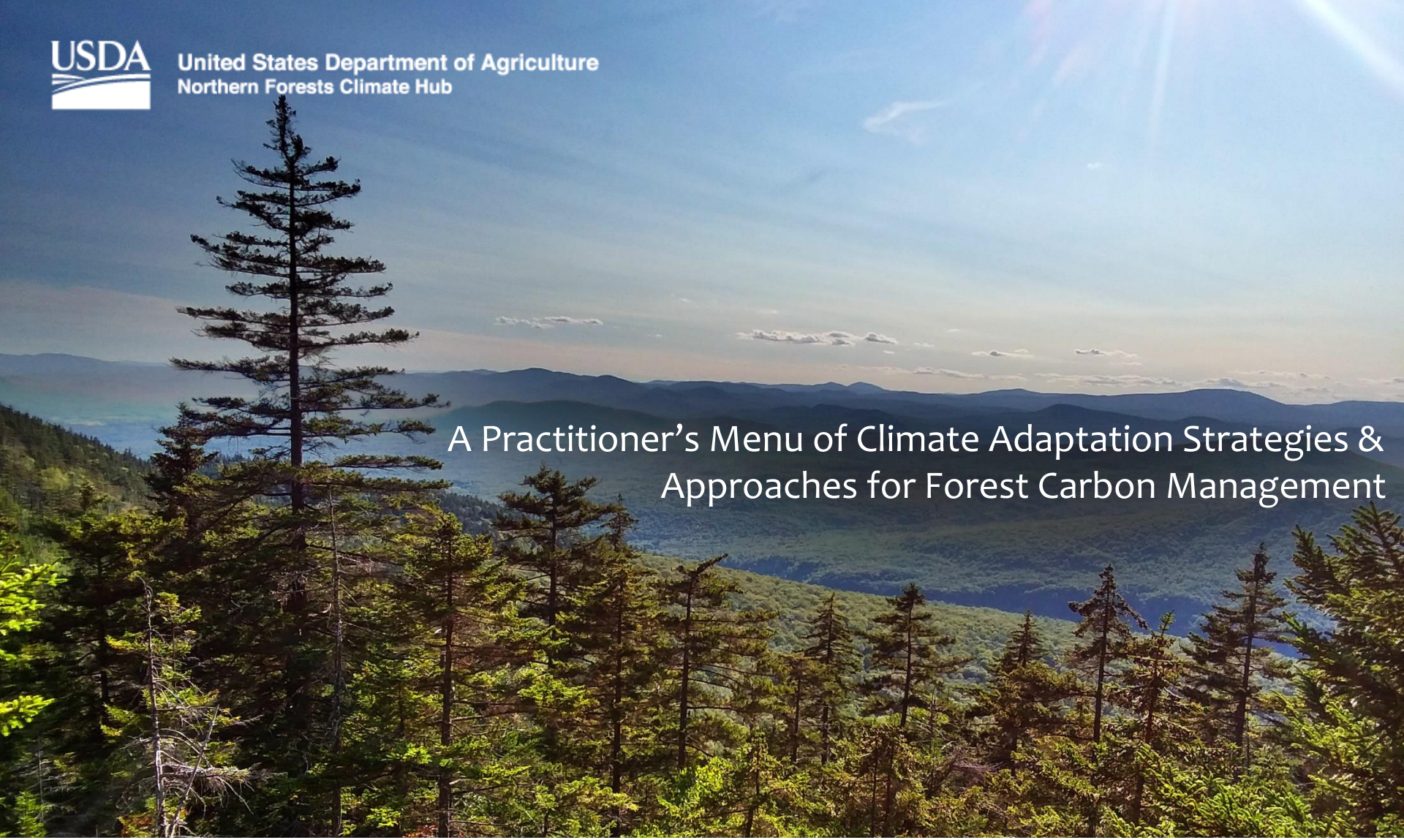


A Practitioner's Menu of Climate Adaptation Strategies & Approaches for Forest Carbon Management

Todd Ontl
USDA Northern Forests Climate Hub Fellow
Northern Institute of Applied Climate Science
USDA Forest Service Northern Research Station

Today's webinar:

1. NIACS & the Climate Change Response Framework
2. Principles and concepts: forest carbon menu
3. Forest carbon menu overview
4. Adaptation demonstration projects

Northern Institute of Applied Climate Science

Climate

Carbon

- Practical information
- Adaptation resources
- Technical assistance

NIACS
Northern Institute of Applied Climate Science

Regional multi-institutional partnership among:

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

AMERICAN FORESTS

Great Lakes Indian Fish & Wildlife Commission

College of Food, Agricultural and Natural Resource Sciences
UNIVERSITY OF MINNESOTA

Michigan Technological University 1885

ncasi

The UNIVERSITY of VERMONT

www.nrs.fs.fed.us/niacs/

“Specialty Hub” for forestry & natural resources

Supports two Regional Hubs

20 states in NE/MW

42% forested

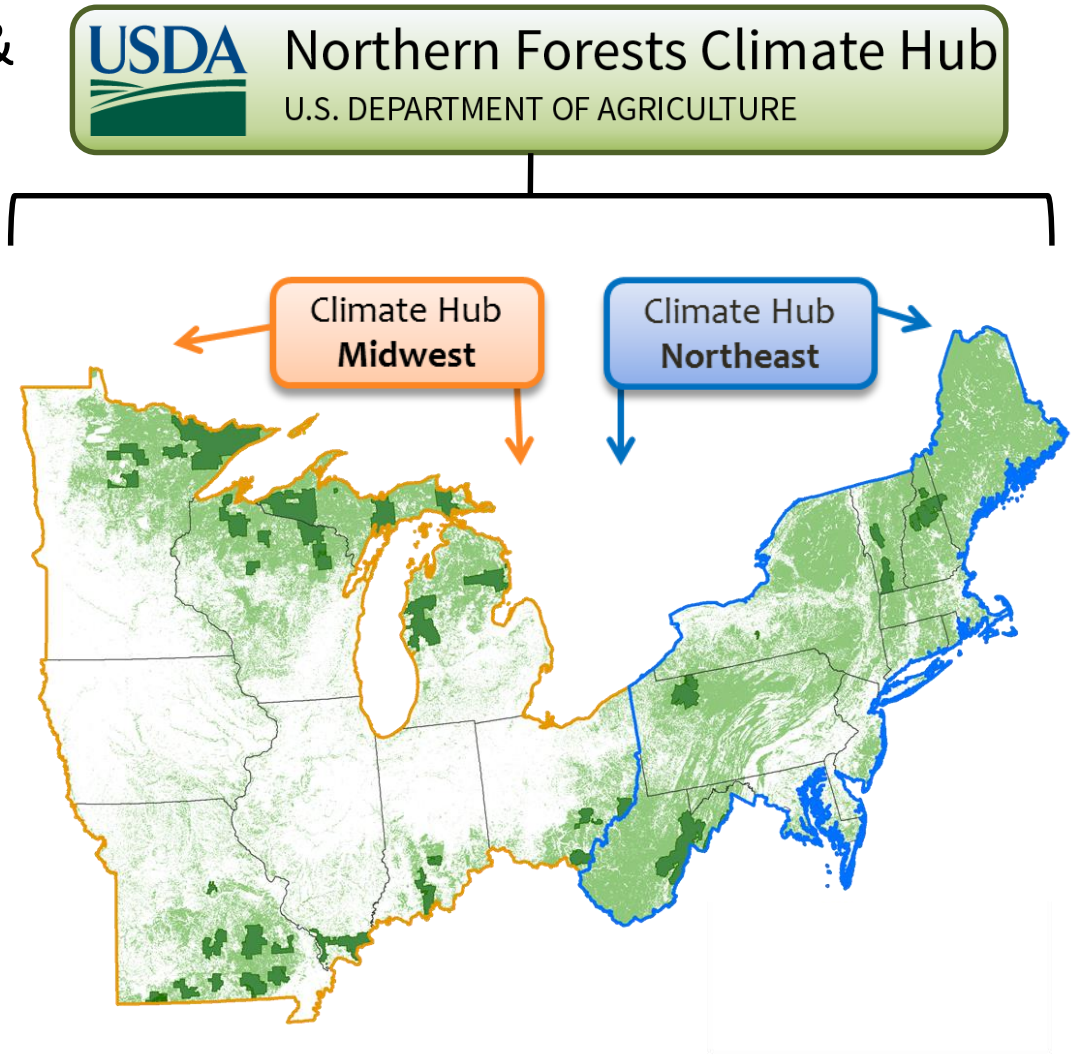
41% of US population

>70% privately owned

Climate Services

- Assessment
- Practical resources
- Technical assistance

Operated by NIACS

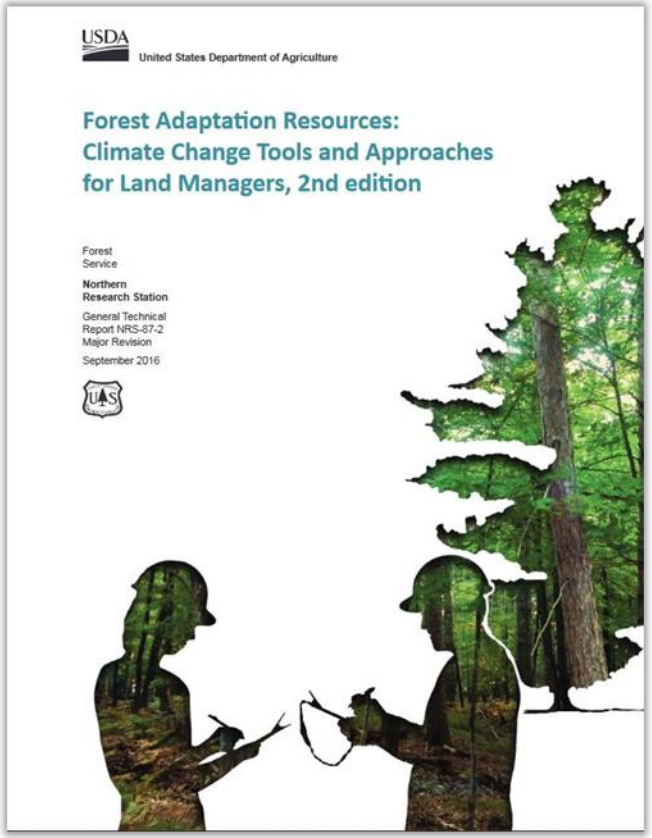


Climate Change Response Framework

What actions can help systems adapt to climate change and other threats while also meeting landowner needs?




Forest Adaptation Resources

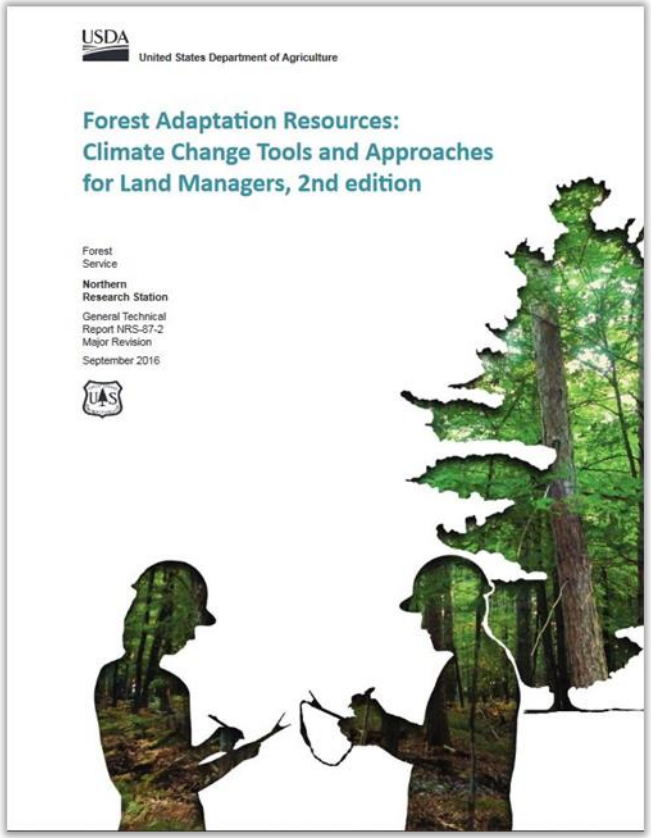


Swanston et al. 2016 (2nd edition)
www.nrs.fs.fed.us/pubs/52760

A flexible approach driven by stakeholder needs and values

- Adaptive management approach to support decision making
- Integrates information from assessments, etc.
- *Does not* make recommendations
- Tested with stakeholders and real-world projects

Forest Adaptation Resources



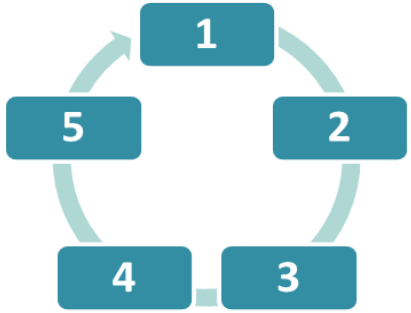
Swanston et al. 2016 (2nd edition)
www.nrs.fs.fed.us/pubs/52760

ADAPTATION STRATEGIES AND APPROACHES

Presents a "menu" of adaptation strategies and approaches for forest ecosystems

ADAPTATION WORKBOOK

Outlines a series of steps for incorporating climate change into existing management

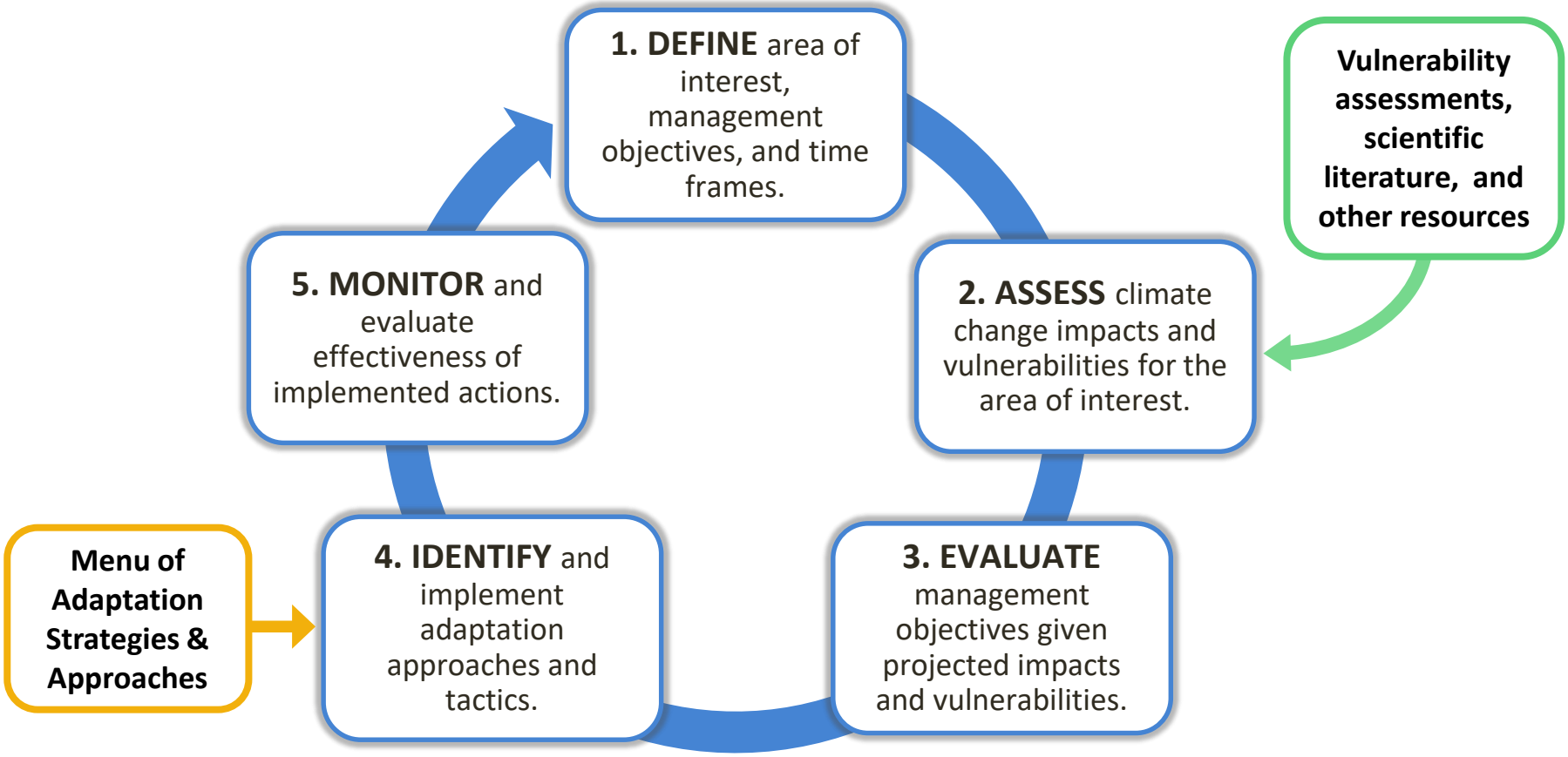


ADAPTATION DEMONSTRATIONS

Provides real-world examples of how the above can be used together to develop tactics for adaptation

Adaptation Workbook

Workbook provides "**structured flexibility**"



Swanston et al. 2016 (2nd edition)
www.nrs.fs.fed.us/pubs/52760

Forest Adaptation Resources

The **Menus** help you create **clear rationale** for your actions by connecting them to **broader adaptation ideas**.

- Intentionality
- Success

Swanston et al. 2016 (2nd edition) www.nrs.fs.fed.us/pubs/52760

Menu components

- **Strategy:** A strategy is a broad adaptation response that is applicable across a variety of resources and sites
- **Approach:** Adaptation response specific to a resource issue or geography
- **Tactic:** Prescriptive action (devised by manager)

***does not make recommendations or set guidelines*

Swanston et al. 2016 (2nd edition) www.nrs.fs.fed.us/pubs/52760

Connecting the Dots…

A clear train of thought shows *intentionality*

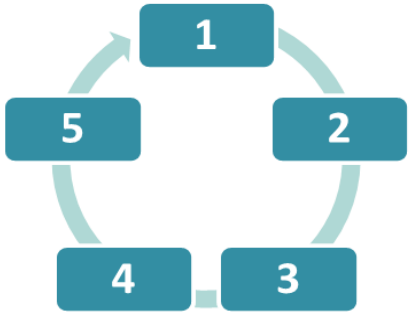
Management Goals & Objectives

Climate Change Impacts

Challenges & Opportunities

Intent of Adaptation
(Resistance, Resilience, Transition)

Make Idea Specific
(Strategy, Approach)



Action to Implement (Tactic)

A “Menu” of menus

Menus for:

Forestry

Urban forestry

Agriculture

In revision

Forest carbon mgmt.

Recreation

Forested watershed mgmt.

Wildlife mgmt.

Tribal perspectives

Coastal ecosystems

California ecosystems

Menu of Adaptation Strategies and Approaches

Strategy 1: Sustain fundamental ecological functions.

1.1. Reduce impacts to soils and nutrient cycling.
1.2. Maintain or restore hydrology.
1.3. Maintain or restore riparian areas.
1.4. Reduce competition for moisture, nutrients, and light.
1.5. Restore or maintain fire in fire-adapted ecosystems.

Strategy 2: Reduce the impact of biological stressors.

2.1. Maintain or improve the ability of forests to resist pests and pathogens.
2.2. Prevent the introduction and establishment of invasive plant species and remove existing invasive species.
2.3. Manage herbivory to promote regeneration of desired species.

Strategy 3: Reduce the risk and long-term impacts of severe disturbances.

3.1. Alter forest structure or composition to reduce risk or severity of wildfire.
3.2. Establish fuelbreaks to slow the spread of catastrophic fire.
3.3. Alter forest structure to reduce severity or extent of wind and ice damage.
3.4. Promptly revegetate sites after disturbance.

Strategy 4: Maintain or create refugia.

4.1. Prioritize and maintain unique sites.
4.2. Prioritize and maintain sensitive or at-risk species or communities.
4.3. Establish artificial reserves for at-risk and displaced species.

Strategy 5: Maintain and enhance species and structural diversity.

5.1. Promote diverse age classes.
5.2. Maintain and restore diversity of native species.
5.3. Retain biological legacies.
5.4. Establish reserves to maintain ecosystem diversity.

Strategy 6: Increase ecosystem redundancy across the landscape.

6.1. Manage habitats over a range of sites and conditions.
6.2. Expand the boundaries of reserves to increase diversity.

Strategy 7: Promote landscape connectivity.

7.1. Reduce landscape fragmentation.
7.2. Maintain and create habitat corridors through reforestation or restoration.

Strategy 8: Maintain and enhance genetic diversity.

8.1. Use seeds, germplasm, and other genetic material from across a greater geographic range.
8.2. Favor existing genotypes that are better adapted to future conditions.

Strategy 9: Facilitate community adjustments through species transitions.

9.1. Favor or restore native species that are expected to be adapted to future conditions.
9.2. Establish or encourage new mixes of native species.
9.3. Guide changes in species composition at early stages of stand development.
9.4. Protect future-adapted seedlings and saplings.
9.5. Disfavor species that are distinctly maladapted.
9.6. Manage for species and genotypes with wide moisture and temperature tolerances.
9.7. Introduce species that are expected to be adapted to future conditions.
9.8. Move at-risk species to locations that are expected to provide habitat.

Strategy 10: Realign ecosystems after disturbance.

10.1. Promptly revegetate sites after disturbance.
10.2. Allow for areas of natural regeneration to test for future-adapted species.
10.3. Realign significantly disrupted ecosystems to meet expected future conditions.

The *Forest Carbon Management* menu

The forest carbon sink offsets ~15% of total US fossil fuel emissions (Woodall et al. 2015)

Forests comprise >90% of the US land sector sequestration capacity (EPA 2016)

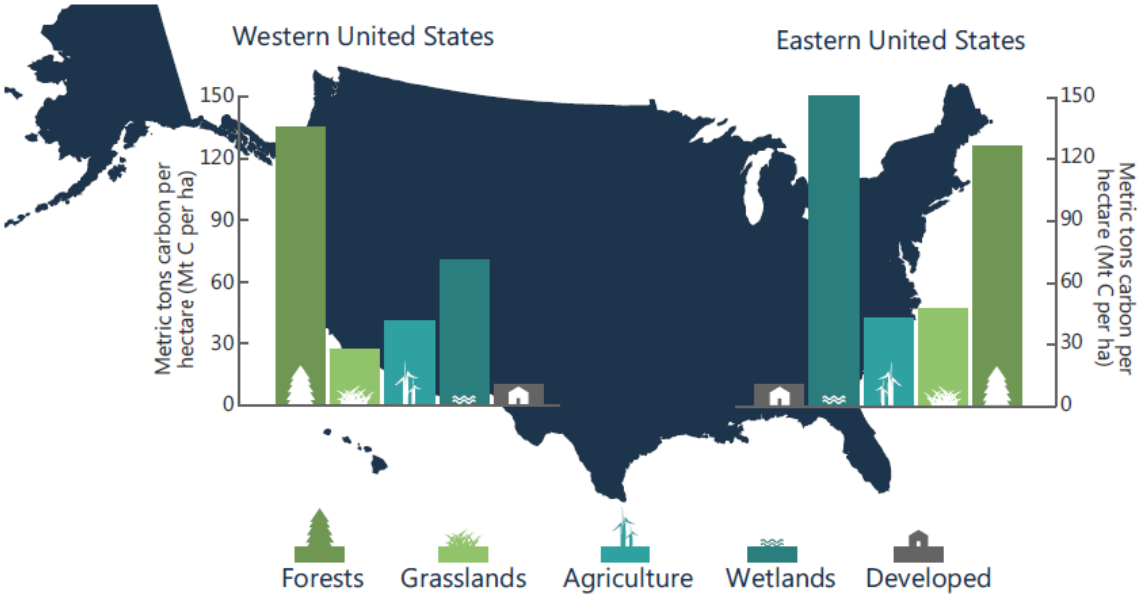


Figure from Janowiak et al. 2017 (data source: Lui et al. 2012, 2014)

www.forestadaptation.org/carbon

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

www.forestadaptation.org/carbon

Forest carbon management

A synthesis of current knowledge on forests and carbon storage in the United States

...cKinley,[1,2,15] Michael G. Ryan,[3,4] Richard A. Birdsey,[5] Christian P. Giardina,[6] ... Heath,[8] Richard A. Houghton,[9] Robert B. Jackson,[10] James F. Morrison,[11] ...[12] Diane E. Pataki,[13] and Kenneth E. Skog[14]

Forest Carbon Management in the United Sta...

Richard Birdsey,* Kurt P...

Reforestation can sequester two petagrams of carbon in US topsoils in a century

Lucas E. Nave[a,b,1], Grant M. Domke[c], Kathryn L. Hofmeister[a,d], Umakant Mishra[e], Charles H. Perry[c], Brian F. Walters[c], and Christopher W. Swanston[f]

A Synthesis of the Science on Forests and Carbon for U.S. Forests

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Forest climate adaptation

Forest carbon management

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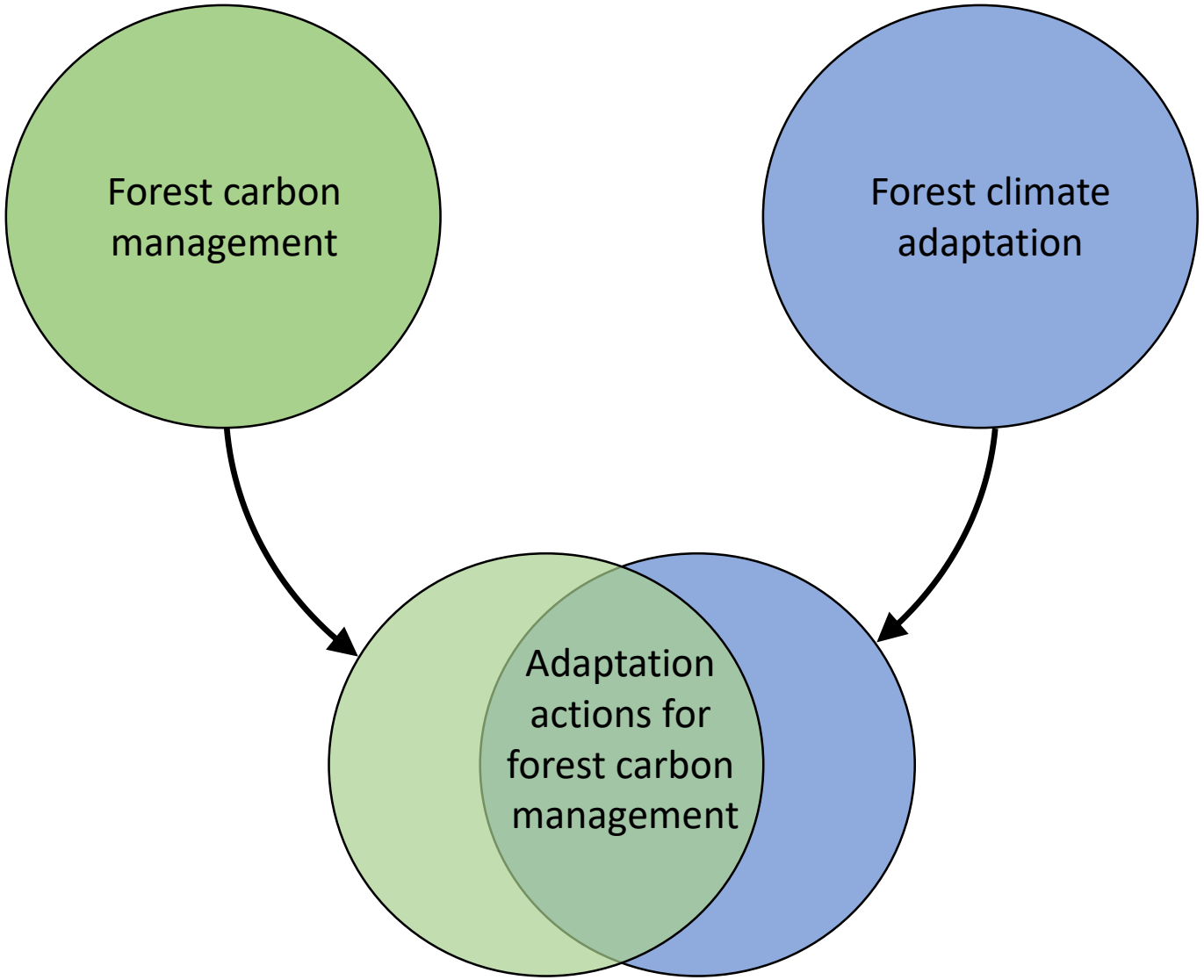
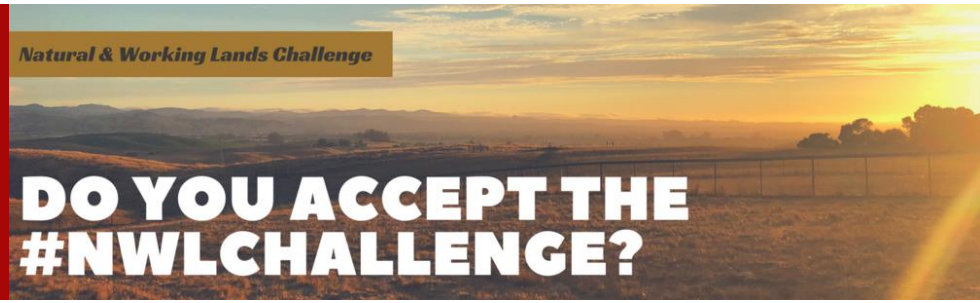


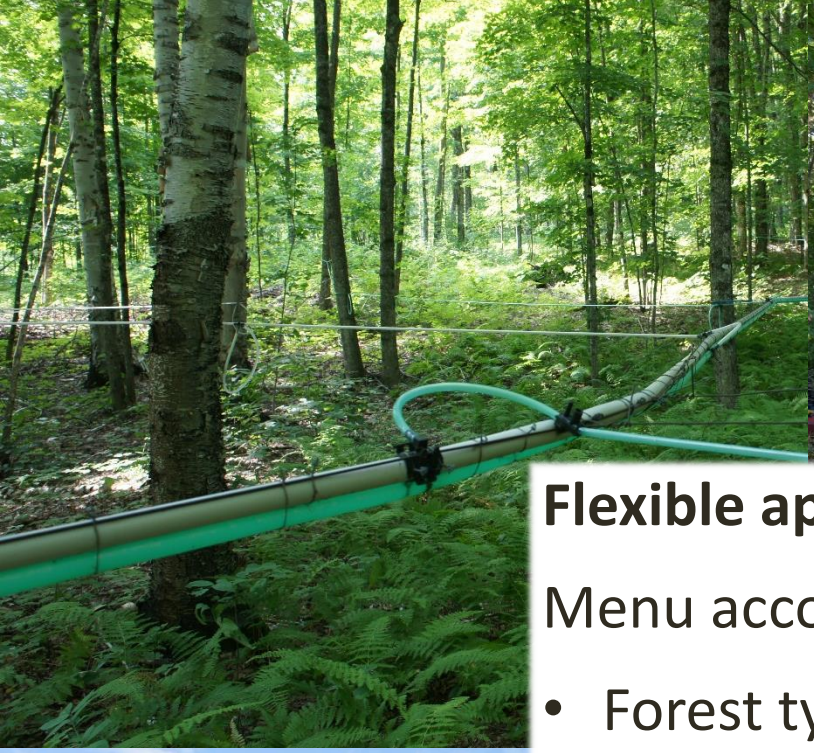
www.forestadaptation.org/carbon

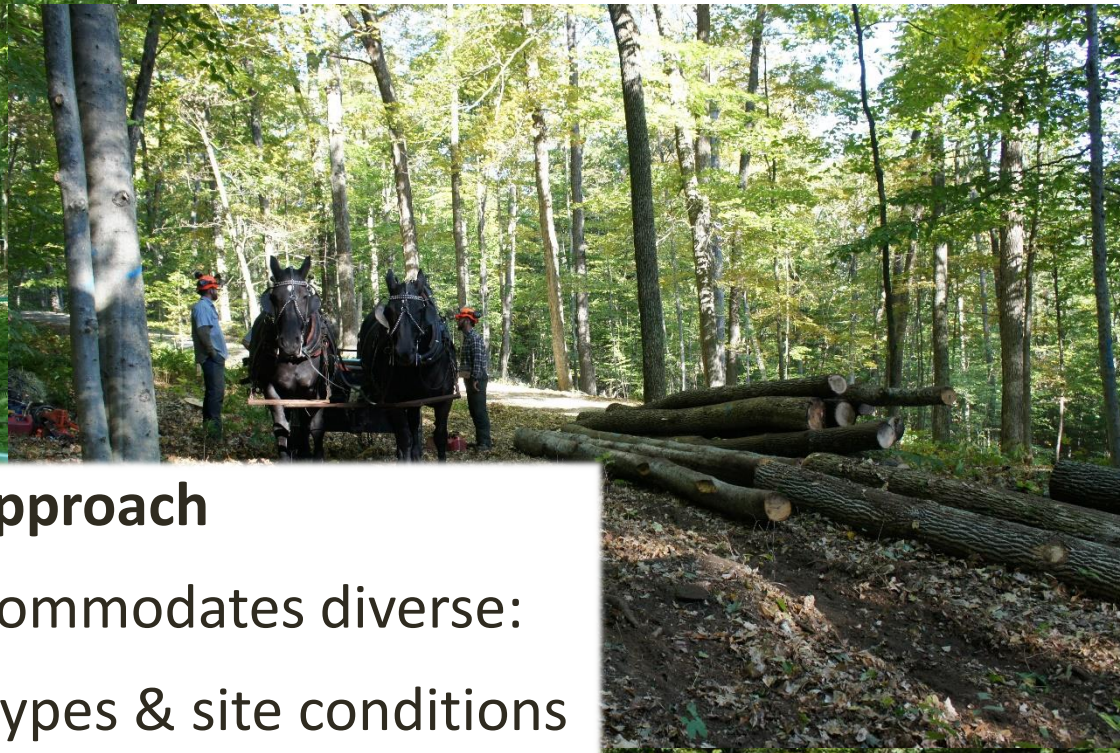
UNITED STATES
CLIMATE ALLIANCE



AMERICAN FORESTS

Natural and Working Lands Learning Lab, Washington D.C., July 2018





Flexible approach

Menu accommodates diverse:

- Forest types & site conditions
- Landowner types
- Management & policy considerations

Climate Adaptation for Forest Carbon

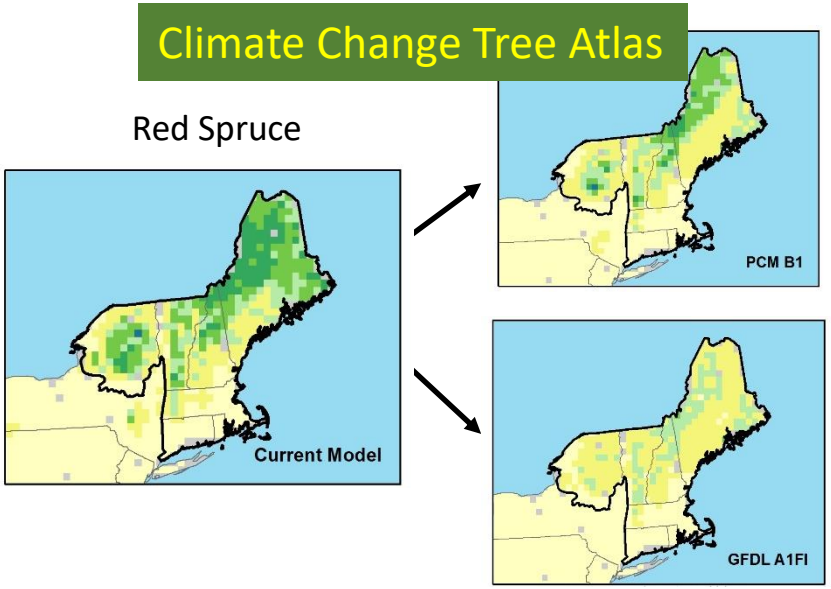
Concept #1: Tension between adaptation & mitigation

Adaptation **Mitigation**

Climate Adaptation for Forest Carbon

Concept #2: Integrates forest vulnerability to C loss from changes in climate and other stressors

Adler Fire, Yellowstone NP (NPS)



www.nrs.fs.fed.us/atlas/tree/

Climate Adaptation for Forest Carbon

Concept #3: Integration of carbon best practices within the context of diverse landowner objectives






Strategy 1: Maintain or increase extent of forest ecosystems

J. Scott, Chicago Park District

USDA NRCS

Strategy 2: Sustain fundamental ecological functions

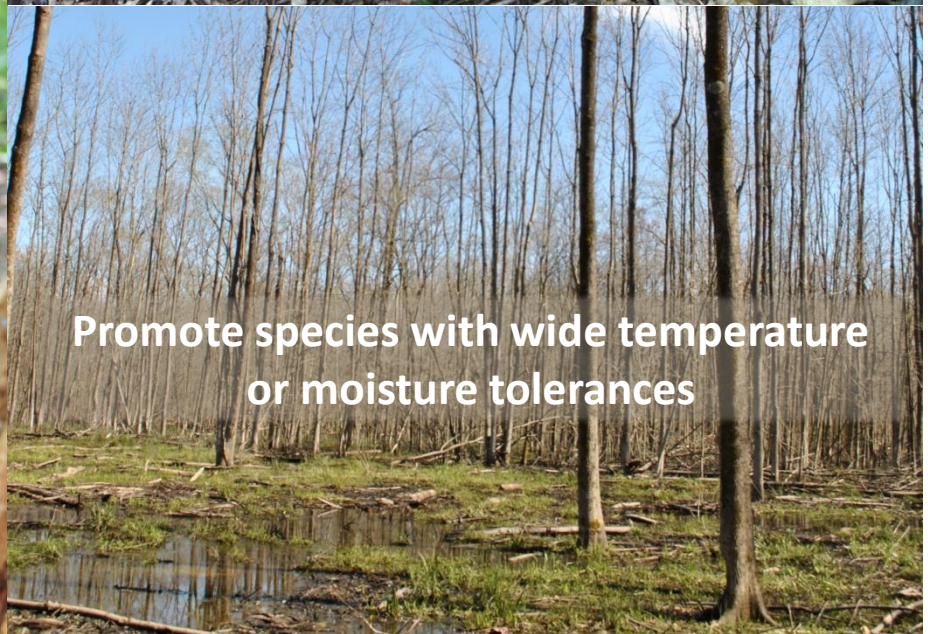
Strategy 3: Reduce carbon losses from natural disturbance

Strategy 4: Enhance forest recovery following disturbance

- Promptly revegetation after disturbance
- Restore with a diversity of future-adapted species
- Guide species composition at early stages of development
- Protect future-adapted species

Strategy 5: Prioritize locations with high carbon value

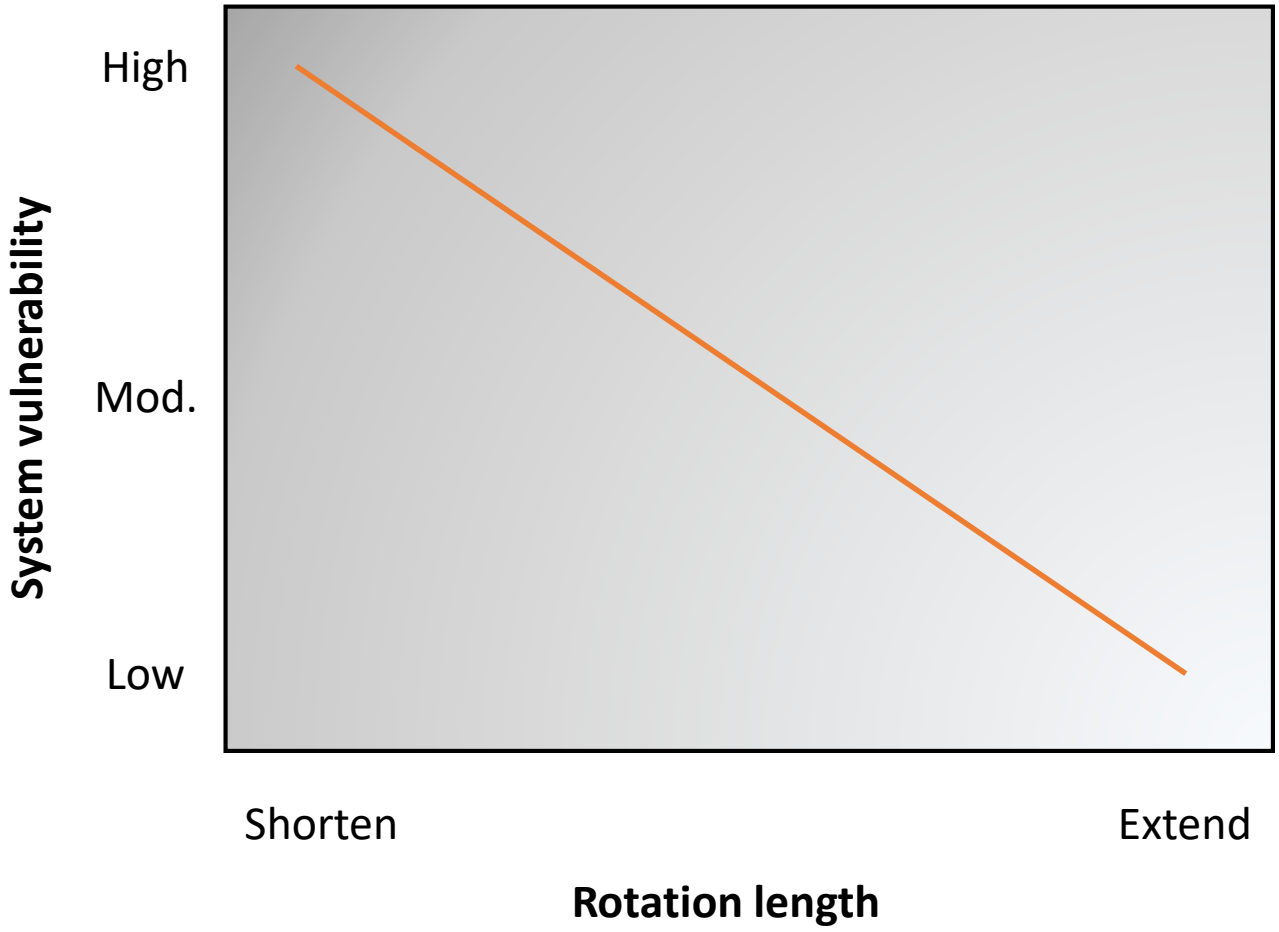
Strategy 6: Enhance existing C stocks while retaining forest character



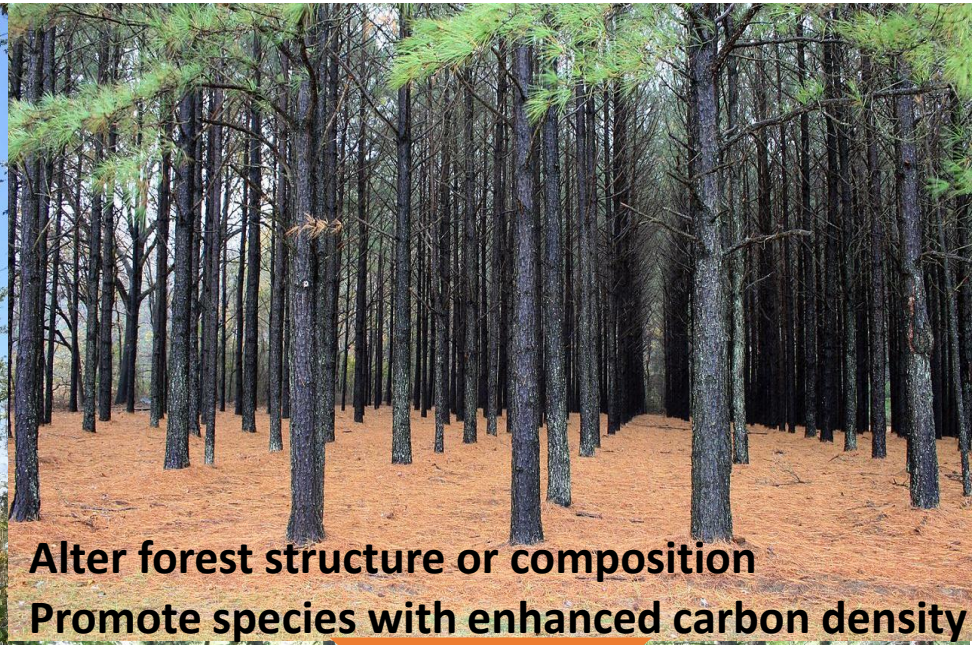
Strategy 6: Enhance existing C stocks while retaining forest character

6.2 Increase stocking on well-stocked or understocked forest lands
6.3 Increase harvest frequency or intensity due to greater risk of tree mortality

Example: Increasing rotation length to store additional carbon



Strategy 7: Enhance sequestration capacity through forest alterations



Alter forest structure or composition

Promote species with enhanced carbon density

Case Study: Minnesota DNR

Split Rock Lighthouse State Park

The Nature Conservancy – MN DNR partnership.

- Historic logging followed by fire
- Lack of regeneration
- <25% stocked stands

Goal to reforest areas of degraded aspen-birch forest on state lands in the north shore highlands region for:

- Carbon sequestration
- Aesthetic value for park visitors
- Stabilizing soils

Case Study: Minnesota DNR

Split Rock Lighthouse State Park

Challenges

Warming winters:

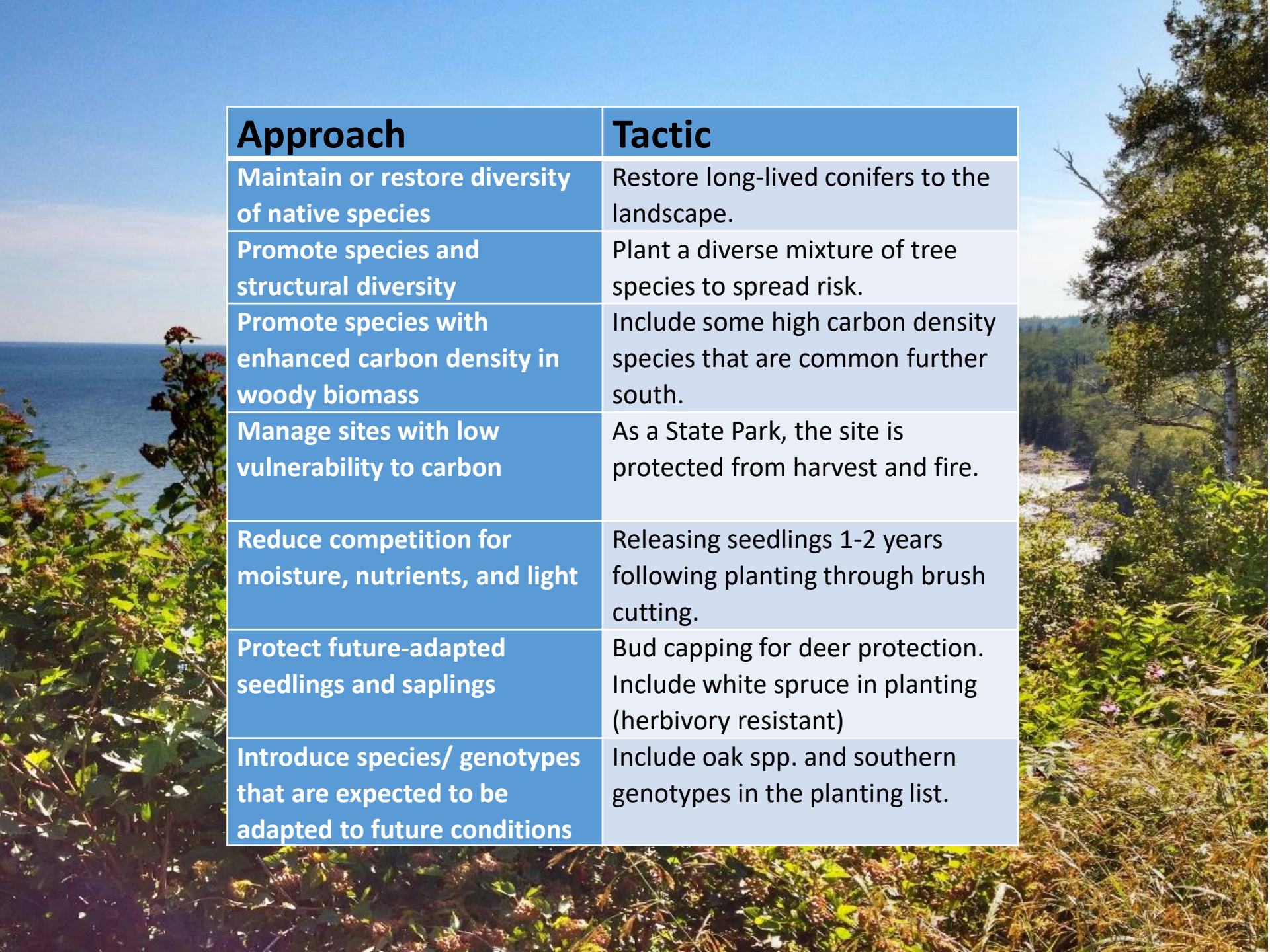
- Intensify deer herbivory
- Tree pests and pathogens

Increased drought frequency + drought-prone soils

Rising temperatures

Extreme storms causing soil erosion

Minnesota DNR



Approach	Tactic
Maintain or restore diversity of native species	Restore long-lived conifers to the landscape.
Promote species and structural diversity	Plant a diverse mixture of tree species to spread risk.
Promote species with enhanced carbon density in woody biomass	Include some high carbon density species that are common further south.
Manage sites with low vulnerability to carbon	As a State Park, the site is protected from harvest and fire.
Reduce competition for moisture, nutrients, and light	Releasing seedlings 1-2 years following planting through brush cutting.
Protect future-adapted seedlings and saplings	Bud capping for deer protection. Include white spruce in planting (herbivory resistant)
Introduce species/ genotypes that are expected to be adapted to future conditions	Include oak spp. and southern genotypes in the planting list.

Case Study: Audubon Vermont

Green Mountain Audubon Center: Forest Birds Initiative

https://forestadaptation.org/GMAC

Audubon Vermont/ Alberto Lopez

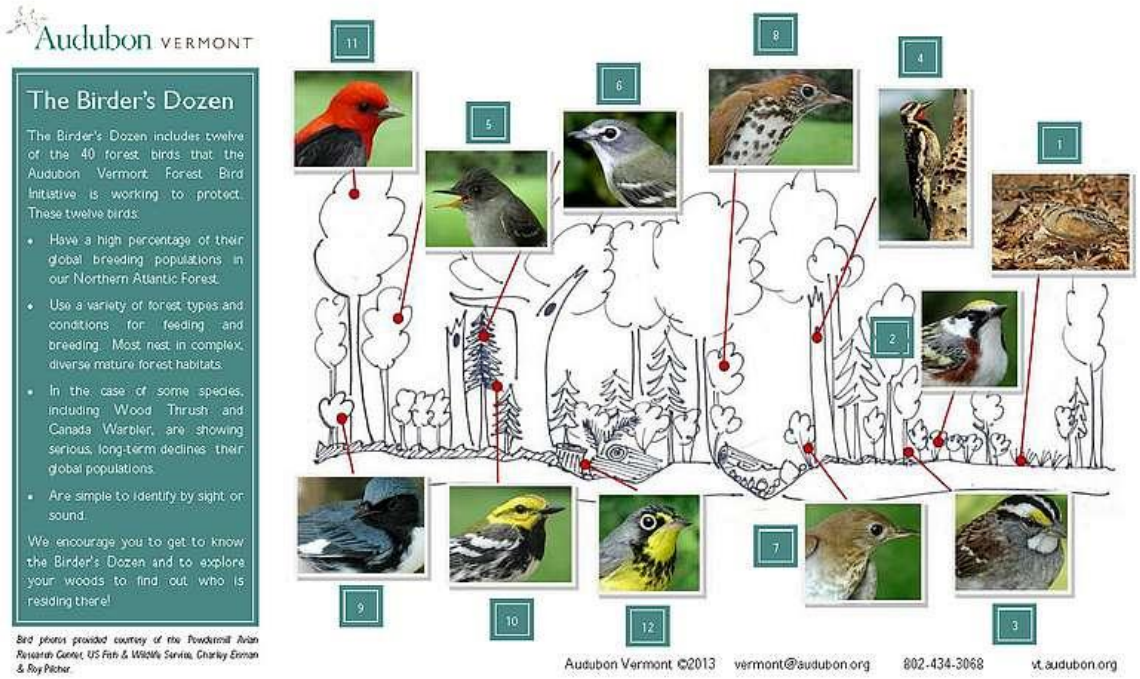
Case Study: Audubon Vermont

Designated Important Bird Area
Environmental education, scientific research, and outdoor recreation
Even-aged, multi-strata northern hardwood stands
10-acre sugarbush

Case Study: Audubon Vermont

Management goals

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



Climate challenges

Warming winters:

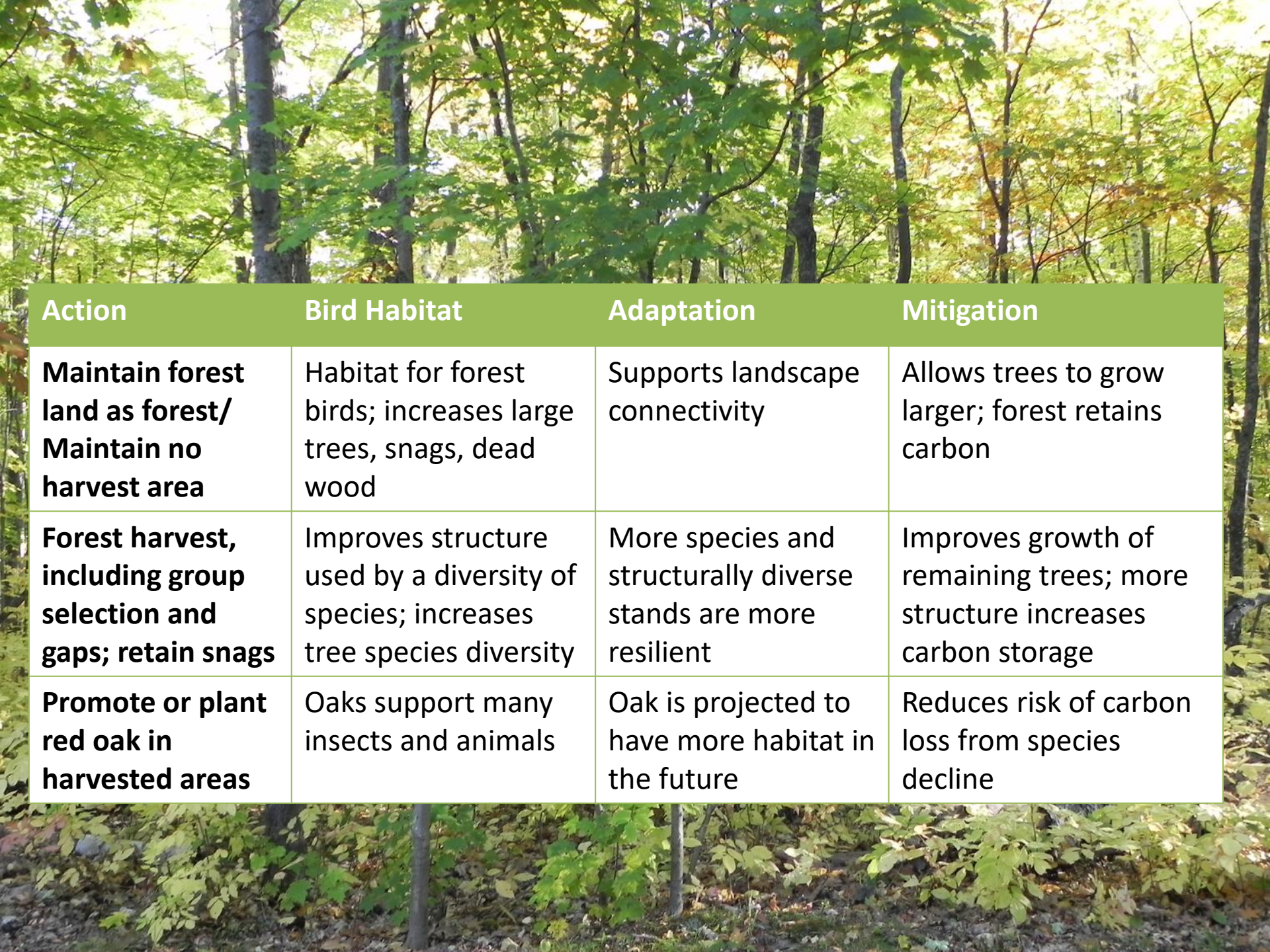
- reduce snowpack
- increase pests

Increased frequency and intensity of extreme weather:

- non-native invasive plant species
- soil erosion

Audubon Vermont

Is it possible to find a win-win-win?



Action	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; increases tree species diversity	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

Is it possible to find a win-win-win?

Thank you!

tontl@fs.fed.us

www.forestadaptation.org/carbon