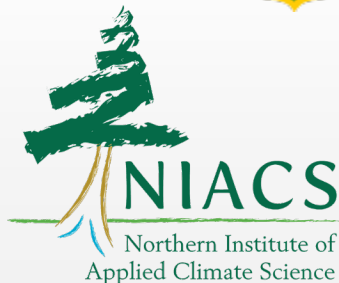
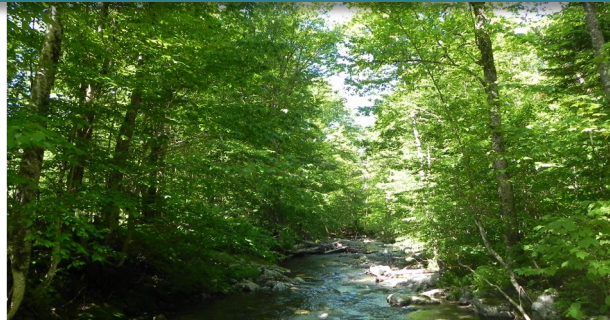


What's at risk?

Implications of climate change in Massachusetts' forests



Maria Janowiak maria.janowiak@usda.gov

Northern Institute of Applied Climate Science

USDA Forest Service

Climate Change Response Framework

www.forestadaptation.org

(aka NIACS)

Northern Institute of Applied Climate Science

Chartered by USDA Forest Service, universities, non-profit, and tribal conservation organizations

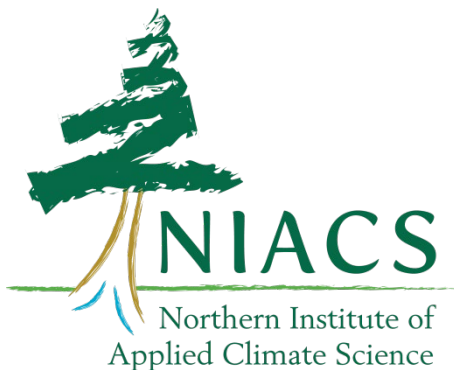
Climate and carbon services

- Climate impacts modeling
- Vulnerability assessment
- Climate adaptation
- Carbon biogeochemistry
- Carbon management

21 staff members

(Forest Service/universities)

- 10 climate outreach specialists
- 7 research scientists
- 2 web specialists
- 2 GIS/lab specialists



**Michigan
Technological
University**



UNIVERSITY OF MINNESOTA



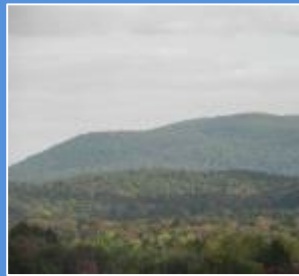
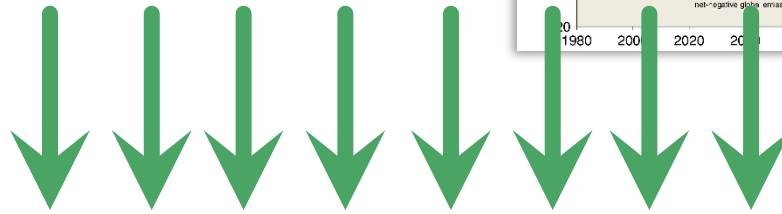
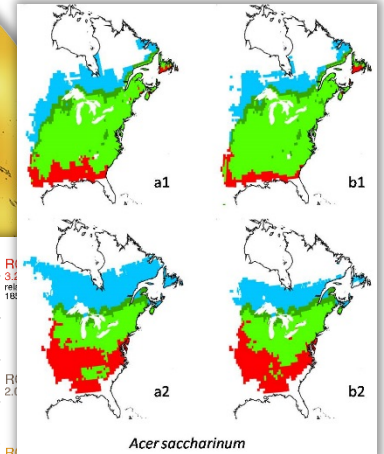
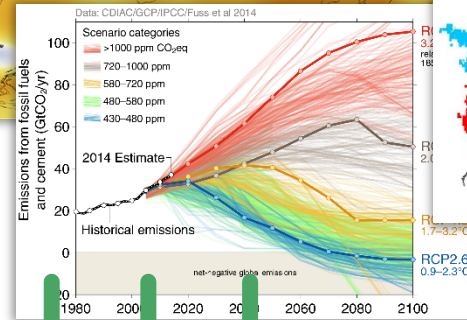
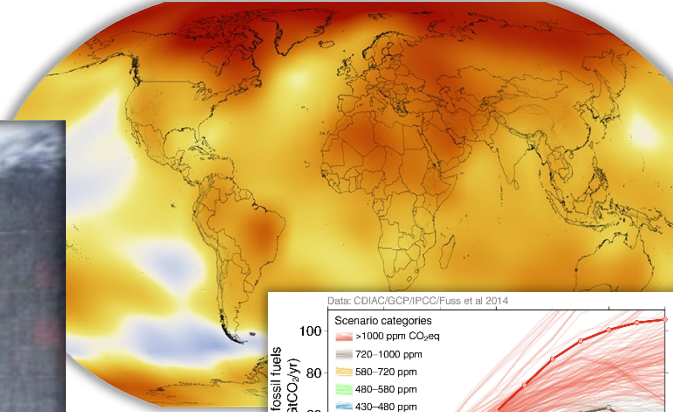
The
**UNIVERSITY
of VERMONT**



Climate Change Information



Climate Change Information



Climate Change Impacts



Ecosystem Adaptation

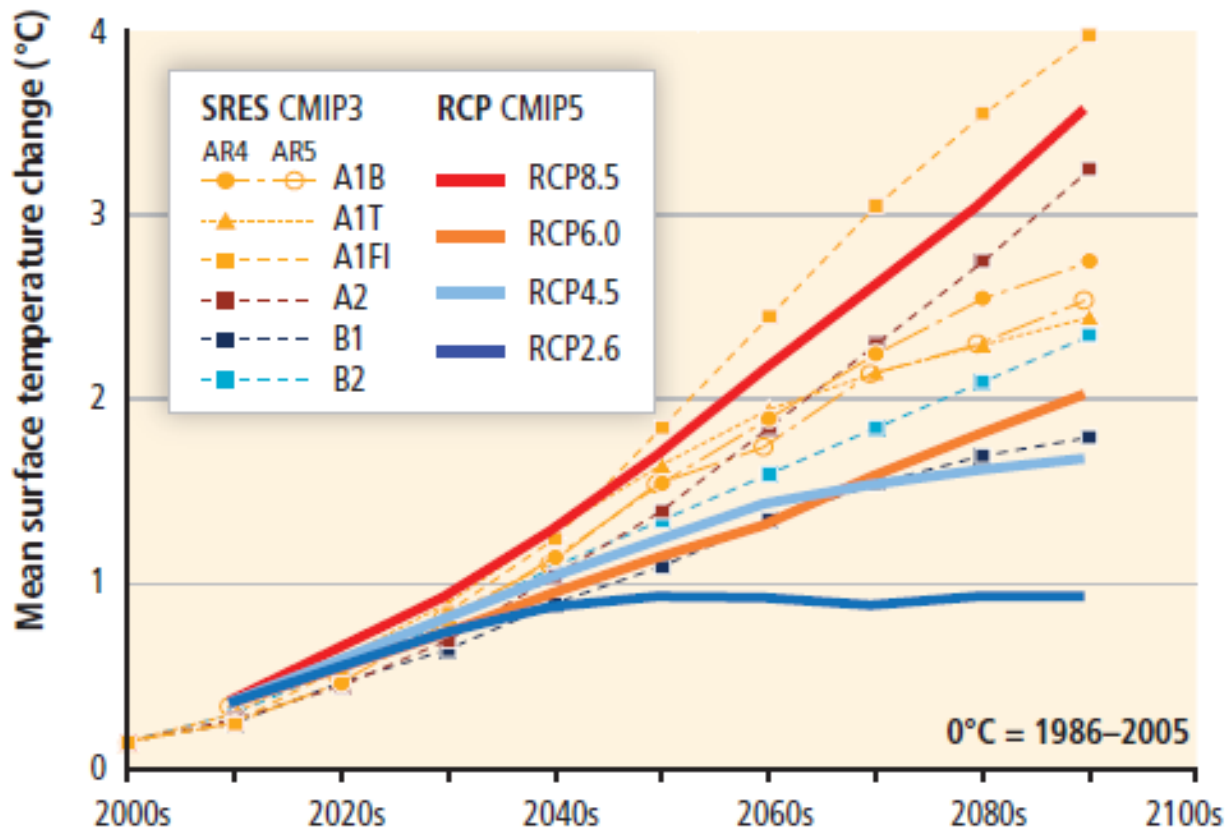


Forest Carbon Management



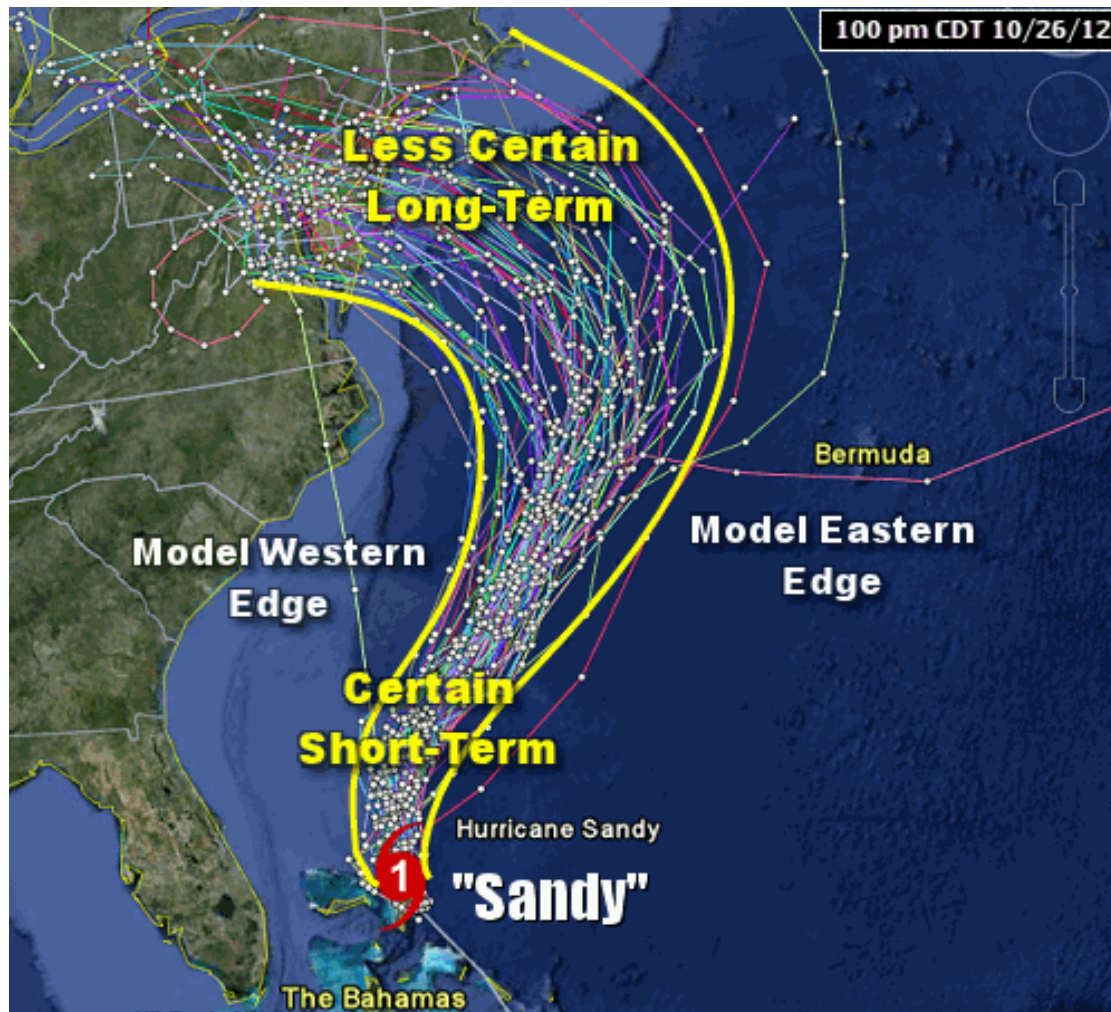
Future Changes in Climate

Models and Emissions Scenarios



Future Changes in Climate

Managing Uncertainty and Risk



Effects on Forests

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:

Longer growing
seasons.



Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:

Longer growing seasons.

THE BAD:

Shorter, warmer winters.



Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

THE GOOD:

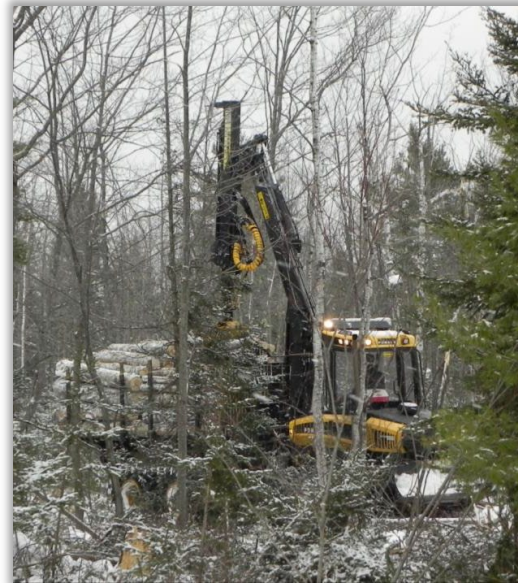
Longer growing seasons.

THE BAD:

Shorter, warmer winters.

THE UGLY:

More extreme events.



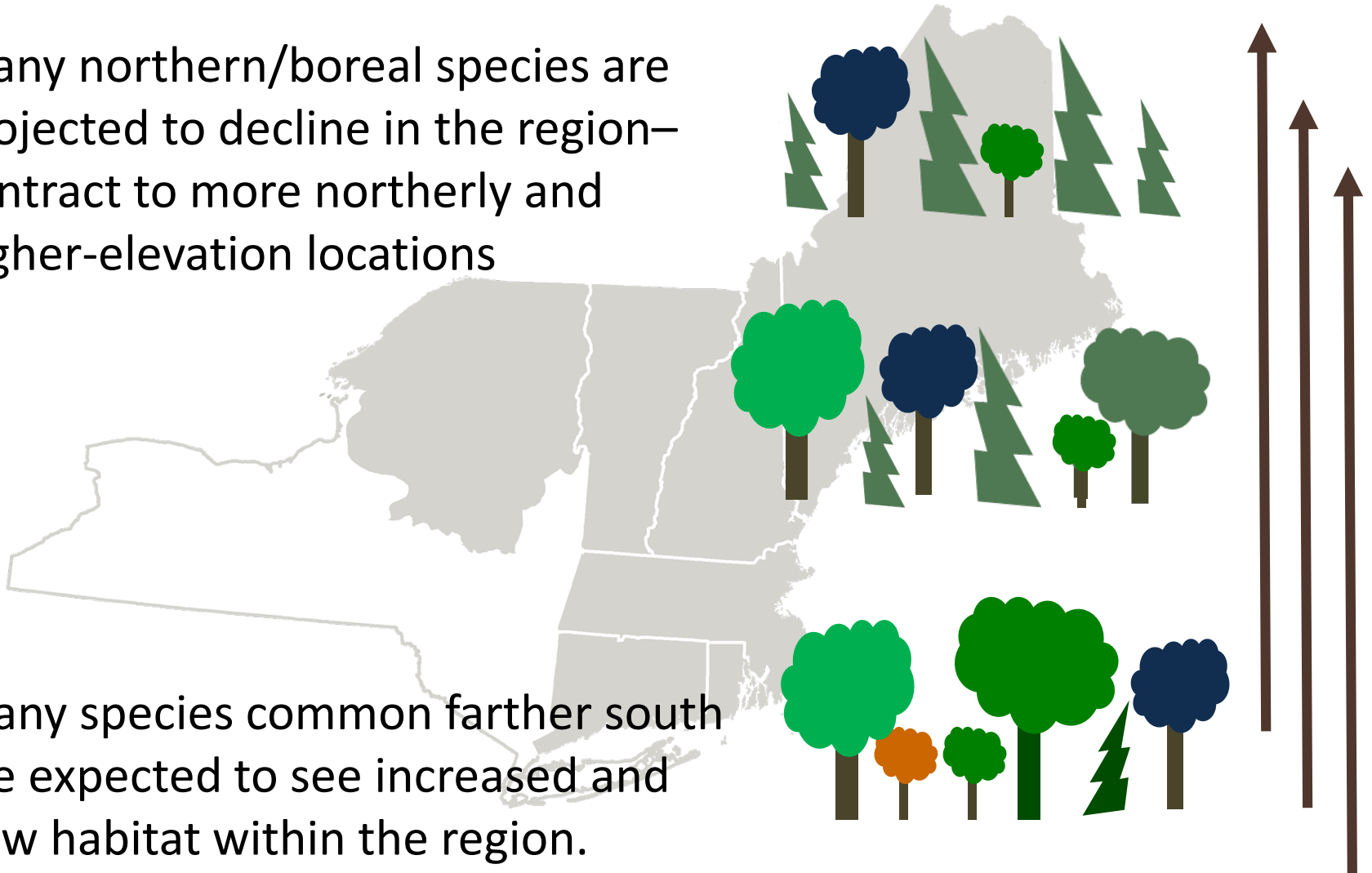
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Many northern/boreal species are projected to decline in the region—contract to more northerly and higher-elevation locations



Many species common farther south are expected to see increased and new habitat within the region.

Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

Likely to decline

- Balsam fir
- Black, red, & white spruce
- Northern white-cedar
- Eastern hemlock
- Black ash
- Paper birch
- Quaking aspen
- Tamarack

Mixed model results

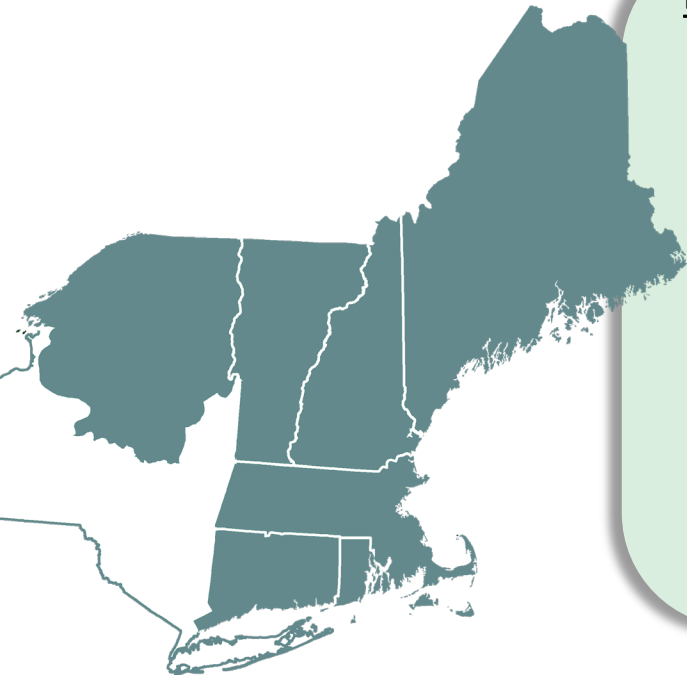
- American beech
- Sugar & red maple
- Yellow birch
- White pine

Potential “winners”

- American elm
- American basswood
- Black cherry
- Eastern hophornbeam
- Gray birch
- Northern red oak
- Serviceberry
- Silver maple
- Sweet birch
- White oak

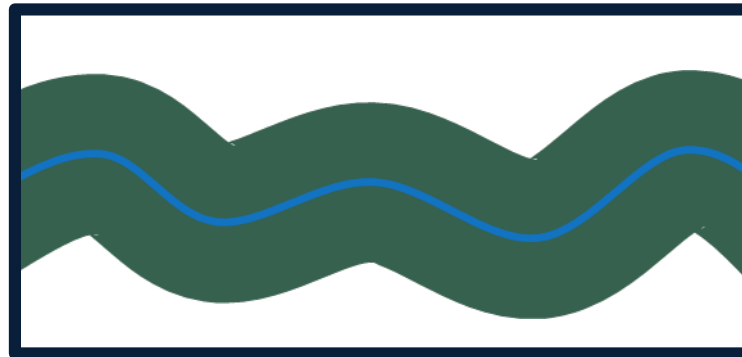
New habitat (esp. south)

- Black hickory
- Chinkapin oak
- Common persimmon
- Hackberry
- Loblolly pine
- Osage-orange
- Shortleaf pine
- Southern red oak
- Sweetgum
- Virginia pine



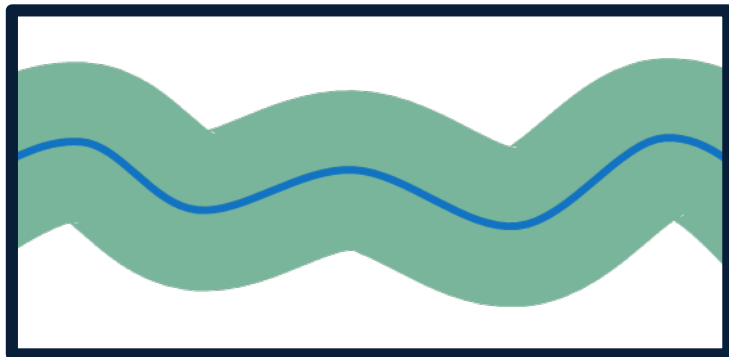
Effects on Forests

SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

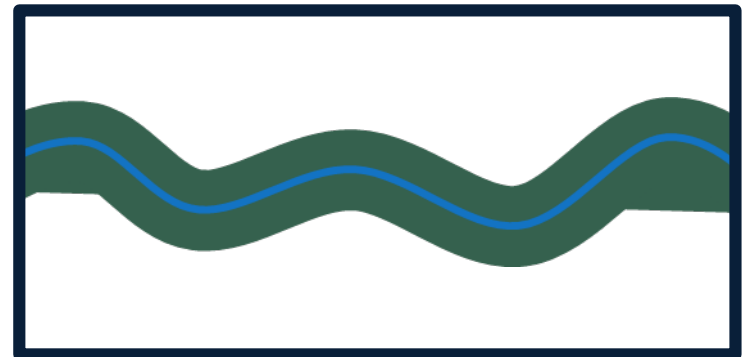


 = species X suitable habitat

50% Reduction in Habitat:



Habitat reduced equally



Best habitats remain

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | **SHIFTING STRESSORS**

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | **SHIFTING STRESSORS**

Climate change is a “threat multiplier”

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

Interactions make all the difference.

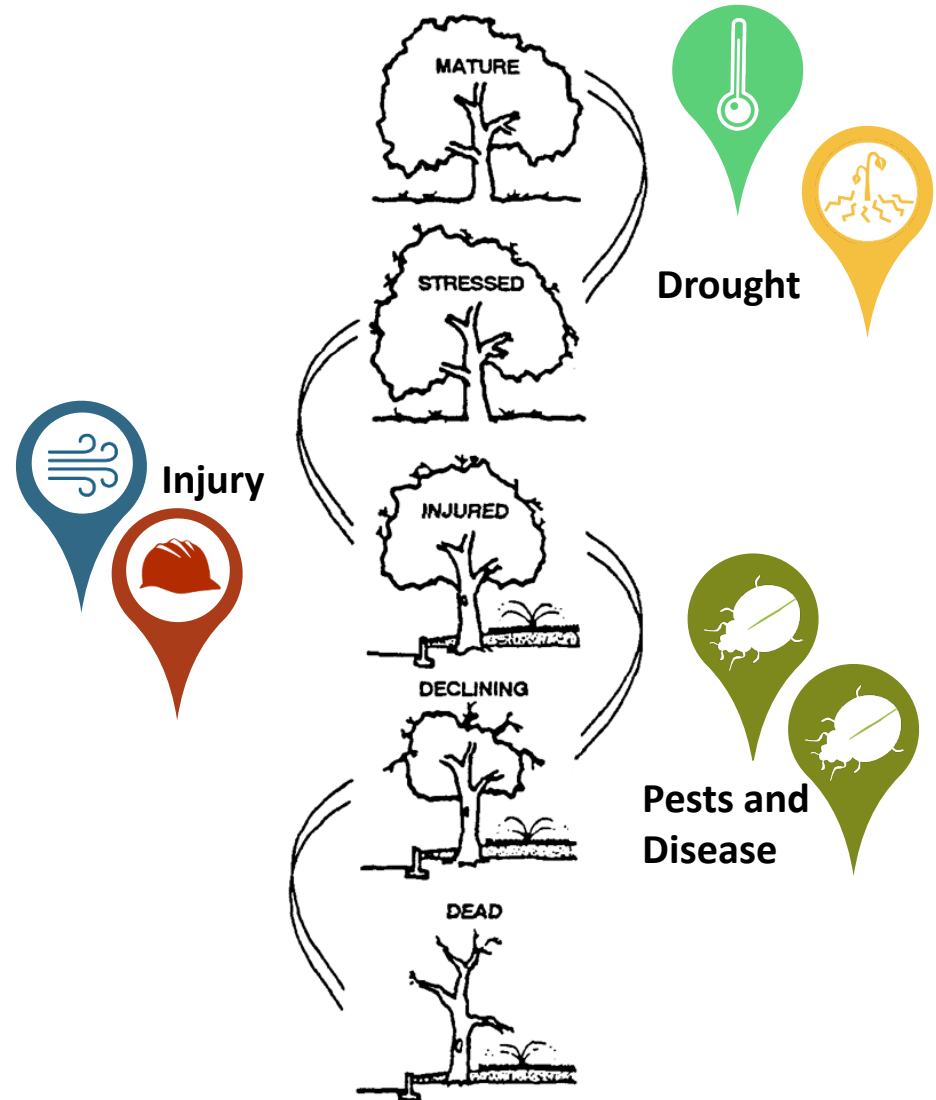


Image: Bartlett Tree Experts

Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS



Location, Location, Location

Research and assessments describe **broad trends** but **local conditions** and **management** make the difference.

Part 2: Climate Change Adaptation



Adaptation is the adjustment of systems in response to climate change.



Adaptation actions are designed to specifically address climate change impacts & vulnerabilities in order to meet goals and objectives

Adaptation is the adjustment of systems in response to climate change.



Ecosystem-based adaptation activities build on sustainable management, conservation, and restoration.

Invasives

Natural Forest
Dynamics

Desired
Conditions

Timber Sale
Revenue

Forest
Health

Past
Management
History

Plan & Project
Requirements

Wildlife
Habitat

Disturbance:
Past + Future

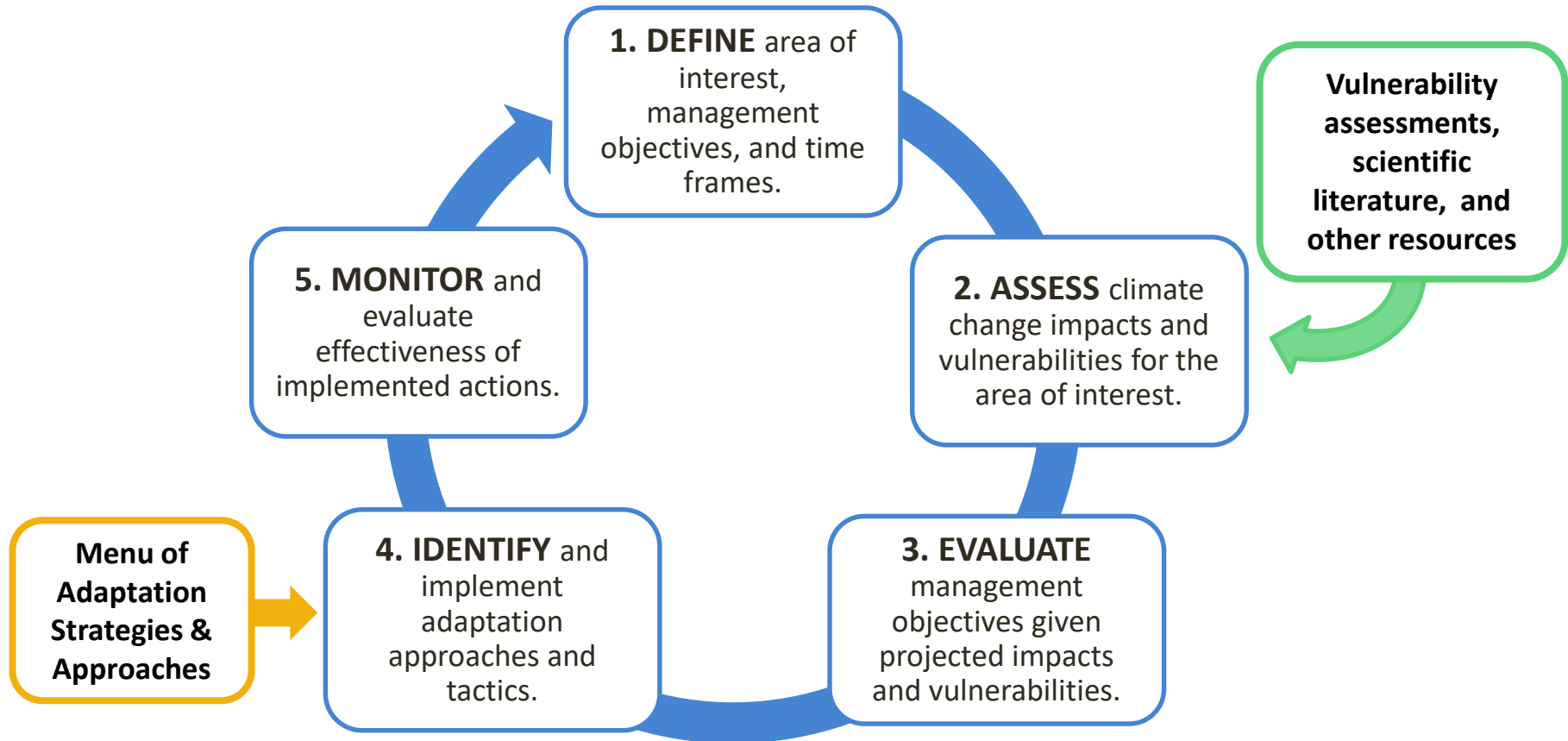
And more!!

Recreation

**Climate
Change**



Adaptation Workbook



A Spectrum of Adaptation Options

RESISTANCE



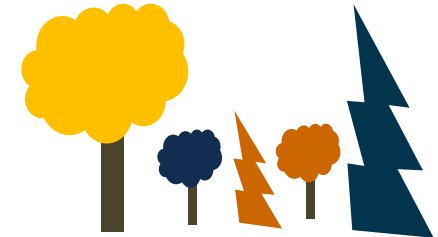
- Improve defenses of forest against change and disturbance
- Maintain relatively unchanged conditions

RESILIENCE



- Accommodate some degree of change
- Return to prior reference condition following disturbance

TRANSITION

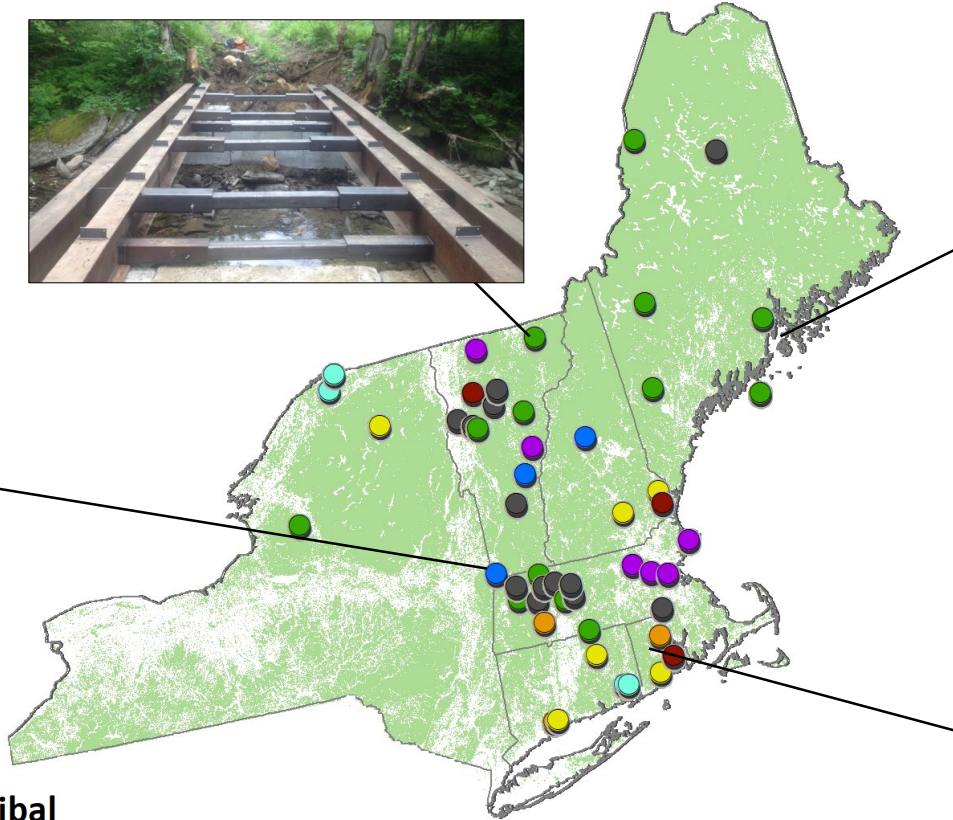


- Intentionally facilitate change
- Enable ecosystem to respond to changing and new conditions



Real-World Adaptation Projects

More than 50 projects in New England



- Federal
- State
- Local
- Multi-ownership
- Tribal
- University
- NGO
- Private

Adaptation Options in Projects

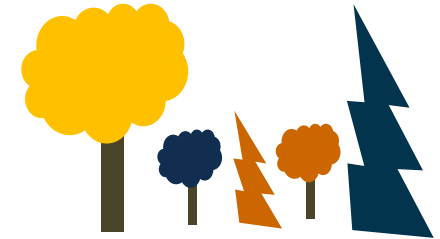
RESISTANCE



RESILIENCE



TRANSITION



Northern New England:



Southern New England:

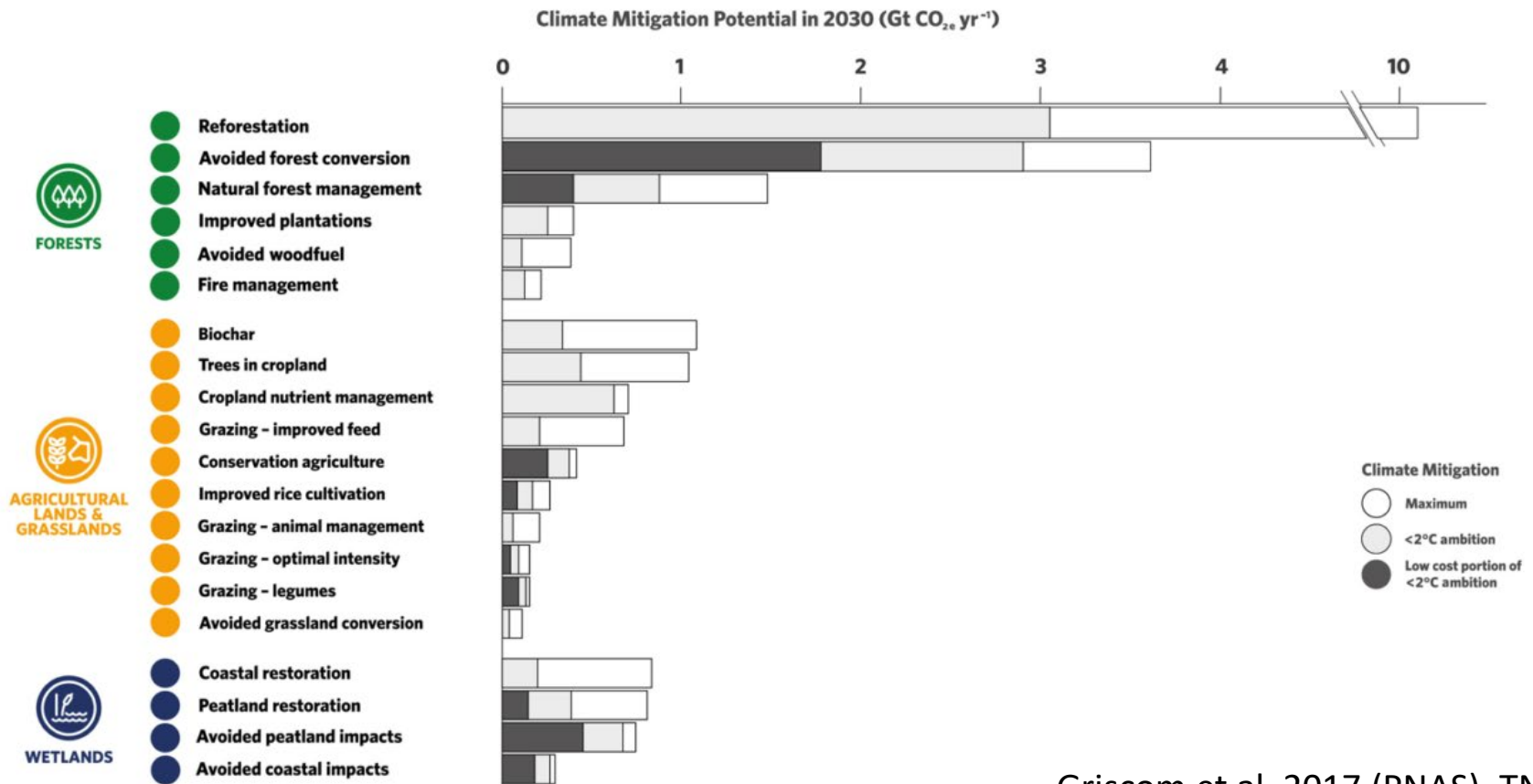


Part 3: Forest Carbon Management



Natural Climate Solutions

“Natural and working lands have the potential to deliver 37% of cost-effective carbon dioxide mitigation needed by 2030”



A scenic view of a lush green landscape. In the foreground, a large tree with dark branches and green leaves frames the top and left sides of the image. The middle ground features a grassy hillside covered in vibrant green vegetation, including tall grasses and small yellow flowers. In the background, a dense forest of green trees covers a rolling hillside under a bright, slightly overcast sky. The overall atmosphere is peaceful and natural.

Three Actions for Land Managers...

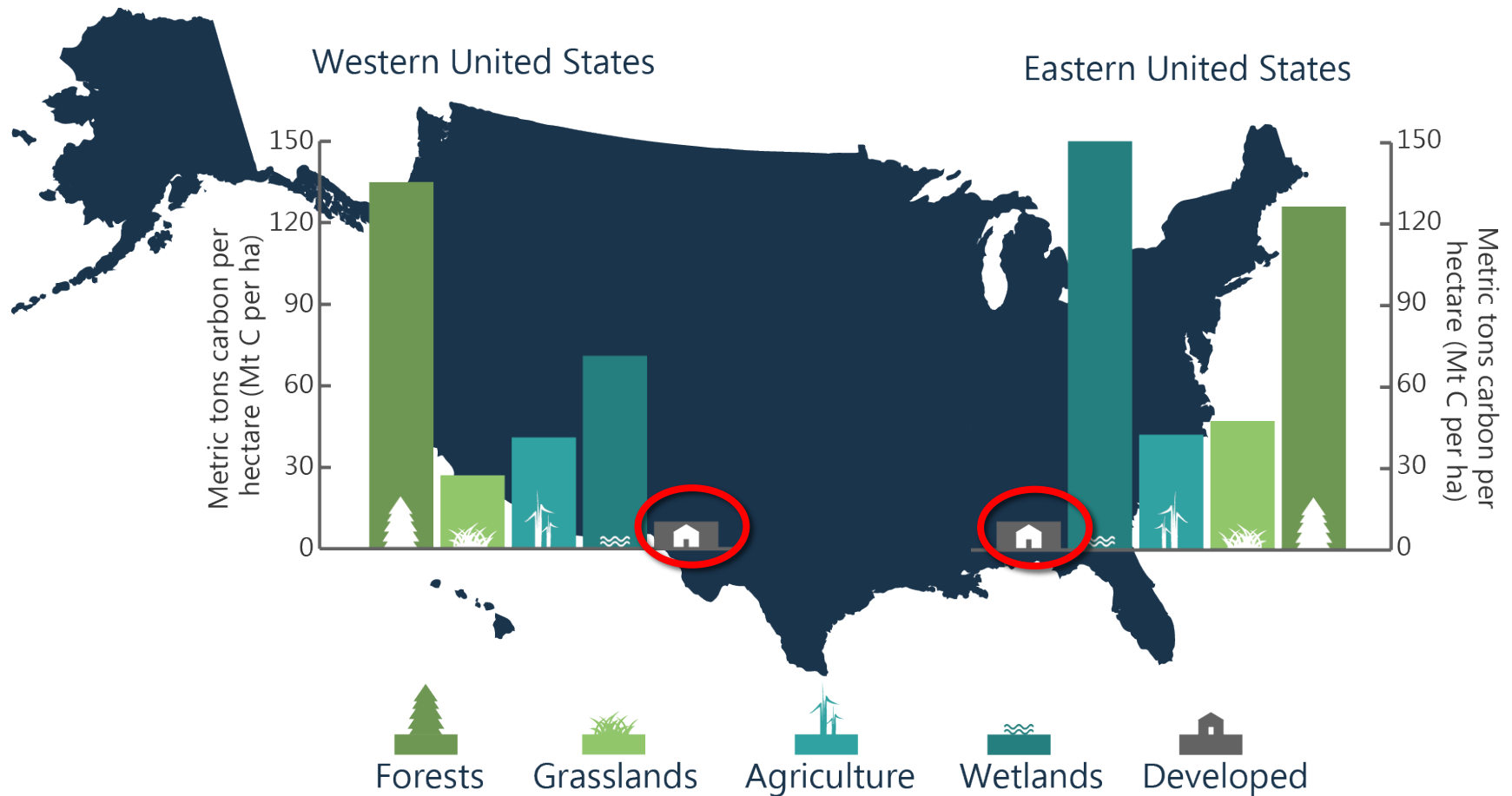
Forest Carbon Management

AVOID FOREST LOSS | REDUCE STRESSORS | ENHANCE SEQUESTRATION

Forest Carbon Management

AVOID FOREST LOSS | REDUCE STRESSORS | ENHANCE SEQUESTRATION

Developed lands = Terrible carbon sinks

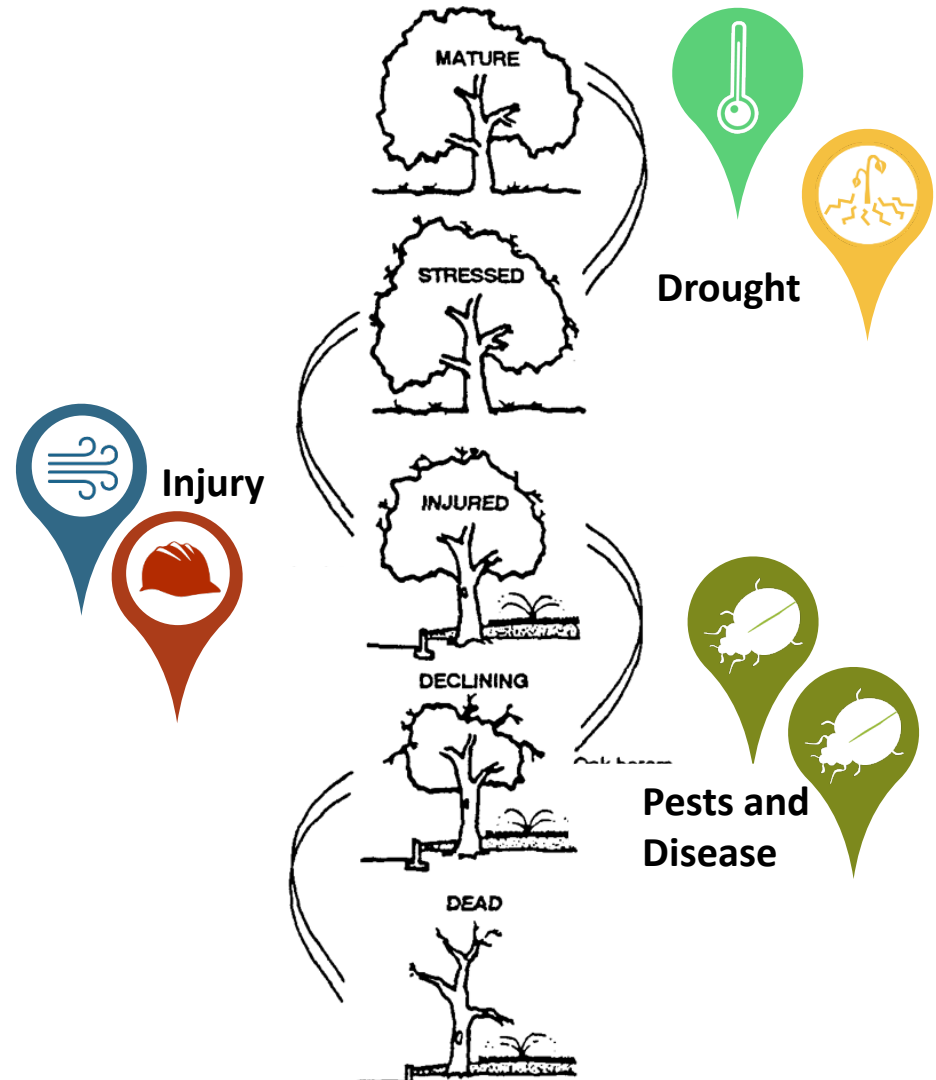


Forest Carbon Management

AVOID FOREST LOSS | **REDUCE STRESSORS** | ENHANCE SEQUESTRATION

“Climate change is increasing the vulnerability of many U.S. forests through fire, insect infestations, drought, and disease outbreaks.”

Forests play an important role in absorbing and storing carbon dioxide, but the rate of uptake is projected to decline.”



Forest Carbon Management

AVOID FOREST LOSS | **REDUCE STRESSORS** | ENHANCE SEQUESTRATION

Management activities, such as:

- Prevent carbon losses for wildfire or natural disturbances
- Improve the ability to withstand pests and pathogens
- Reduce impacts from invasive species
- Reduce risks associated with tree species or forest declines



Forest Carbon Management

AVOID FOREST LOSS | REDUCE STRESSORS | **ENHANCE SEQUESTRATION**

Forest Sector Carbon Cycle

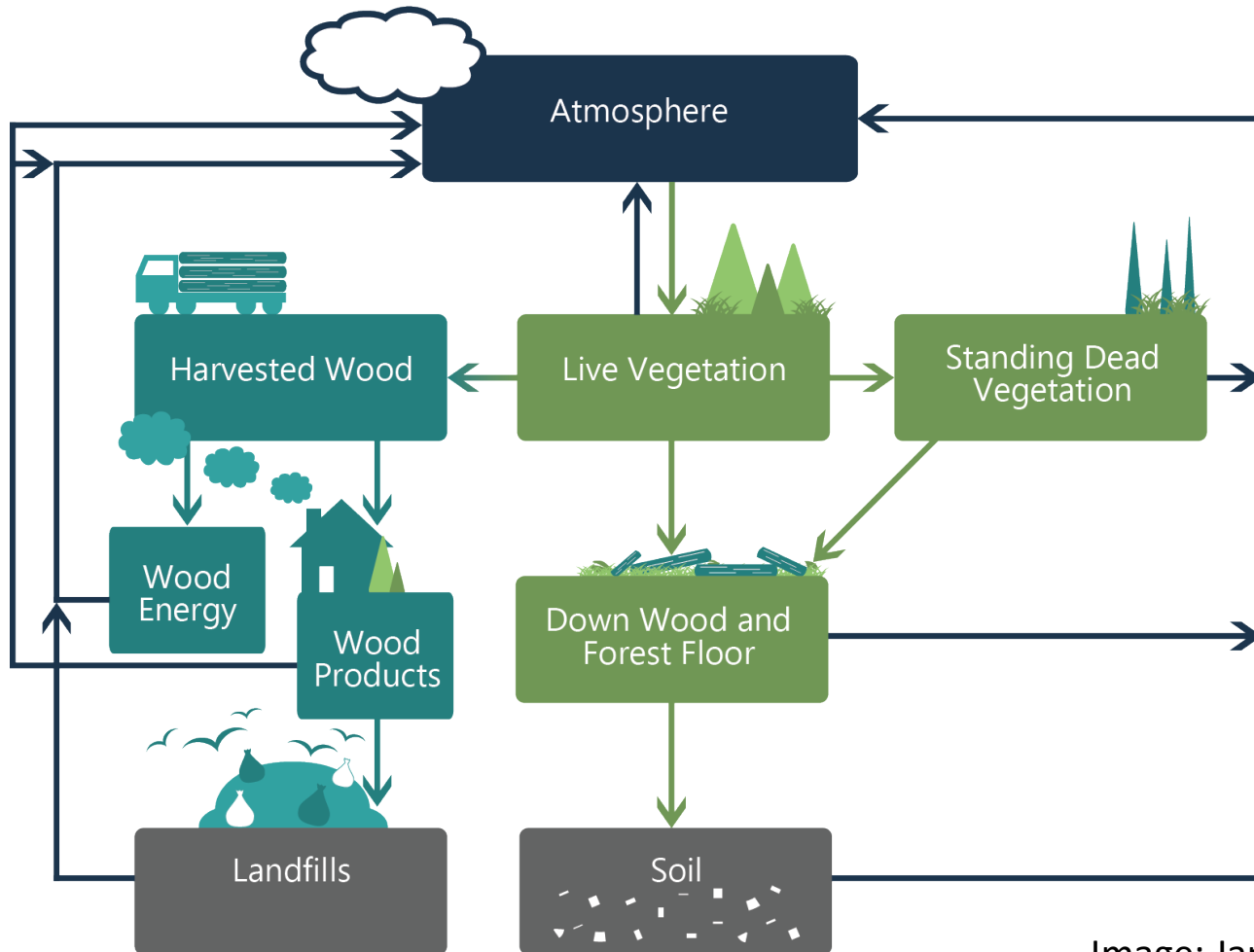


Image: Janowiak et al. 2017

Integrating Adaptation and Carbon Mitigation...



Case Study: Audubon Vermont

Green Mountain Audubon Center: Forest Birds Initiative



Case Study: Audubon Vermont

Green Mountain Audubon Center: Forest Birds Initiative

Forest origin



Case Study: Audubon Vermont

Green Mountain Audubon Center: Forest Birds Initiative



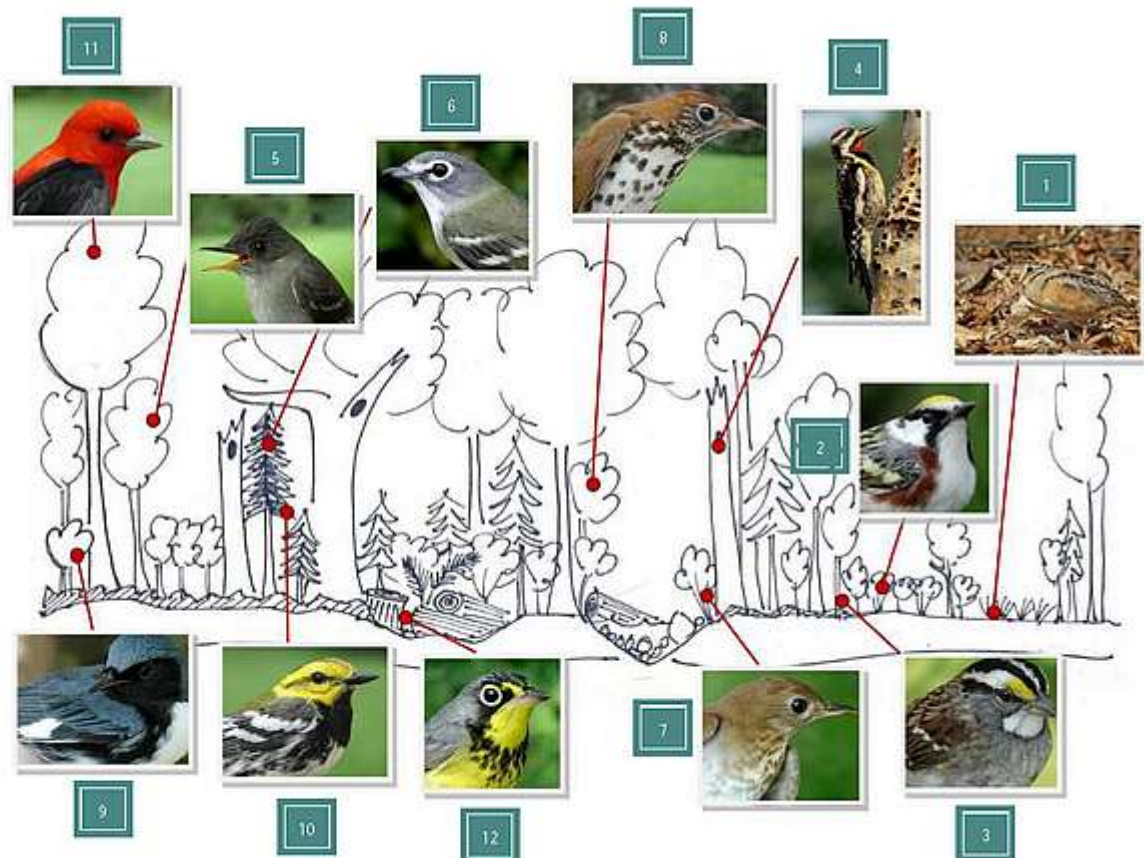
The Birder's Dozen

The Birder's Dozen includes twelve of the 40 forest birds that the Audubon Vermont Forest Bird Initiative is working to protect. These twelve birds:

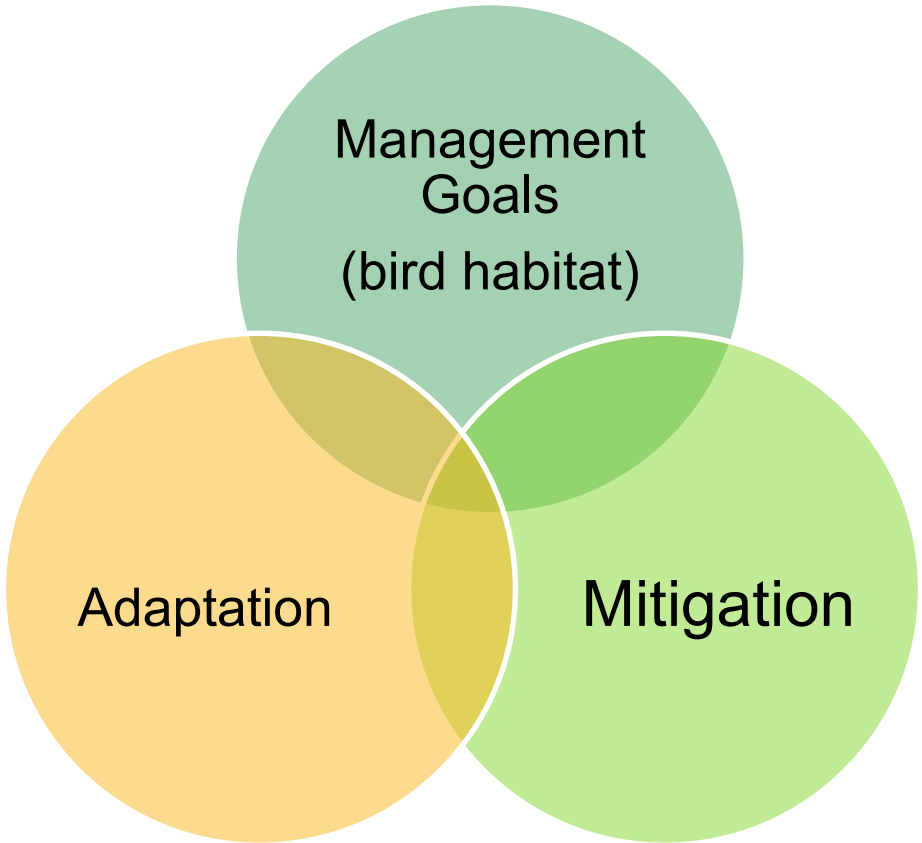
- Have a high percentage of their global breeding populations in our Northern Atlantic Forest.
- Use a variety of forest types and conditions for feeding and breeding. Most nest in complex, diverse mature forest habitats.
- In the case of some species, including Wood Thrush and Canada Warbler, are showing serious, long-term declines in their global populations.
- Are simple to identify by sight or sound.

We encourage you to get to know the Birder's Dozen and to explore your woods to find out who is residing there!

Bird photos provided courtesy of the Powdermill Avian Research Center, US Fish & Wildlife Service, Charley Eroman & Roy Pitcher.



Can all these goals be accomplished?

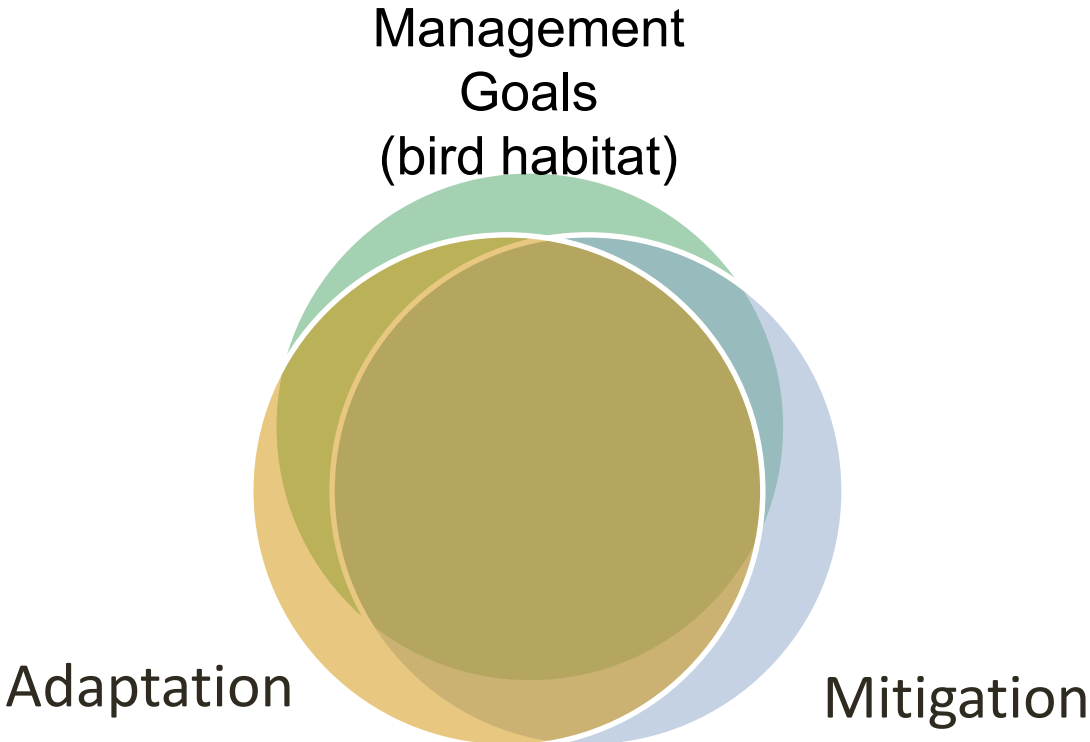


Case Study: Audubon Vermont

Green Mountain Audubon Center: Forest Birds Initiative

Action	Bird Habitat	Adaptation	Mitigation
Maintain forest land as forest	Habitat for forest birds	Supports broader landscape connectivity	Maintains carbon stocks and sequestration
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 can increase 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 from species declines by increasing diversity
Maintain no harvest area	Habitat for interior birds; increases large trees, snags, dead wood	Supports landscape connectivity and diversity	Allows trees to grow larger; forest retains carbon

Can all these goals be accomplished?



Final Thoughts

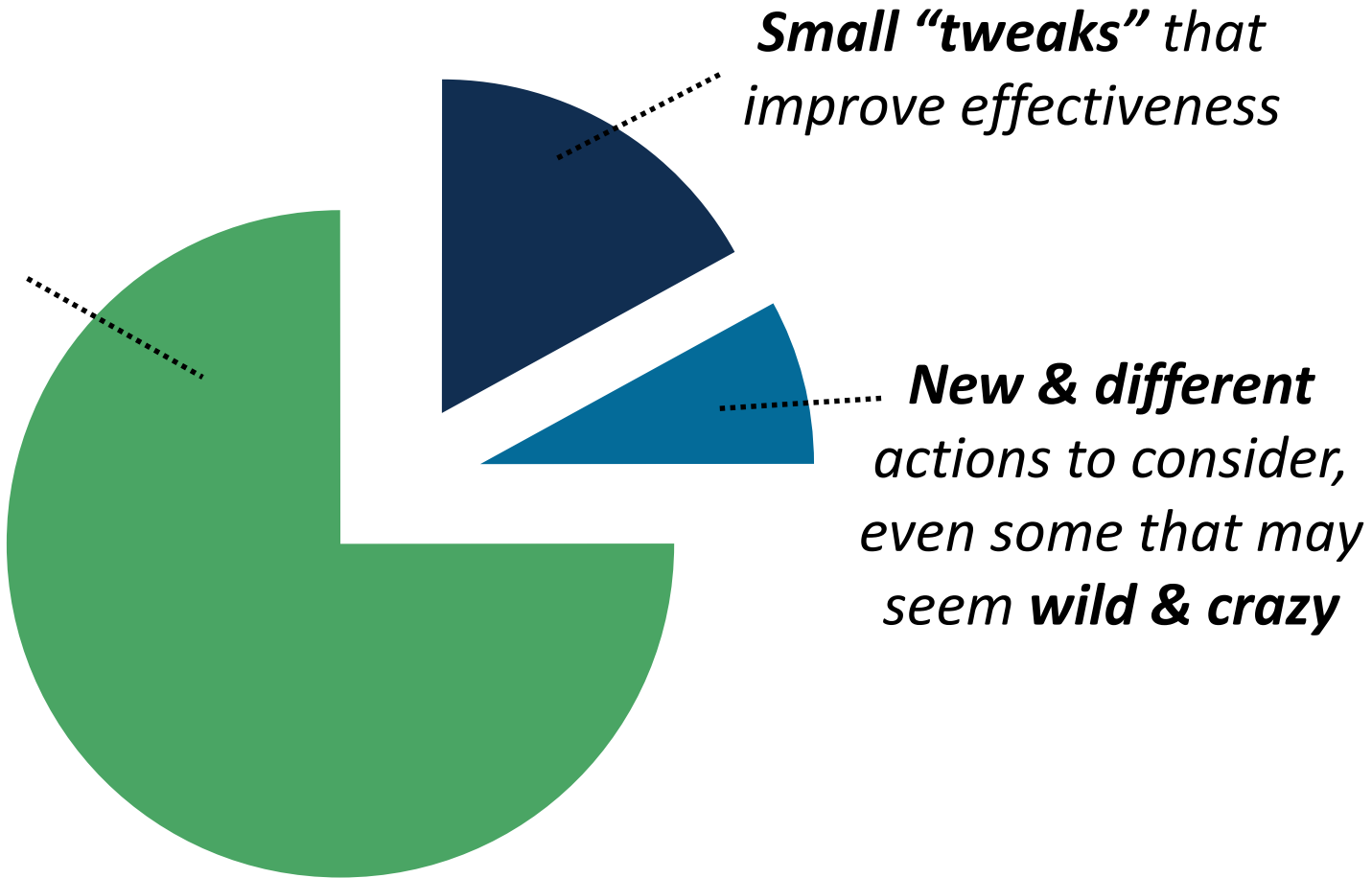
Final Thoughts

Should I manage differently for climate change?

Final Thoughts

Be intentional in considering climate change.

*Same actions—
climate change
just makes them
that much more
important*



*Small “tweaks” that
improve effectiveness*

*New & different
actions to consider,
even some that may
seem **wild & crazy***

**individual results will vary*