Climate Change Response Framework for Landscape Management

A case study

Northern Research Station USDA Forest Service
Northern Institute of Applied Carbon Science

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Overview

- USDA-FS climate strategies
- Climate change education and adaptation
- Case study in northern Wisconsin
  - approach and setting
  - project components
  - ongoing progress and challenges

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
  - Advance our understanding of climate change and its effects

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
  - Enhance the capacity of forests and grasslands to adapt

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
- Mitigation
  - Promote the management of forests and grasslands to reduce the buildup of greenhouse gasses

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
- Mitigation
- Policy
  - Integrate climate change into all FS policies, program guidance, and communications

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
- Mitigation
- Policy
- Sustainable operations
  - Reduce the FS environmental footprint

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
- Mitigation
- Policy
- Sustainable operations
- Education
  - Advance awareness and understanding

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

- Science
- Adaptation
- Mitigation
- Policy
- Sustainable operations
- Education
- Alliances
  - Establish and retain strong alliances &

Broad Strategies

USDA Forest Service Strategic Framework for Climate Change

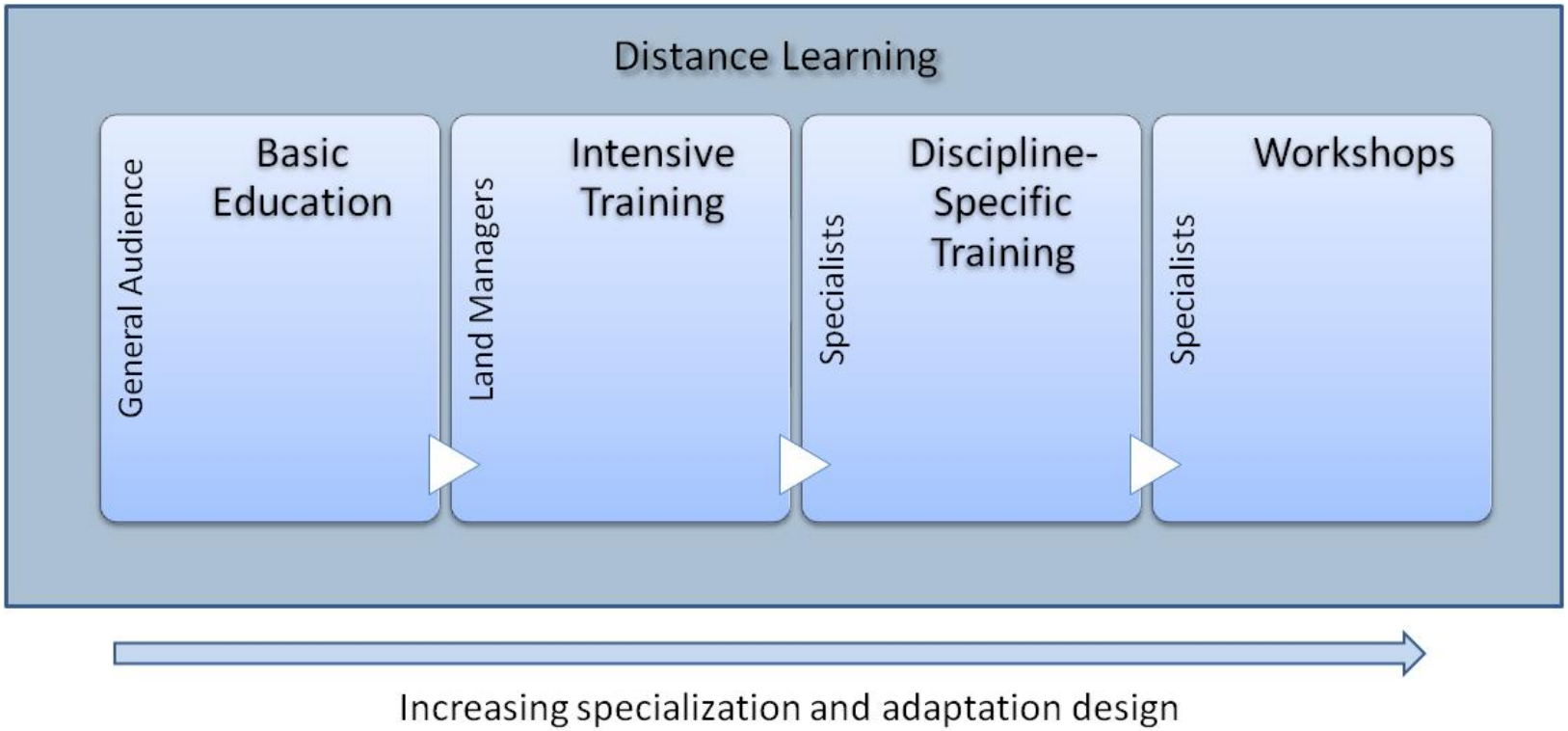
- Science
- Adaptation
- Mitigation
- Policy
- Sustainable operations
- Education
- Alliances

Education and adaptation

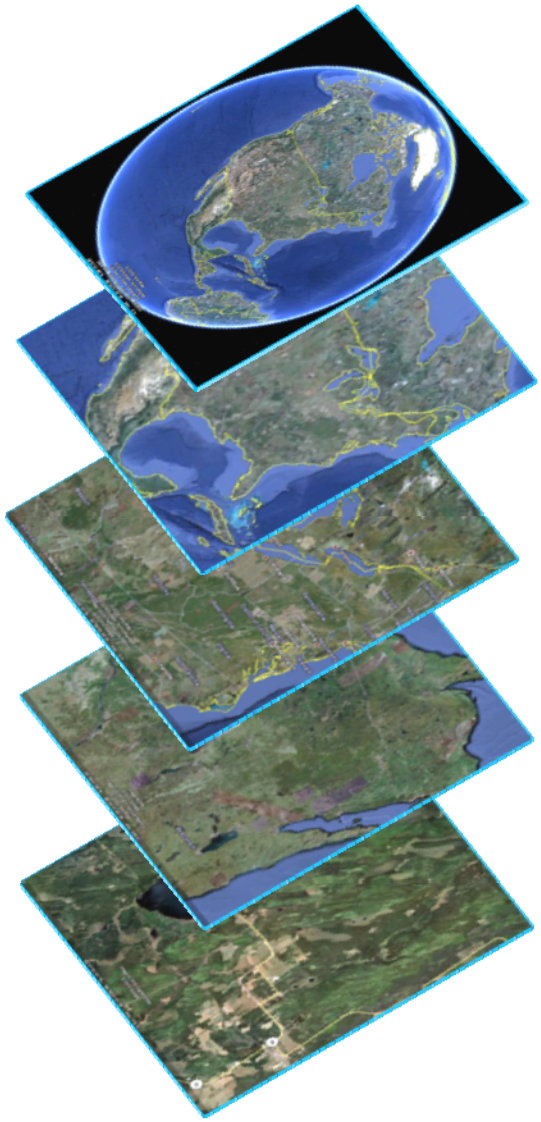
Forest Management for an Uncertain Climate Future Project

- Providing climate change information
- Encouraging *dialogue*

Decision support is not just a tool.
It's people!



Scales for Assessment



Global/International

National

Regional

Sub-regional

Forest- and Stand-level

Climate Change Response Framework

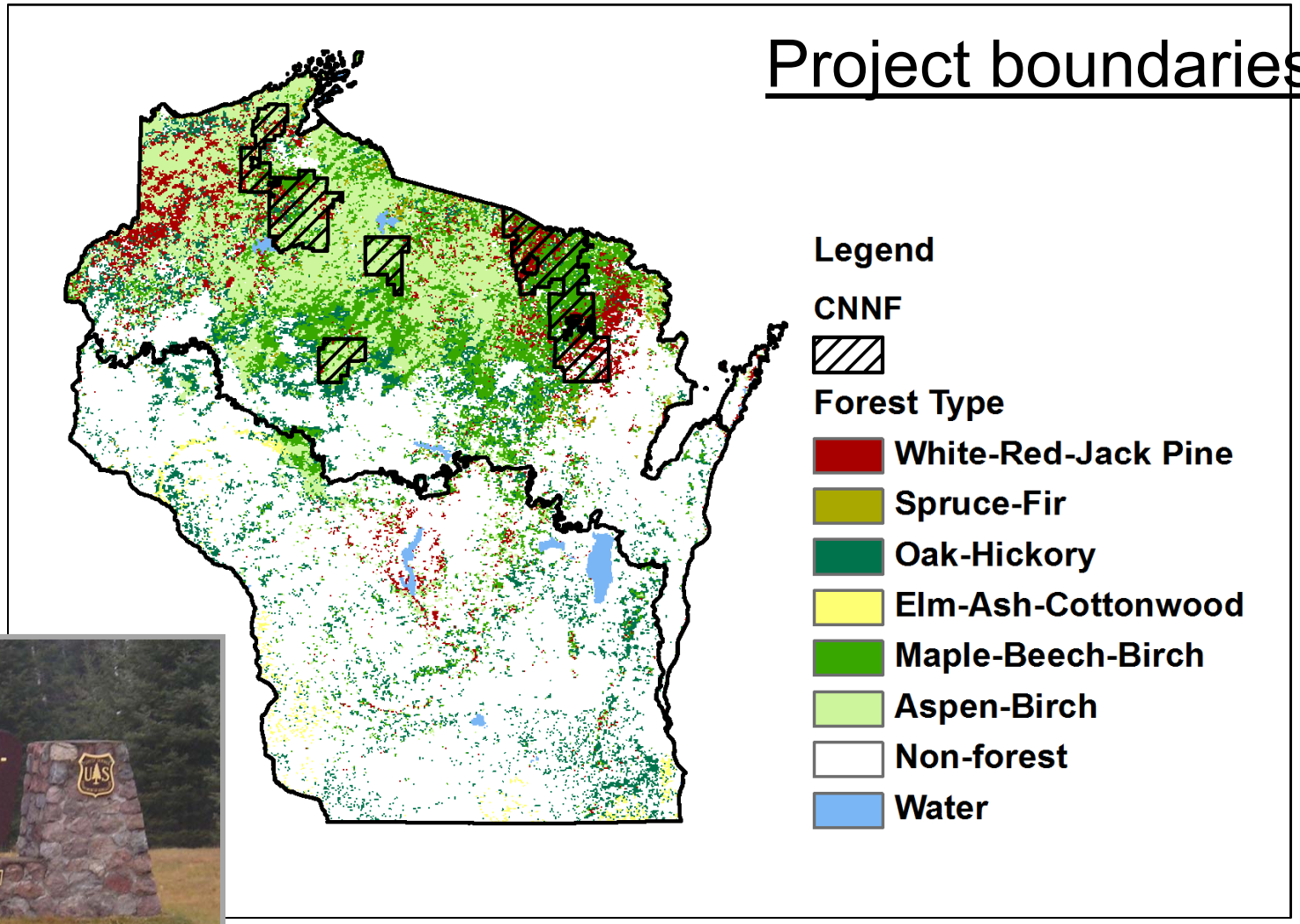
Our goal:

Identify strategies and approaches to climate change adaptation and mitigation relevant to ecosystems in CNNF and northern Wisconsin.

Bridge the gap between

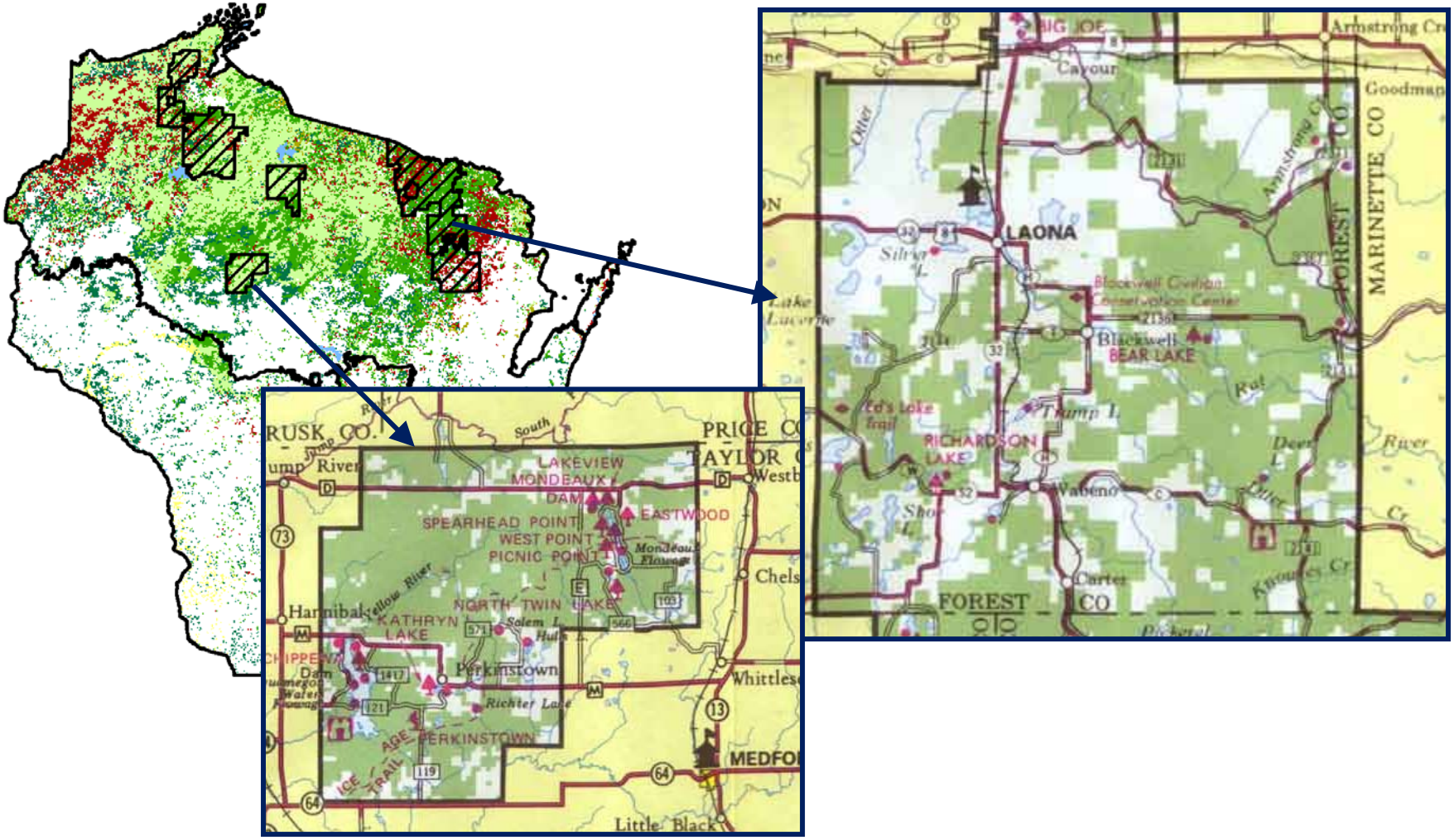
- scales of prediction and need
- academic discussions of ecosystem responses
- management activities on National Forests
- interactions with the greater community

Climate Change Response Framework



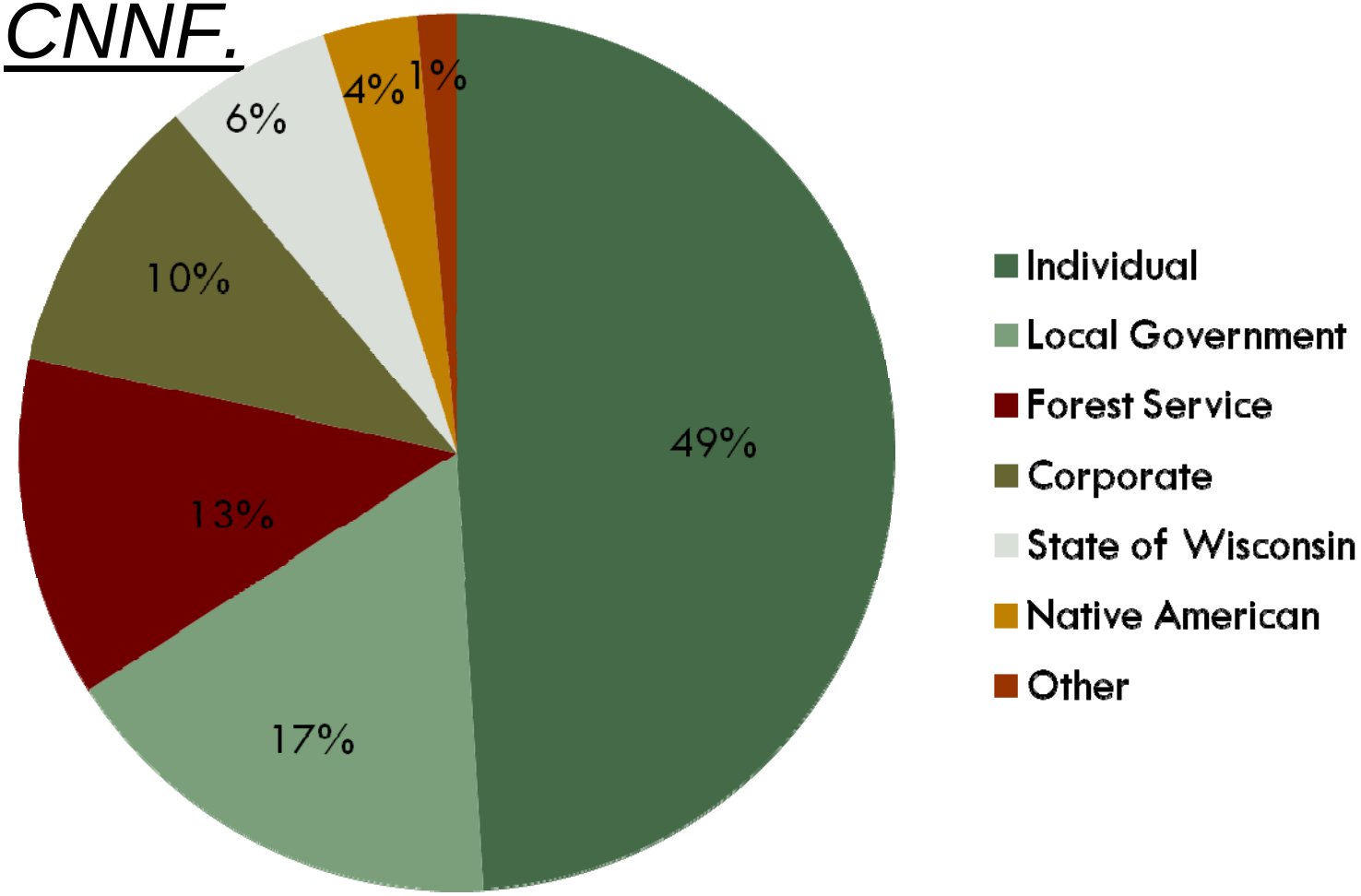
Climate Change Response Framework

The CNNF is not contiguous



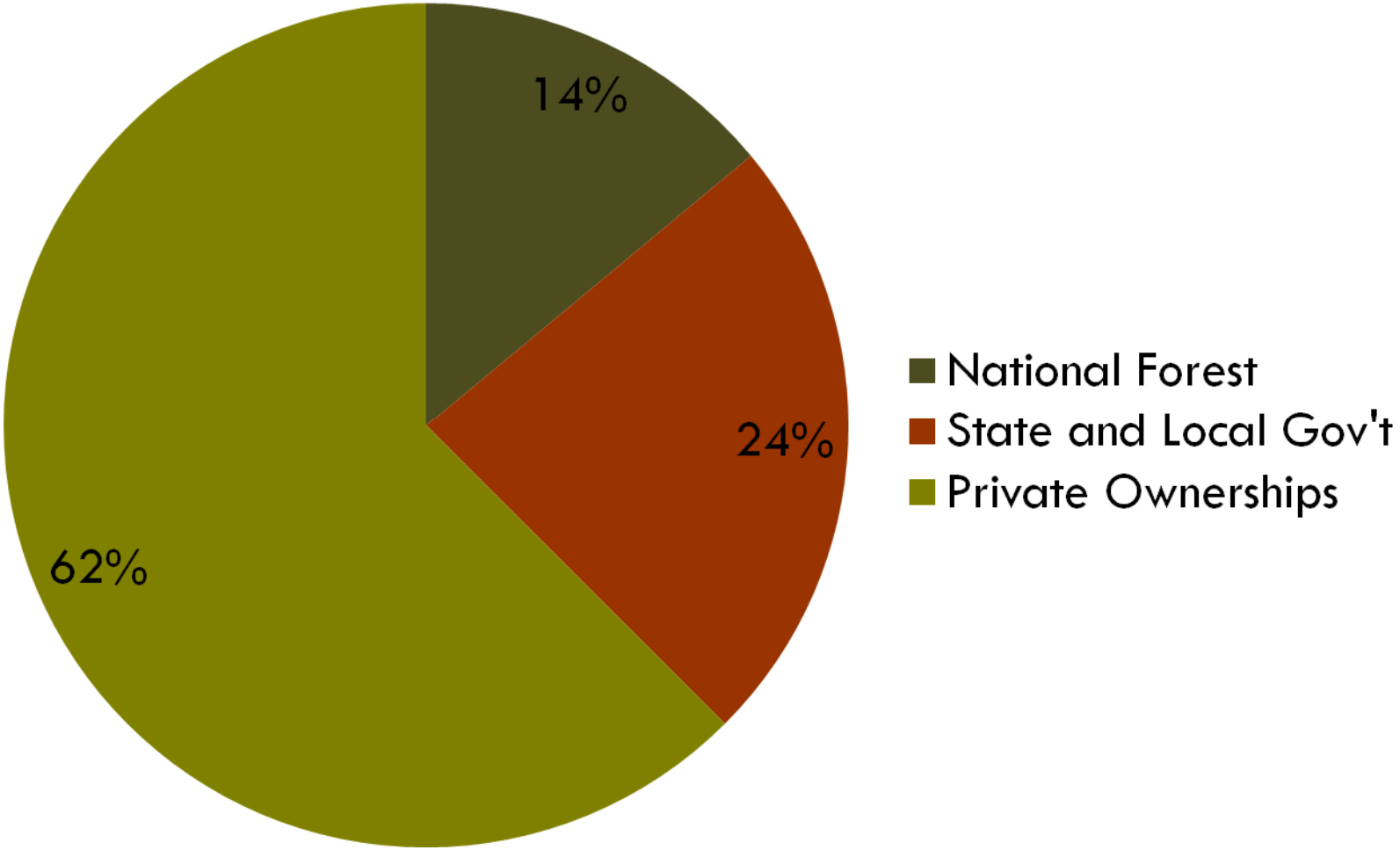
Climate Change Response Framework

Only 13% of the forested land is in the CNNF.



Climate Change Response Framework

Only 14% of the forest carbon is in the CNNF.



Climate Change Response Framework

Northern Research Station

Lead: Chris Swanston (also NIACS)
Collaborators: Rich Birdsey, Louis Iverson, Sarah Hines

Chequamegon-Nicolet National Forest

Lead: Tony Erba
Collaborators: Geoff Chandler, Linda Parker, Matt St. Pierre, Suzanne Flory, Connie Chaney

Eastern Region Regional Office

Lead: Tom Doane

Northeastern Area State and Private Forestry

Lead: Barbara Tormoehlen
Collaborators: Gina Childs, Sarah Hines

Northern Institute of Applied Carbon Science

Project Coordinator: Maria Janowiak
Collaborators: Leslie Brandt, Patricia Butler

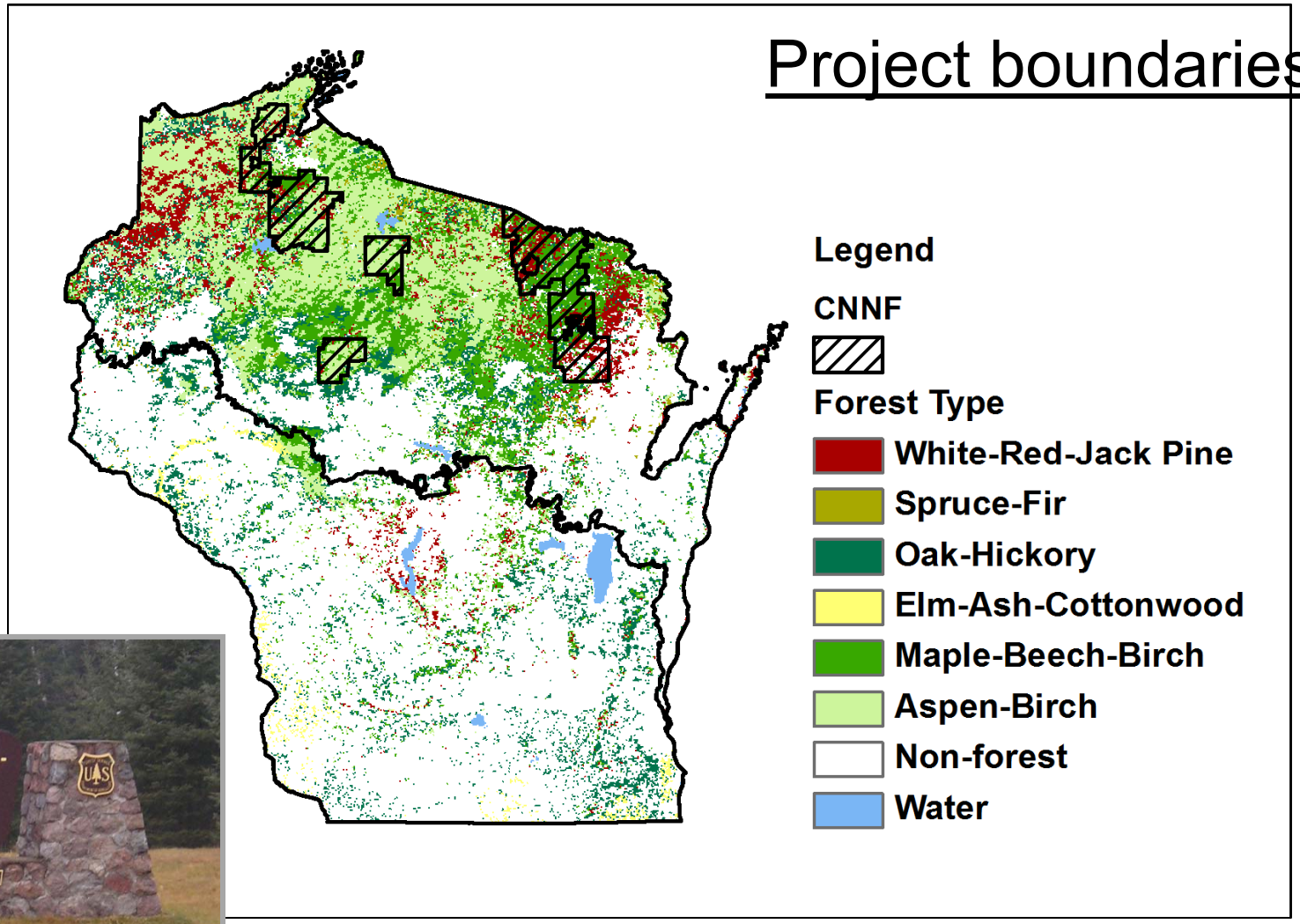
University of Wisconsin-Madison

Collaborators: David Mladenoff, Tom Gower

Additional Collaborators

Wisconsin Department of Natural Resources
Wisconsin Initiative on Climate Change Impacts (WICCI)

Climate Change Response Framework



Climate Change Response Framework

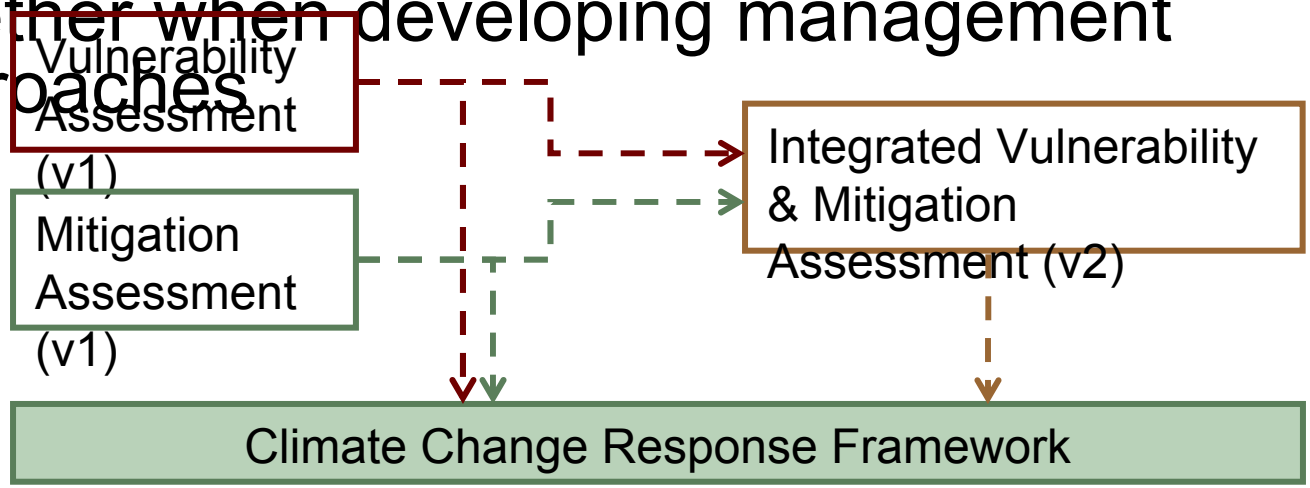
Project component

1) Vulnerability and Mitigation Assessments

Evaluate key ecosystem vulnerabilities and mitigation opportunities within CNNF under a range of future climate uncertainty using existing models and information

Climate Change Response Framework

- Will integrate vulnerability and mitigation assessments into a single assessment, and also into Framework
- Adaptation and mitigation need to be considered together when developing management approaches



Climate Change Response Framework

Project component

1) **Vulnerability and Mitigation Assessments**

2) **Shared Landscapes Initiative**

Foster *dialogue* about climate change, ecosystem response, ecosystem management, and cooperative activities among *CNNF,* regional landowners, and the general public.

Climate Change Response Framework

Project component

1) **Vulnerability and Mitigation Assessments**

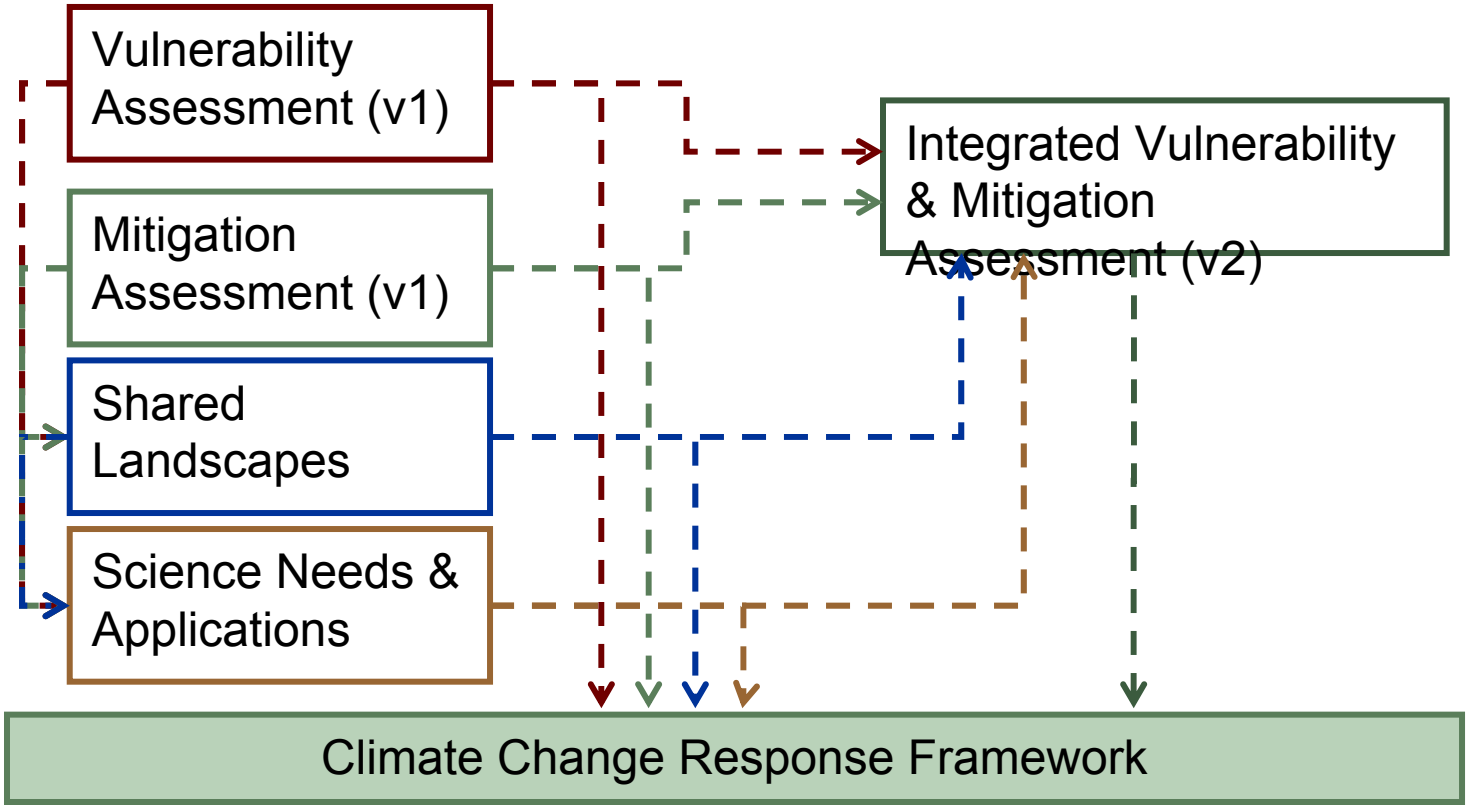
2) **Shared Landscapes Initiative**

3) **Science Needs & Applications Workshop**

Identify the science needs, monitoring infrastructure, and applications necessary for making science-based management decisions at CNNF within the context of climate uncertainty

Climate Change Response Framework

- Framework integrates Assessments, reports, and experience
  - Strategies, approaches, examples



Climate Change Response Framework

1) **Vulnerability and Mitigation Assessments**

2) **Shared Landscapes Initiative**

3) **Science Needs & Applications Workshop**

4) **Climate Change Response Framework**

Provide guidance on rapidly incorporating science and monitoring information into CNNF management activities to mitigate carbon emissions and better adapt ecosystems to changing climate

Climate Change Response Framework

drafts

1) **Vulnerability and Mitigation Assessments**

launched April

2) **Shared Landscapes Initiative**

October

3) **Science Needs & Applications Workshop**

4) **Climate Change Response Framework**

Lessons

- Learn from partners.
- We know enough to begin planning for contingencies.
- Take small risks.
- Be flexible – adapt!

Thank you.

Climate Change Response Framework

Vulnerability Assessment - Modeling

- Climate Change Tree Atlas
  - Species distribution model
  - Potential changes in suitable habitat
  - Climate Change Atlas Lab (L. Iverson, USDA Forest Service)
- LANDIS II
  - Process model
  - Simulates interactions, disturbance, management
  - Forest Landscape Ecology Lab (D. Mladenoff, UW–Madison)

Implications …species respon

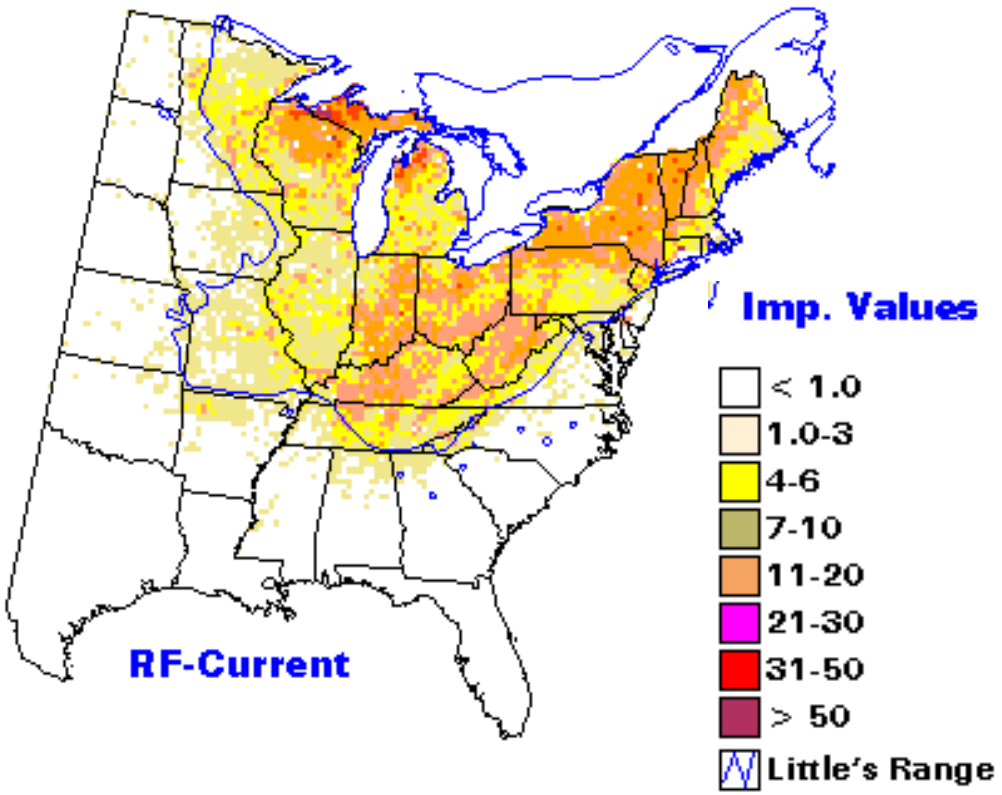
Climate Change Tree Atlas

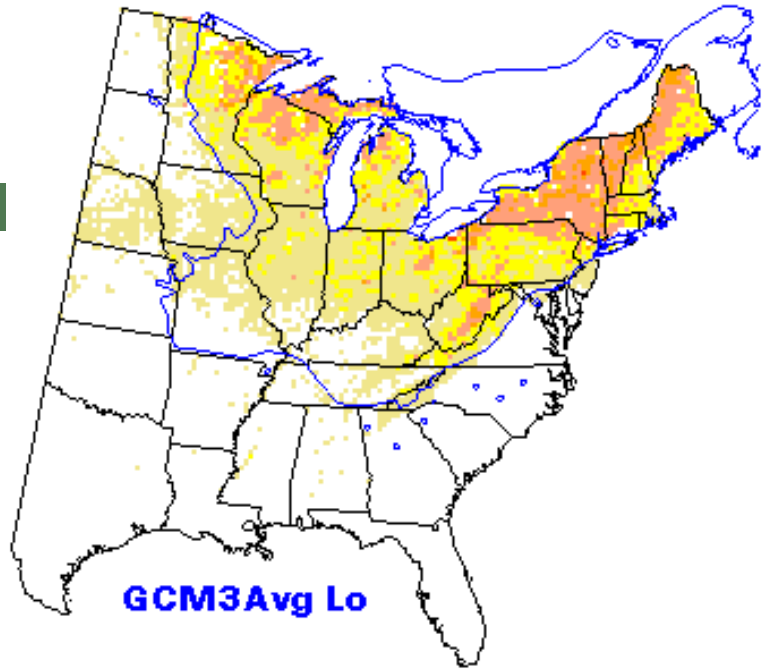
- 76 species
  - 21 show some potential to increase
  - 19 show some potential to decrease
  - 7 show little or no change
  - 29 species have new suitable habitat entering the region

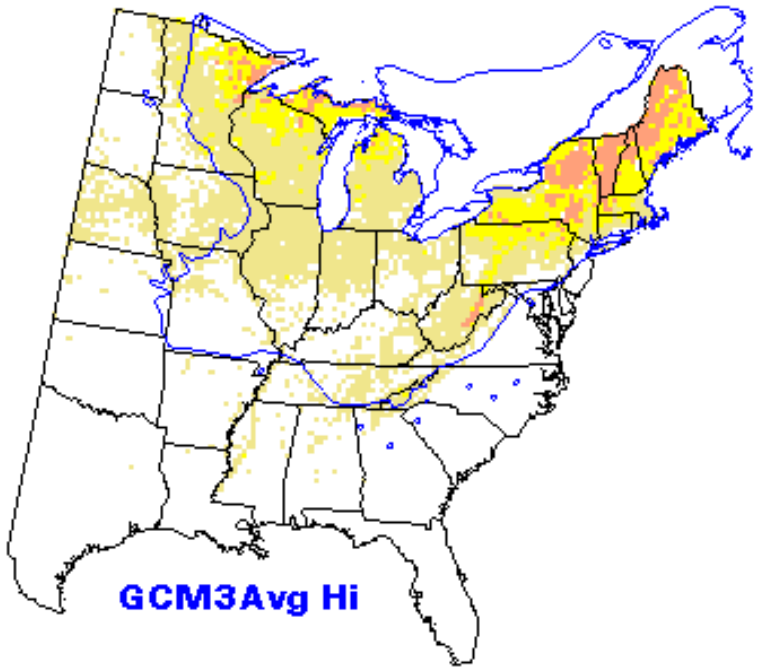
Implications

Climate Change Tree Atlas

Sugar maple (decline)







Figures courtesy of Climate Change Atlas Lab

Implications …species respon

Climate Change Tree Atlas

Balsam fir
(extirpation)

Hadhi

PCMlo

Current

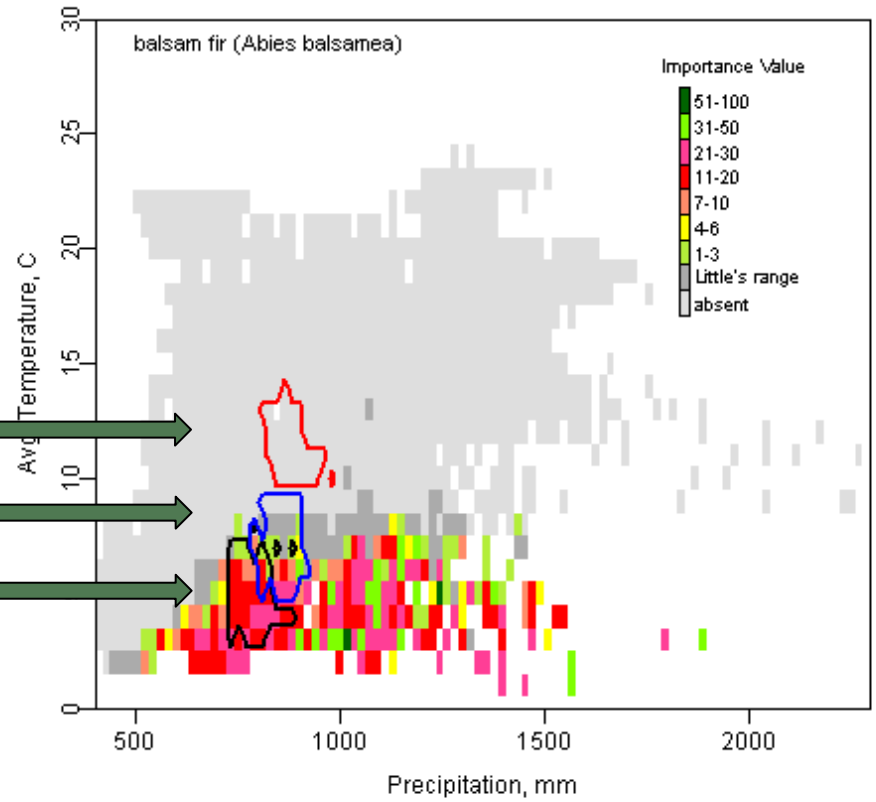


Figure courtesy of Climate Change Atlas Lab

Implications …species respon

Climate Change Tree Atlas

Red maple
(small decline)

Hadhi

PCMlo

Current

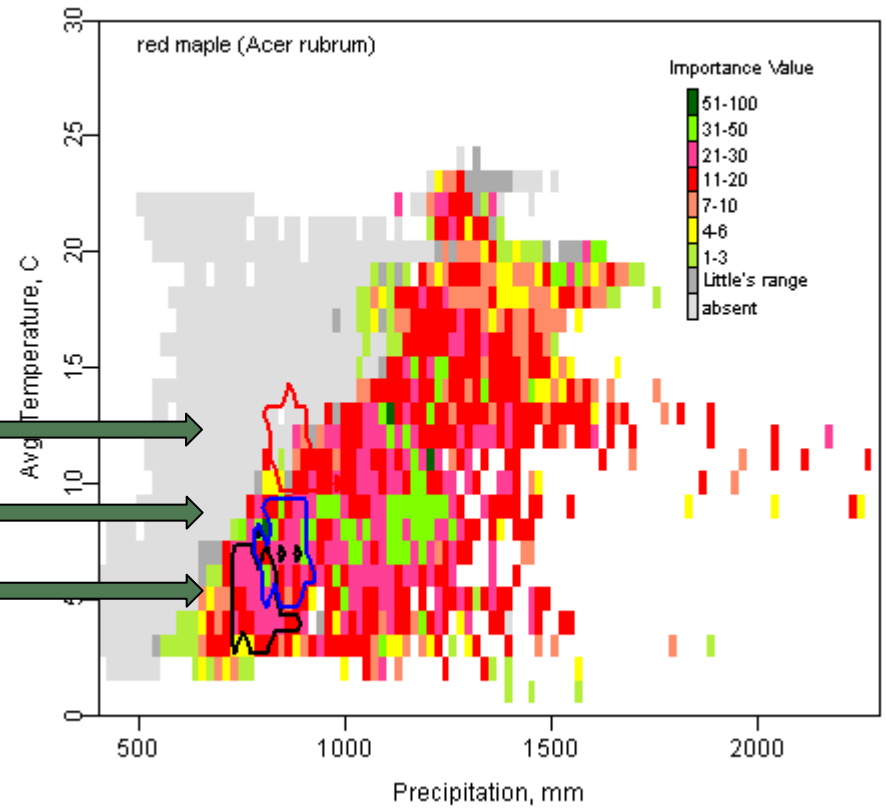


Figure courtesy of Climate Change Atlas Lab

Implications …species respon

Climate Change Tree Atlas

Chinkapin oak
(new entry)

Hadhi

PCMlo

Current

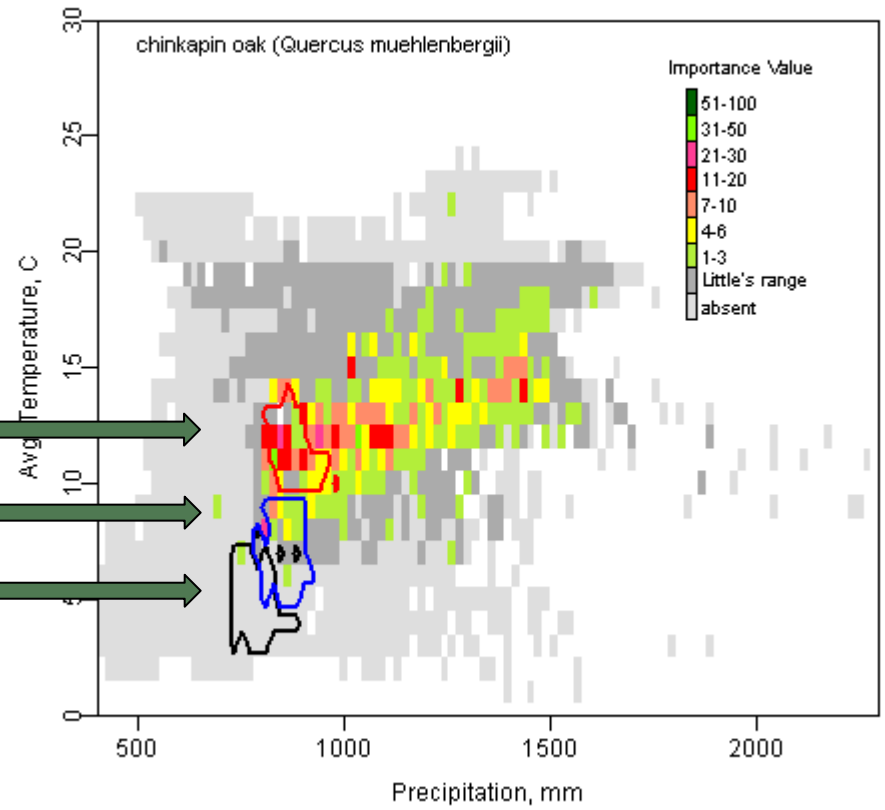


Figure courtesy of Climate Change Atlas Lab

Implications …species respon

Climate Change Tree Atlas

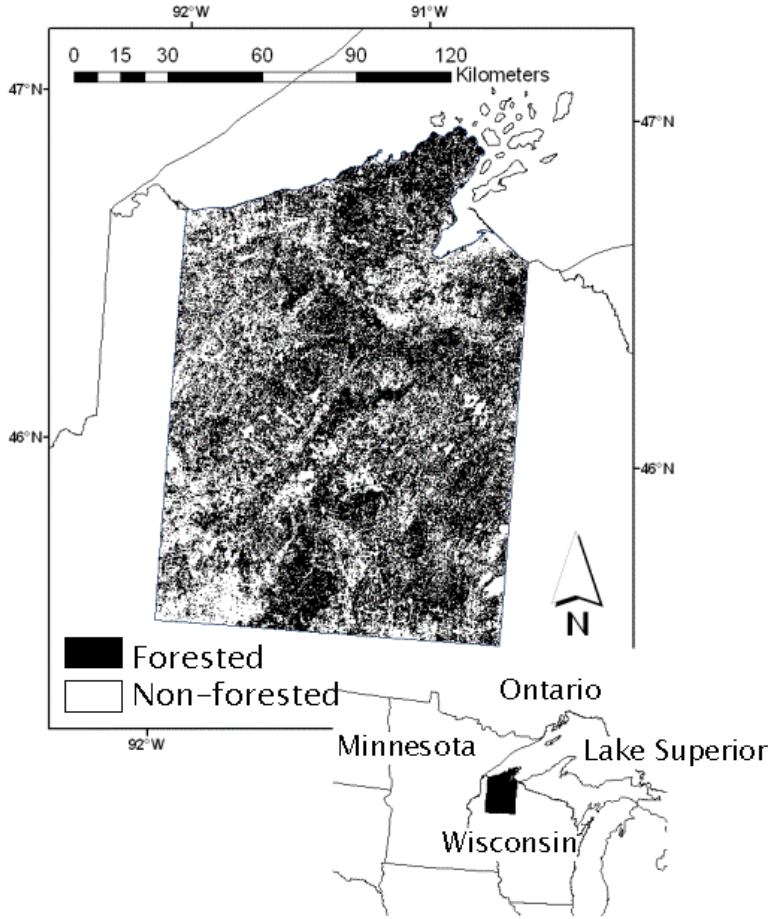
- Range shifts ≠ instant catastrophic dieback
- Mature trees should fare better
  - Developed root systems
  - Greater carbohydrate reserves
- Stress factors will increase in severity
  - Temperature
  - Moisture
  - Competition
- Increased susceptibility to disturbance

Dale et al. 2001, Iverson et al. 2008

Implications …species respon

LANDIS II

- Control - little change
  - no climate change
  - similar disturbance
  - similar management



Scheller and Mladenoff 2008

Implications …species respon

LANDIS II

- Control - little change
- No disturbance - Increase in late successional species
  - no wind disturbance
  - no management

Scheller and Mladenoff 2008

Implications …species respon

LANDIS II

- Control - little change
- No disturbance - Increase in late successional species
- Climate change - increase in biomass, species extirpation/decline
  - Both high/low scenarios
  - Balsam fir, paper birch, white spruce, jack pine, and red pine (establishment failure)

Scheller and Mladenoff 2008

Implications …species respon

Agreement between models:

- Northern and boreal species decrease in extent and/or abundance
- Species highly likely to show severe declines
  - balsam fir, paper birch, and white spruce
- Species likely to show some decline
  - red pine, jack pine, northern white-cedar, quaking aspen, and yellow birch
- Species with potential to increase
  - bur oak, black oak, and bitternut hickory

Implications …vulnerabiliti

Synthesis exercise:

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
  - Low species diversity
  - Low functional diversity
    - Reliance on saturated soils (e.g., lowland conifers)

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
  - Low resilience
    - Lowland conifers, lowland hardwoods, and hemlock

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
- Greater problems for species already in decline
  - Mostly from reduced habitat suitability
    - hemlock, white cedar, yellow birch, and white spruce

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
- Greater problems for species already in decline
- Resilience may be weakened in fragmented ecosystems
  - Isolated fragments may not adapt as easily as continuous areas
  - Smaller patch sizes support less species and genetic diversity
  - Greater inhibition of dispersal

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
- Greater problems for species already in decline
- Resilience may be weakened in fragmented ecosystems
- Further reductions in habitat will impact threatened, endangered, and rare species
  - Often rare due to specific habitat requirements or low resilience

Implications …vulnerabiliti

Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
- Greater problems for species already in decline
- Resilience may be weakened in fragmented ecosystems
- Further reductions in habitat will impact threatened, endangered, and rare species
- Ecosystem changes will have significant effects on wildlife
  - Spruce grouse – dependent on black spruce, jack pine, balsam fir

Implications …vulnerabiliti

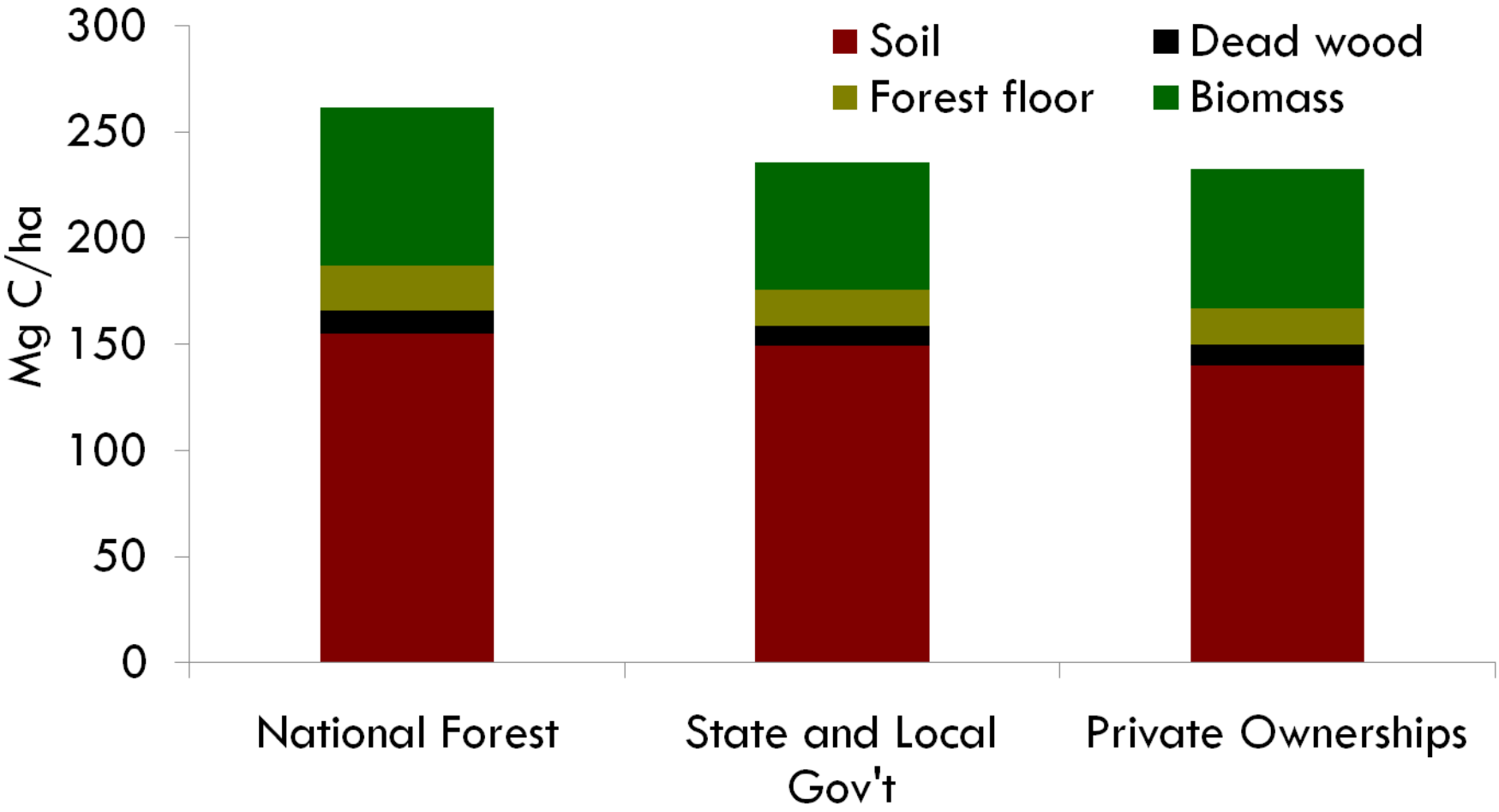
Synthesis exercise:

- Risk will be greater in low diversity ecosystems
- Disturbance will destabilize static ecosystems
- Greater problems for species already in decline
- Resilience may be weakened in fragmented ecosystems
- Further reductions in habitat will impact threatened, endangered, and rare species
- Ecosystem changes will have significant effects on wildlife

Key concept: Beware of generalities!

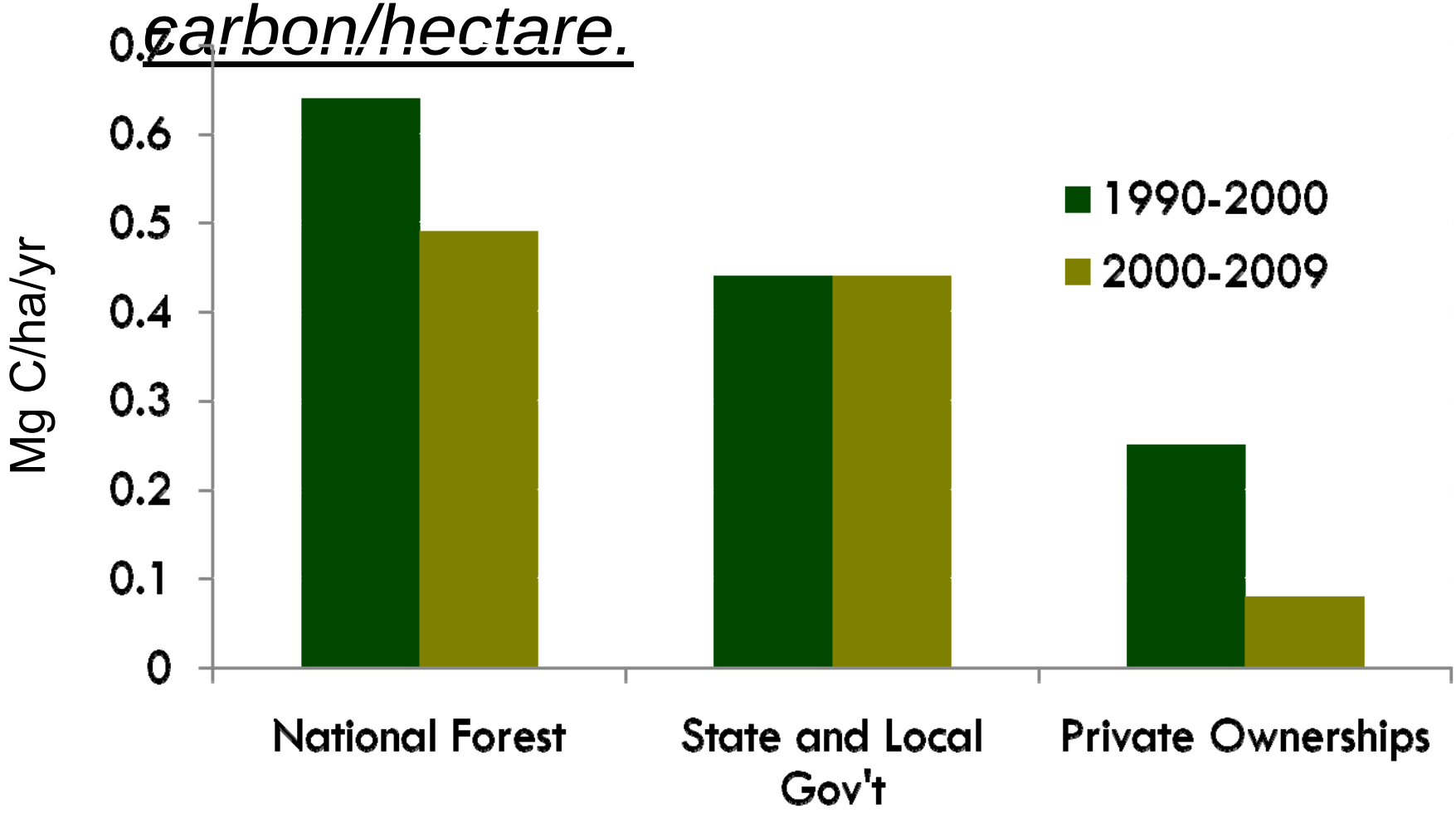
Northern Wisconsin Forest Carbon

The CNNF stores slightly more



Northern Wisconsin Forest Carbon

The CNNF sequesters slightly more carbon/hectare.



Parallel & Integrated Assessments

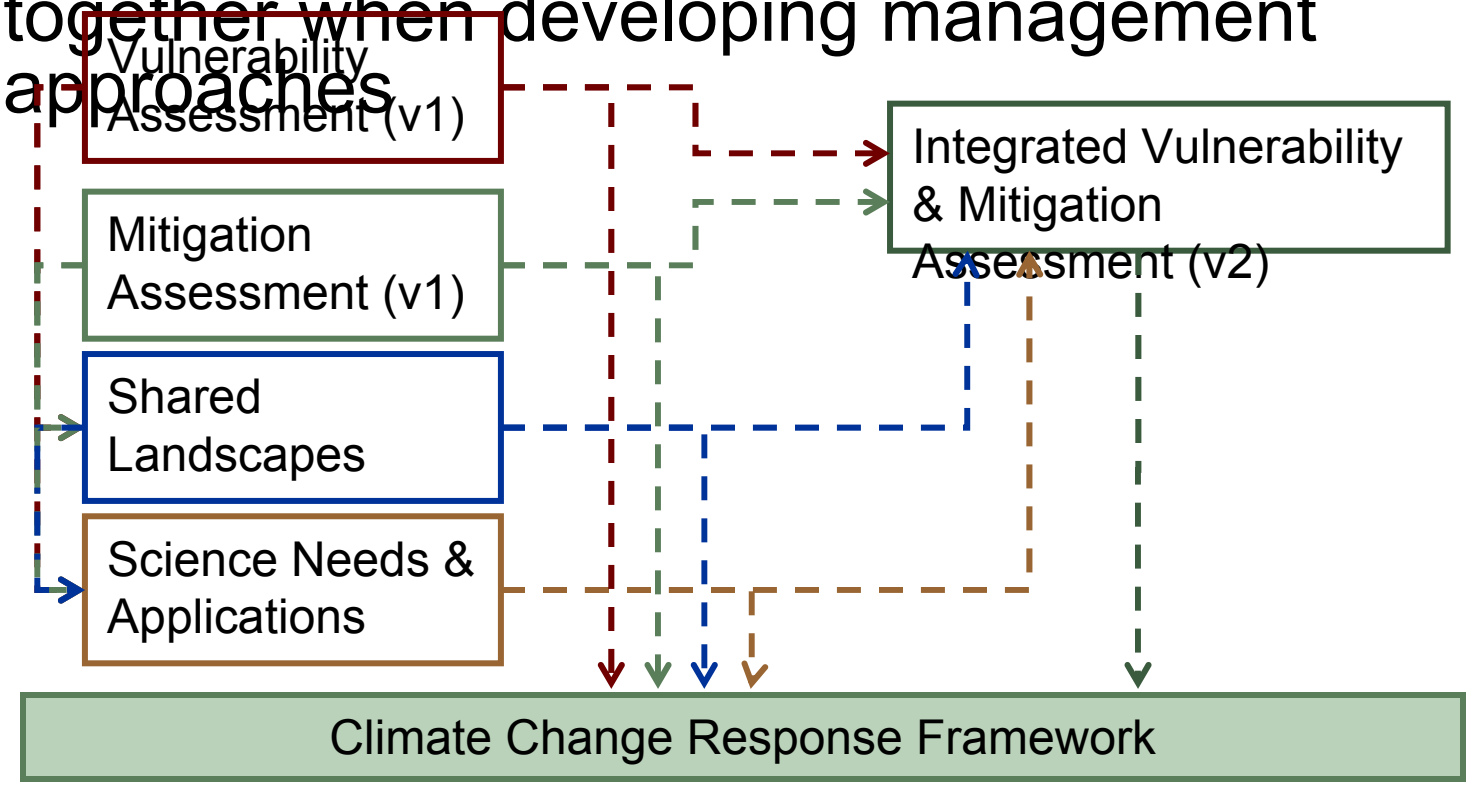
- Understanding responses of forest ecosystems to climate change across an entire landscape will provide greater insight into selection of mitigation strategies
  - Increased disturbance:
    - Localized stress & mortality
    - Windthrow and ice damage
    - Pest & disease
    - Fire
  - Species distribution changes:
    - Decline of existing species
    - Potential for species expansion
    - Successional uncertainties
  - Most vulnerable:
    - Tree species
    - Ecosystems & communities
    - Management objectives

Thoughts for a National Assessment

- **Place**
  - regional and forest type differences
  - management approaches and constraints
  - industry
- **Scale**
  - tools and questions
  - user communities
  - integration
- **Time**
  - adaptation
  - dynamics, reversals

Parallel & Integrated Assessments

- Will integrate vulnerability and mitigation assessments into a single assessment, and also into Framework
- Adaptation and mitigation need to be considered together when developing management approaches



Thoughts for a National Assessment

- Return to idea of scale – while national in level, should try to incorporate issues at smaller scales
  - Regional differences in forest type, management approaches and constraints, …
- Also return to idea of adaptation- we are beyond thinking only about mitigation. Adaptation will be occurring at the same time as mitigation. Identify where two goals seem at odds. Favor mitigation strategies that are adaptive.

Climate Change Response Framework

- *Ecosystem Vulnerability Assessment and Synthesis* – determine what ecosystem components are most vulnerable to change under a variety of future climate scenarios
- *Mitigation Assessment* – describe options to increase carbon stocks in forests and wood products, increase the use of wood for bioenergy, and engage in greenhouse gas markets and registries.
- *Shared Landscapes Initiative* – bring together local forest owners and managers and the public to encourage discussion and effective ecosystem management
- *Science Applications and Needs Workshop* – bring scientists and managers together to discuss climate change science needs, applications, and monitoring at the CNNF to continue science-based land management.
- *Climate Change Response Framework* for the CNNF – incorporate information from the above to provide guidance to:
  - better adapt ecosystems to changing climate
  - mitigate carbon emissions
  - respond to climate change impacts across ownership boundaries
  - rapidly incorporate science and monitoring information into management

General Flow- notes #1

- Intro (big picture)
  - (One) purpose of workshop: explore approaches for assessing the capacity of national forests to mitigate climate change
  - Scales of interest – this workshop is looking at national assessment, but scenarios will need to consider on-the-ground realities and constraints to be relevant
  - This talk will describe on an assessment that includes broader objectives (adaptation AND mitigation) but focuses on a smaller spatial scale.
  - Assessments should scale up/scale down
- Climate Change Response Framework Project
  - People, purpose, components, landscape
  - Vulnerability and Mitigation Assessments
    - Goals, process (briefly)
    - Relationship – adaptation and mitigation. Two assessments help guide realistic mitigation approaches under climate change

General Flow- notes #2

- Carbon in the northern Wisconsin landscape
  - Need to think outside the green(?) line
    - Percent area, percent carbon not federal
    - Noncontiguous- many more neighbors
    - Importance of forest industry??
      - Wood products matter…
      - Interactions between public/private in the marketplace??
    - Mitigation potential (in progress – prelim results)
  - Summary
    - Need to consider how NF role varies by landscape (east vs. west)
    - Integrated assessment (adaptation and mitigation) may be more comprehensive– more informed selection of mitigation approaches

Northern Wisconsin Forest Carbon

Maximum Potential Carbon (preliminary estimate)

Current:

- Ecosystem: 1.0 Tg C/yr
- Products: 0.5 Tg C/yr
- **Total: 1.5 Tg C/yr**

No harvest, 50 years:

- Ecosystem: 4.3 Tg C/yr
- Products: 0.0 Tg C/yr
- **Total: 4.3 Tg C/yr**

Net Increase of 2.8 Tg C/yr

- Next steps: Determine scenarios timeline for more detailed analysis.