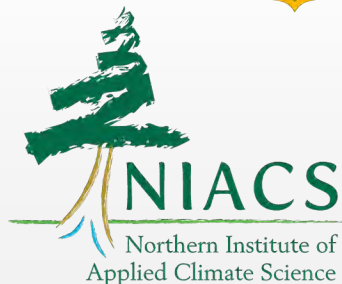


# Climate Change & Connecticut Forests: *Management Options for Adaptation and Mitigation*

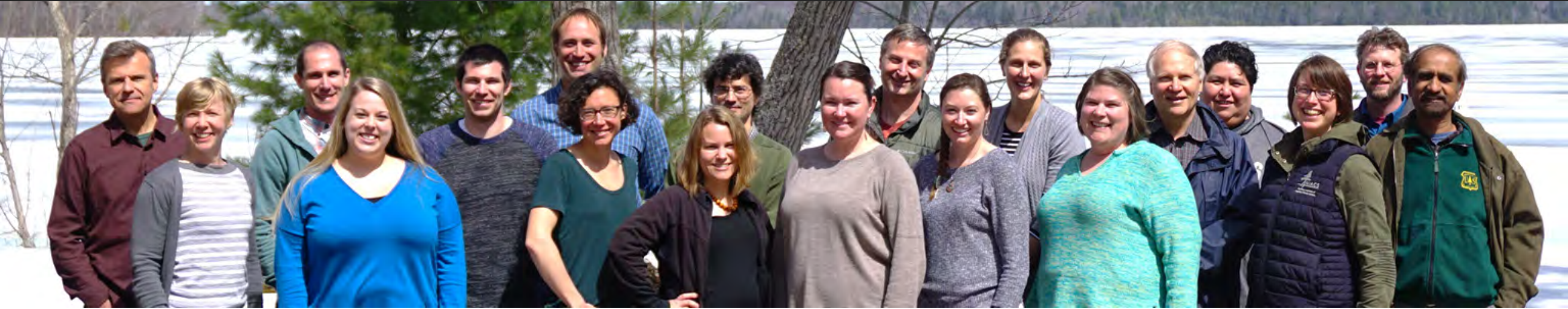


**Maria Janowiak, Todd Ontl**

Northern Institute of Applied Climate Science

[www.niacs.org](http://www.niacs.org) / [www.forestadaptation.org](http://www.forestadaptation.org)

# Northern Institute of Applied Climate Science



Climate  
Carbon



Provides practical information, resources, and technical assistance related to forests and climate change

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



Michigan Technological University



NCASI



UNIVERSITY OF MINNESOTA



AMERICAN FORESTS



The UNIVERSITY of VERMONT



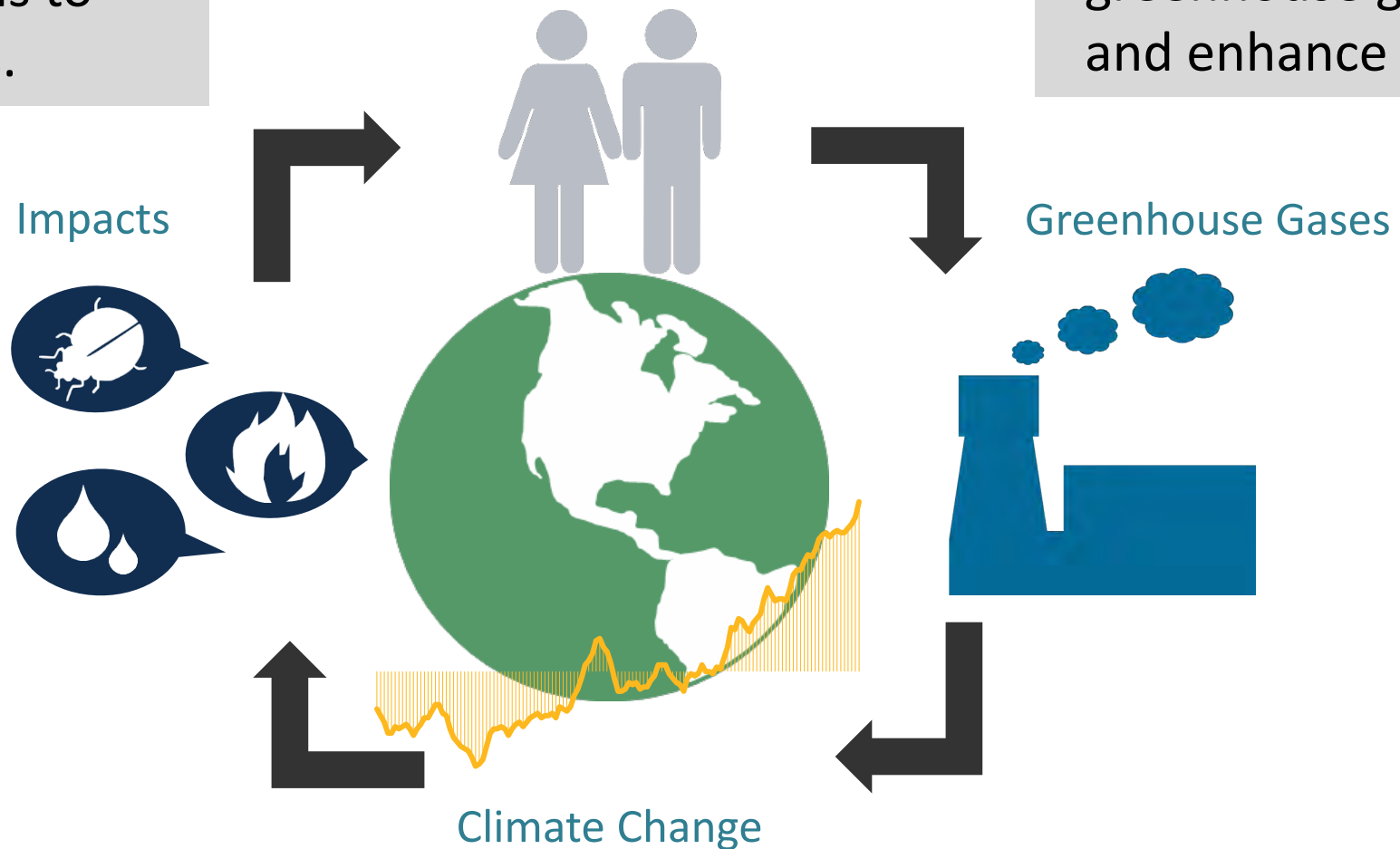
# Climate Responses

## Adaptation

Actions to reduce the vulnerability of systems to climate change effects.

## Mitigation

Actions that reduce greenhouse gas emissions and enhance carbon sinks.



# Effects on Forests

Vulnerability assessment, story map, and additional resources from NIACS:

[www.forestadaptation.org/new-england](http://www.forestadaptation.org/new-england)

Even more resources, search by state in Resource Library:

[www.adaptationworkbook.org/resources](http://www.adaptationworkbook.org/resources)



# Effects on Forests

SHIFTING SEASONS | SHIFTING SPECIES | SHIFTING STRESSORS

# 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

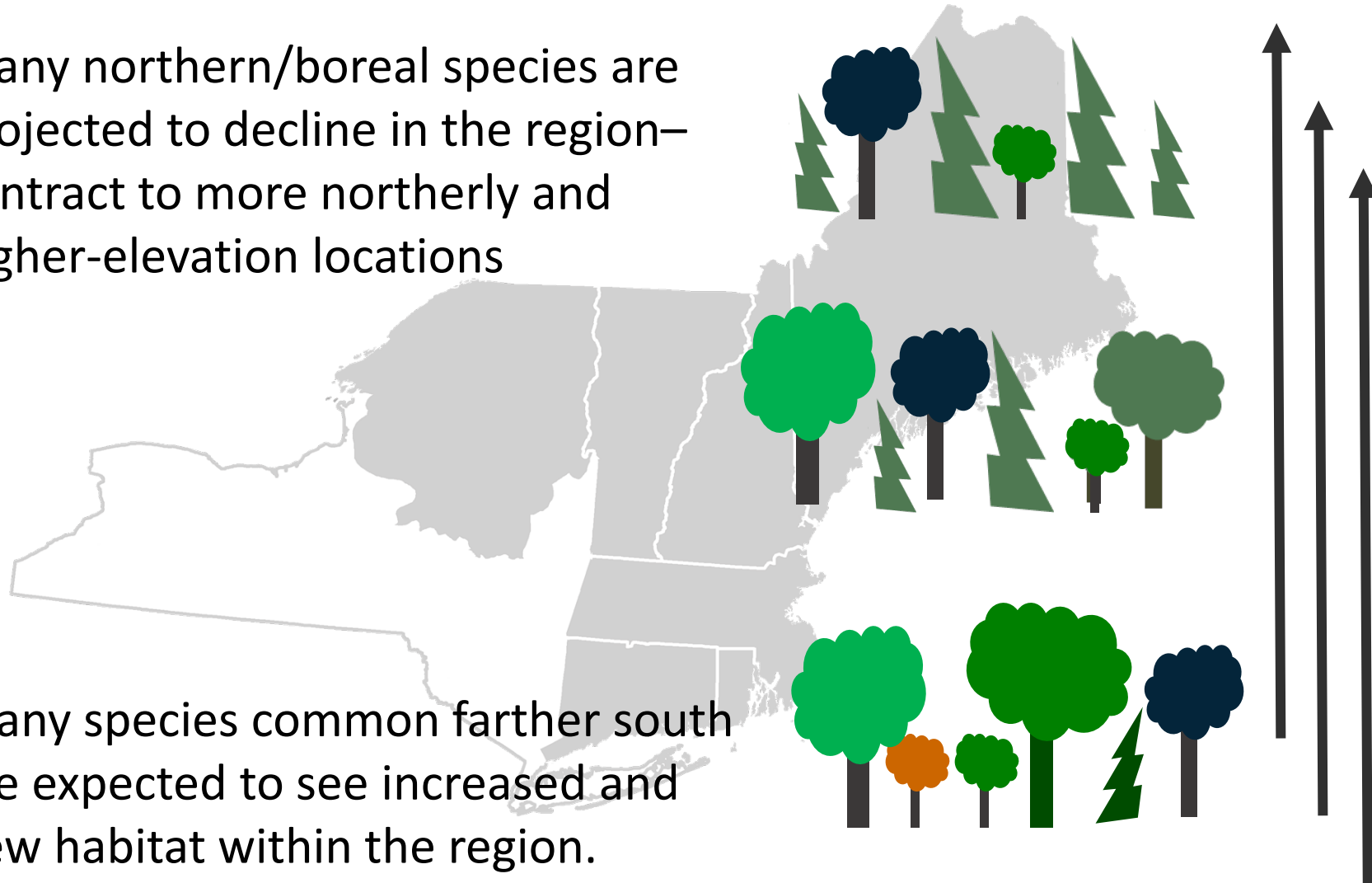
SHIFTING SEASONS | **SHIFTING SPECIES** | SHIFTING STRESSORS

# 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

## Declining Habitat

- Balsam fir
- Black ash
- Striped maple
- Sycamore

## Persisting Habitat

- American basswood
- Atlantic white cedar
- Bitternut hickory
- Black locust
- Eastern cottonwood
- Eastern redcedar
- Gray birch
- Northern red oak
- Pitch pine
- Sassafras
- Shagbark hickory
- Sugar maple
- Scarlett oak
- Yellow birch
- White oak



## Increasing Habitat

- American beech
- Blackgum
- Black cherry
- Black oak
- Chestnut oak
- Pignut hickory
- Yellow-poplar

## New habitat

- Bald cypress
- Black hickory
- Chinkapin oak
- Eastern redbud
- Loblolly pine
- Shortleaf pine
- Southern red oak
- Virginia pine

# Effects on Forests

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

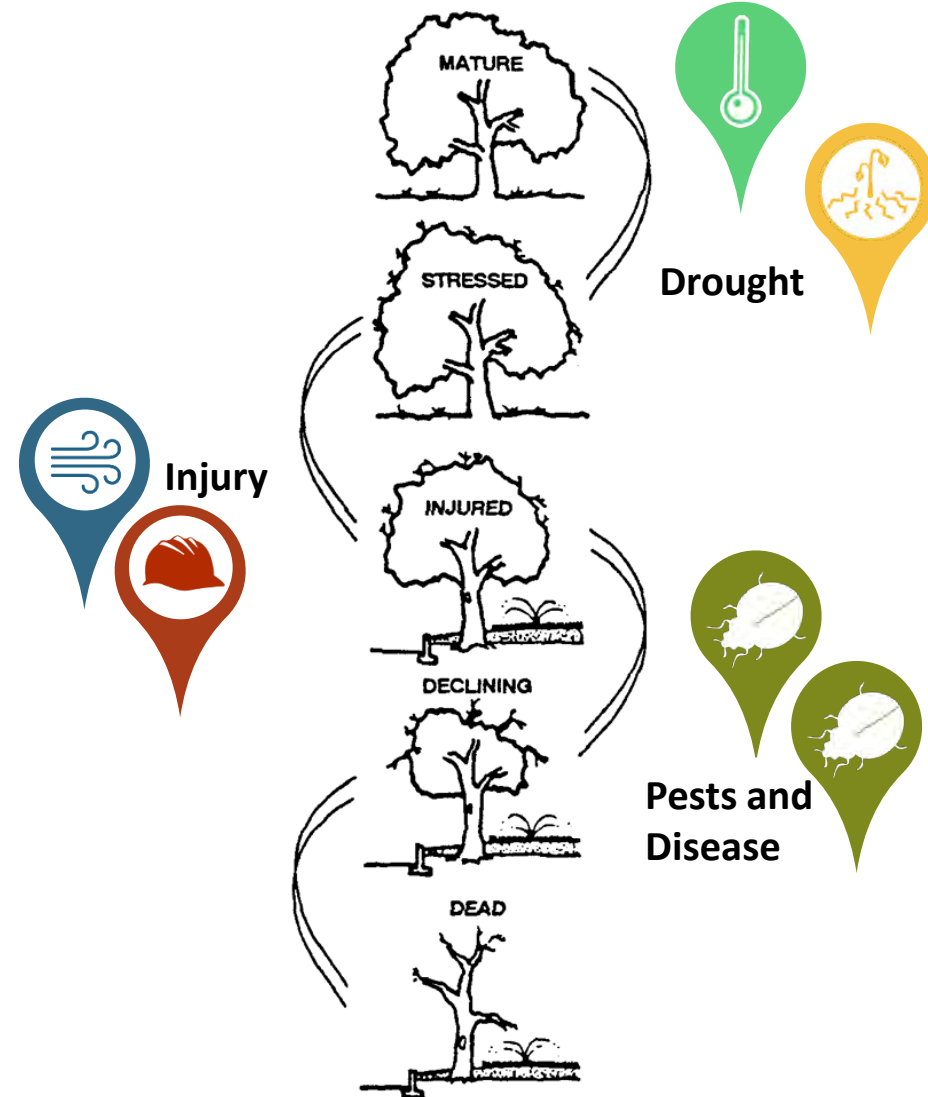
# Effects on Forests

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.**



# Responding to Climate Change



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If you want a single “answer” for how to respond to climate change, it’s

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If you want a single “answer” for how to respond to climate change, it’s

**“It depends”**

It depends on **where** you are working and **what** you’re trying to achieve.

# Adaptation Options

## RESISTANCE



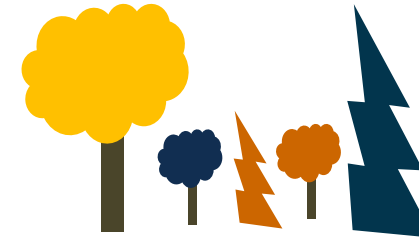
- Improve defenses of forest against change and disturbance
- Maintain relatively unchanged conditions

## 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



# Adaptation Options

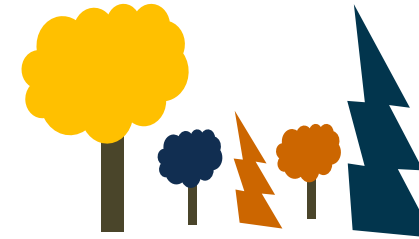
RESISTANCE



RESILIENCE



TRANSITION



**Northern New England:**



**Southern New England:**

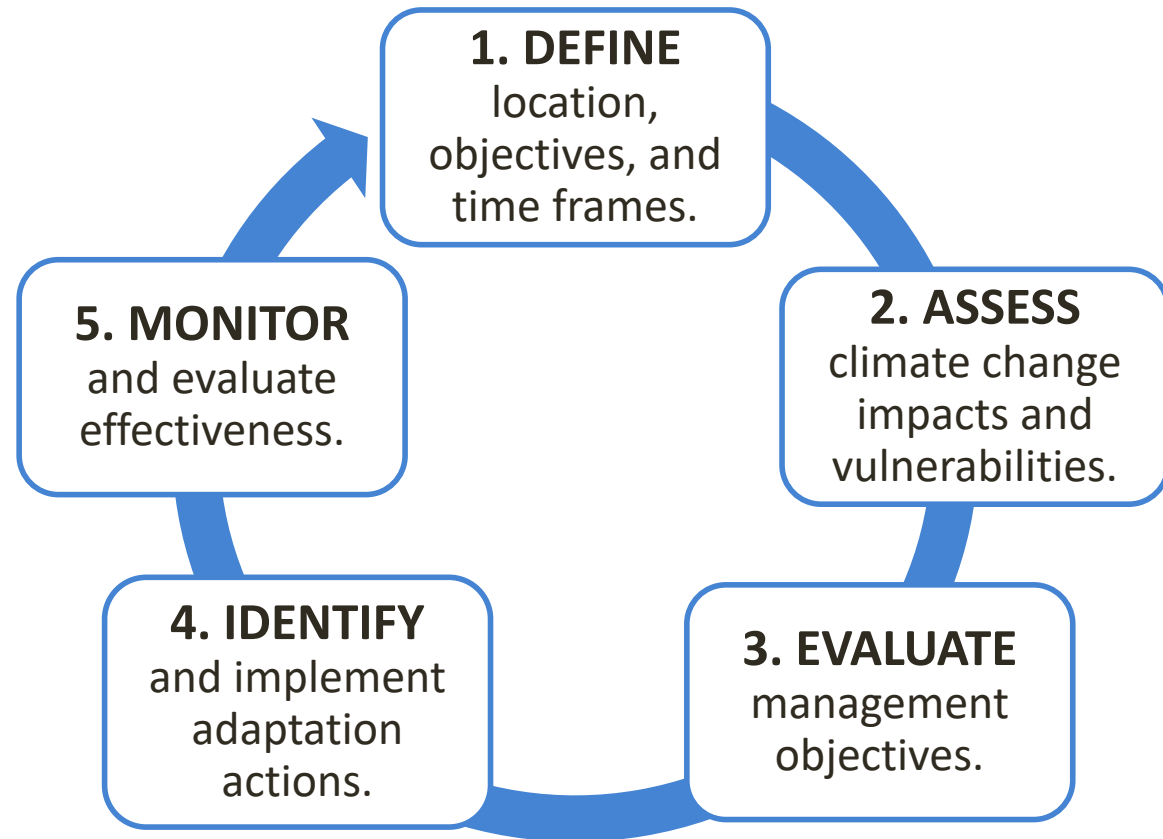




# Responding to Climate Change

**Adaptation Workbook** provides **structured process** to integrate climate change considerations into management planning and activities

- Supports diverse goals and objectives for public, private, & tribal lands
- Menus of adaptation strategies and approaches for forest ecosystems, urban forests, carbon mitigation, etc.
- Does not make recommendations



# 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.

## Published:

- Forestry
- Urban Forestry
- Agriculture
- Forested Watersheds
- Tribal Perspectives
- Forest Carbon
- Recreation

## In Preparation:

- Wetlands
- Wildlife Management
- Ocean Coastal Ecosystems
- Great Lakes Coastal Ecosystems
- Fire Management
- Grasslands

<i>Brunch Classics</i>			
<b>Lemon Ricotta Pancakes</b> Whipped Mascarpone, Maple, Berries	15	<b>AJ's Omelet</b> Fontal Cheese, Spinach, Mushrooms	14
<b>Cornflake Crusted French Toast</b> Berries, Maple Syrup	15	<b>Eggs Florentine</b> Spicy Capicola, House-Made Cheddar Biscuit, Spinach	15
<b>Bacon, Egg &amp; Cheese</b> Bacon, Two Eggs, Fajrigo Cheese, Cabatta	14	<b>Porchetta Hash</b> Poached Egg, Calabrian Chili Hollandaise	16
<b>Avocado Toast</b> Pinehead Eggs, Tomatoes, Chili Flakes, Sea Salt	15	<b>Chia Pudding</b> Chia Seeds, Toasted Coconut, Banana, Strawberry	14
<b>Chicken Parmigiana</b> Spicy Marinara, Fresh Mozzarella	22	<b>Farmhouse Breakfast</b> Two Eggs, House-Made Cheddar Biscuit, Chicken Sausage	14
<b>Squid Ink fettuccine Vongole</b> Little Neck Clams, Garlic, White Wine, Butter, Chili	22	<b>Chicken Kale Caesar</b> Chicken, Kale, Croutons	16
<i>Create Your Own Pasta</i>			
<b>Rigatoni</b> Semolina, All-Purpose Flour, Olive Oil	14	<b>Marinara</b> San Marzano tomatoes, Garlic, White Wine, Basil, Chili	
<b>Cavatelli</b> All-Purpose Flour, Durum Flour, Eggs, Ricotta	15	<b>Arrabiata</b> All-Purpose Flour, Durum Flour, Eggs, Ricotta	+1
<b>Tagliatelle</b> All-Purpose Flour, Durum Flour, Eggs	15	<b>Broken Meatball</b> House Tomato Sauce with the Addition of Broken Meatballs	+4
<b>Gluten-Free Rigatoni</b> Gluten-Free All-Purpose Flour, Olive Oil, Eggs	16	<b>Sunday Sauce</b> House Tomato Sauce with Short Billy Sausage, Veal	+4
<b>Spaghetti</b> Semolina, Durum Flour, Olive Oil	15	<b>Roasted Garlic Pecorino</b> Semolina, Durum Flour, Olive Oil	+2
<b>Four Cheese Herb Ravioli</b> Fontal, Ricotta, Parmesan, Pecorino	18	<b>Carbonara</b> Pancetta, Eggs, Peas, Pecorino	+3
<i>Sides</i>		<i>Brunch Cocktails</i>	
<b>Pecorino Truffle Fries</b>	8	<b>Bloody Mary</b>	10/45
<b>Potato Hash</b>	6	<b>Cointreau Spritz</b>	12/55
<b>Racon</b>	6	<b>Green Side</b>	12/55
<b>Turkey Sausage</b>	6	<b>Morning Derby</b>	12/55
<b>Field Greens</b>	7	<b>Sangria</b>	10/45
<b>Two Eggs Any Style</b>	6	<b>Firing Squad</b>	12/55
<b>Beignets</b>	8	<b>Tall Mimosa</b>	12/55
<b>Baked Goods</b>	10		



# Forest /Urban Forest Adaptation Strategies

- Sustain fundamental ecological functions.
- Reduce existing biological stressors.
- Reduce impacts of severe disturbances.
- Maintain or create refugia.
- Enhance species and structural diversity.
- Promote ecosystem redundancy.
- Increase landscape connectivity.
- Enhance genetic diversity.
- Facilitate species transitions.
- Realign ecosystems after disturbance.





# Example: MassConn Woods Outreach

- Protect water and soils on your land.
- Improve ability of your trees to resist bugs and disease.
- Maintain or improve the ability of forests to resist pests and pathogens
- Prevent and control non-native plants and weeds that already threaten native plants and animals.
- Manage damage to young trees from excessive deer browsing.
- Prepare for big weather events by promoting strong, healthy trees in your woodlot.
- Respond quickly after big disturbance events to help your woods bounce back.
- Promote a diversity of tree species and tree sizes.
- Protect rare or sensitive plant and animal communities.
- Consider how your current trees will react to future conditions and new species you might want to promote.
- Monitor your woods and the effect of different management tactics.

The screenshot shows a digital form with a green header and a brown sub-header. The main title is 'Keeping Your Woods Healthy Through the Years Ahead'. Below this is a section titled 'Considerations for Your Woodlot' with a small logo. The text reads: 'The following are general recommendations to keep your woods healthy and able to adapt to changes into the future. While all of these actions are important, the checked recommendations are most applicable to your woods and your situation. To learn more, consult our fact sheet, consider working with a professional to implement these practices on the ground or visit our website at <http://mymassconnwoods.org/>.' There are two columns: 'Top Forest Stressors to Keep an Eye On' and 'Extreme Weather Vulnerabilities'. Below these are several rows of recommendations, each with a green bar and a checkbox. The first row has 'Protect water and soils on your land' checked. The second row has 'Improve ability of your trees to resist bugs and disease' checked. The third row has 'Prevent and control non-native plants and weeds that threaten native plants and animals' checked. The fourth row has 'Manage damage to young trees from excessive deer browsing' checked. The fifth row has 'Prepare for big weather events by promoting strong, healthy trees in your woodlot.' checked. The sixth row has 'Respond quickly after big disturbance events to help your woods bounce back.' checked. The seventh row has 'Promote a diversity of tree species' checked. The eighth row has 'Promote a diversity of tree sizes' checked. The ninth row has 'Protect rare or sensitive plant & animal communities' checked. The tenth row has 'Consider how your current trees will react to future conditions and which tree species you might want to promote' checked. The final row has 'Monitor your woods and the effect of different management tactics' checked.



# Example: MassConn Woods Outreach

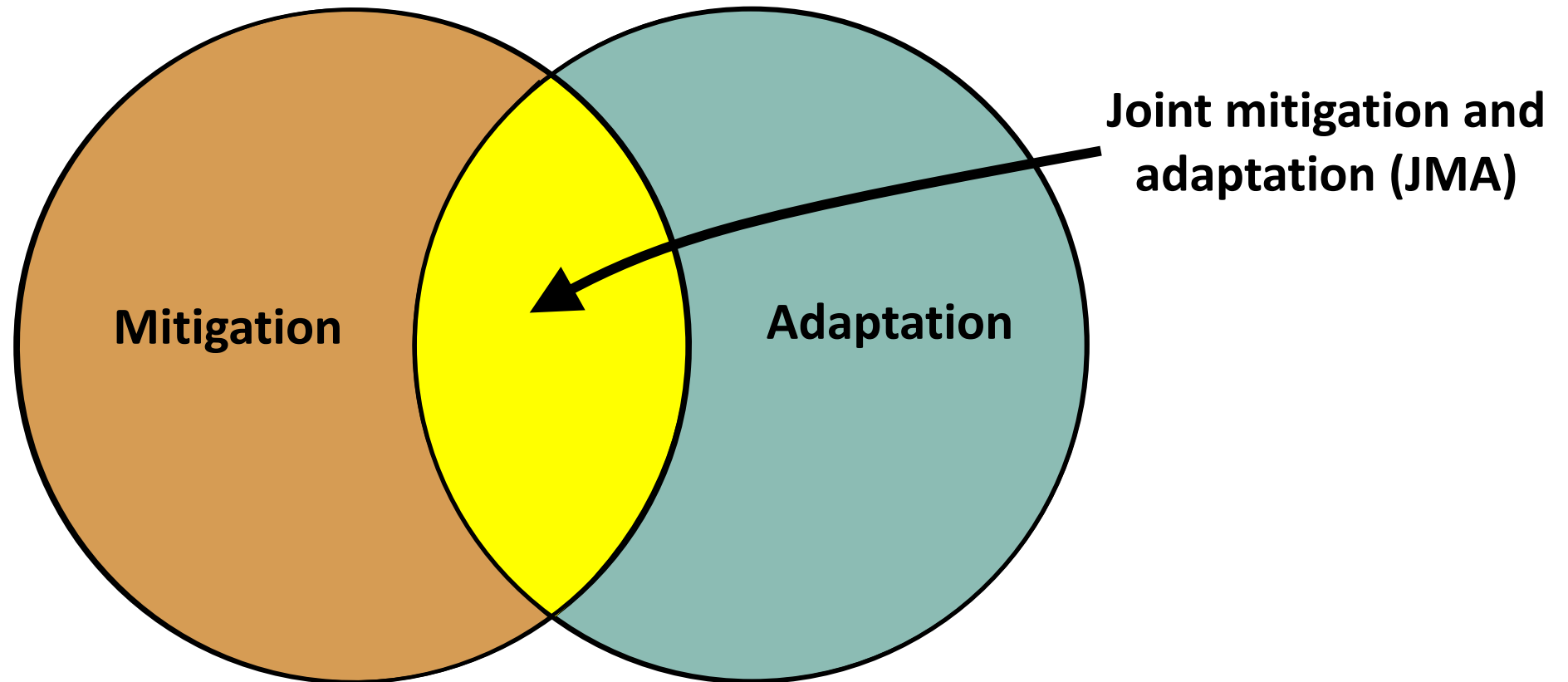
- Climate adaptation visits by NIACS-trained foresters (NEFF, AFF, MassConn partnership)
- 102 private owner visits completed on total ownership of 8,100 acres since 2016
  - Within CT: 43 parcels of 3,270 combined acres
- Demonstrations on private and CT DEEP forest lands



KENEY PARK, HARTFORD: 128-acre area  
NIACS Adaptation Workbook in progress – NEFF FS grant

# Adaptation + Forest Carbon

Integrating climate mitigation and adaptation is needed for  
**resilient carbon sequestration**



# Adaptation + Forest Carbon

## FIRST REDUCE STRESSORS

- Avoid forest conversion to nonforest land uses
- Reduce impacts on soils and nutrient cycling
- 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

## THEN ENHANCE CARBON

- Reforest (convert back to forest)
- Increase tree cover in urban areas
- Integrate trees into agricultural systems
- Prioritize low-vulnerability sites for maintaining or enhancing carbon stocks
- Increase structural complexity
- Increase tree stocking in low-risk stands
- Alter species or structure to maximize carbon stocks
- Promote future-adapted species

# Example: Audubon Vermont

- Green Mountain Audubon Center – Forest management plan update to include climate adaptation and carbon
- Integration with Forest Birds Initiative



Action	Bird Habitat Benefits	Adaptation Benefits	Mitigation Benefits
Maintain forest land as forest/ Maintain no harvest area	Habitat for forest birds; more 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	Species and structural diversity increases resilience	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



# Conclusions

- There is no single “answer” for responding to climate change. A portfolio approach is needed.
- Actions for adaptation and mitigation need to consider site conditions, landowner goals or desired outcomes, and climate risks.
- Management actions to maximize any single management objective above others (e.g., carbon) can increase risks. Work to optimize across a wide range of benefits.

