Climate Adaptation for Forest-Dependent Wildlife

Webinar Series

Forest Carbon Cycle: Harnessing Climate Adaptation for Enhancing Mitigation Goals

USDA Northern Forests Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

NIACS

Todd Ontl, PhD
Climate Adaptation Specialist
Northern Institute of Applied Climate Science
Michigan Technological University
Houghton, MI
taontl@mtu.edu

Northern Institute of Applied Climate Science

Climate

Carbon

The Northern Institute of Applied Climate Science (NIACS) develops synthesis products, fosters communication, pursues science, and provides technical assistance in climate change adaptation and carbon management.

Multi-institutional collaborative chartered by USDA Forest Service, universities, and non-profit and tribal conservation organizations

NIACS
Northern Institute of Applied Climate Science

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

American Forests™

Great Lakes Indian Fish & Wildlife Commission

NCASI

Michigan Technological University
1885

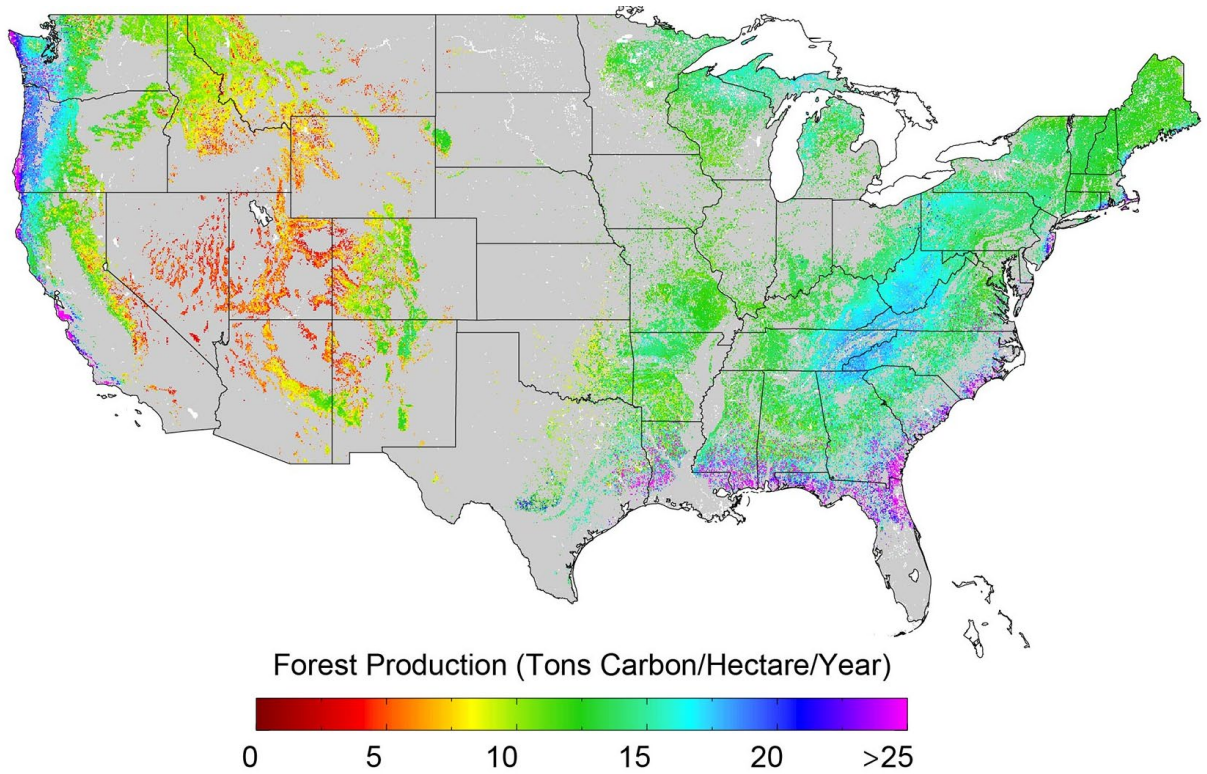
The UNIVERSITY of VERMONT

UNIVERSITY OF MINNESOTA

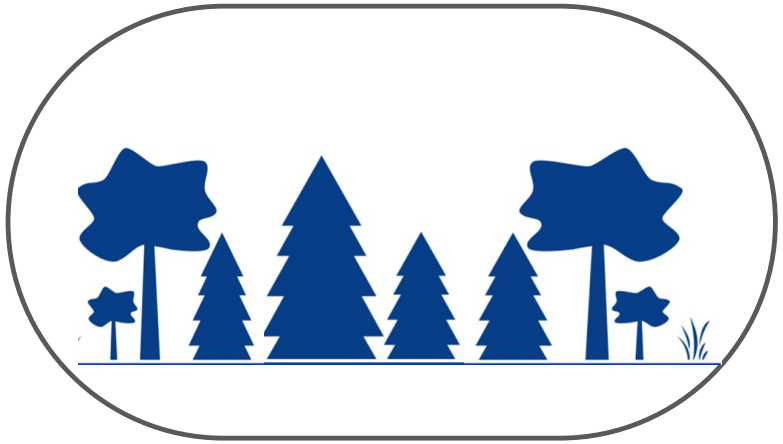
MICHIGAN STATE UNIVERSITY

US forests:

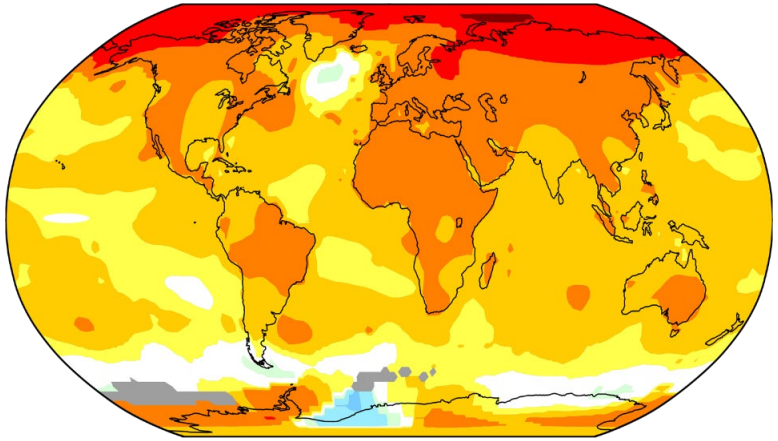
- Absorb **11-15%** of total CO_2 emissions
- Contain **68%** of terrestrial carbon stocks
- Are **90%** of the land sector sequestration capacity

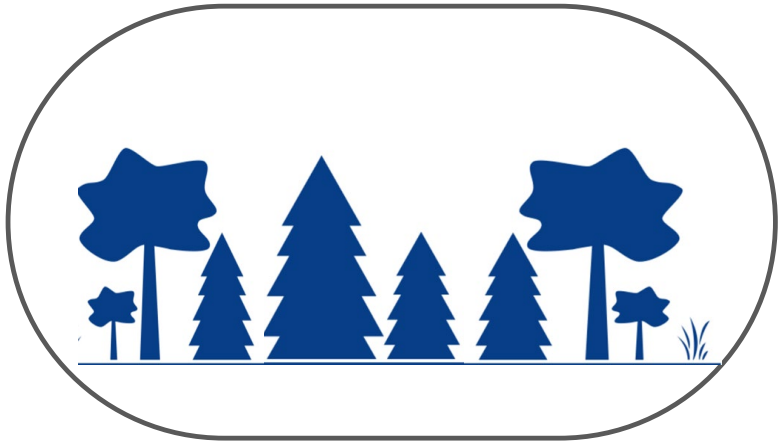


Data: Forest Inventory Analysis, Figure: 4th National Climate Assessment 2018



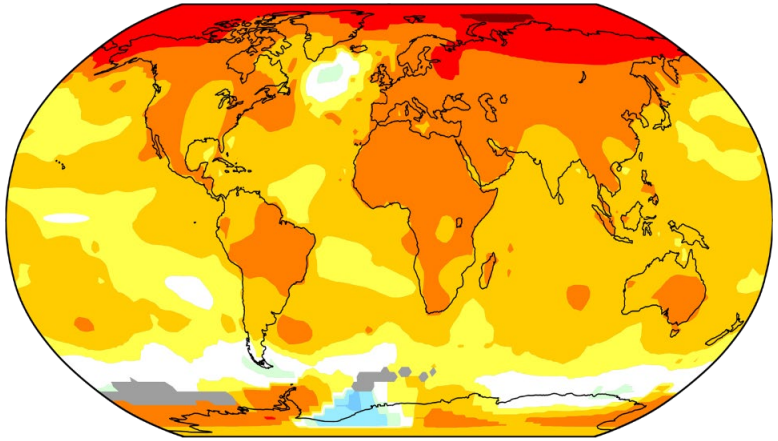
Climate mitigation





Climate mitigation

Climate impacts



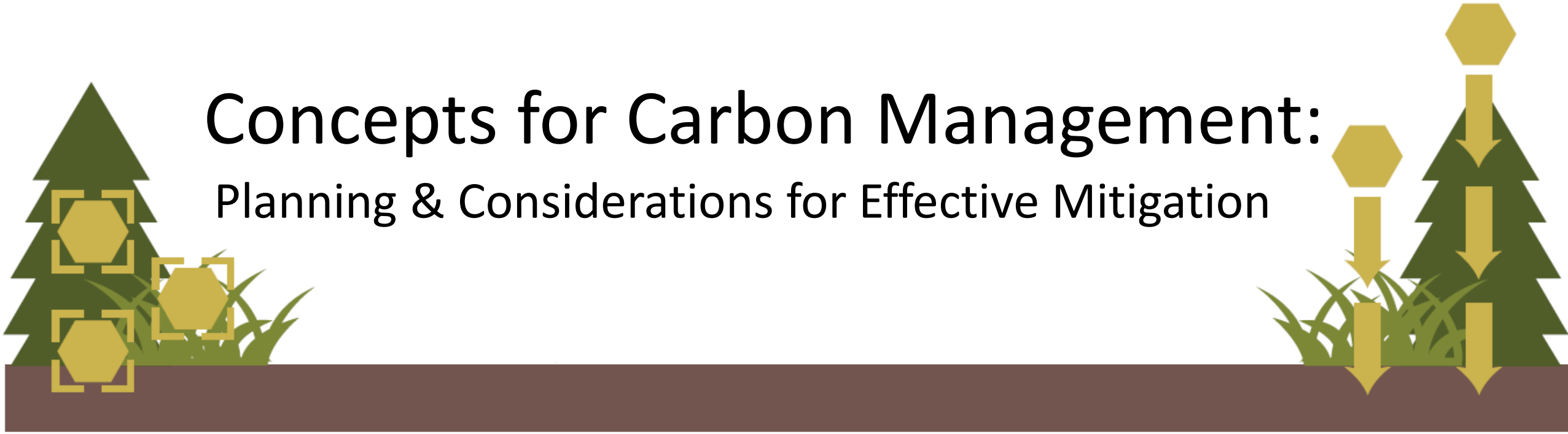
US forests:

- Absorb **11-15%** of total CO_2 emissions
- Contain **68%** of terrestrial carbon stocks
- Are **90%** of the land sector sequestration capacity

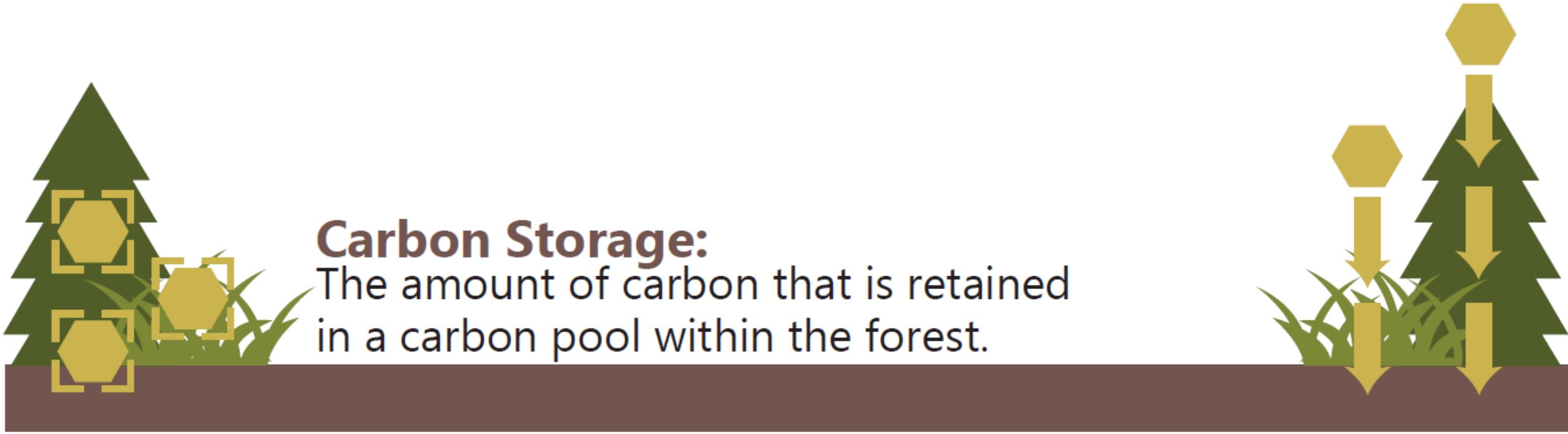
A changing climate puts those forests
and the carbon they sequester and store
at risk

Concepts for Carbon Management:

Planning & Considerations for Effective Mitigation



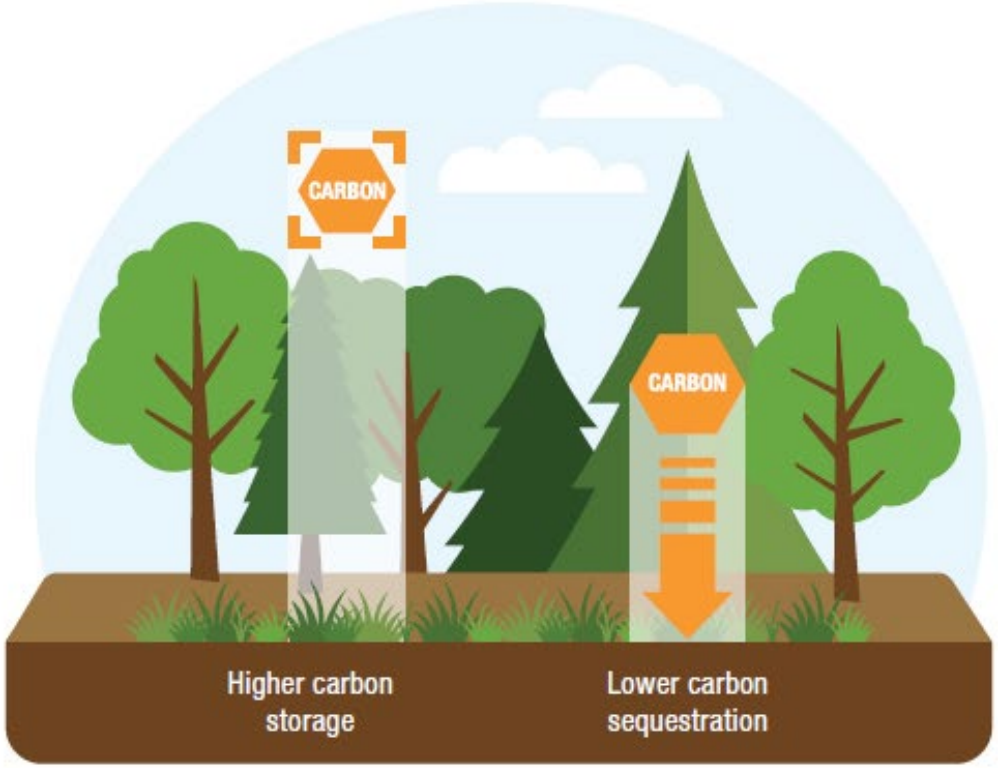
Carbon benefits include both carbon *storage* and carbon *sequestration*



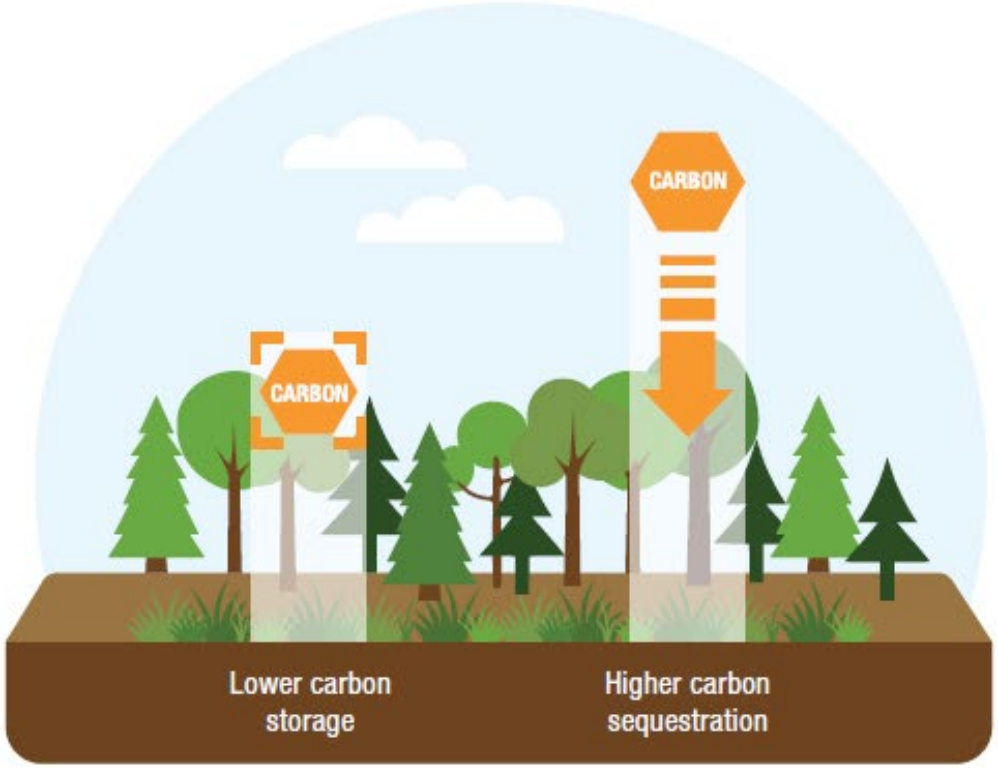
Carbon Storage:
The amount of carbon that is retained in a carbon pool within the forest.

Carbon Sequestration:
The process of removing carbon from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees.

Carbon benefits are provided by a multitude of forest stand conditions



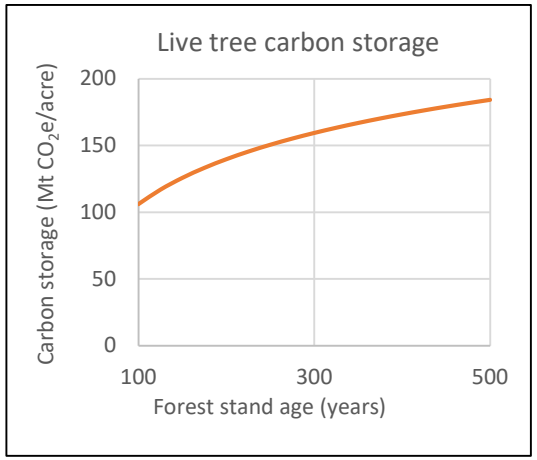
Mature forest



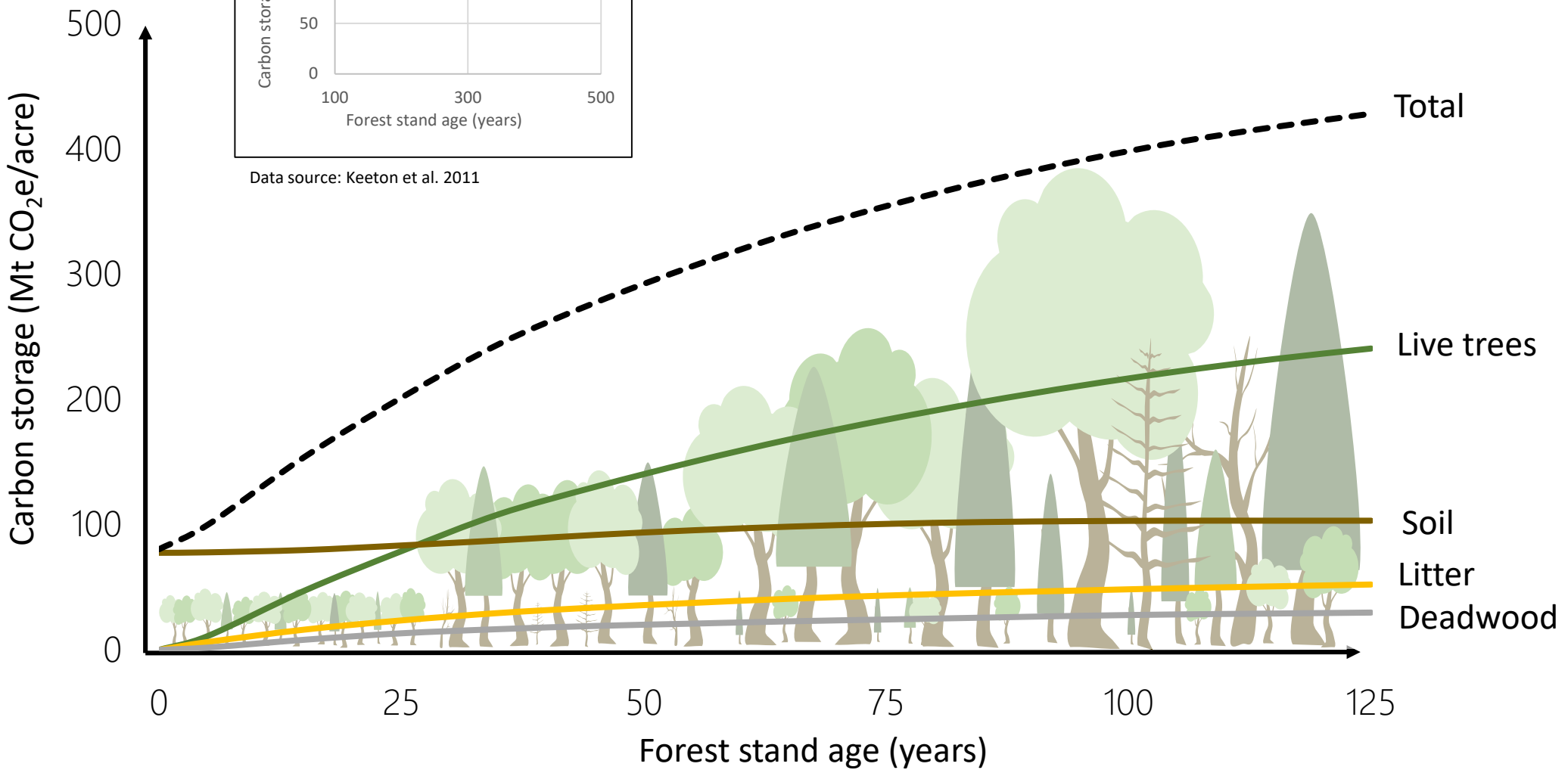
Young forest

Source: *Caring for Your Woods - Managing for Forest Carbon: A Landowner Guide from the MA Department of Conservation and Recreation*
www.mass.gov/doc/caring-for-your-woods-managing-for-forest-carbon/download

Carbon storage varies over forest stand development



Data source: Keeton et al. 2011

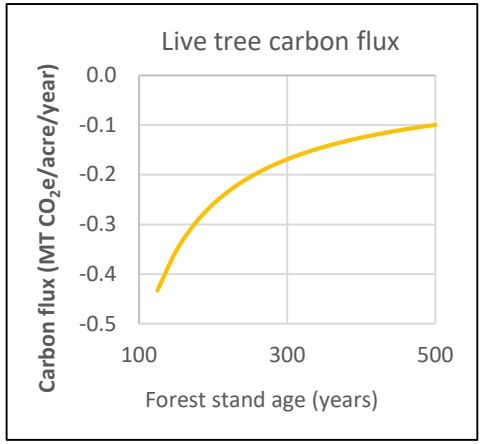


Note: modeled carbon dynamics following afforestation for Maple-Beech-Birch forest in the Northeast, does not include management or other disturbances. Data source: Smith et al. 2006.

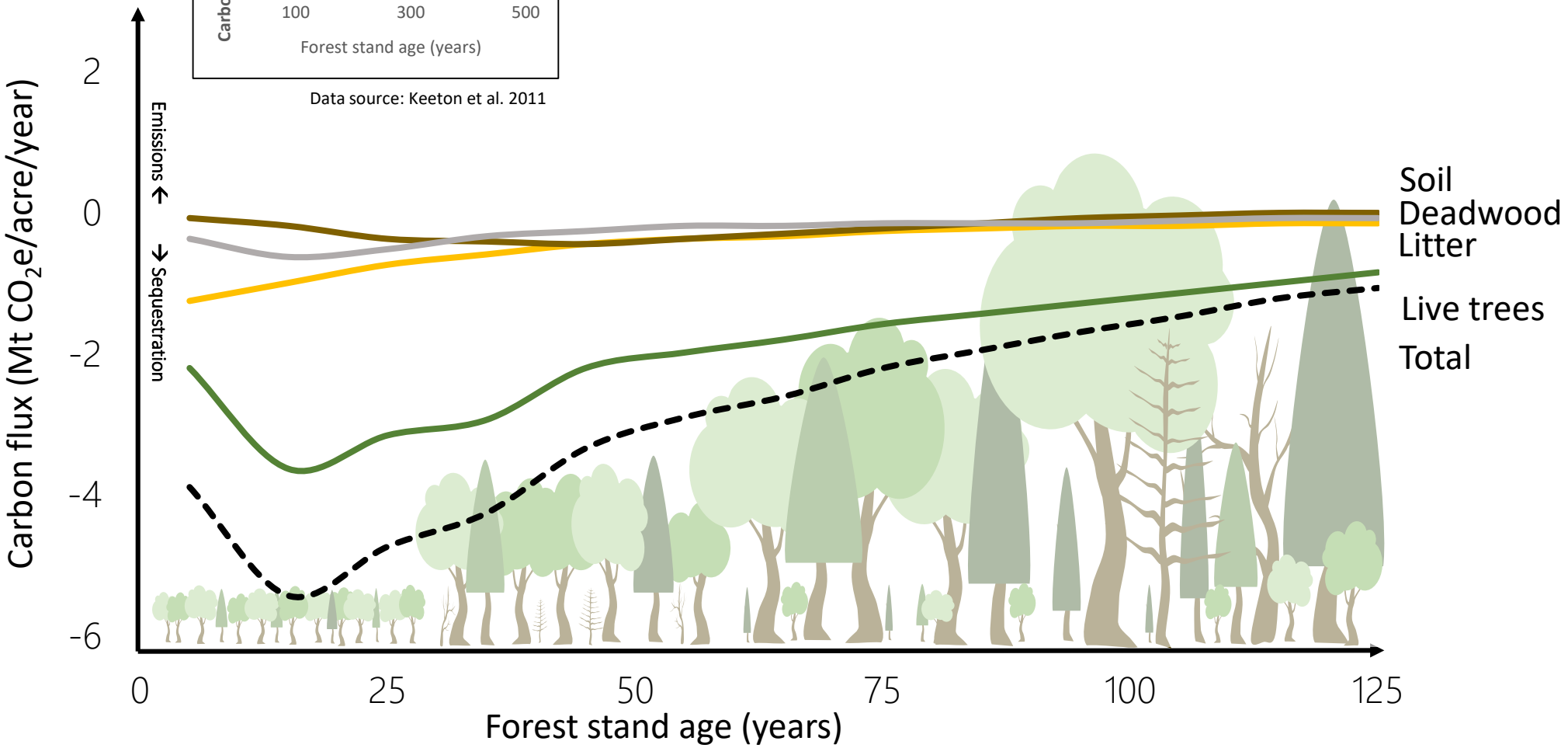
Figure source: Ali Kosiba (2022)

Securing Northeast Forest Carbon Program
www.northeastforestcarbon.org

Carbon sequestration varies over forest stand development



Data source: Keeton et al. 2011



Note: modeled carbon dynamics following afforestation for Maple-Beech-Birch forest in the Northeast, does not include management or other disturbances. Data source: Smith et al. 2006.

Figure source: Ali Kosiba (2022)

Securing Northeast Forest Carbon Program
www.northeastforestcarbon.org

Forest Management Actions for Carbon

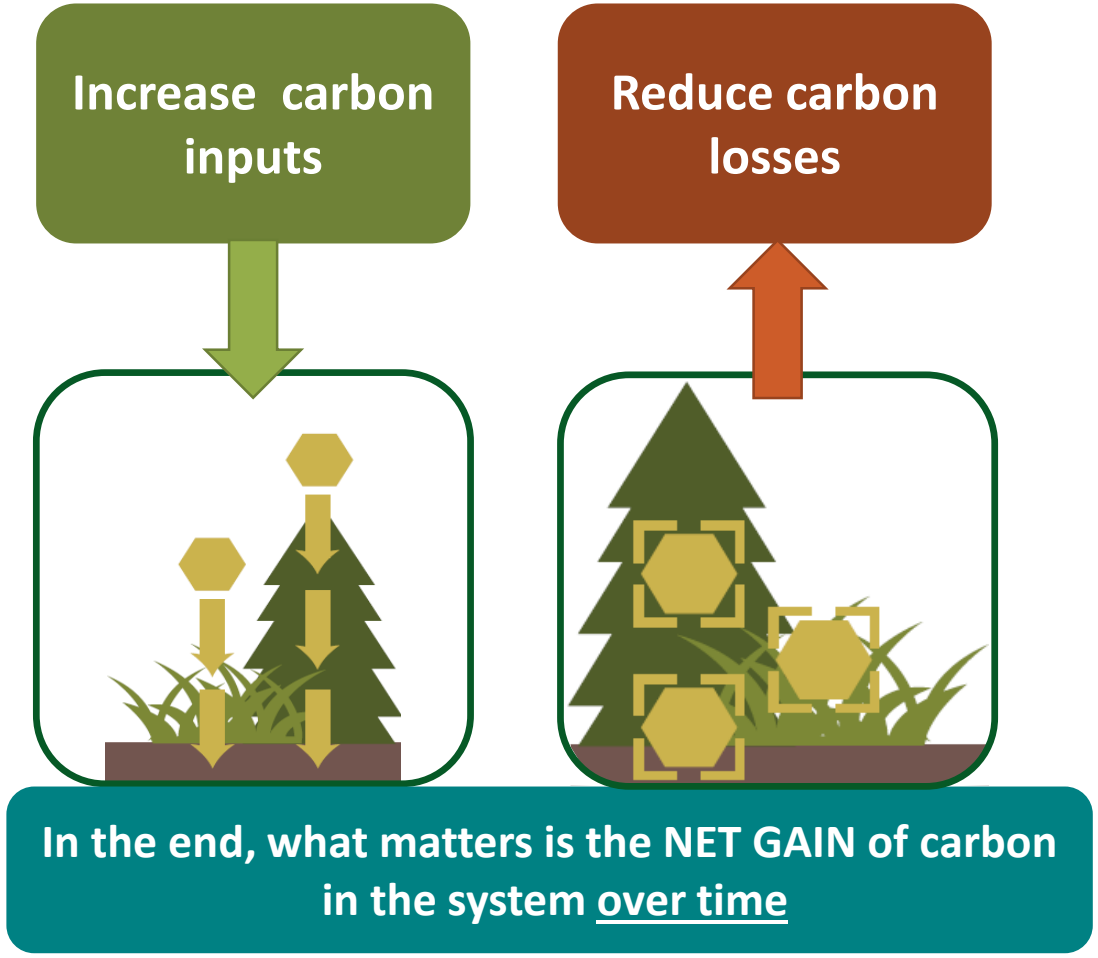
Creating a more positive ecosystem carbon balance:

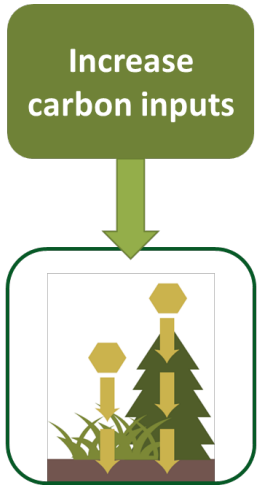
<u>Increase inputs to carbon pools</u>

- Enhanced productivity (sequestration)
- Transfer of live tree carbon into other pools (while maintaining productivity rates)

<u>Reduce unplanned forest carbon losses</u>

- Catastrophic wildfire
- Widespread tree mortality (*e.g.* drought, pests, or diseases)





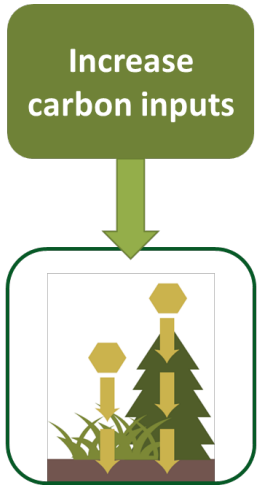
Management to Increase Carbon Inputs

Forest Productivity & Regeneration

- Enhancing growth of existing mature trees
- Improving forest health
- Improving tree regeneration to increase future productivity
- Increasing stocking levels

Existing Carbon Pools

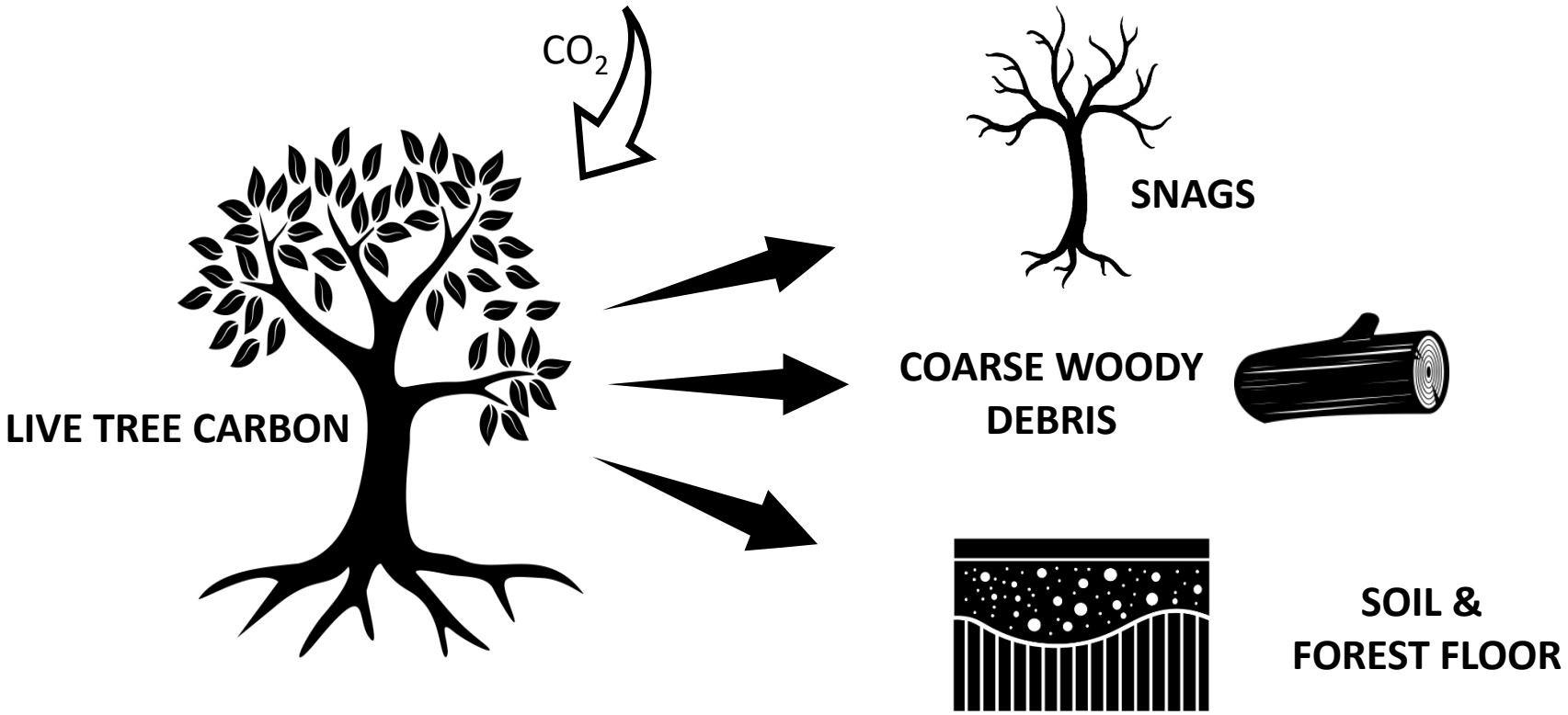
- Enhancement of carbon in soil, litter, coarse woody debris/snags, and understory vegetation

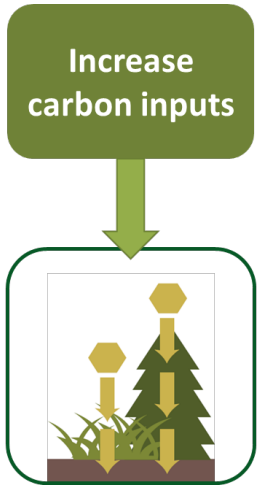


Management to Increase Carbon Inputs

Increasing carbon inputs to the forest is driven by increased photosynthesis in live trees, but actions to increase inputs to other carbon pools are important to consider…

particularly pools that have been depleted from past management or disturbance

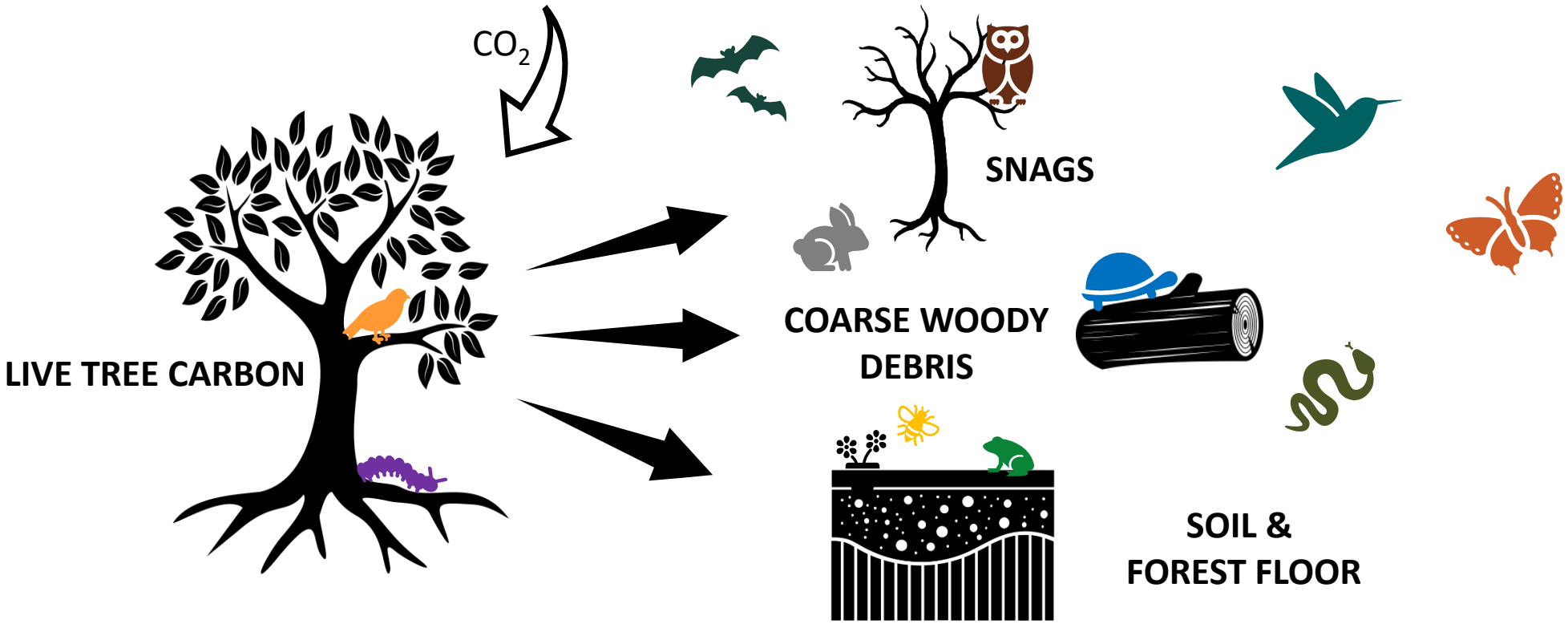


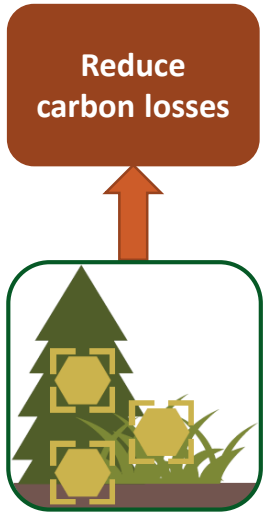


Management to Increase Carbon Inputs

Increasing carbon inputs to the forest is driven by increased photosynthesis in live trees, but actions to increase inputs to other carbon pools are important to consider…

particularly pools that have been depleted from past management or disturbance



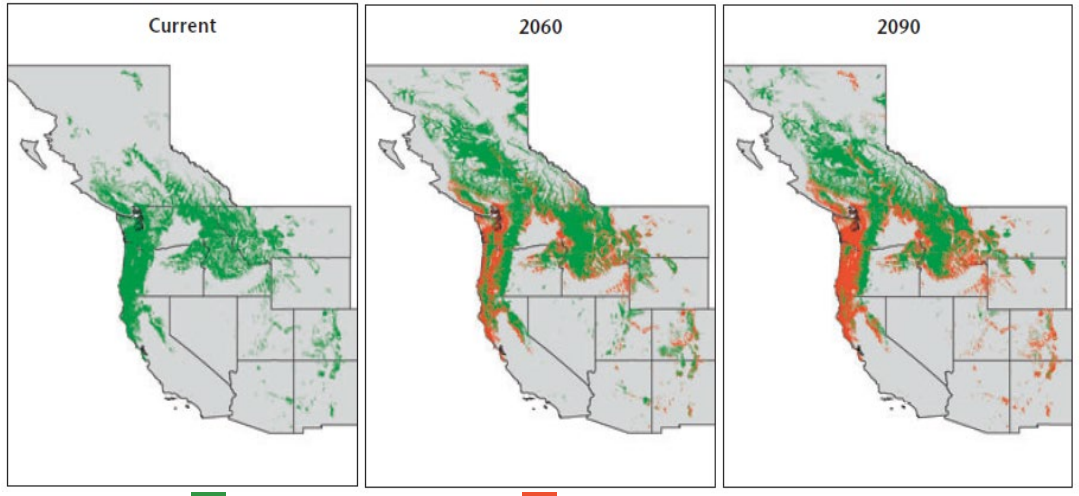


Management for Avoiding Forest Carbon Losses

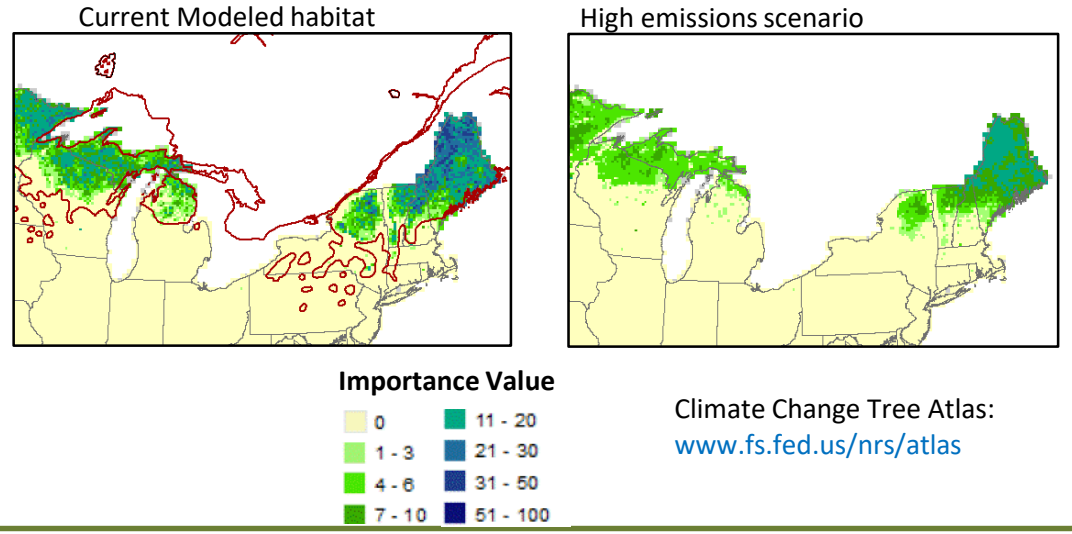
Reducing carbon losses requires assessment of risk for both immediate and long-term losses from a variety of disturbances

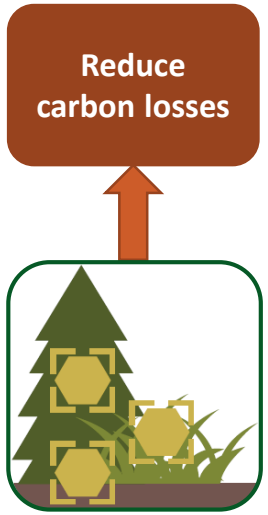
Addressing vulnerability for forest productivity declines (*e.g.* forest health or regeneration concerns)

Suitable habitat projections for Douglas-fir (*P. menziesii*)



Suitable habitat projections for Balsam fir (*Abies balsamea*)





Management for Avoiding Forest Carbon Losses

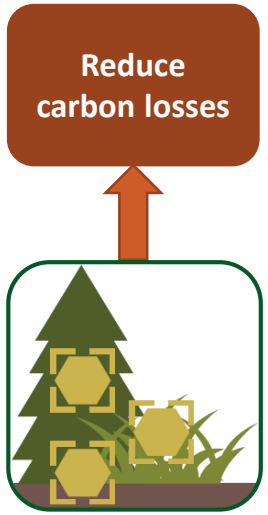
Reducing carbon losses requires assessment of risk for both immediate and long-term losses from a variety of disturbances

Reducing vulnerability to large-scale or intense disturbance from insect pests, wildfire, high winds, etc.

Photo: Widespread tree mortality in Rhode Island due to *Lymantria dispar.* **Credit:** NASA Earth Observatory.

Photo: Catastrophic carbon loss during crown fire, Yellowstone NP, Aug. 2013. **Credit:** National Park Service

Photo: Tree loss resulting from Hurricane Laura, eastern Texas, 2020. **Credit:** Jim Gulden, US Forest Service



Management for Avoiding Forest Carbon Losses

Carbon benefits are often dependent on the level of:

- Risk of disturbance
- Severity of disturbance: vulnerability of an important tree species or ecosystem type to a stressor that would lead to significant carbon loss

Risk of catastrophic loss in any given year may be small, but over the course of decades this risk may increase substantially as the climate changes.

Recent disturbances showing wildfire (1984-2017) and insect and disease (1997-2017) extent in the Northwest.

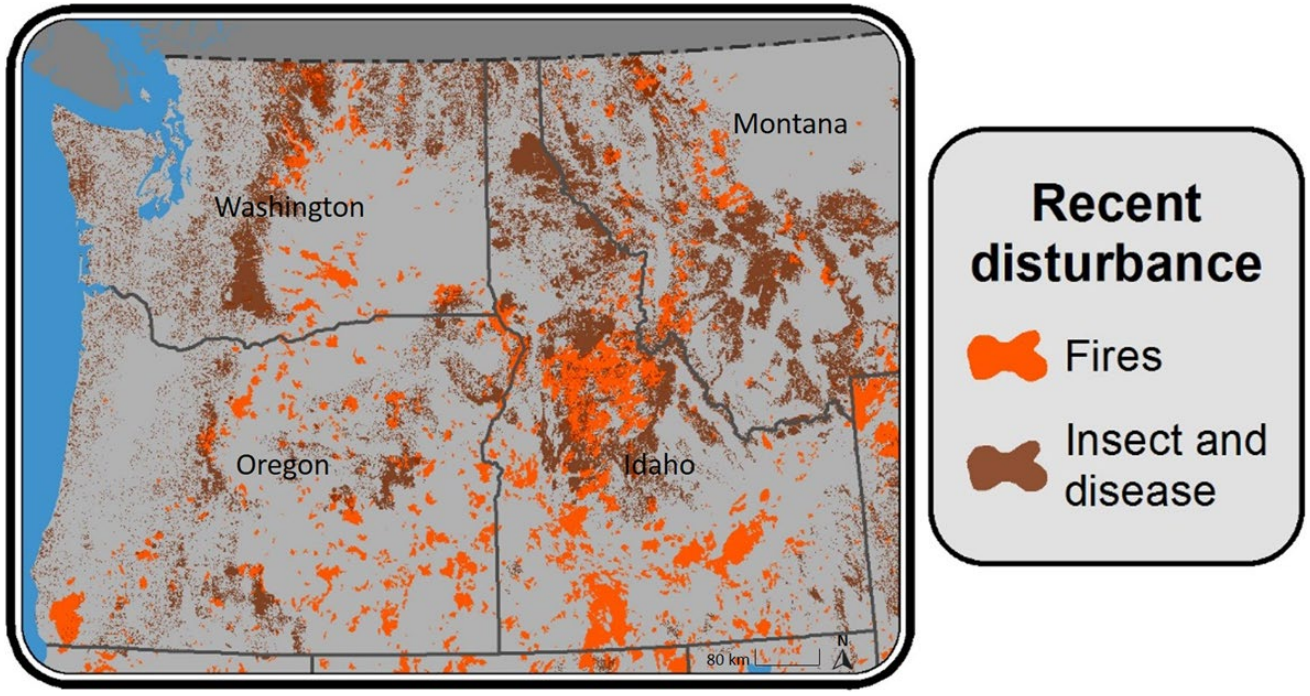
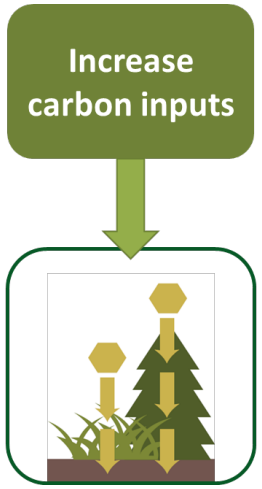


Figure: Robert Norheim in Halofsky et al. 2020

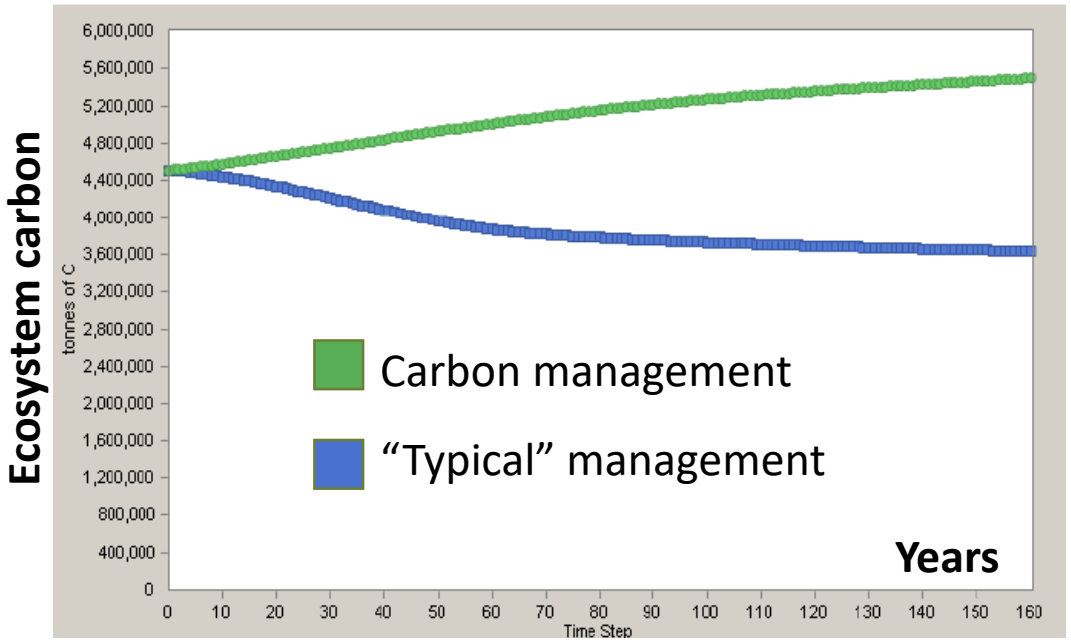


Management to Increase Carbon Inputs

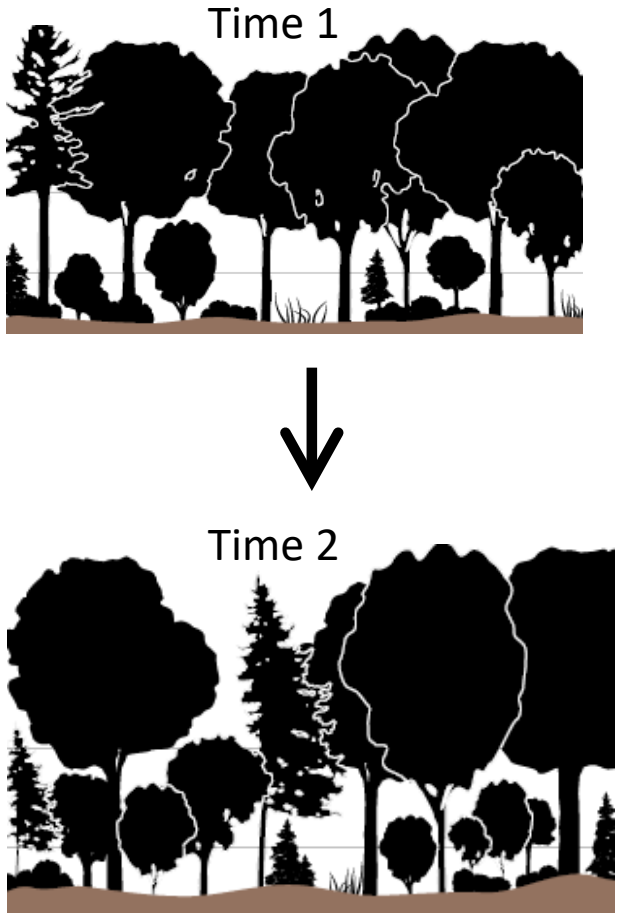
Passive management (low vulnerability)

Systems with **low climate vulnerability**:

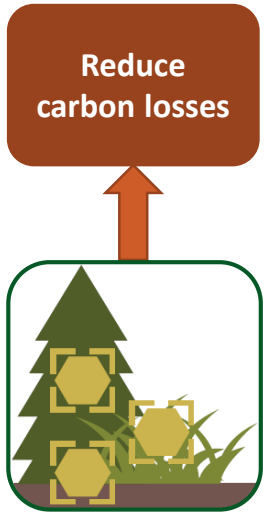
- Low risk of disturbance/ productivity declines
- Increased stocking rates = greater carbon benefits
- **Reduced carbon losses from reducing harvest removals**



Gain in ecosystem carbon



Hypothetical scenarios, your results will vary!

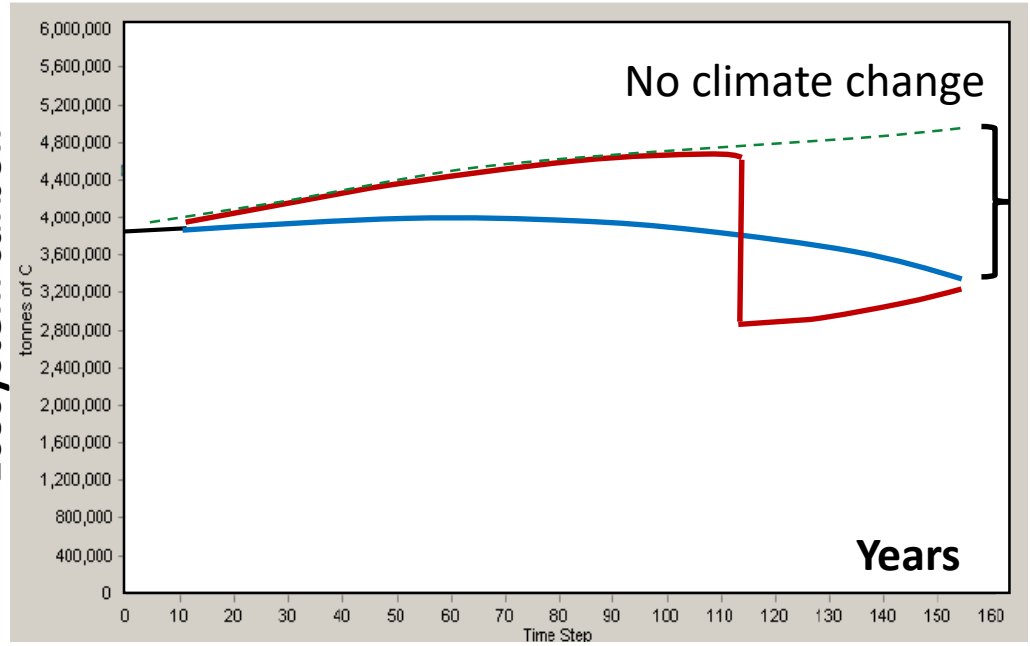


Management for Avoiding Forest Carbon Losses

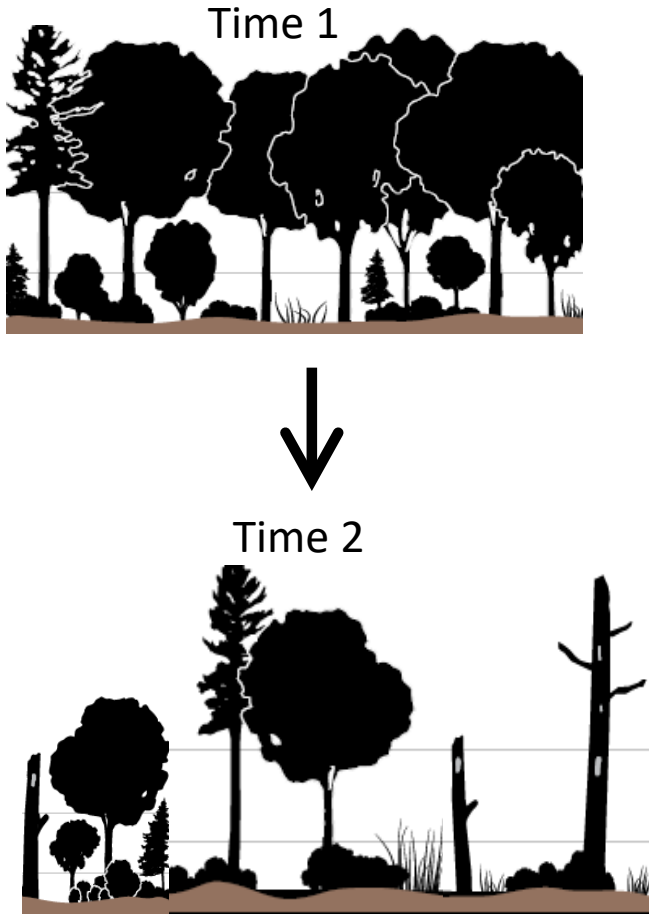
Passive management (high vulnerability)

Systems with **high climate vulnerability**:

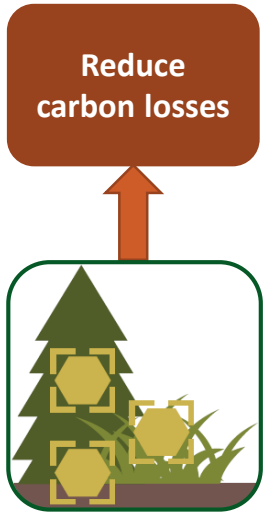
- High risk of carbon loss from disturbance/ productivity declines
- Increased stocking rates = greater risk of carbon loss
- ~~**Reduced carbon losses from reducing harvest removals**~~



Loss in ecosystem carbon



***Hypothetical scenarios, your results will vary!**

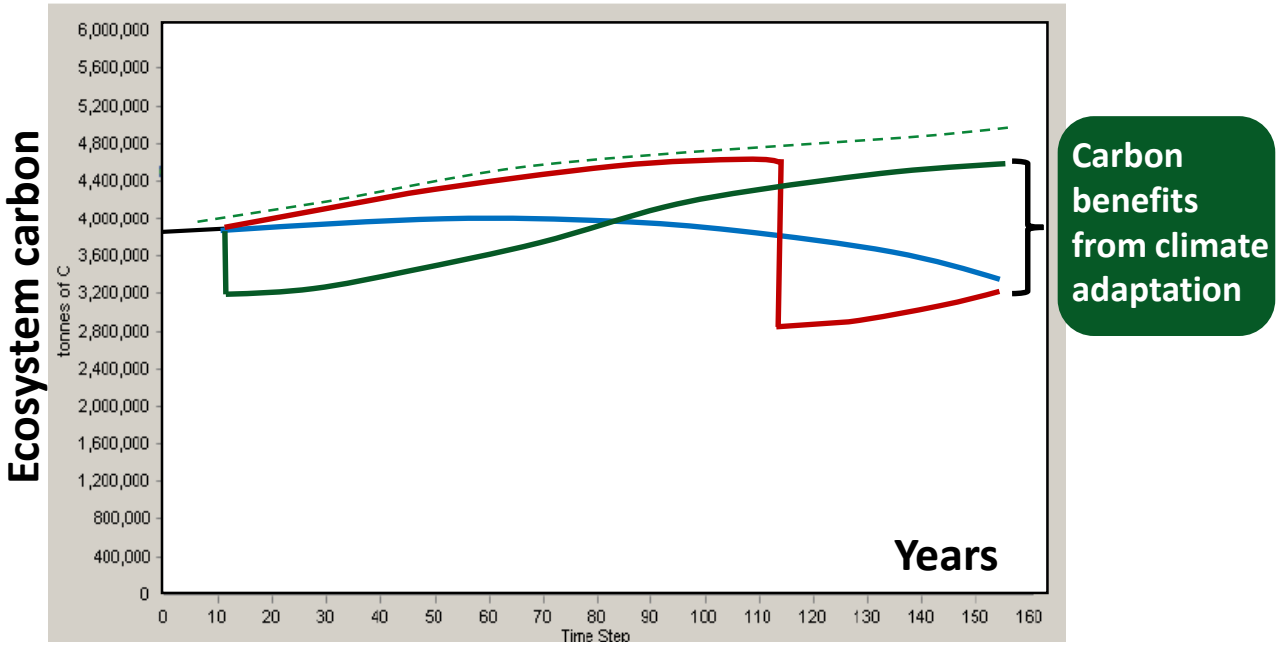


Management for Avoiding Forest Carbon Losses

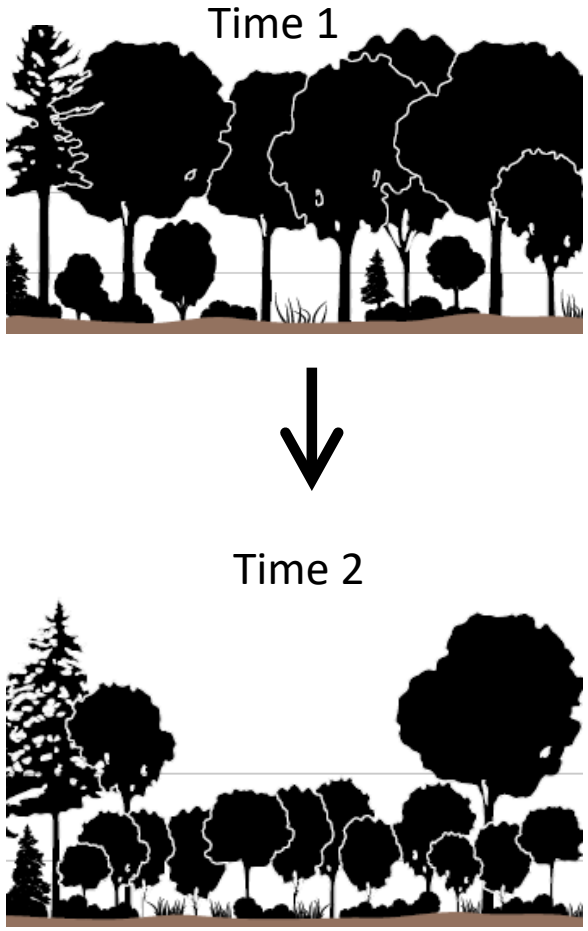
Reducing carbon losses may entail a small reduction in carbon in the **short-term** to *prevent wide-spread or severe carbon losses in the future*.

Systems with **high climate vulnerability**:

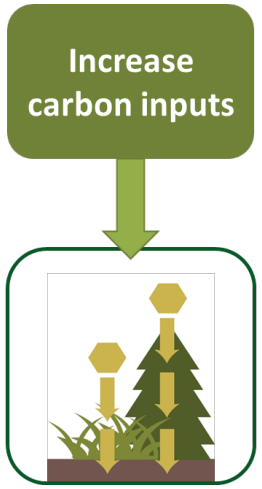
- Climate adaptive management to reduce risk of future carbon losses



Active management (high vulnerability)



Hypothetical scenarios, your results will vary!

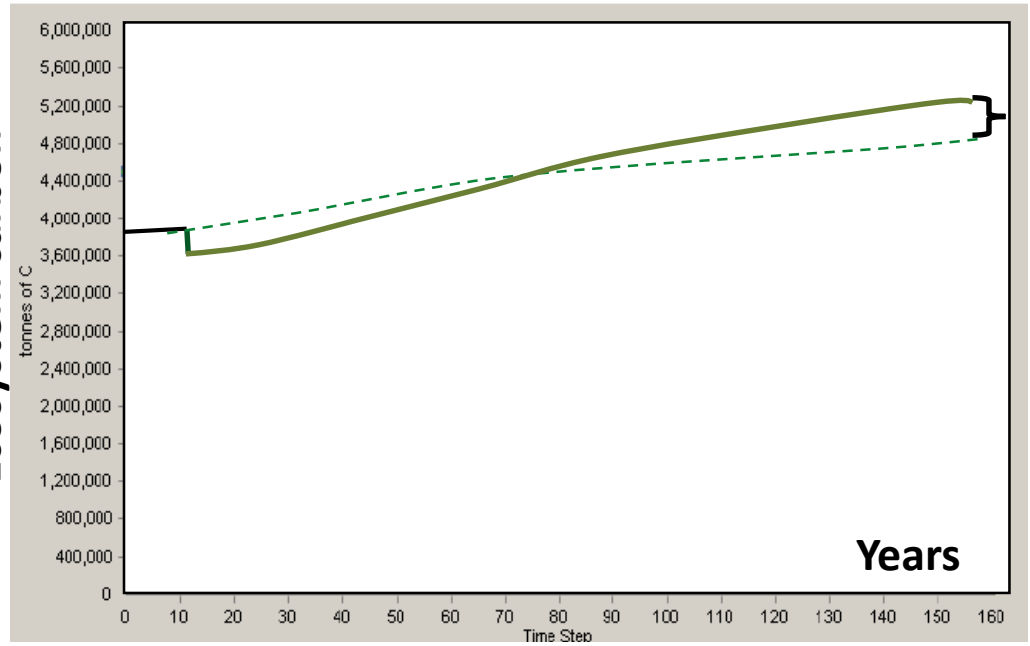


Management to Increase Carbon Inputs

Active management (low vulnerability)

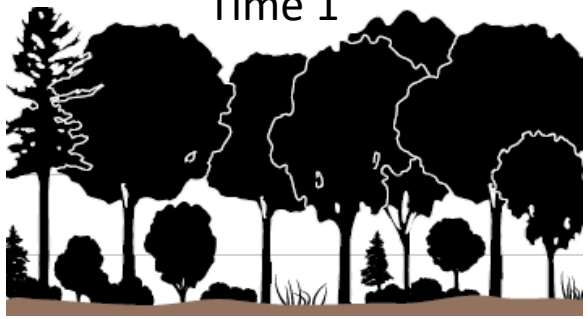
Systems with **low climate vulnerability**:

- Carbon management to enhance sequestration
- Increased complexity provides enhanced habitat for certain forest-dependent species



Carbon benefits from enhanced forest stand complexity

Time 1

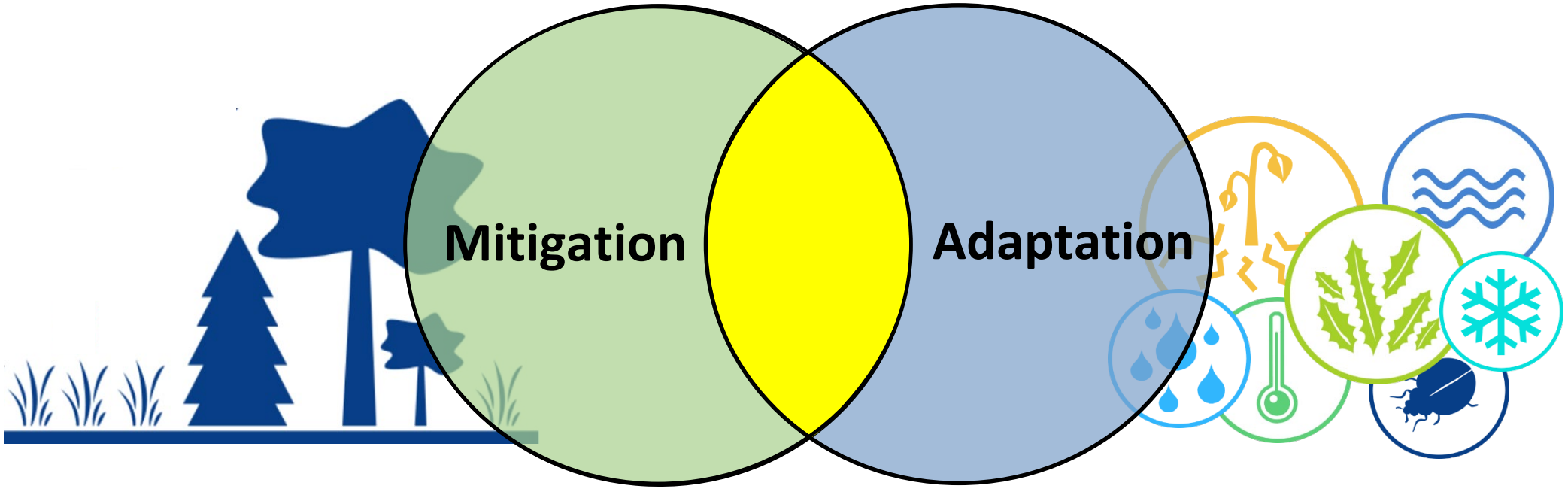


Time 2

Hypothetical scenarios, your results will vary!

Integrate climate adaptation & mitigation practices for:

- *More resilient carbon sequestration*
- *Enhanced residence time of ecosystem carbon stocks*



Carbon Trade-offs: Wildlife Habitat

How can we maximize carbon benefits on our forest lands?

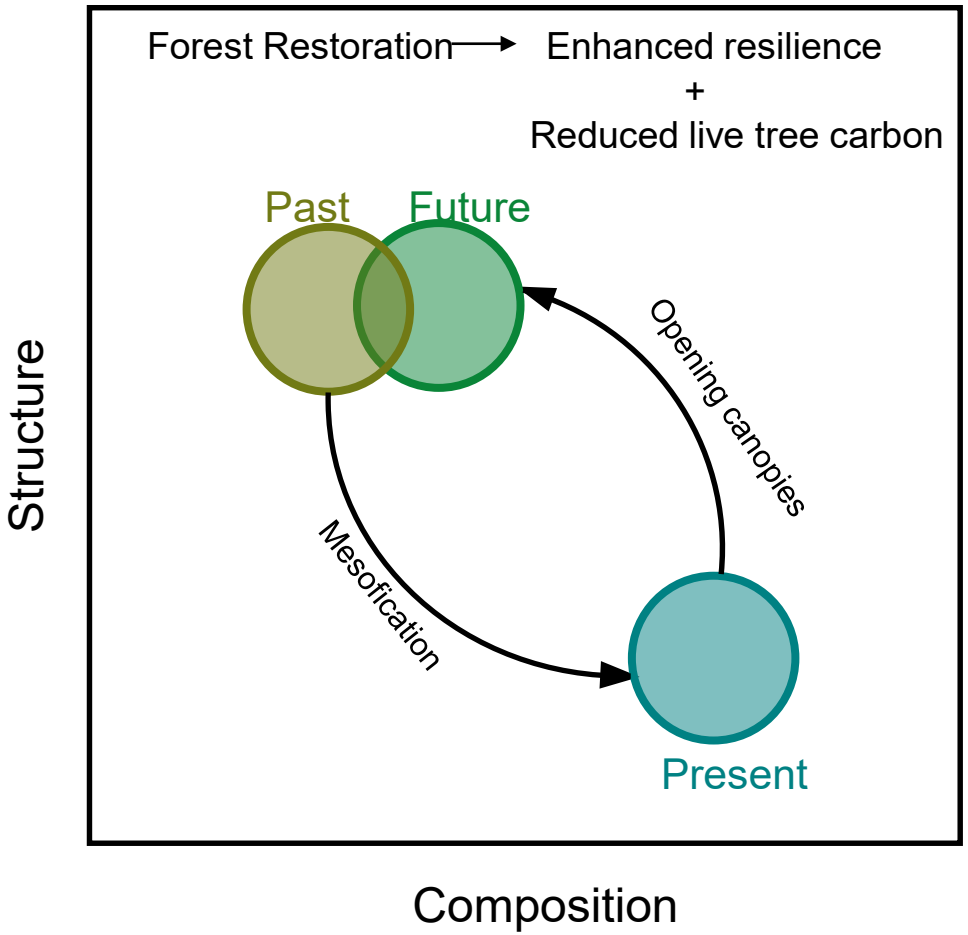
Carbon Trade-offs: Wildlife Habitat

~~*How can we maximize carbon benefits on our forest lands?*~~

Are there carbon practices help us achieve our mitigation AND other desired goals?




Carbon Trade-offs: Wildlife Habitat



Habitat to be restored and maintained	Habitat quality for focal species	Stand-level carbon storage in trees	Habitat and wildlife species diversity	Risk of carbon release from severe disturbance	Enhanced resilience and adaptive capacity
Early successional n. hardwoods	↗	↘	↗	↘	↗
Tallgrass aspen parklands	↗	↘*	↗	↘	↗
Oak savanna	↗	↘*	↗	↘	↗
Pitch pine-scrub oak barrens	↗	↘	↗	↘	↗

Stand-level effects Landscape-level effects

*soil carbon may increase over time

From: Ontl *et al.* (2018) *Clim. Change;* DOI: 10.1007/s10584-017-1983-3

From: Littlefield and D'Amato (2021) *Cons. Sci. & Practice;* DOI: 10.1111/csp2.12631

Strategies & Approaches for Carbon Management: *Identifying Actions*

Forest Adaptation Resources

A flexible workbook and menus to address the diverse needs of land managers

- Designed for eastern forest types…
- … and a variety of land owners with diverse goals
- Does not make recommendations
- Includes:
  - Adaptation Workbook
  - Adaptation strategies for different resource areas (menus)

Swanston et al. 2016 (2nd edition); www.treesearch.fs.fed.us/pubs/52760; www.adaptationworkbook.org

Menus of Adaptation Strategies and Approaches

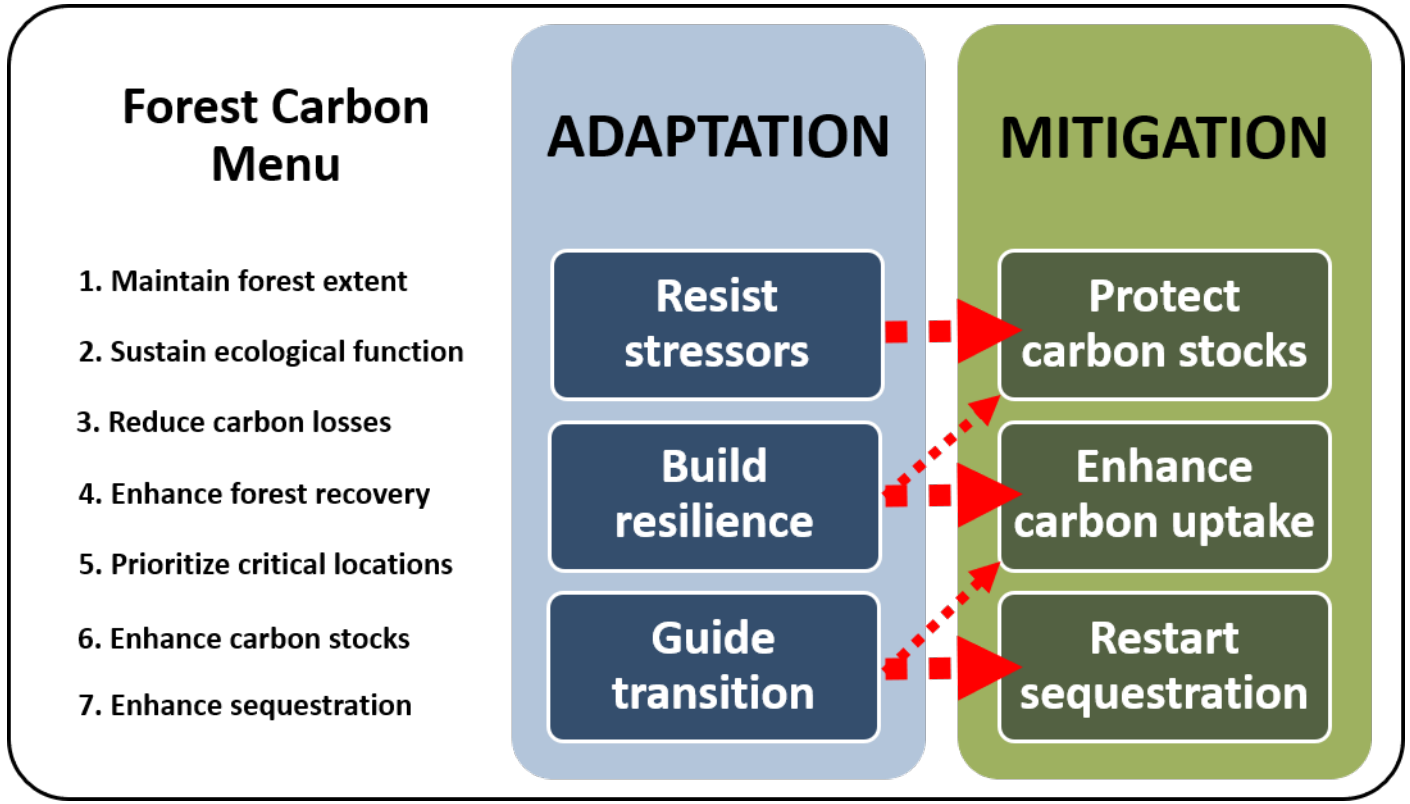
A “menu” of **possible actions** that allows you to decide what is ***most relevant for a particular location and set of conditions.***

www.AdaptationWorkbook.org/strategies

Menu of Strategies and Approaches for Forest Carbon Management

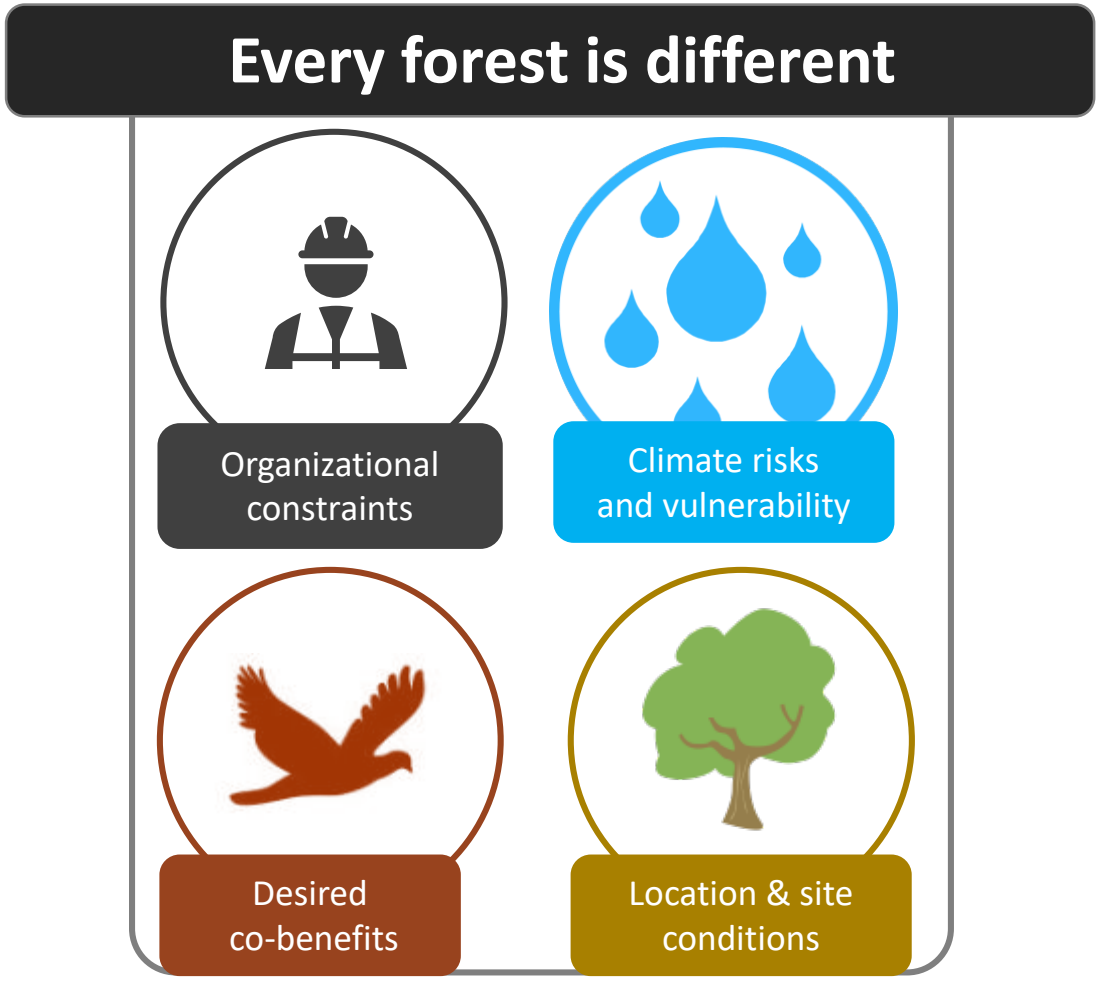
7 strategies, 31 approaches

Builds off of practices for sustainable forest management



Ontl *et al.* (2020) *J. For;* DOI:10.1093/jofore/fvz062; **www.ForestAdaptation.org/carbon**

Forest carbon: there is no single answer



Each decision is unique and will vary based upon:

People: Values, Culture, & Resources

Place: Location & Site Conditions

Purpose: Goals & Objectives

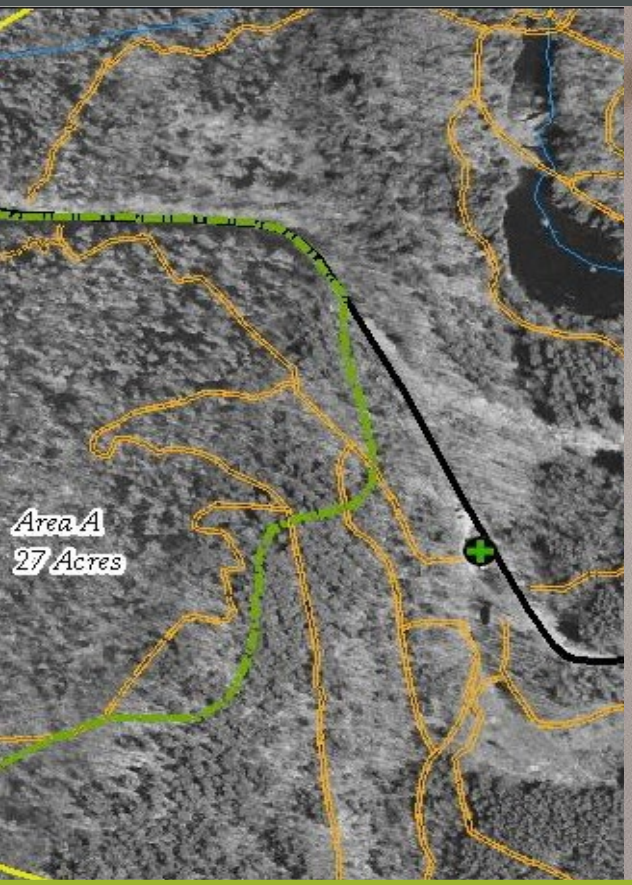
Practices: Equipment, Procedures, & Methods

Don’t ignore climate risks and vulnerability!!!

Identifying climate co-benefits case study:

Audubon Vermont

Green Mountain Audubon Center



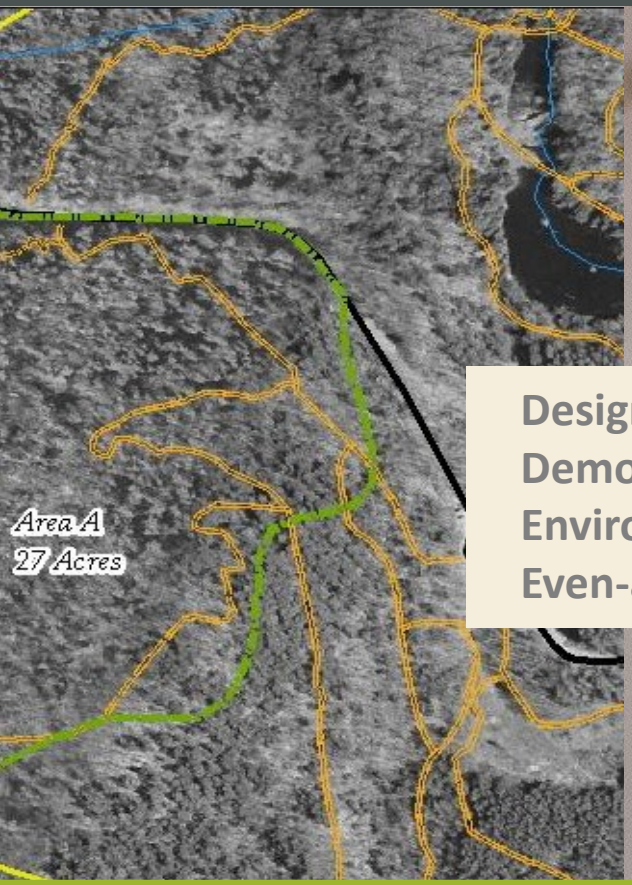
https://forestadaptation.org/GMAC

Audubon Vermont/ Alberto Lopez

Identifying climate co-benefits case study:

Audubon Vermont

Green Mountain Audubon Center



Designated Important Bird Area
Demonstration site for Foresters for the Birds
Environmental education, scientific research, and outdoor recreation
Even-aged, multi-strata northern hardwood stands

GREEN MOUNTAIN Audubon CENTER

https://forestadaptation.org/GMAC

Audubon Vermont/ Alberto Lopez

Integrating climate co-benefits case study: Green Mountain Audubon Center

Management goals

- Neotropical songbird breeding habitat
- Increase sawtimber quantity & quality
- Increase understory development
- Increase regeneration through controlling beech
- Control invasive plant species

Climate impacts

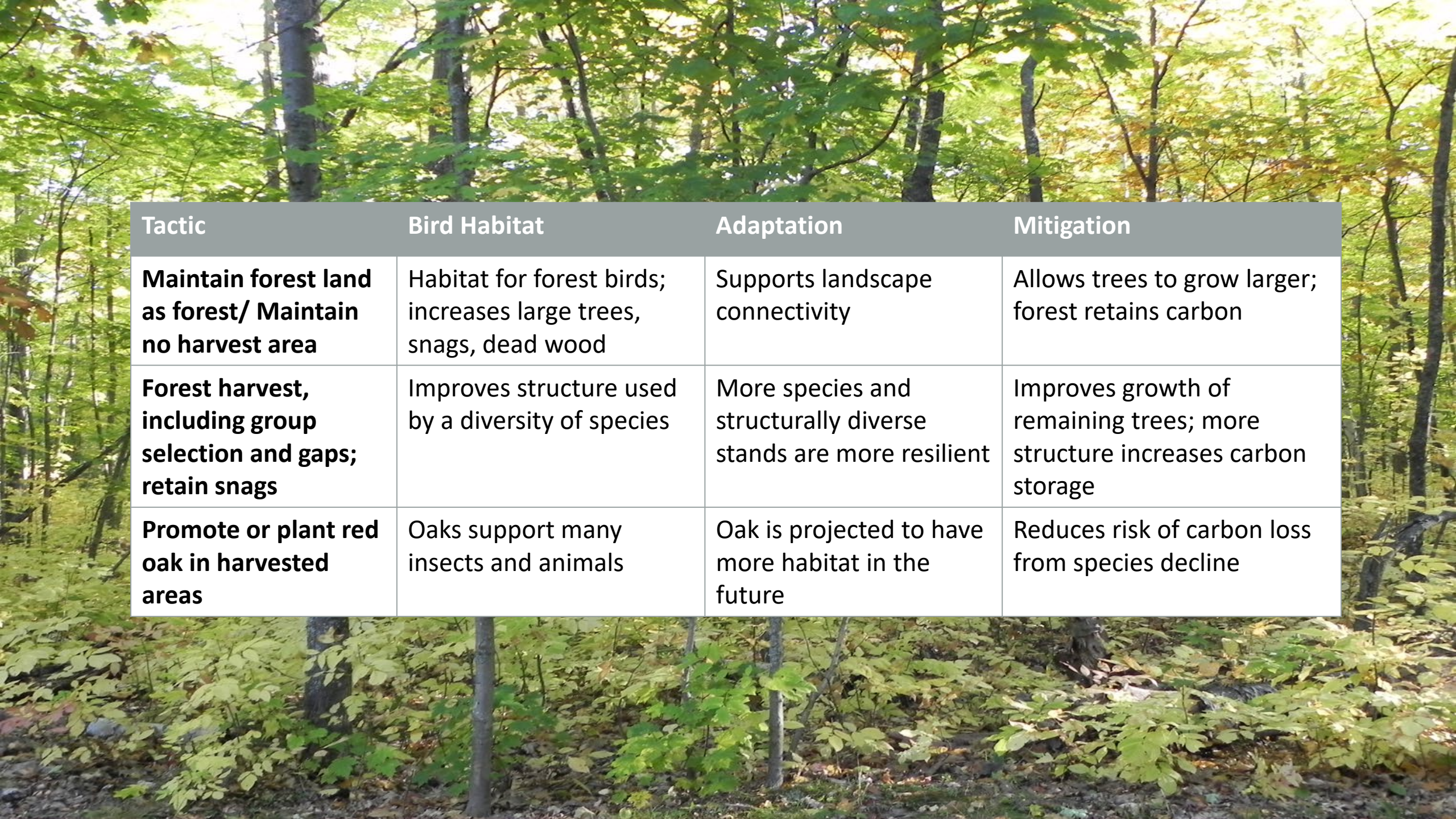
Warming winters:

- reduce snowpack
- increase pests

Increased frequency and intensity of extreme weather:

- non-native invasive plant species
- soil erosion

Audubon Vermont



Tactic	Bird Habitat	Adaptation	Mitigation
Maintain forest land as forest/ Maintain no harvest area	Habitat for forest birds; increases large trees, snags, dead wood	Supports landscape connectivity	Allows trees to grow larger; forest retains carbon
Forest harvest, including group selection and gaps; retain snags	Improves structure used by a diversity of species	More species and structurally diverse stands are more resilient	Improves growth of remaining trees; more structure increases carbon storage
Promote or plant red oak in harvested areas	Oaks support many insects and animals	Oak is projected to have more habitat in the future	Reduces risk of carbon loss from species decline

CLIMATE CHANGE
RESPONSE FRAMEWORK

Who we are | Assess | Adapt | Learn | Focus | Contact

There's no single answer for responding to climate change

Our team will work with you to find solutions that fit your individual needs.

> Learn More

Understanding risk

Climate change introduces uncertainty about future conditions and increases challenges for natural resource managers interested in sustaining

Adaptation in action

Responding to climate change requires an approach that tailors actions to the unique needs of a particular project.

forestadaptation.org/adapt/demonstration-projects
forestadaptation.org/focus/forest-carbon-management

CLIMATE CHANGE
RESPONSE FRAMEWORK

Who we are | Assess | Adapt | Learn | Focus | Contact

There's no single answer for responding to climate change (or managing for carbon…)

Our team will work with you to find solutions that fit your individual needs.

> Learn More

Understanding risk

Climate change introduces uncertainty about future conditions and increases challenges for natural resource managers interested in sustaining

Adaptation in action

Responding to climate change requires an approach that tailors actions to the unique needs of a particular project.

forestadaptation.org/adapt/demonstration-projects
forestadaptation.org/focus/forest-carbon-management