Forests and Forest Products as a Natural Climate Solution for Michigan

Lauren Cooper, Program Director
Daphna Gadoth, Senior Research Assistant
FCCP Background
FCCP Expertise

- Forest ecology, biology, and management
- Graphic design, animation, data visualization
- Advanced statistical analysis, carbon modeling, survey design
- Stakeholder engagement, program management
- Writing, synthesis, and presentation for diverse audiences
Professional Short Course

Understanding Forest Carbon Management

• Launched 2019
• ~400 participants
• 20+ countries
• Natural resource managers, policymakers, C project managers/analysts, corporations, industry, NGO’s
SPEAKER LINEUP
2022-23 FORESTS + CLIMATE LEARNING EXCHANGE SERIES

OCT. 12
Innovative Approaches to Forest Carbon Monitoring and Measurement
Colin Beier, SUNY ESF
Mark Bradford, Yale

NOV. 2
Assessing landscape-scale, climate-smart forest management strategies: Is it possible?
Aaron Weiskittel and Erin Simons-Legaard,
The University of Maine

DEC. 7
Use of FIA Data to Determine the Carbon Footprint of a Large Forest Landowner
Thomas Fox, Rayonier, Inc.

JAN. 4
Tax Dimensions of Forest Carbon Projects
Tamara Cushing, University of Florida

FEB. 1
Assessing the Economic Impacts of Forest Carbon Management
Raju Pokharel and Shivan Gc,
Michigan State University

MAR. 1
Resilience, Equity, and Nature-Based Climate Solutions in New York City
Timon McPhearson, The New School
Emily Maxwell, The Nature Conservancy

APR. 5
Remote Sensing Technology for Improved Forest Carbon Inventory
Monika Moskal, University of Washington

MAY. 3
Looking at Forest Carbon from Multiple Dimensions: Evaluating Tradeoffs and Opportunities to Forest Carbon Management
Tony D'Amato, University of Vermont

JUN. 7
Dimensions of Urban and Community Forestry
Asia Dowlin, Michigan State University
Beattra Wilson, U.S. Forest Service

Additional Sponsors
Forest Carbon and Climate Program
Department of Forestry
MICHIGAN STATE UNIVERSITY
Open Source Library (FCCP ORL)

Interactive Module

USDA Climate Change Resource Center (CCRC)

Forest Carbon Science, Policy, and Management

A Brief Introduction

Intensives on Forests, Climate, and Carbon - US Regions

- Focused content designed to take learners beyond the basics of forest carbon science
  - In-depth analysis of trends, challenges, and opportunities for a chosen US region
- Original maps and figures
  - Created using spatial analyses and FIA data
  - Illustrate status and trends of forests and forest carbon dynamics within each region
Background: Forests and Climate
The Greenhouse Effect

1. Solar radiation passes through the clear atmosphere.

2. Some solar radiation is reflected by the atmosphere and earth's surface.

3. Remaining solar radiation passes to earth's surface.

4. Solar energy is absorbed by the earth's surface and warms it. This is converted into heat causing the emission of IR back to the atmosphere.

5. Some of the IR is absorbed and re-emitted by GHG molecules. The direct effect is the warming of the earth's surface and the troposphere. Surface gains more heat and IR is emitted again.

6. Some of the IR passes through the atmosphere and is lost in space.
Recent Trends in CO$_2$ and Temperature

Global Temperature and Carbon Dioxide

What are “NCS”?

Natural climate solutions: conservation, restoration, and improved land management actions in landscapes and wetlands that:

1. increase carbon storage, or
2. avoid greenhouse gas emissions

NCS offer some of the best options in the response to climate change (Griscom et al. 2017)

- When combined with clean energy and other efforts to decarbonize economies
- Can provide roughly 37% of CO₂ mitigation needed by 2030 for a >66% change of holding warming below 2 °C
NCS Opportunities

• Reforestation = highest climate mitigation potential across 21 NCS assessed for the US

• Opportunity Assessment conducted in 2019 for MI (next slide)

• Reforestation pathway: 3,122,474 tCO2e/yr
  • C gain rates represent a 20-yr annual average
  • 2nd highest C gain potential of all pathways assessed
  • Reflects potential on all lands in the state that were historically forested but now have <25% tree cover

Fargione et al. 2018
MI Opportunities

**Michigan Carbon Gain Potential**

- **Forest Restocking**: 3,266,462 tCO2e/yr
- **Reforestation**: 3,122,474 tCO2e/yr
- **Reforestation: Peri-urban Open Space**: 1,839,807 tCO2e/yr
- **Reforestation: Frequently Flooded Landscapes**: 1,338,024 tCO2e/yr
- **Reforestation: Biodiversity Corridor**: 1,025,732 tCO2e/yr
- **Reforestation: Challenging Agricultural Lands**: 943,578 tCO2e/yr
- **Reforestation: Riparian Buffer**: 472,843 tCO2e/yr
- **Reforestation: Post-fire Restocking**: 138,097 tCO2e/yr
- **Silvopasture**: 3,053,339 tCO2e/yr
- **Avoided Grassland Conversion**: 2,316,988 tCO2e/yr
- **Legume Cover Crops**: 1,601,133 tCO2e/yr
- **Cropland Nutrient Management**: 813,397 tCO2e/yr
- **Avoided Forest Conversion**: 698,894 tCO2e/yr
- **Urban Reforestation**: 626,682 tCO2e/yr
- **Grassland Restoration**: 179,218 tCO2e/yr

*Reforestation subpathways are not mutually exclusive.*
Agriculture

Cover crops  Conservation tillage  Crop rotations  Compost amendment

Grassland restoration  Legumes in pasture  Grazing optimization

EMERGING
Biochar  Deep soil inversion

Image source: Mulligan et al. 2020
Wetlands and waterways

• Wetlands contain a disproportionate amount of the earth’s total soil carbon; holding between 20 and 30% of the estimated 1,500 Pg of global soil carbon despite occupying 5–8% of its land surface (Nahlik and Fennessy, 2016)

• Conditions characteristic of wetland soils slow decomposition and lead to the accumulation of organic matter

• In Michigan we have swamps, bogs, marshes, and fens

Map of the distribution of wetland probability sites

Nahlik and Fennessy, 2016
NE Regional Overview

Forests, carbon, and climate-oriented management in this region
Forest Overview

- One of the most highly forested regions in the US
  - >40% total land area forested (68.8 million hectares)\(^1\)
- Home to >40% of U.S. population\(^2\)
- Large variation in forest types
  - Stretching from the Mississippi river to the Atlantic coast
  - High biodiversity and climatic variation present

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\(^1\) USDA Forest Service 2005
\(^2\) Shifley et al. 2016

Figure: FCCP 2021

% of Tree Canopy Cover

Data Source: Sexton et al, 2013
30m resolution
Carbon Storage

**Forest Carbon Density: Total carbon**

**Forest Carbon Density: AG Live & Dead**

**Forest Carbon Density: Soil organic**

Forest Background

Figures: FCCP 2021, using USFS FIA data

Forest Carbon and Climate Program
Department of Forestry
MICHIGAN STATE UNIVERSITY
Changing Precipitation Regimes

• More heavy precipitation with increasing storm events & extreme weather
  • More water goes into runoff instead of groundwater recharge
  • Increased soil & streambank erosion

Risk may be greatest:
• Traditionally dry sites with species that aren’t adapted to significant precipitation or standing water
• Riparian sites & buffer zones where erosion from severe precipitation can cause mortality and limit regeneration

Figure: Walsh et al., 2014
Shifts in Temporal Dynamics

- Earlier springs and longer growing seasons
- Freeze-thaw cycles can damage tissues and alter soil processes
  - Bud damage with increased potential for "late" spring frosts
  - Conifers are particularly susceptible
- Increased evapotranspiration
  - Drought stress

Figure: Wolfe et al. 2018 in Koehler 2018

Projected change in final spring, and first fall, frost dates from 1994 to 2055.
Climate Change as a “Threat Multiplier”

*Interactions* between climate change impacts increase disturbance likelihood & severity

- **Drought**
  - Causes moisture stress in trees and reduces their resistance to other disturbances (i.e., pests & diseases)

- **Pests**
  - Warming winters provide better conditions for insect outbreaks
  - Forests with high levels of insect-induced mortality have increased wildfire risk

- **Fire**
  - Burned stands have reduced soil moisture and provide shelter to forest pests

Example: Oak decline has been widely observed across the Northeast and is believed to be caused by a suite of concurrent stressors acting on the trees. Invasive pests, drought, fire suppression, and soil compaction are all believed to contribute to decline and together, can cause mortality.
Ecological Concerns for Forest Management

• Appropriate restoration of heterogeneity in vegetation
• Promoting resilient ecosystems
• Adapting to changing climate conditions
• Supporting biodiversity goals
• Water protection

Active management involves social and ecological tradeoffs, including tradeoffs for carbon goals.

Helpful approaches include:
• Assessment of risks
• Monitoring
• Cross-boundary collaboration
Carbon Implications of Common Forestry Practices:
Afforestation & reforestation

- Both practices benefit carbon sequestration by increasing the density of trees, increasing site productivity as trees establish and grow larger.
- Sequestration benefits from reforestation are typically highest on sites where natural regeneration is low or unpredictable.
Carbon Management in the Northeast

APPROACH: Increase carbon stocking on well-stocked or understocked forest lands

Example TACTICS:

- Increase retention when harvesting, including during commercial thinning and regeneration harvests

- Protect forests through creating or enhancing reserves, especially in high carbon density areas or sites with low vulnerability

- Extend buffer zones around wetlands and riparian zones when conducting harvests

Best suited for:
Michigan NCS in Action
State of Michigan

- Climate Alliance Regional Learning Labs in NWL
  - FCCP was the state facilitator for MI
  - Created interactive spreadsheet used by states
  - Pre- and post- team meetings on the Climate Alliance, NWLs, and the
- Output: NWL Pathways Document

Identifying priorities, opportunities, and barriers with the State of Michigan at the regional USCA meeting in St. Paul, MN, fall 2019
Governor signed Executive Order Sept 2020 committing to carbon neutrality by 2050
- Economy will lower emissions in line with state targets and Paris Agreement
- Carbon neutrality further indicates ongoing emissions will need to be offset
- Michigan 10th state to commit to 100% economic carbon neutrality
- Points to potential need to offset emissions in the land sector
- Executive Order also created an advisory Council on Climate Solutions
  - Cooper appointed to co-chair NWL working group
Council on Climate Solutions

- Cooper appointed co-lead of Natural and Working Lands Group by Governor Whitmer in 2020
  - with Scott Whitcomb (MDNR)
- Over 1 year, lead ~130 diverse individuals into recommendations
- Reporting the Council and continuing engagement as expert
# Workgroups and Co-Chairs

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<td>Douglas Jester, 5 Lakes Energy</td>
<td>Charlotte Jameson, Michigan Environmental Council</td>
<td>Charles Griffith, Ecology Center</td>
<td>Steven Holty, Hemlock Semiconductor</td>
<td>Lauren Cooper, MSU</td>
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<td>Katherine Peretick, Commissioner</td>
<td>Karen Gould, MPSC</td>
<td>Judson Herzer, LEO</td>
<td>Robert Jackson, EGLE</td>
<td>Scott Whitcomb, DNR</td>
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1. Maintain and develop healthy forests across public and private land.

2. **Implement a Healthy Soils Act for Michigan** in which the Legislature and Governor can set a floor for future funding and attract additional funding for soil, water, and habitat conservation by recognizing that protecting and enhancing the state's soils have a direct impact for climate solutions.

3. **Protect existing wetlands and waterways, create new and restore wetlands** where appropriate, and increase carbon storage in waterway green infrastructure in increase both mitigation and adaptation benefits.

4. **Enhance and develop a transformative bioeconomy** that:
   1. implements and promotes natural, sustainable, and low-emission materials production and use
   2. reduces emissions across all NWL commodities (agricultural and forest products)
   3. reduces waste and increases efficiency, and 4) promotes sustainable land use planning

5. **Promote climate initiatives and ensure multi-level action for mitigation and adaption** across natural and working lands by acting in a leadership capacity, fostering enabling conditions, promoting knowledge transfer, and increasing access to needed data and information.
NRCS Regional Conservation Partnership Program

• Reforestation Project: **Climate Action and Reforestation in Northern MI**

• Partnership with MDARD, MI DNR, TNC, WRI, Huron Pines, Arbor Day Foundation, USDA NRCS

• Project: $5,393,506 to plant trees on 16,400 acres in 27 counties in the Northern Lower Peninsula
Overall project aims

1. Develop new forested areas and keep them that way
   • Influence the economics that drive land use decisions
   • Minimize incentives to develop/agricultural conversion

2. Make restocking and reforestation more attractive to landowners

3. Increasing emphasis on carbon storage and climate in programs and communication

4. Boost capacity to engage in dialogue and incentives around carbon values for forests
RCPP Reforestation Project

Partnership with MI MDARD, MI DNR, TNC, WRI, Huron Pines, Arbor Day Foundation, USDA NRCS

FCCP Activities

• Research:
  • **Carbon**: assess sequestration benefits using a forest planning and analytics model (Remsoft) using site-specific inputs
  • **Social and Economic Impacts**: topics include potential future revenue generated from forest harvest and potential tax benefits.
  • **Assessment of landowner likelihood** of new practice adoption/ effectiveness of knowledge transfer materials

• Outreach/ Knowledge Transfer
  • Supporting knowledge gaps among landowners
  • Implement ‘train the trainers’ learning session for implementing partners focusing on carbon storage and management, carbon measurements, and emerging carbon incentive programs
Thank you!

Contact
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