon	
1 (2,3)	STEW	Suppress or eradicate invasive plants	Remove invasive vegetation	2023 - 2025	Improves regeneration capacity of forest	Increase carbon sequestration in native trees	Cost Potential NRCS cost-share
4	STEW	Minimize damage from forest pests	Beech brush treatment	2023	Reduce competition for healthy native trees	Increase carbon sequestration of healthy native trees and stability of carbon stocks	Cost Potential NRCS cost-share
2,4	STEW	Sequester and/or store carbon to mitigate climate change	Establish forest reserves	2023	Develop old-growth characteristics in healthy sections of stands	Maintain high carbon storage in areas with low vulnerability to climate and other stressors	Minimal cost associated with marking areas Lost income through not harvesting
1	CH61	Enhance the quality and/or quantity of forest products / Minimize damage from forest pests	Facilitate forest transition to better match future conditions (Transition)	2025 - 2027	Create conditions for establishment of diverse climate-adapted native tree regeneration	Convert dying trees into long-lived forest products to capture stored carbon / Enhance carbon sequestration in regenerating stands	Value of harvested trees
3	STEW	Minimize damage from forest pests	Facilitate forest transition to better match future conditions (Transition)	2025 - 2027	Create conditions for establishment of diverse climate-adapted native tree regeneration	Enhance carbon sequestration in regenerating stands	Cost Potential NRCS cost-share

Planning Goals

- linkages are made between climate change, vulnerability, landowner goals
- landowner should understand how the recommended management actions will help them meet their goals and be inspired to take action
- Foresters are able to assess property level climate vulnerabilities

Program Goals



Forest Climate Resilience Program
Family Forest Carbon Program
Other Carbon Programs
NRCS practices for climate or carbon
NEFF ‘s climate actions
Others still to come…….

Questions?

- https://www.mass.gov/info-details/state-forestry-laws-forms-and-instructions#directions-and-plan-forms-

- https://www.mass.gov/climate-forestry

Update on the New England Climate-Smart Forest Partnership

Massachusetts Land Conservation Conference

Jennifer Shakun,

Bioeconomy Initiative Director

March 25, 2023

NEW ENGLAND FORESTRY FOUNDATION

NEW ENGLAND FORESTRY FOUNDATION

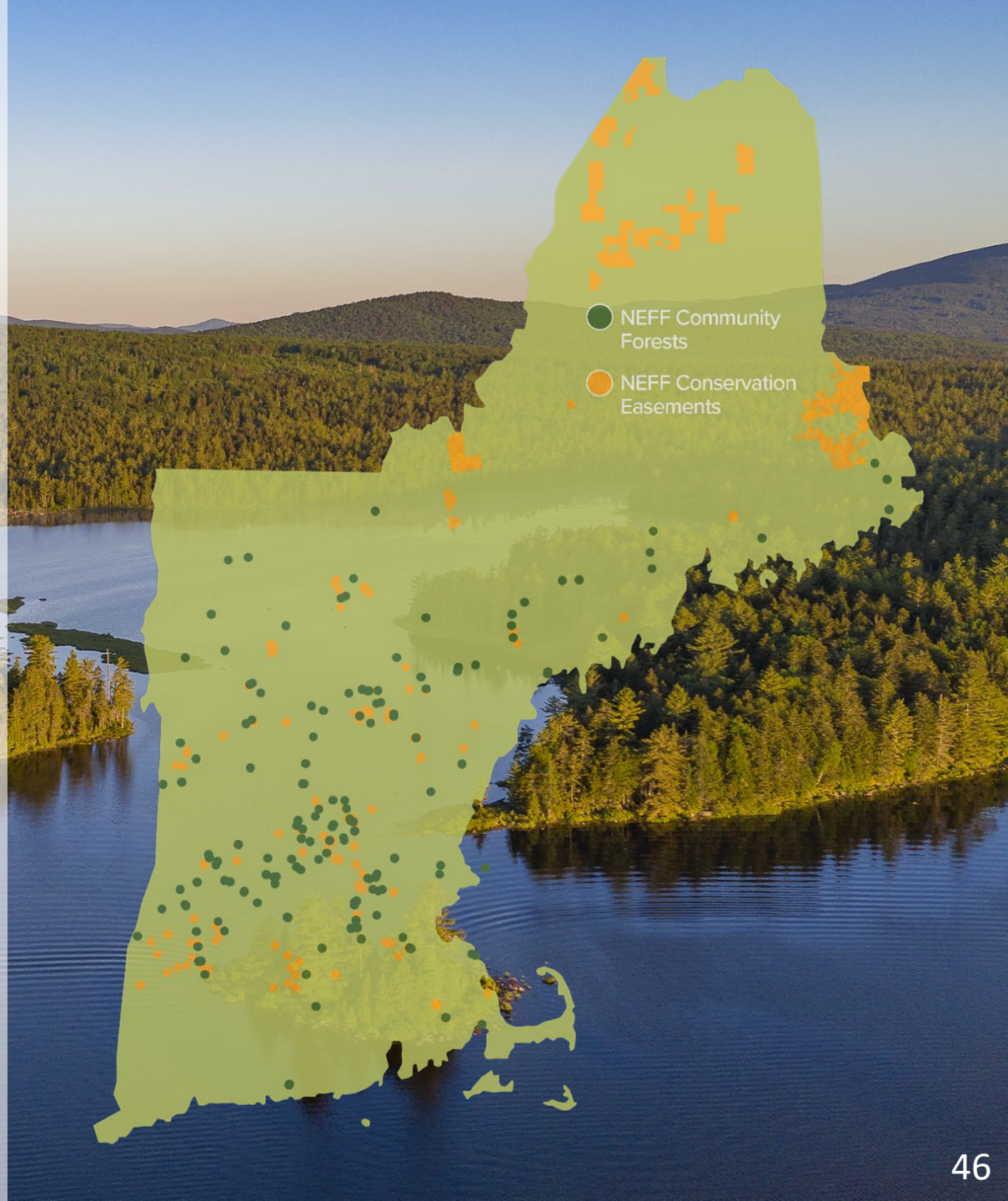
Conserving and Sustainably Managing Forests for Future Generations

1944
Year Founded

1.2 Million
Acres Protected

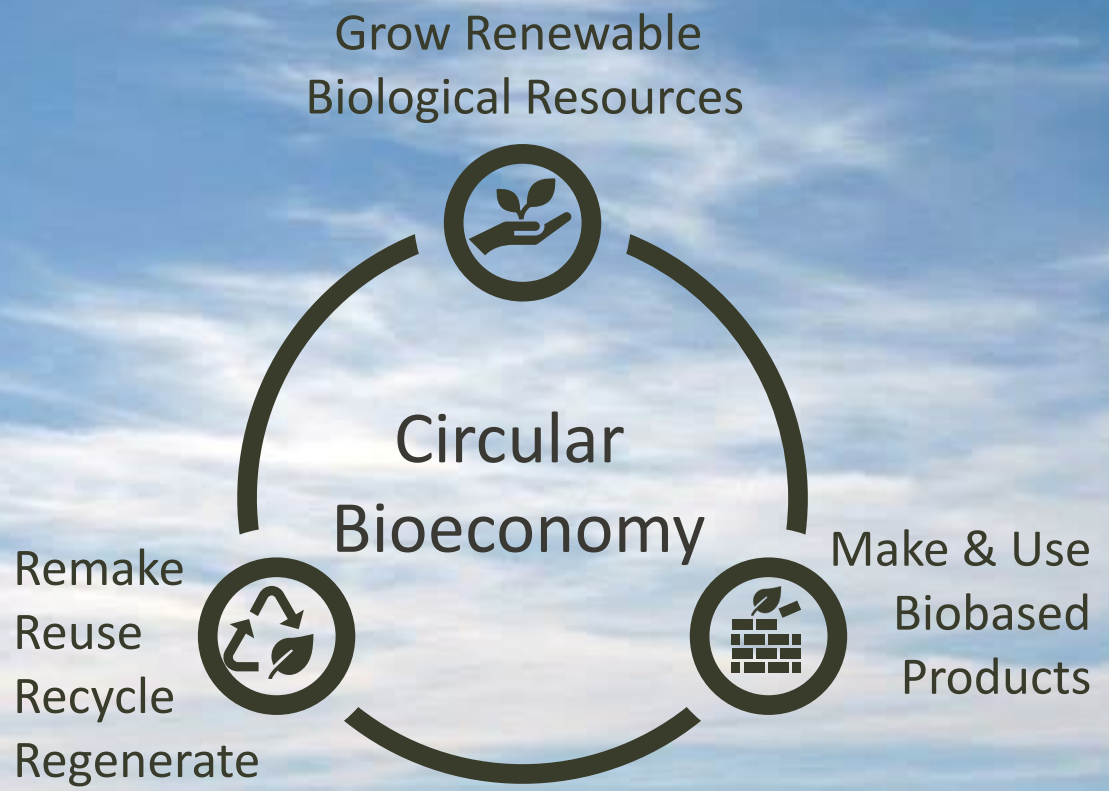
National Impact:
Third largest land trust in the U.S.

Specialties:
- Working Forest Conservation
- Exemplary Forest Management
- Climate Change Mitigation



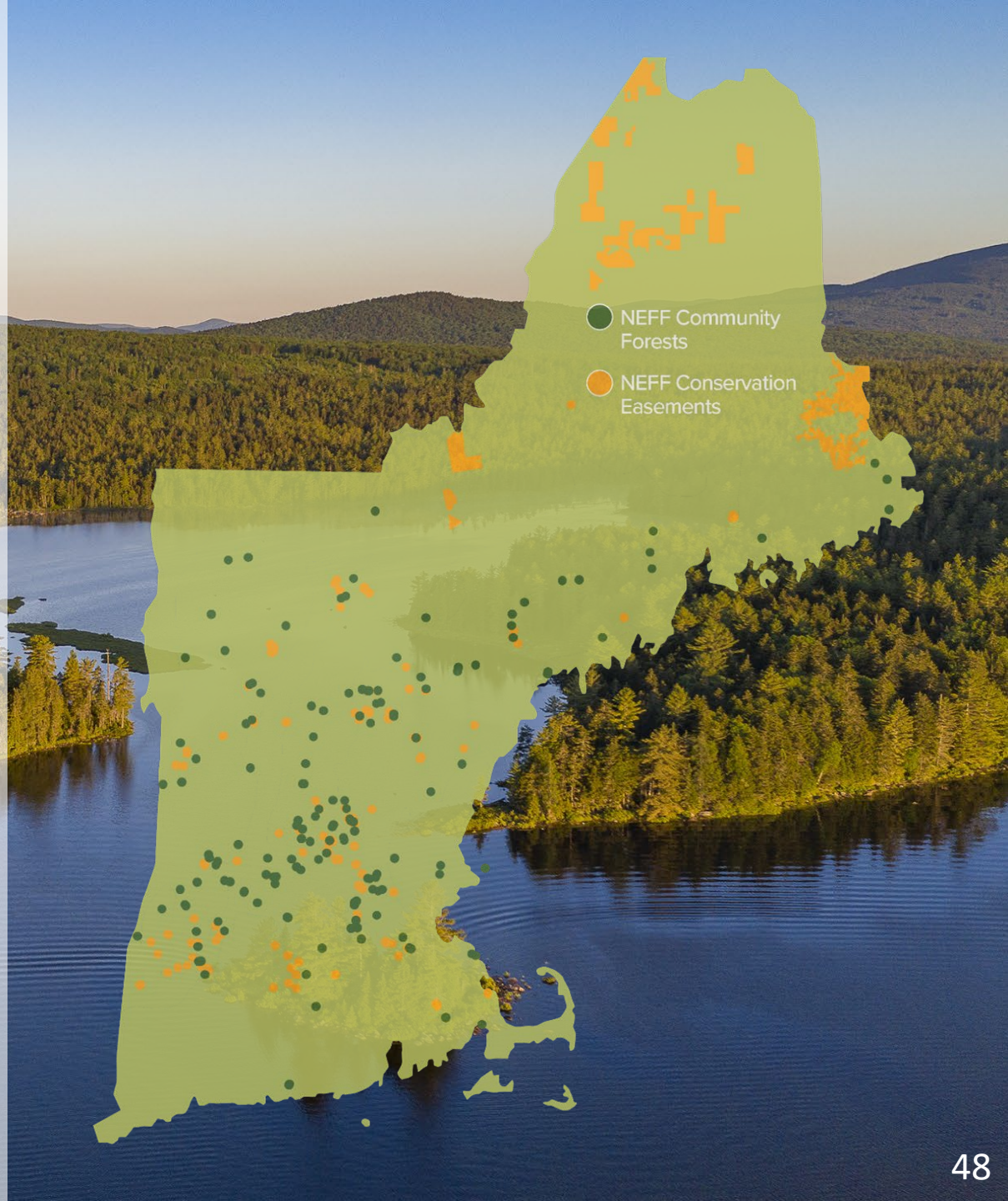
Solving the Climate Crisis

- ✓ Use less energy
- ✓ Switch to renewable energy
- ✓ Carbon removal
- ✓ Renewable materials



NEW ENGLAND FORESTRY FOUNDATION

- An advocate for forest-climate solutions
- A generator of new information and science on how Exemplary Forestry can advance the integrated goals of ecological health, forest carbon, and a dynamic bioeconomy
- A conservation landowner that actively manages forest land
- A collaborator in support of ecologically aligned forestry



End Forest Conversion to maintain CO_2 already stored

+

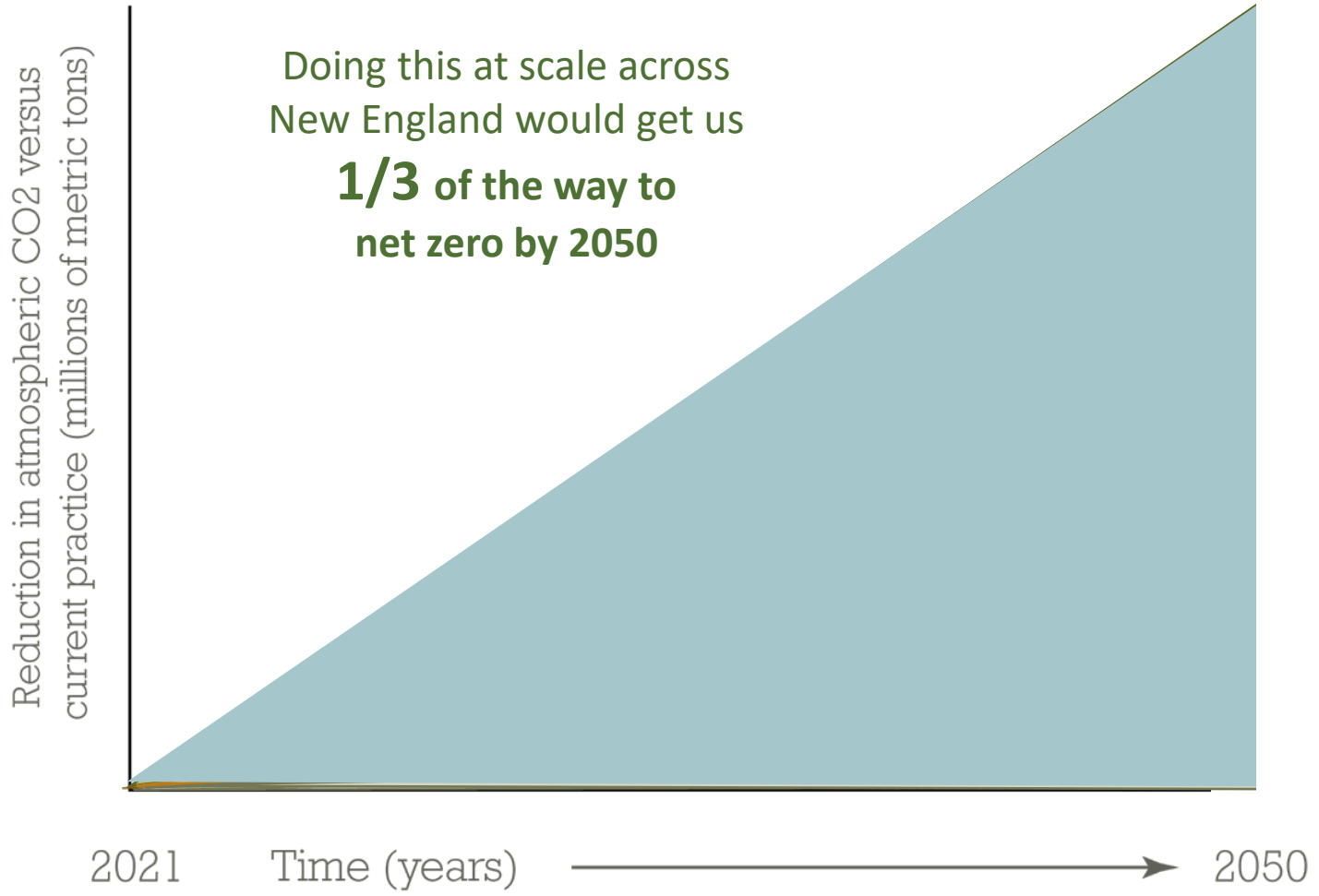
Climate-smart Forestry to remove and store CO_2

+

Wood Buildings to reduce emissions and store more CO_2

=

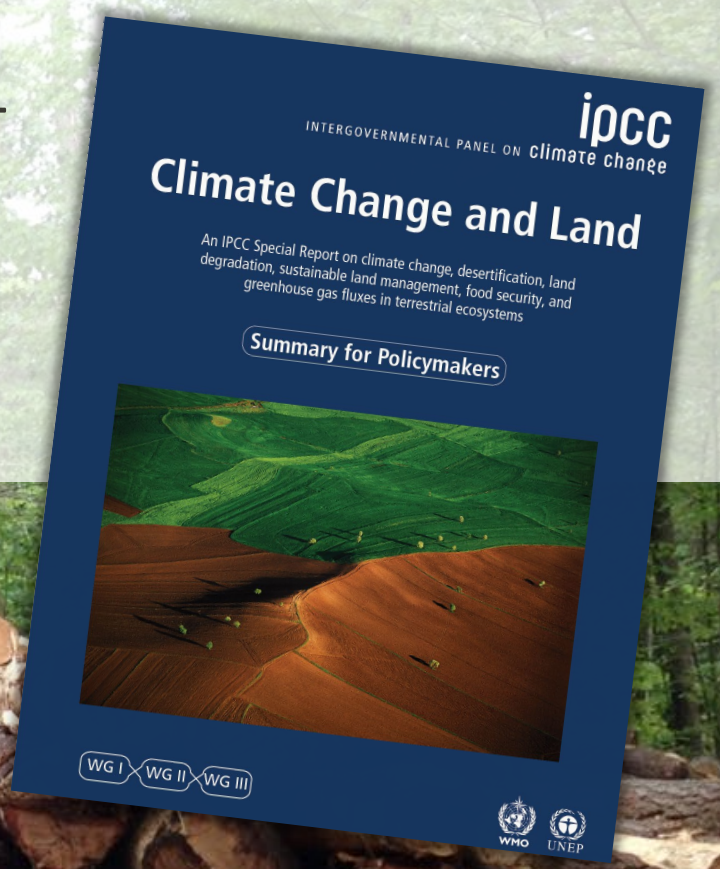
Major Climate Mitigation Benefit



https://newenglandforestry.org/learn/initiatives/30-percent/

"B5.4. Sustainable forest management can maintain or enhance forest carbon stocks, and can maintain forest carbon sinks, including by transferring carbon to wood products, thus addressing the issue of sink saturation (high confidence). Where wood carbon is transferred to harvested wood products, these can store carbon over the long-term and can substitute for emissions-intensive materials reducing emissions in other sectors (high confidence)."

Excerpt from IPCC special report on Climate Change and Land
Available at: https://www.ipcc.ch/srccl/



forests

MDPI

Article

Storing More Carbon by Improving Forest Management in the Acadian Forest of New England, USA

Robert Alec Giffen [1], Colleen M. Ryan [1,*], Ethan P. Belair [2], Michael A. Pounch [3] and Seth Brown [4]

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[2] The Nature Conservancy, Portland, ME 04011, USA
[3] Maine Bureau of Parks & Lands, Augusta, ME 04333, USA
[4] Quantified Ventures, Chevy Chase, MD 20815, USA
* Correspondence: cryan@newenglandforestry.org

Abstract: The capacity of forests to store carbon, combined with time-tested approaches to managing forests, make forests a useful tool for atmospheric carbon mitigation. The primary goals of this study are to determine the amount of unrealized mitigation available from Improved Forest Management (IFM) in the Acadian Forest of New England in the northeastern U.S., and to demonstrate how this mitigation can feasibly be attained. This study used the Forest Vegetation Simulator (FVS) to model the impacts of IFM practices articulated by the New England Forestry Foundation on carbon storage in the Acadian Forest. Our results, together with empirical data from well-managed forests, show that if the modeled improved management is employed on privately owned timberland across the Acadian Forest of New England, carbon storage could be increased by 488 Tg CO_2e. Our financial modeling shows that IFM could be funded in this region by combining income from carbon markets with the philanthropic funding of conservation easements, timber revenues, and capital investments from private investors who prioritize social and economic goals alongside financial returns. This study adds to the body of evidence from around the world that the potential for managed forests to contribute to climate change mitigation has not been fully realized.

Keywords: carbon storage; forest management; mitigating climate change; natural climate solutions; improved forest management

check for updates

Citation: Giffen, R.A.; Ryan, C.M.; Belair, E.P.; Pounch, M.A.; Brown, S. Storing More Carbon by Improving Forest Management in the Acadian Forest of New England, USA. *Forests* **2022**, *13*, 2031. https://doi.org/10.3390/f13122031

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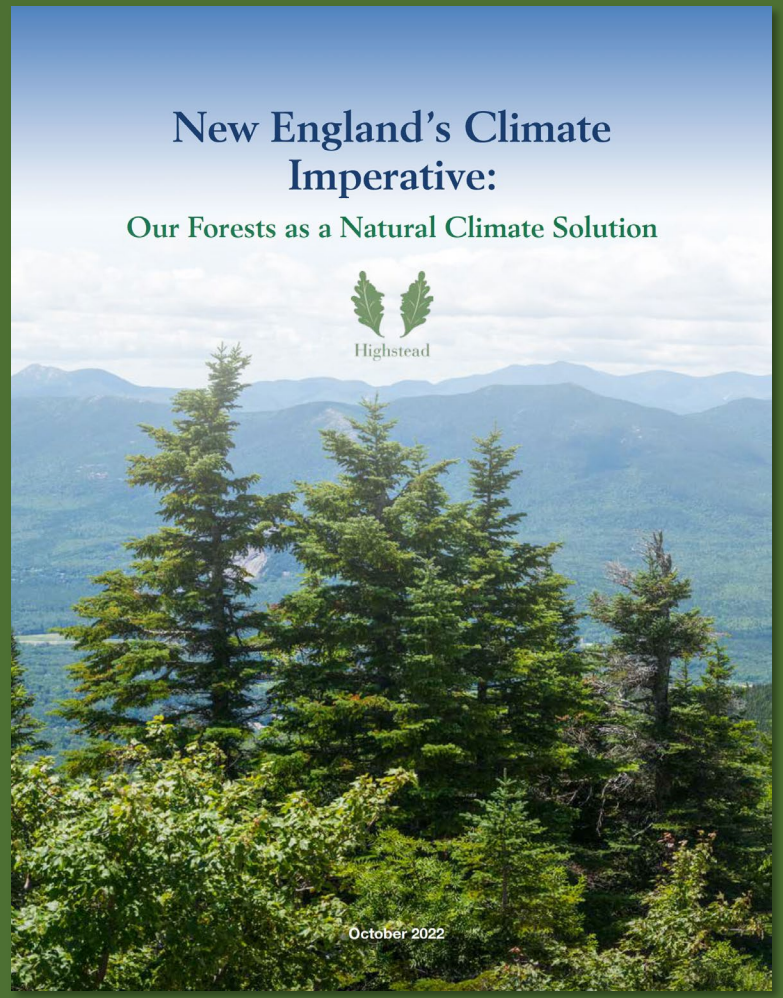
1. Introduction

The world's forests play a key role in mitigating climate change by both storing and sequestering carbon. Global forest ecosystems are estimated to store 861 Pg C, with 363 Pg C in live biomass (above and below ground; [1]). In addition, managed forests produce durable wood products that can store carbon and reduce greenhouse gas (GHG) emissions when they are substituted for alternative products with higher embodied emissions [2].

Forests already serve as a carbon sink globally, but recent work has demonstrated their capacity to do far more to mitigate climate change, and carbon markets are rapidly developing to incentivize a shift in management [3–5]. In contrast with other carbon sinks, such as blue carbon or peatlands, resource managers have more than a century of experience managing forests for a variety of outcomes, which can now include carbon storage [6,7]. Improved Forest Management (IFM) can lead to substantially increased carbon storage simultaneous with increased timber harvests, which allow for additional carbon storage in harvested wood products and reduced GHG emissions from substituting wood for more CO_2-emission-intensive materials [8]. This increase in carbon storage also produces a commodity product in terms of marketable carbon credits where markets exist, an increasingly common situation. While the specific opportunity will vary by forest type and region, studies indicate strong potential for increased climate mitigation in northeastern North America resulting from IFM in this region [9–11]. Additional analyses are needed to help document the scope and scale of such opportunities more broadly [7,12]. In this study,



USDA

U.S. DEPARTMENT OF AGRICULTURE

PARTNERSHIPS FOR CLIMATE-SMART COMMODITIES

USDA CSC requested projects that…

New England Climate-Smart Forest Partnership

Provide technical and financial assistance to producers to implement climate-smart production practices on a voluntary basis on working lands

Climate-Smart Forestry

Pilot innovative and cost-effective methods for quantification, monitoring, reporting and verification of greenhouse gas benefits

Monitoring, Verification, & Reporting

Develop markets and promote the resulting climate-smart commodities

Mass Timber for Affordable Housing

Mass Timber 101

UBC Media Relations; Credit: Acton Ostry, CC BY-NC 2.0

Sustainability & Smart Growth

- ✓ Lower emissions
- ✓ Carbon storage in the building
- ✓ Different pattern of development
  - ↑ density near transit
  - ↑ housing supply/ affordability
  - ↓ sprawl
  - ↓ transportation emissions
  - ↓ development pressure on forests

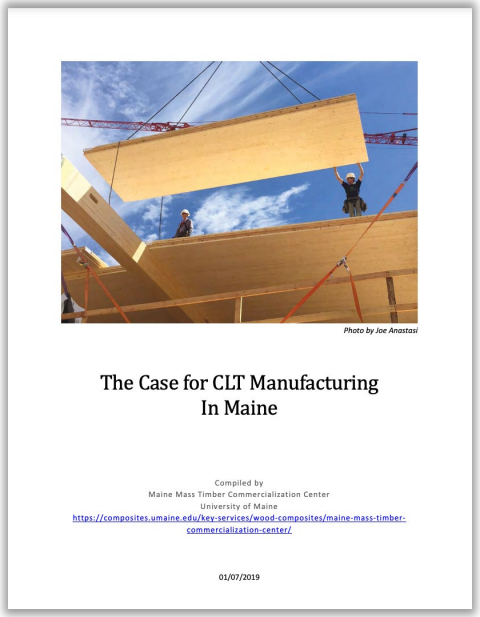
Tallest Timber Building (18-stories), Brumunddal, Norway

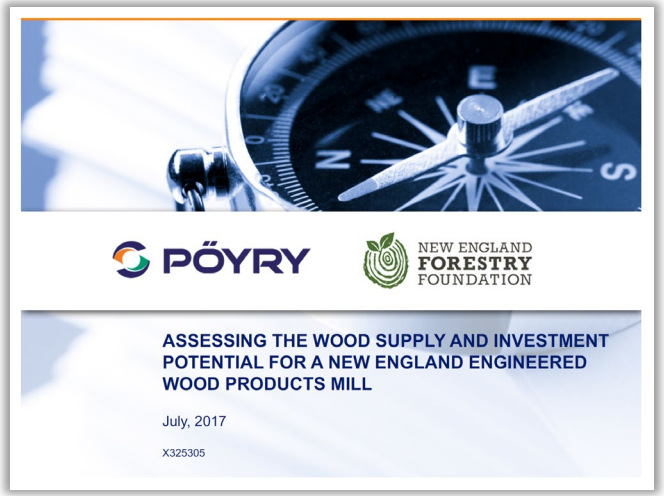
Mass Timber Species

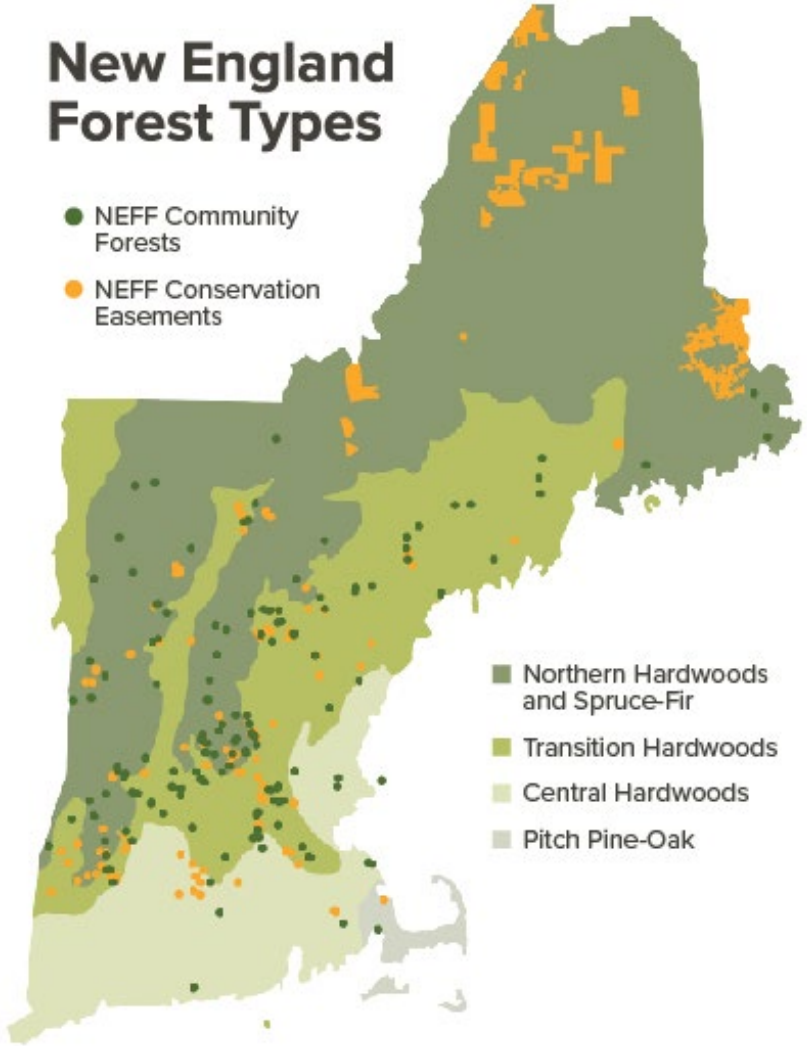
Mass timber is made from softwood lumber (e.g. pine, spruce, fir)

- ➢ New: Potential for hemlock

We have the species and supply…







USDA

U.S. DEPARTMENT OF AGRICULTURE

PARTNERSHIPS FOR CLIMATE-SMART COMMODITIES

BY THE NUMBERS

The U.S. Department of Agriculture is investing over **$3.1 billion** in **141 selected** projects under the Partnerships for Climate-Smart Commodities.

PROJECTS BY COMMODITY

- 42 — FRUIT, VEGETABLES, & SPECIALTY CROPS
- 31 — BEEF & LIVESTOCK
- 11 — DAIRY
- 19 — CORN & SOY
- TIMBER & FORESTS — 09
- 07 — COTTON & PEANUTS
- 05 — HEMP
- 05 — RICE
- 03 — ENERGY
- SORGHUM, WHEAT, & GRAINS — 09

$30 Million for…

Advisory Committee

1

Climate-Smart Forestry Incentives

- **$15.7M** (approx.) for incentive payments*
- Available to large and small private forestland owners, First Nations, foresters, and loggers
- $ to help implement uneconomic silvicultural practices that increase storage of carbon in the forest and in forest products

2

GHG Benefit

- Baseline monitoring
- Predict in-forest carbon benefits that will accumulate following application of climate-smart practices funded through this pilot
- Model increases in carbon stored in wood products and substitution benefits of wood vs. other materials.

3

Building Commodity Markets

- Support development of markets for climate-smart forest products to increase carbon storage in wood and substitute for carbon-intensive building materials
- Focus on mass timber for affordable housing--market potential, pilot prototype, outreach, innovative financing

* Cost share, with some exceptions

Partnership Coordinated By

NEW ENGLAND FORESTRY FOUNDATION

Delivery Partnerships

1

Climate-Smart Forestry Incentives

- Commercial Landowners
- American Forest Foundation/Family Forest Carbon Program (Small Landowners)
- First Nations & UMaine
- Trust to Conserve Northeast Forestlands

2

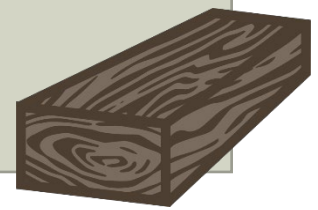
GHG Benefit

- Expert Advisors/Resource Economists
- AFF/FFCP
- University of Maine
- Spatial Informatics Group
- Innovative Natural Resource Solutions, LLC
- Quantified Ventures

3

Building Commodity Markets

- WoodWorks
- Spiritos Properties
- Leers Weinzapfel Associates
- Climate-smart forestry partners/experts

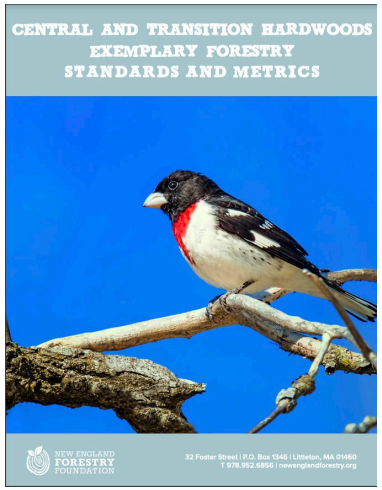


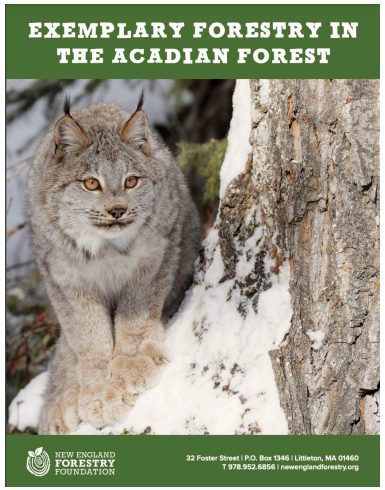
Climate-Smart Forestry Practices

CSF applied through the program will integrate forest ecological health with the role forests play to absorb and store carbon, serving three combined outcomes:

- ✓ Improved wildlife habitat and biodiversity
- ✓ Increased carbon sequestration and storage
- ✓ Harvesting more sustainably produced wood.

Practices will be informed by:





American Forest Foundation

The Nature Conservancy

Family Forest Carbon Program

Example Practices*

- Planting to improve species composition
- Pre-commercial thinning
- Early commercial thinning
- Improved silviculture in certain small-diameter low-value stands, where harvesting is not currently financially feasible and where improved silviculture will increase productivity and reduce rotation ages.
- Maintaining very heavily-stocked old growth stands and legacy trees

* *Not a complete or final list*

Same original stand regenerated @ 40 years ago after a clearcut, on the same site within 100 yards of one another

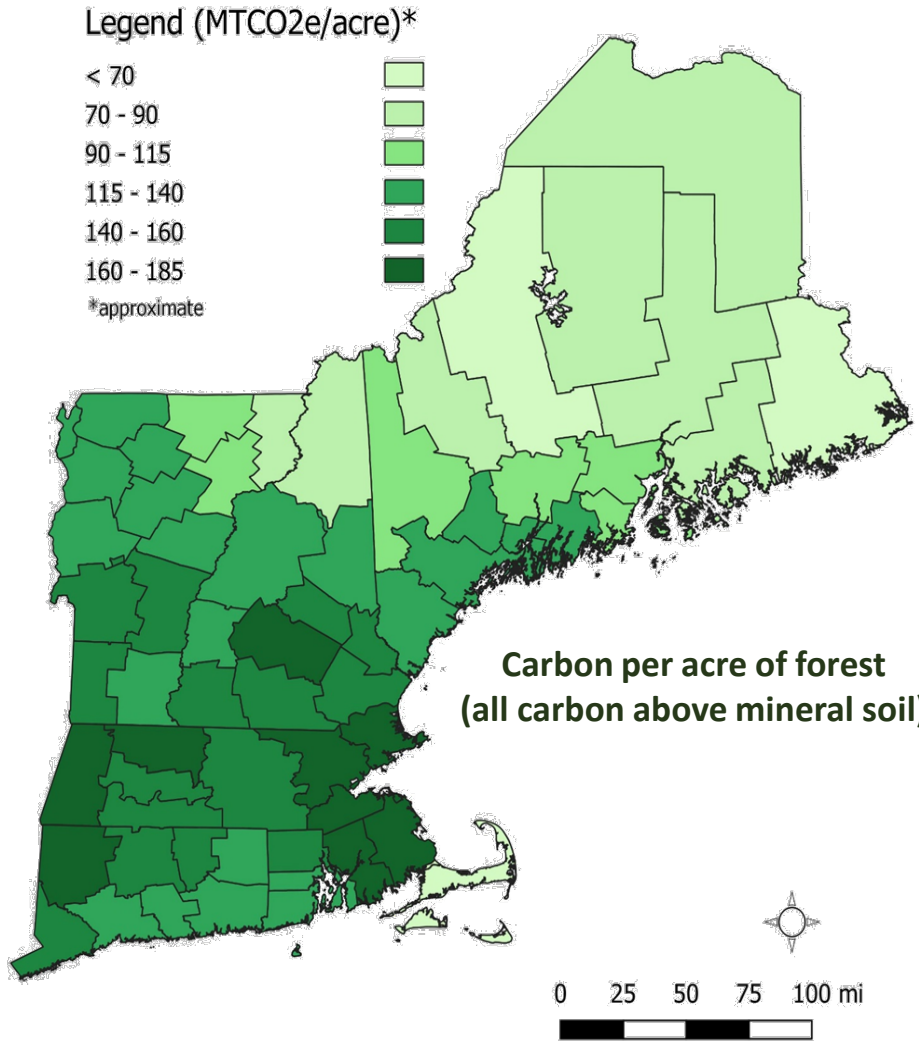
No Treatment

Pre-Commercial Thinning 20 years ago

Regional Context Informs Outreach & Implementation Strategy

- **Northern New England -** Commodity production of pulp for bioenergy and paper has reduced average stocking and degraded many forest lands.

- **Southern New England -** Decline of wood products industry has resulted in reduced harvests for decades, with greater and greater carbon stocking in the woods, particularly near developed areas.



Informational Webinar

Wednesday, April 26th @ 1:00 - 2:30 pm

Introducing NEFF's Climate-Smart Forestry Partnership:
A Win for the Forests, Climate, and Communities of New England

We welcome you to join us and our USDA partners for an informational webinar and panel discussion.

Panelists will include Richard Campbell of the American Forest Foundation's Family Forest Carbon Program, Ted Wright of the Trust to Conserve Northeast Forestlands, Jeff Spiritos of Spiritos Properties, and Dan Hudnut of Wagner Forest Management, Ltd.

Please register in advance:
bit.ly/Climate-Smart-Zoom

Join Our Team!

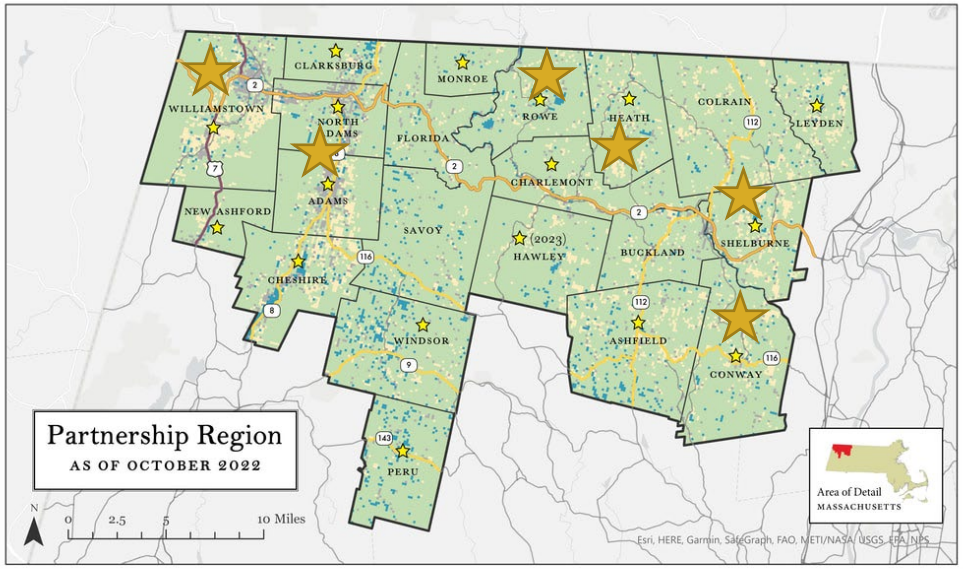
NEFF is expanding – join our group of passionate, high-level and visionary forest and climate professionals.

- **Senior Forester**
- **CSC Program Forester**
- **CSC Forest Biometrician**
- **CSC Climate-Smart Wood Sourcing Specialist**
- **Outreach Manager for Climate-Smart Forestry**
- **CSC Project & Grant Coordinator**
- **Staff Forester**
- **Woodlands Partnership Coordinator**

Position descriptions and application information at: https://newenglandforestry.org/about/careers-2/

Forest Climate Resilience Program Pilot

- Program Design
  - Climate-Smart Forestry Practices Manual
- Demonstrating Implementation
  - Forest Stewardship Climate Plan
  - Practice Implementation
  - Monitoring



OHKETEAU

Mass Audubon

NIACS
Northern Institute of Applied Climate Science

The Nature Conservancy

dcr
Massachusetts

NEW ENGLAND FORESTRY FOUNDATION

MVP
Municipal Vulnerability Preparedness

Massachusetts Woodlands Institute
A SUBSIDIARY OF FRANKLIN LAND TRUST

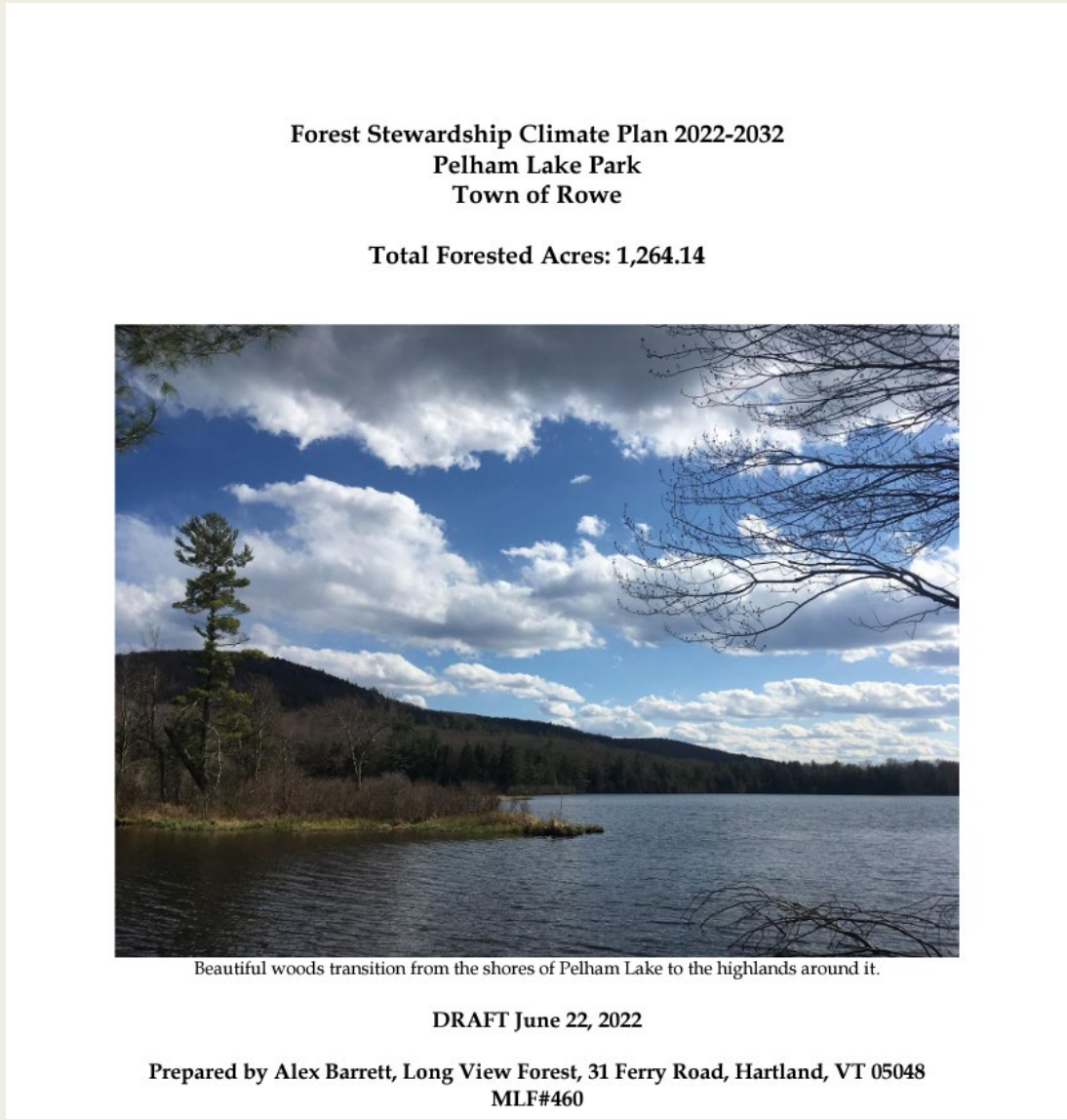
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

BRPC
Berkshire Regional Planning Commission

frcog
Franklin Regional Council of Governments

FCRP Step 1: Forest Stewardship Climate Plan

- Landowner (Town) obtains a Forest Stewardship Climate Plan (FSCP)
  - Contains Climate-Smart Practices
  - Implementation recommendations over 10 years
- 6 municipalities received FSCPs for 11 properties totaling 4300+ acres



Forest Stewardship Climate Plan 2022-2032
Pelham Lake Park
Town of Rowe

Total Forested Acres: 1,264.14

Beautiful woods transition from the shores of Pelham Lake to the highlands around it.

DRAFT June 22, 2022

Prepared by Alex Barrett, Long View Forest, 31 Ferry Road, Hartland, VT 05048
MLF#460

FCRP Step 2: Climate-Smart Practice Implementation

- Technical assistance
  - Operational Planning in 2 towns
- Cost-share
  - Long-term vision – dedicated state funding
  - Pilot –grant funding for municipalities

FCRP Step 3: Monitoring

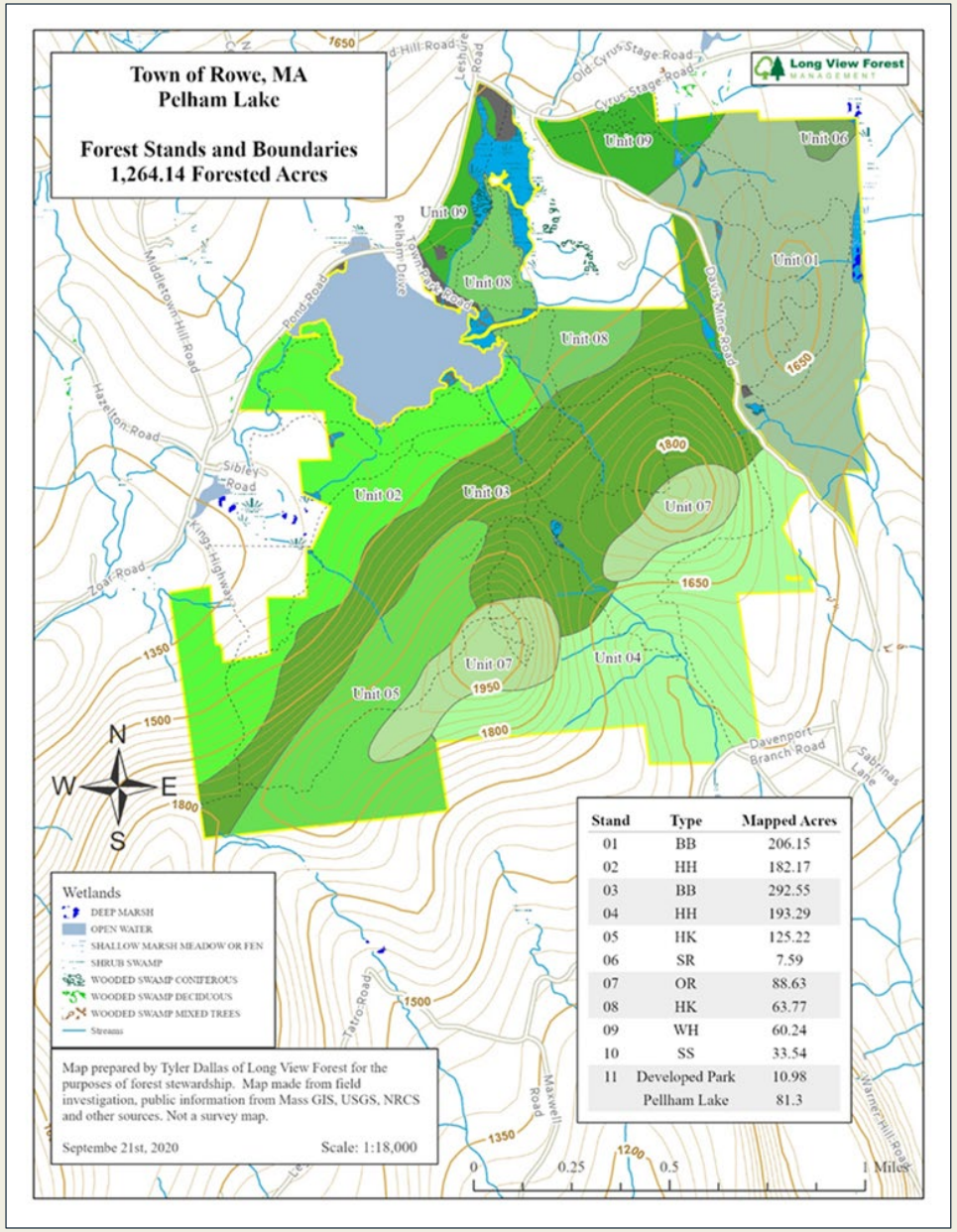
- **Practice Implementation:** post-implementation site visit and documentation
- **Adaptive Management:** identify the need for follow up treatments
- **Practice Outcomes:** permanent monitoring plots to measure practices success long-term.

Case Study: Climate-Smart Forestry Practices at Pelham Lake Park in Rowe

Alex Barrett
Forester,
Longview Forest

Pelham Lake Park

- 1955 Percy Brown gift
- 1264 forested acres
- Covenant and non-covenant areas
- Governance and Town involvement
- Current goals: resilience, biodiversity, trails, and recreation
- Forest stewardship process, 2018 to present- working with a large group
  - Forest Stewardship Plan- Mary Wigmore co-author
- Trade-offs among multiple landowner values



Community Engagement

- Foresters worked closely with Park Commission and Manager
- Rowe townspeople- woods walks, zoom, surveys
- Rowe Elementary School

Climate-Smart Forestry Practices

- **Keeping the Forests We Have**
  - Land protection
  - Trail improvement, data, maintenance
- **Reduce Stressors**
  - Hemlock monitoring plots
  - White ash- inoculation
  - Climate-smart trails and trail infrastructure
- **Grow New Forests and Trees**
  - Assisted migration planting of white and red oak
- **Let Trees Grow**
  - Old growth demonstration area
- **Shape the Future Forest**
  - Patch Cuts with reserves and fences
  - Thinning in spruce/pine

Long View's Jeff Dacey on planting day

Hemlock Wooly Adelgid Monitoring

- Trees still healthy, but HWA observed
- 4 plots with 30-40 trees per plot
- Monitoring led by Park Staff, teachers, consultant and students

Park Manager Sean Loomis helps 2nd graders measure hemlock trees in a monitoring plot

Climate-smart trails and trail infrastructure

- 20+ miles of trail
- Longview mapped all trails and noted vulnerabilities
- Regulatory challenges
- Summer Crew labor

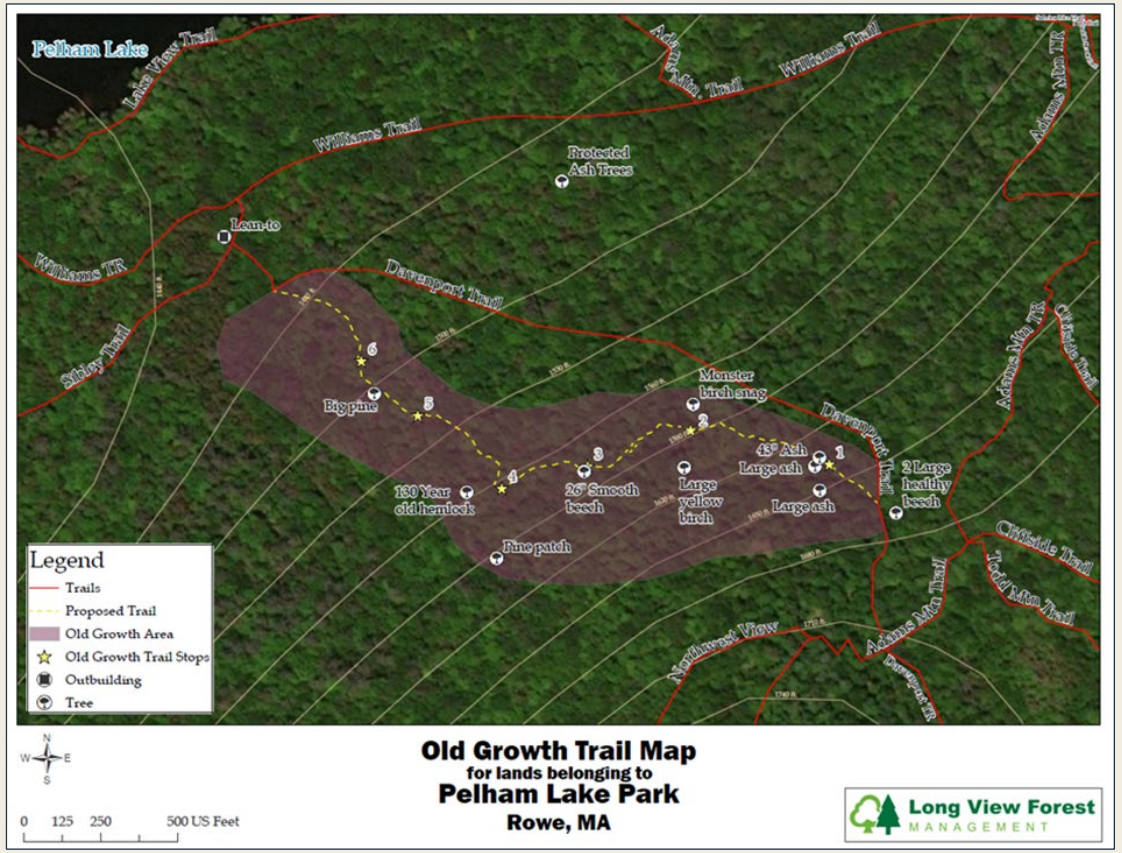
An elevated boardwalk made of local timber replaces a vulnerable section of bog bridges

Assisted Migration and Enrichment

- Planted 100 white oak, 100 red oak in three patches
- Grant funded – short timeline
- Seedlings sourced from Michigan
- Pre-cutting of beech sprouts
- Crew of 4, 9-hour day
- Hemlock wooly adelgid on site
- Ongoing monitoring and tweaking

Old Growth Demonstration Trail

- Highlight carbon dynamics
- Old growth features with some human intervention planned




Questions?
climateforestry@massaudubon.org
massaudubon.org/csf