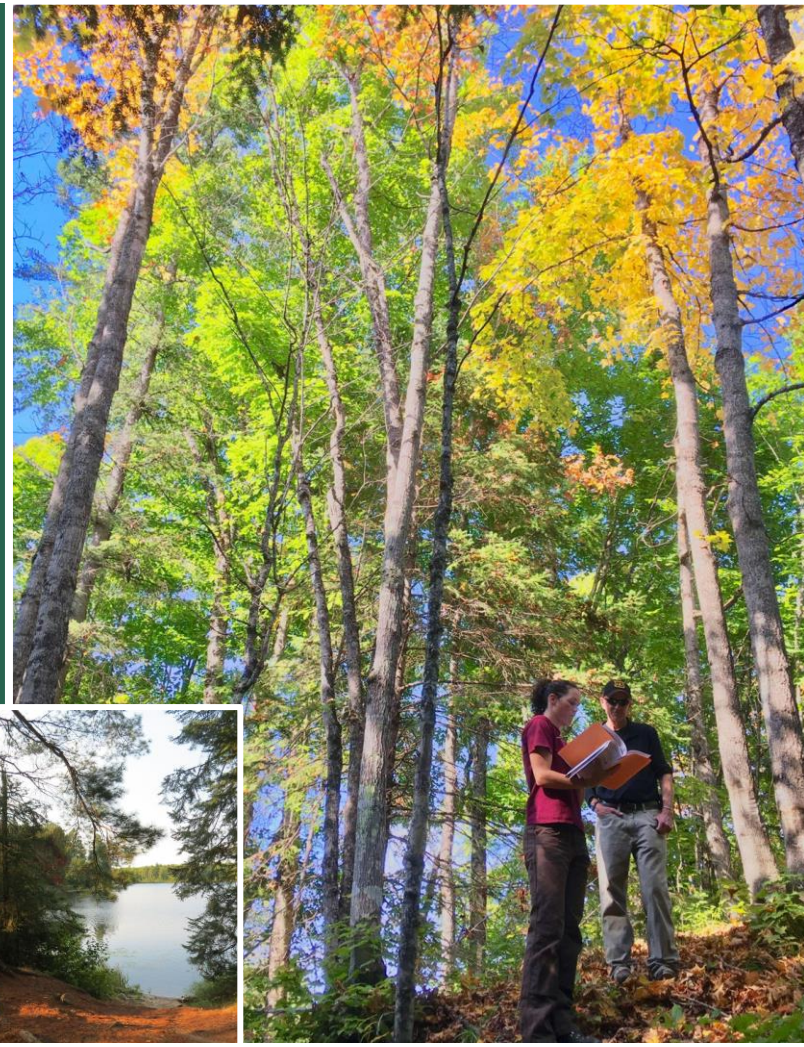
Adaptation Strategies for Forest Management

Penn State Goddard Forum on Climate-Smart Forestry
October 16, 2024



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Northern Institute of Applied Climate Science

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.

Climate Change Adaptation

Forest Carbon Management

NIACS is a collaborative, multi-institutional partnership led by the USDA Forest Service and comprised of federal, forest sector, conservation, higher education, and tribal organizations.

USDA Northern Forests Climate Hub

The Northern Forests Climate Hub provides additional capacity to two USDA Regional Climate Hubs the **Northeast and Midwest Hubs**—and works within their broader scope and organization.

The Northern Institute of Applied Climate Science is a multi-organizational collaborative led by the USDA Forest Service that provides additional capacity to the USDA Northern Forests Climate Hub.

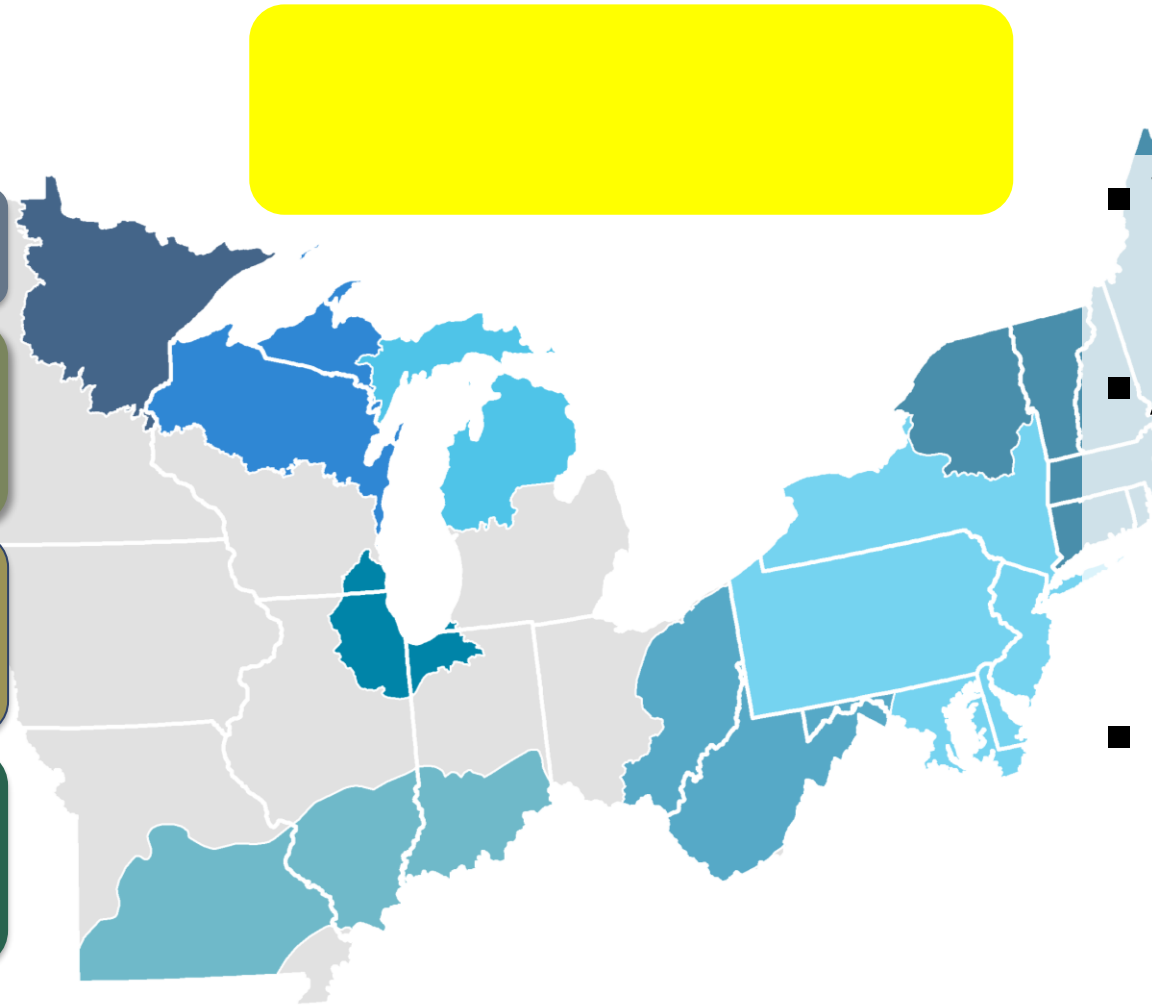
USDA Climate Hubs
U.S. DEPARTMENT OF AGRICULTURE

Mission: To develop and deliver science-based, region-specific information and technologies, with USDA agencies and partners, to agricultural and natural resource managers that enable climate-informed decision-making, and to provide access to assistance to implement those decisions.

Climate Change Response Framework

4 Components:

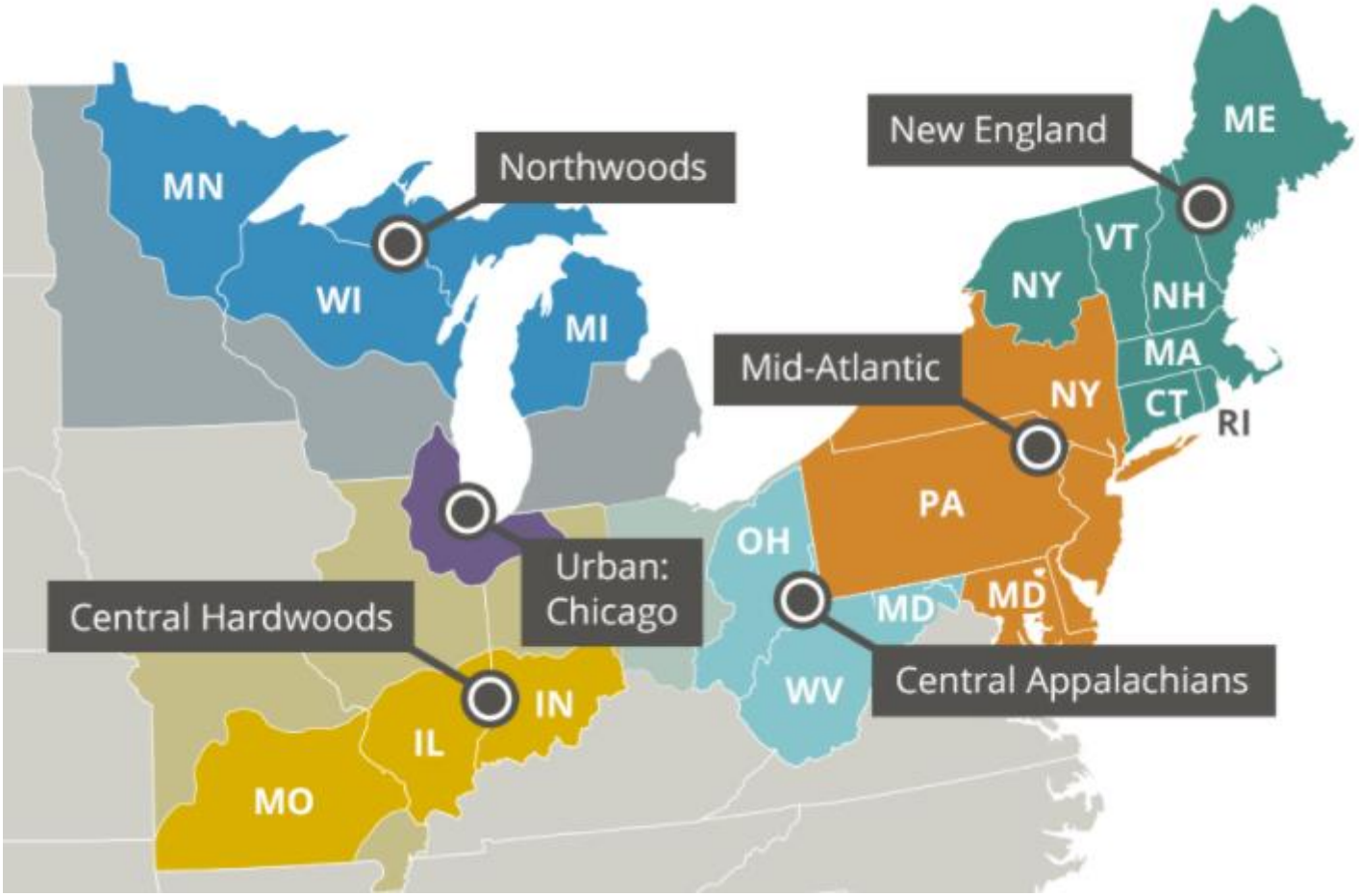
- Partnerships
- Vulnerability Assessment
- Forest Adaptation Resources
- Adaptation Demonstrations



- Work with land managers
- Apply climate-lens to management planning
- Customize approaches for adaptation

Ecosystem Vulnerability Assessments

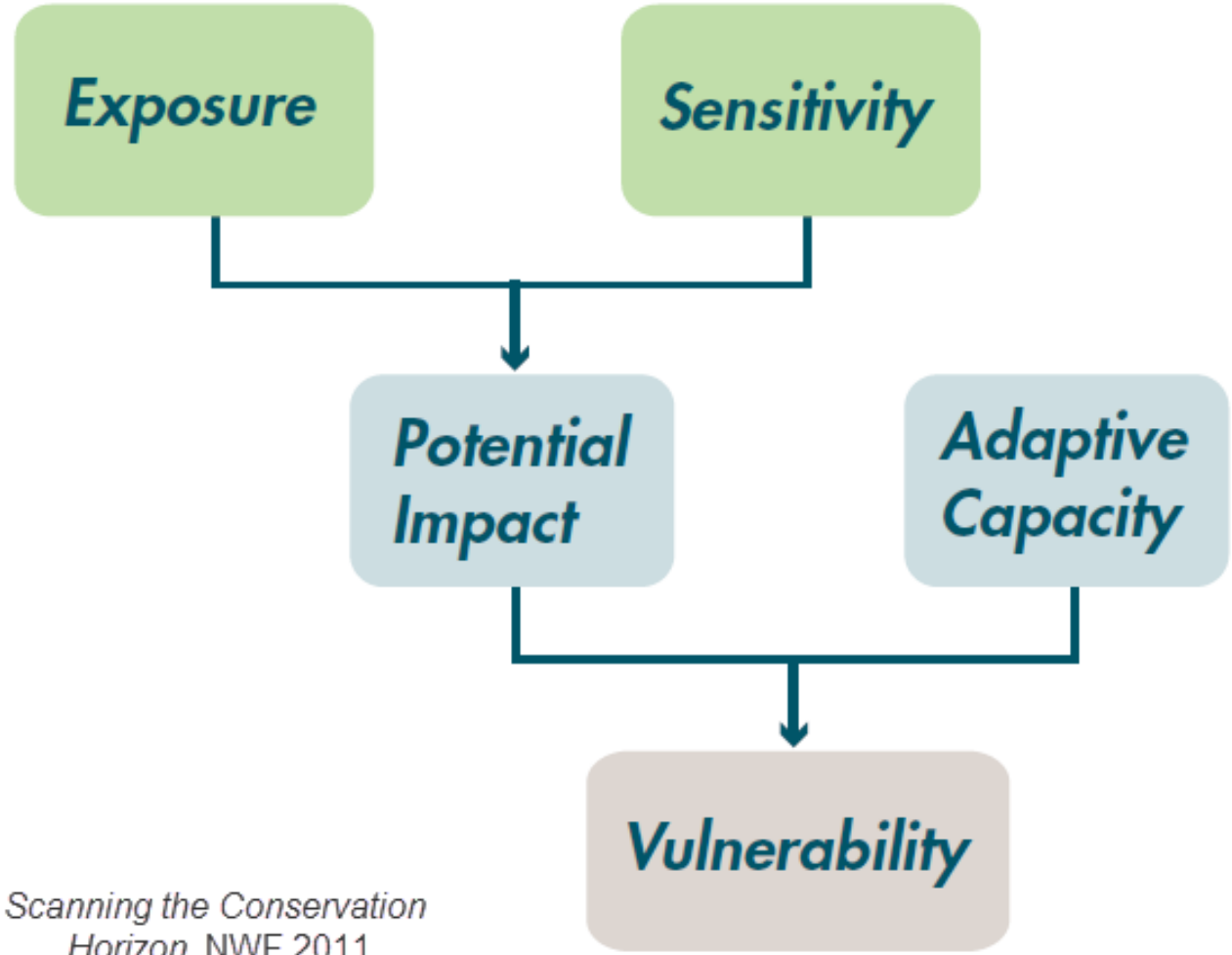
- Multiple sources of information
- Peer-reviewed
- Expert-driven
- Summaries of regional forest health concerns
- Expectations for climate effects on stressors for major forest types



What is climate change vulnerability?

the degree to which a system is susceptible to and unable to cope with adverse effects of climate change

Vulnerability



Scanning the Conservation Horizon, NWF 2011

Exposure: size and rate of climate changes

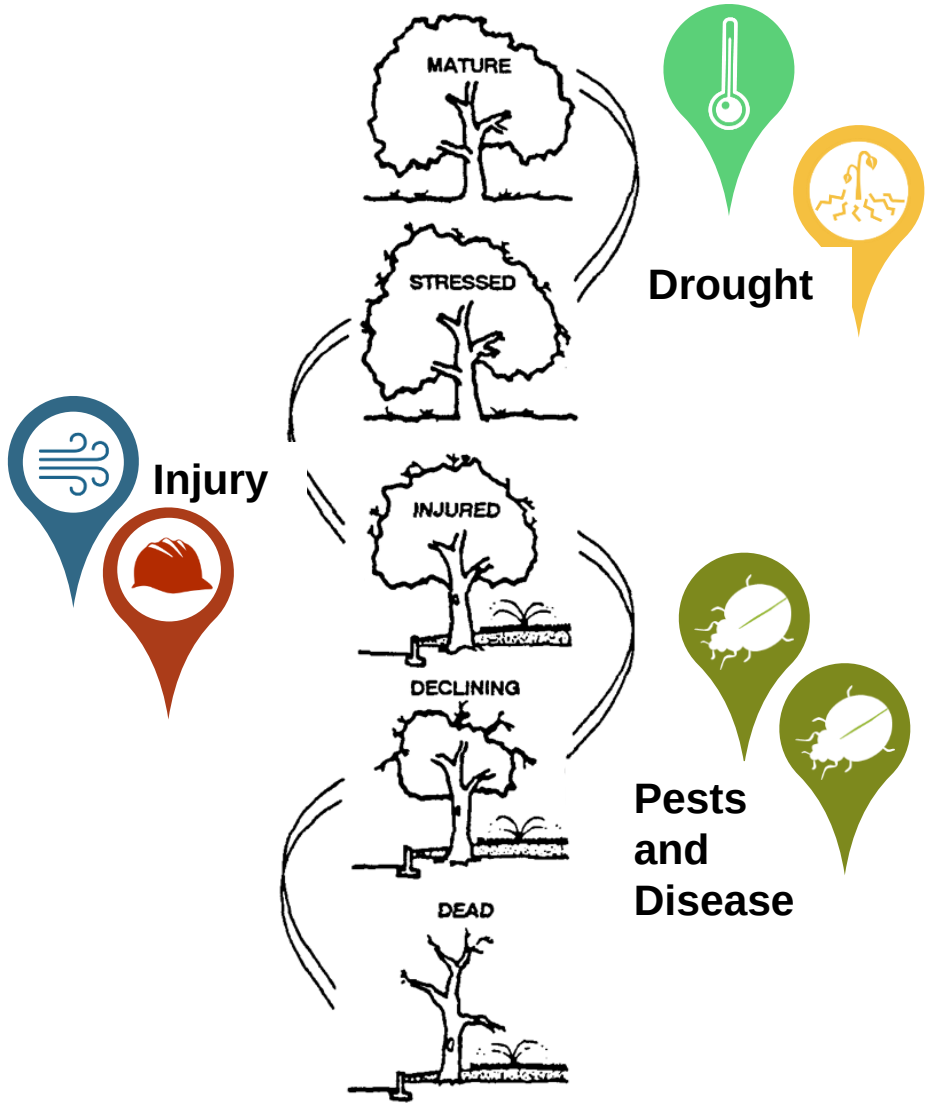
Sensitivity: the *tolerance* of the system to climate changes

Impact: the effect of climate change on natural or human systems

Adaptive Capacity: the ability of the system to cope with potential impacts

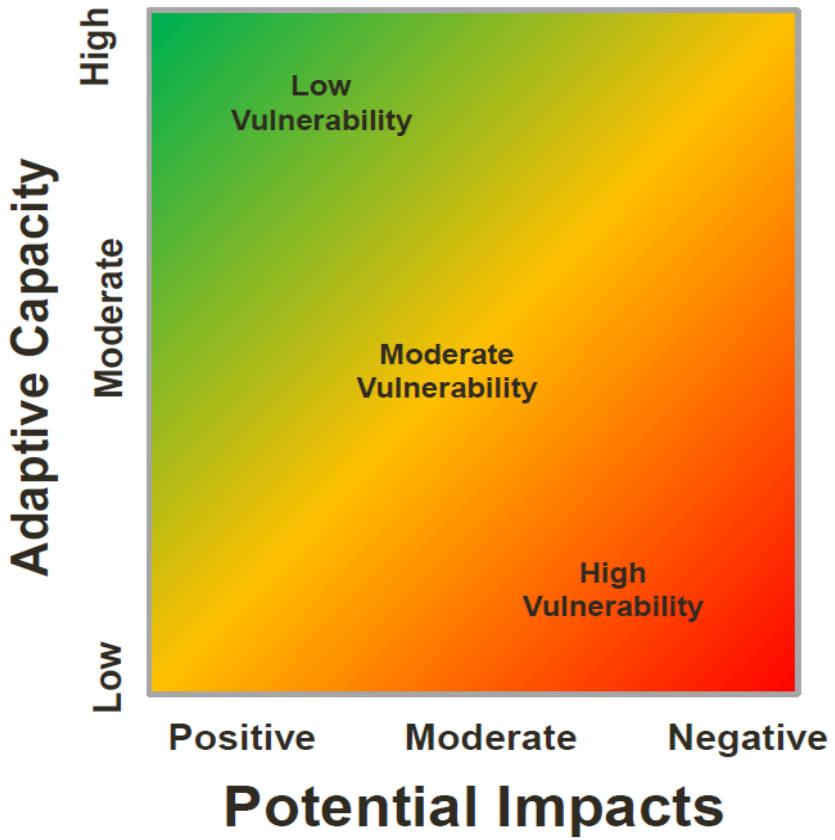
A changing climate poses risks to forests (and the carbon they sequester)

- Altered climate
- Extreme weather
- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species
- Altered habitat suitability



Drawing: Bartlett Tree Experts

Vulnerability of the Mid-Atlantic Region



Forest community	Potential impacts	Adaptive capacity	Vulnerability
Montane Spruce-Fir	Negative	Low	High
Northern Hardwood	Moderate-Negative	Moderate	Moderate-High
Central Oak-Pine	Moderate-Positive	Moderate-High	Moderate-Low
Woodland, Glades, and Barrens	Positive	Moderate-High	Low
Lowland and Riparian Hardwood	Moderate	Moderate	Moderate
Lowland Conifer	Negative	Moderate-Low	High
Forest community	**Potential impacts**	**Adaptive capacity**	**Vulnerability**
Coastal Plain Swamp	Moderate	Moderate-High	Moderate-Low
Coastal Plain Tidal Swamp	Moderate-Negative	Moderate-Low	Moderate-High
Coastal Plain Oak-Pine-Hardwood	Moderate-Positive	High	Moderate-Low
Coastal Plain Pine-Oak Barrens	Moderate	Moderate	Moderate-Low
Coastal Plain Maritime Forest	Negative	Moderate-Low	High

Modified from Swanston and Janowiak

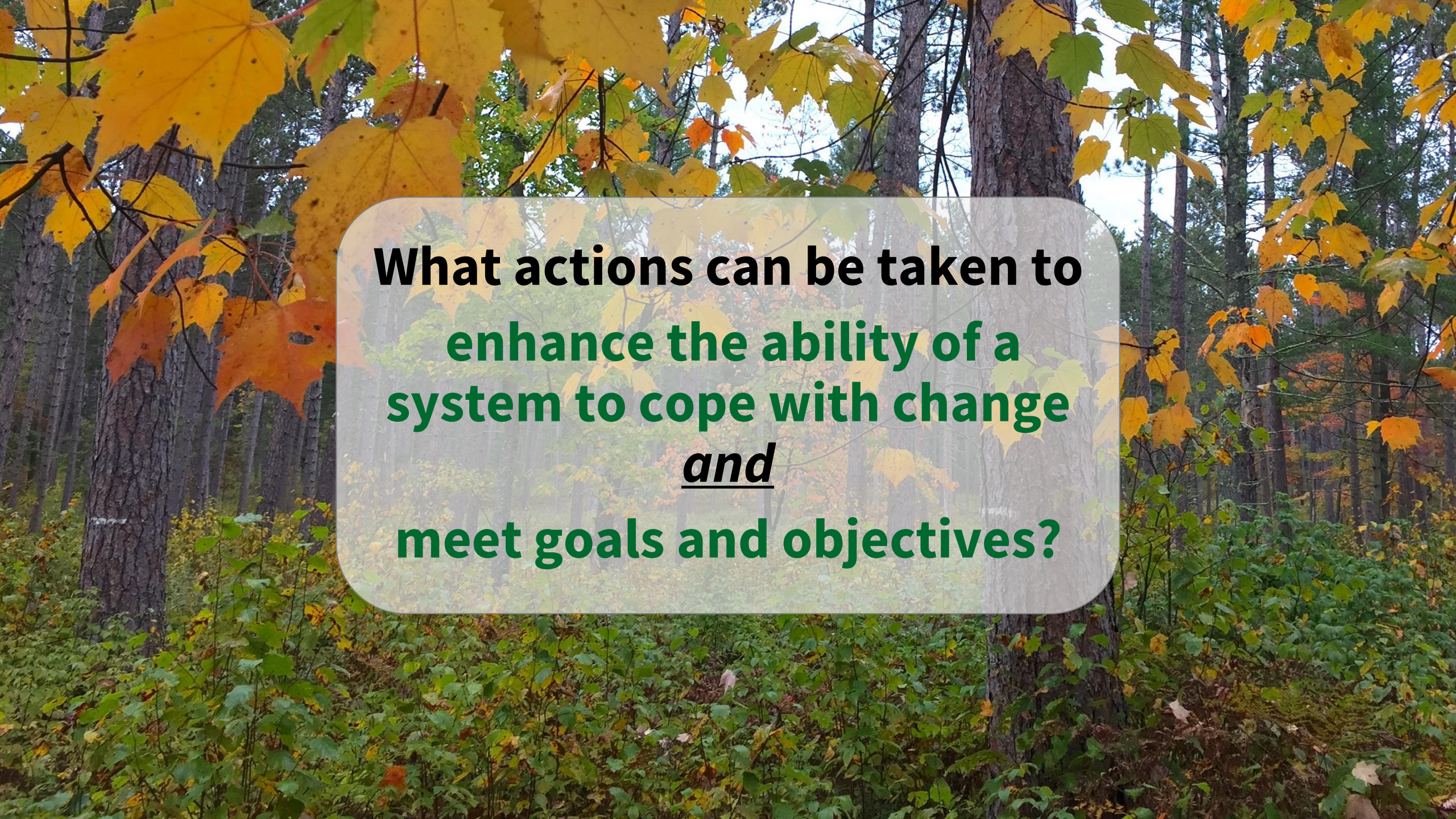
Climate Change Impacts on Forests

- Suitable habitat for northern species will decline
- Habitat will become more suitable for southern species
- Climate changes are likely to affect early growth and regeneration conditions first
- Species composition will change across the landscape
- A major transition in species composition is not expected before 2040-2069, in the absence of stand-replacing events
- Increased disturbance (e.g. fire frequency) and harvesting will accelerate shifts

Forests in a Time of Rapid Change

- Forests provide essential ecosystem services, including spiritual and material benefits
- Global change is creating increasingly dynamic, uncertain futures
- Contemporary disturbances are often catastrophic events with frequent intervals and repeated occurrences
- Forest recovery may be decadal or longer
- Legacy of land use and fire suppression
- Changing societal expectations of forests
- ***Climate adaptation will be key to a sustainable future***

Photo: Colorado State Forest Service

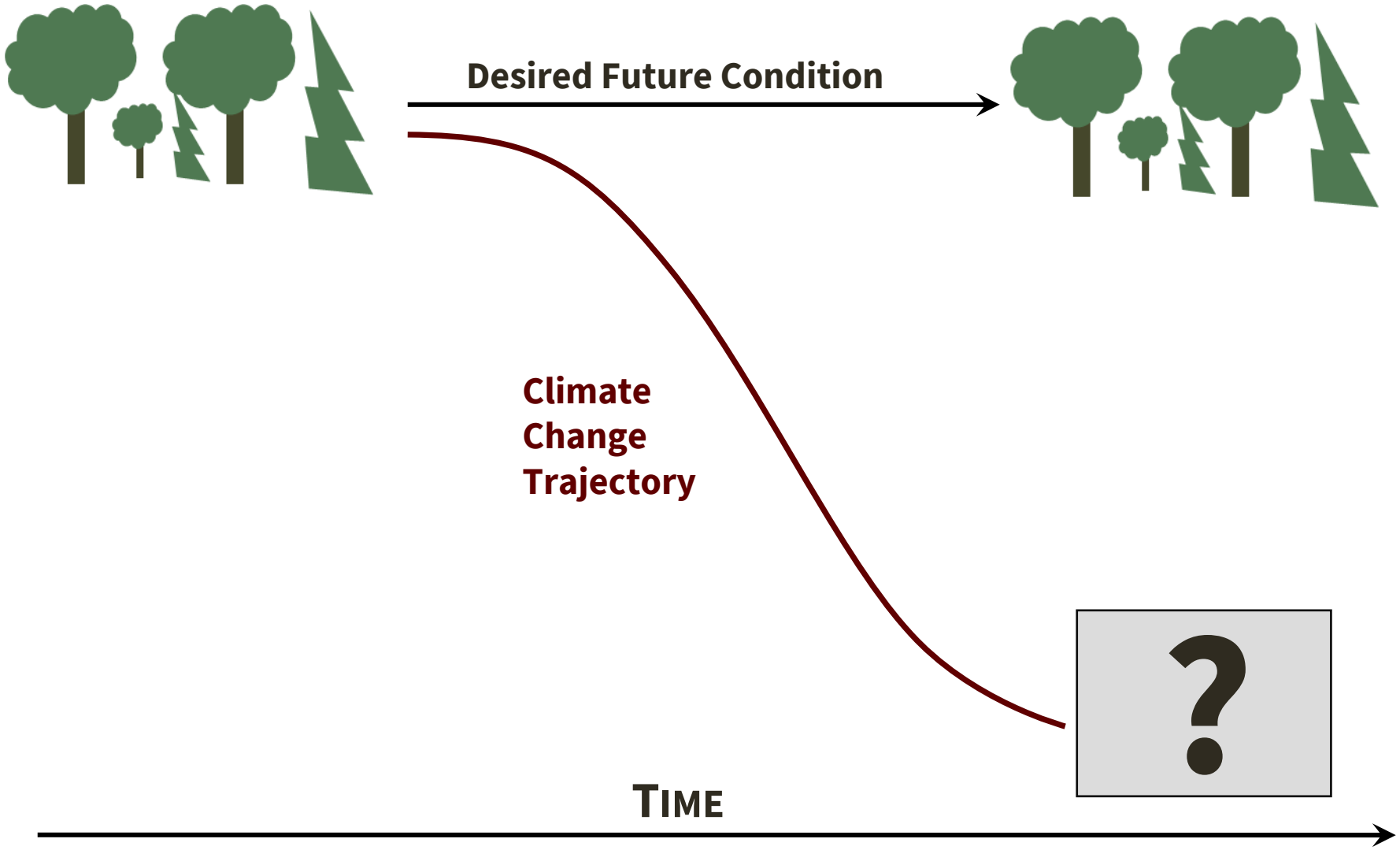

What actions can be taken to
enhance the ability of a system to cope with change
and
meet goals and objectives?

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



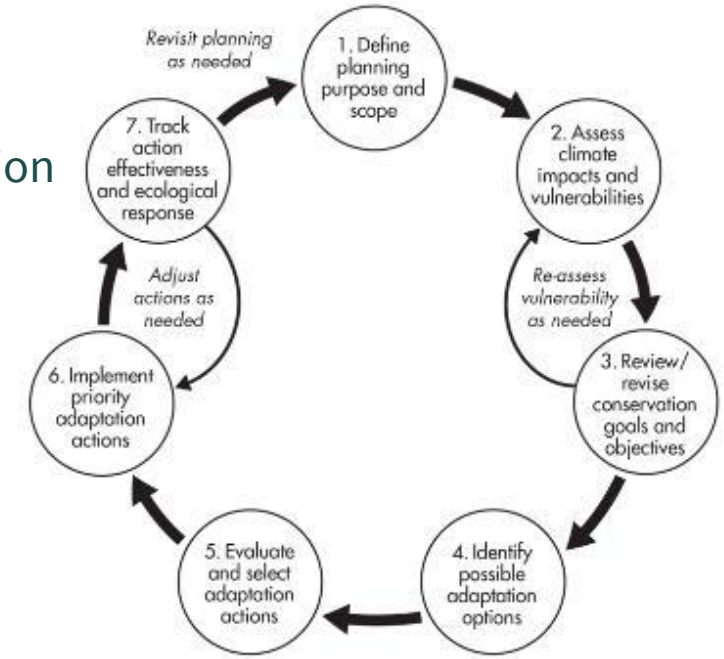

Adaptation actions are designed to **intentionally** address climate change impacts and vulnerabilities in order to meet goals and objectives

Climate-Driven Changes

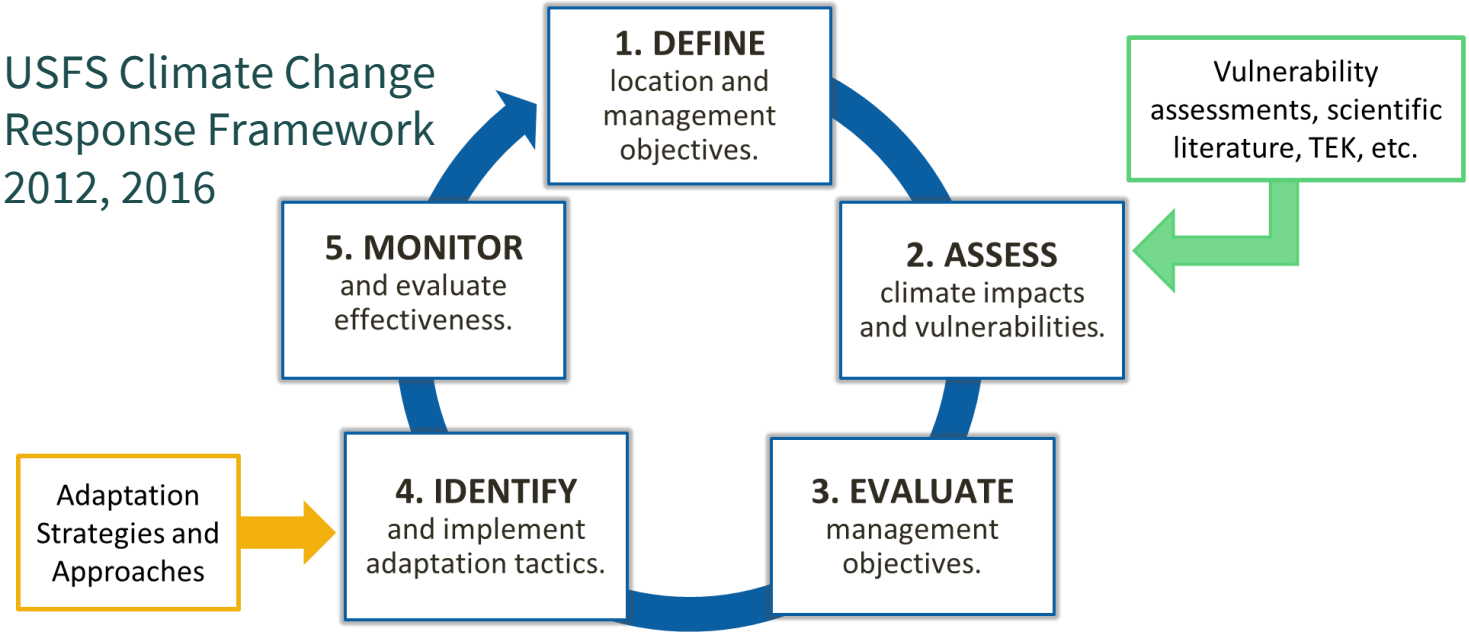


Many Adaptation Planning Approaches

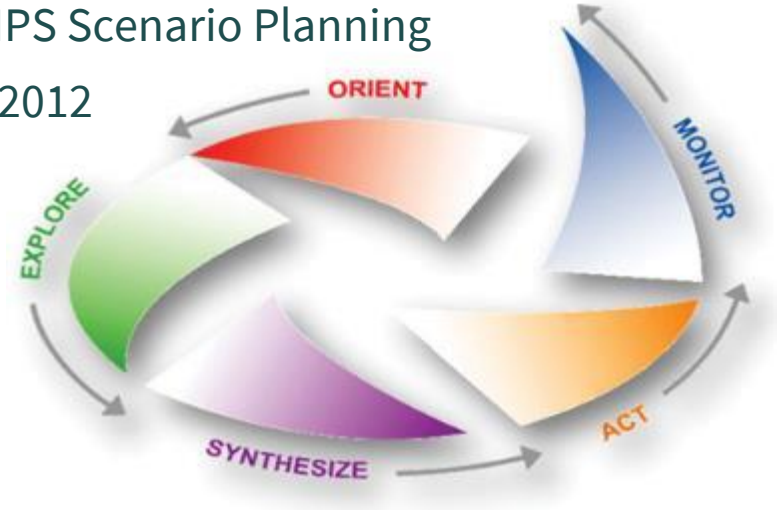
Climate-Smart Conservation Cycle
NWF 2014



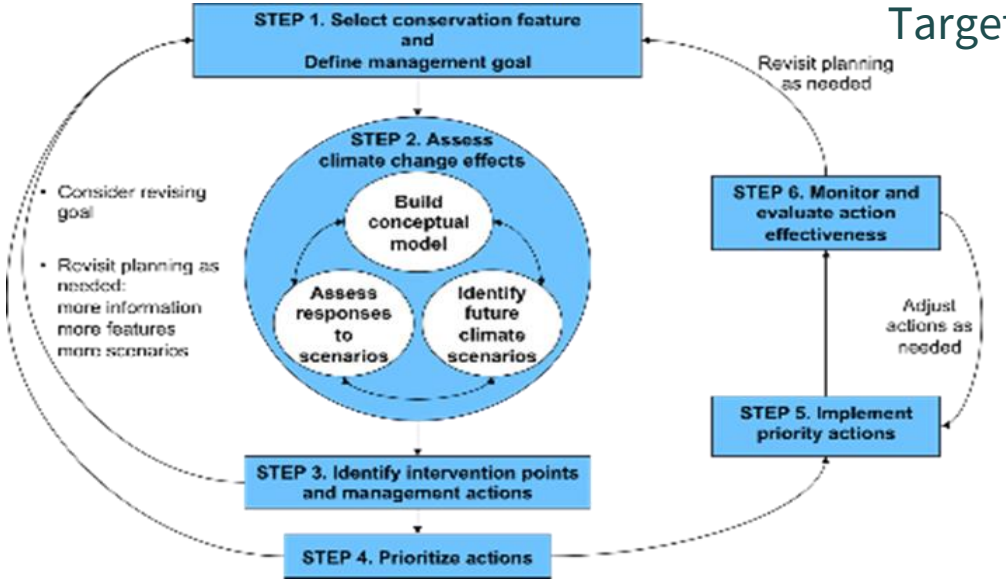
USFS Climate Change Response Framework
2012, 2016



NPS Scenario Planning
~2012



Adaptation for Conservation Targets (ACT)
2012

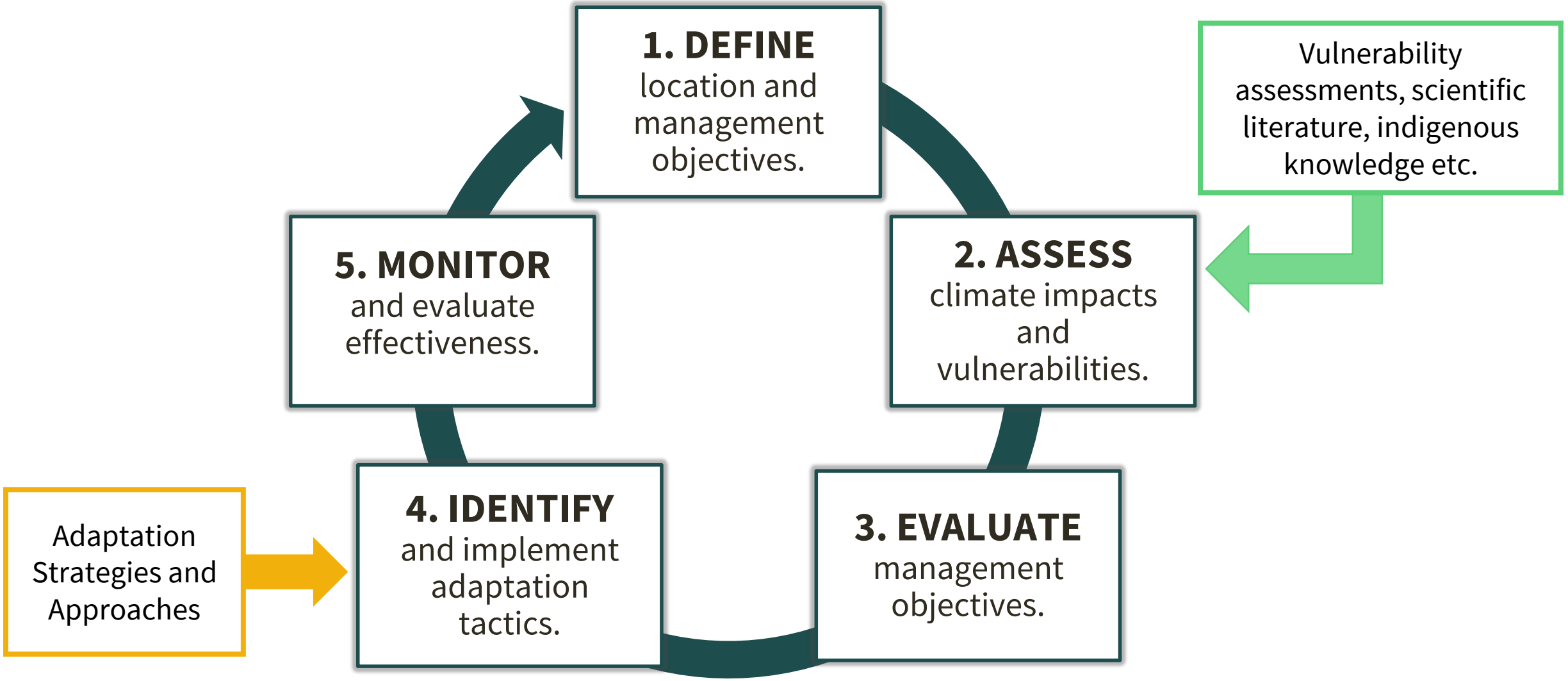


Adaptation Planning = Intentionality

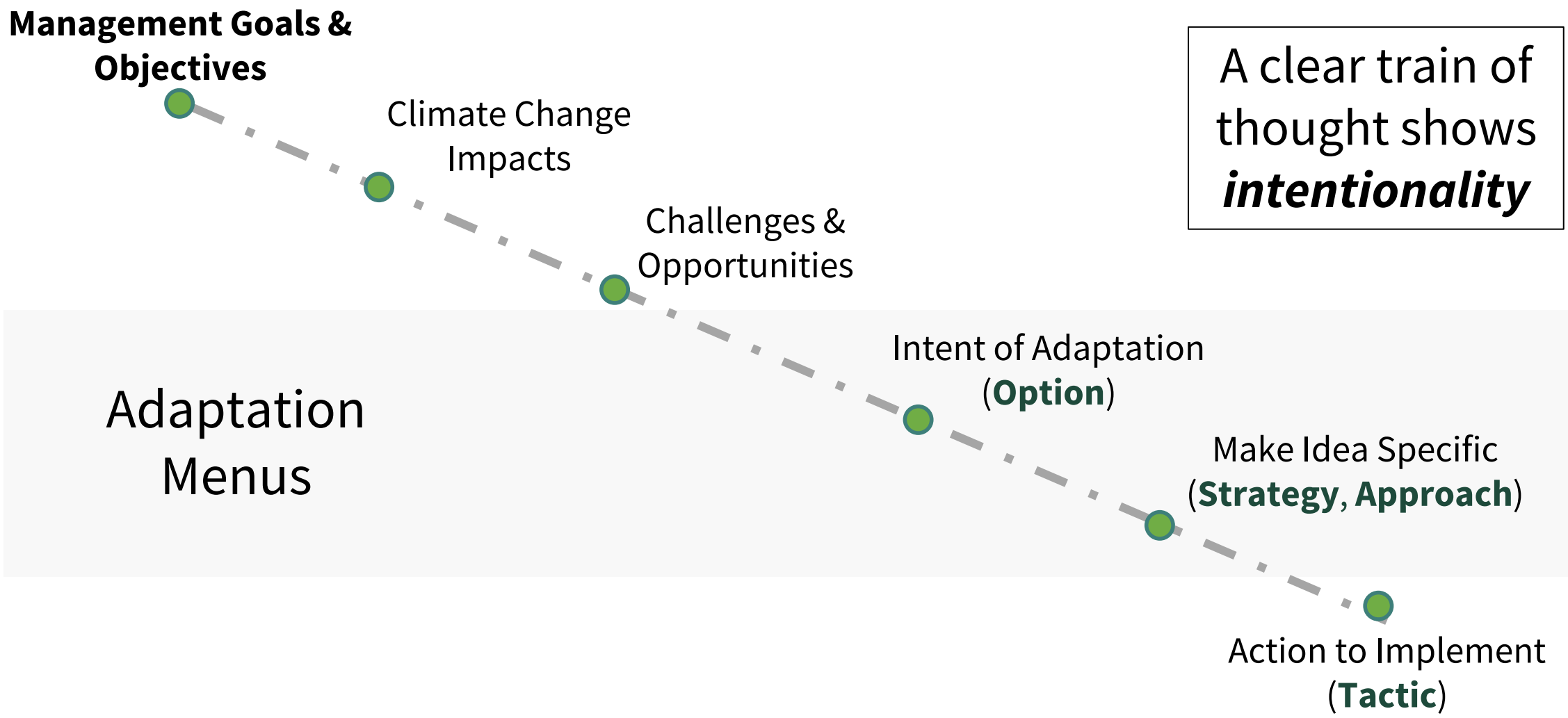
Every management decision
(active or passive)
is essentially an experiment.

Show your work!

Adaptation Workbook



Workbook + Menu (Show your work!)



A clear train of thought shows ***intentionality***

Adaptation Options: A spectrum, not strict categories

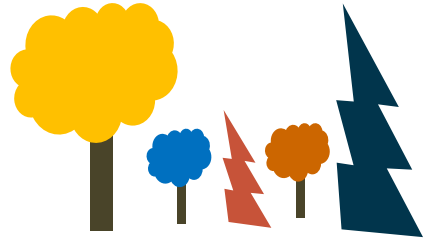
RESISTANCE

- 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

Reduce impacts/maintain current conditions

Forward-looking/promote change

Millar et al. 2007, Swanston et al. 2016, Nagel et al. 2017

Adaptation Menus

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

Brunch

Classics

Lemon Ricotta Pancakes Whipped Mascarpone Maple, Berries	15	**AJ's Omelet** Fontal Cheese, Spinach, Mushrooms	14
Cornflake Crusted French Toast Berries, Maple Syrup	15	**Eggs Florentine** Spicy Capicola, House-Made Cheddar Biscuit, Spinach	15
Bacon, Egg & Cheese Bacon, Two Eggs, Taleggio Cheese, Ciabatta	14	**Porchetta Hash** Poached Egg, Calabrian Chili Hollandaise	16
Avocado Toast Poached Eggs, Tomatoes, Chili Flakes, Sea Salt	15	**Chia Pudding** Chia Seeds, Toasted Coconut, Banana, Strawberry	14
Chicken Parmigiana Spicy Marinara, Fresh Mozzarella	22	**Farmhouse Breakfast** Two Eggs, House-Made Cheddar Biscuit, Chicken Sausage	14
Squid Ink fettuccine Vongole Little Neck Clams, Garlic, White Wine, Butter, Chili	22	**Chicken Kale Caesar** Chicken, Kale, Croutons	16

Create Your Own Pasta

Shapes

Rigatoni Semolina, All-Purpose Flour, Olive Oil	14
Cavatelli All-Purpose Flour, Durum Flour, Eggs, Ricotta	15
Tagliatelle All-Purpose Flour, Durum Flour, Eggs	15
Gluten-Free Rigatoni Gluten-Free All-Purpose Flour, Olive Oil, Eggs	16
Spaghetti Semolina, Durum Flour, Olive Oil	15
Four Cheese Herb Ravioli Fontal, Ricotta, Parmesan, Pecorino	18

Sauces

Marinara San Marzano tomatoes, Garlic, White Wine, Basil, Chili	
Arrabiata All-Purpose Flour, Durum Flour, Eggs, Ricotta	+1
Broken Meatball House Tomato Sauce with the Addition of Broken Meatballs	+4
Sunday Sauce House Tomato Sauce with Short Rib, Sausage, Veal	+4
Roasted Garlic Pecorino Semolina, Durum Flour, Olive Oil	+2
Carbonara Pancetta, Eggs, Peas, Pecorino	+3

Sides

Pecorino Truffle Fries	8
Potato Hash	6
Bacon	6
Turkey Sausage	6
Field Greens	7
Two Eggs Any Style	6
Beignets	8
Baked Goods	10

Brunch Cocktails

Bloody Mary Vodka, Spiced Fresh DOP Tomato Juice, Horseradish	10/45
Cointreau Spritz Cointreau Spritz, Aperol, Crème de Peche, Sparkling Wine	12/55
Green Side Reyka Vodka, Green Juice, Lemon	12/55
Morning Derby Bourbon, Grapefruit, Ginger, Carrot Juice	12/55
Sangria Red Wine, Fresh Fruit, Pisco, Crème de Peche	10/45
Firing Squad Milagros Tequila, Cointreau, Fresh Lime, Grenadine	12/55
Tall Mimosa Reyka Vodka, Cointreau, Jake's Mimosa Juice, Sparkling Wine	12/55

Adaptation Menus

Specific to a discipline

Organized into a tiered hierarchy

Thoroughly researched, co-developed, and tested

- Forests
- Urban Forests
- Agriculture
- Forested Watersheds
- Tribal Perspectives
- Carbon Management
- Recreation
- Wetlands (non-forested)
- Wildlife
- Fire-adapted ecosystems
- Great Lakes Coastal Ecosystems
- Grasslands

Menu of Adaptation Strategies and Approaches

Developed for forests

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.

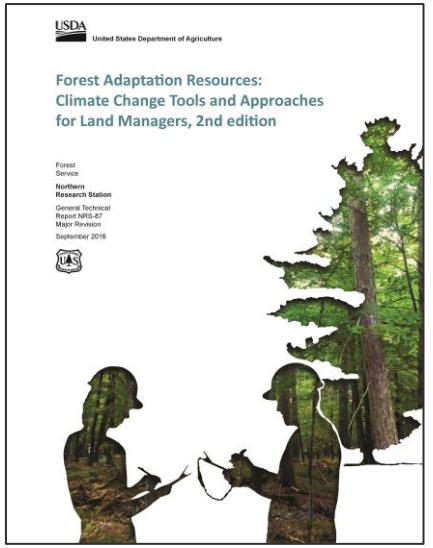
Strategy 10: Realign ecosystems after disturbance.
10.1 Promptly revegetate sites after disturbance.
10.2. Allow for areas of natural regeneration to test for future-adapted species.
10.3. Realign significantly disrupted ecosystems to meet expected future conditions.

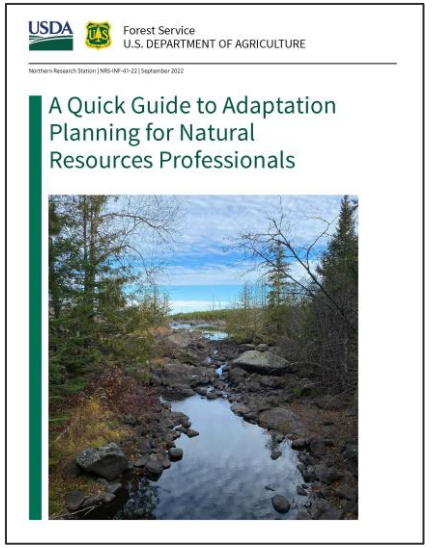
NIACS

To be used in the Adaptation Workbook decision-support framework – Swanston et al, 2016. Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition http://www.treesearch.fs.fed.us/pubs/52760 ***More information can be found at*** *www.forestadaptation.org/strategies*

Adaptation Workbook: Versions

Version	Format	Most Suitable for
Full Workbook doi.org/10.2737/NRS-GTR-87-2 Spanish in development (forests) Agriculture workbook Some Hub have regional versions	A complete set of climate change considerations and detailed step-by-step instructions for using the adaptation process (excel, word)	• First-time users of the workbook Less familiar with the information on projected climate change impacts • Working in situations where the consideration of climate change in management needs to be documented
Quick Guide (Short) doi.org/10.2737/NRS-INF-41-22 *Also available in Spanish* Land trusts: doi.org/10.2737/NRS-INF-40-22	A streamlined set of considerations that uses the overarching adaptation process	• Familiar with the adaptation process or have used the comprehensive workbook before • Familiar with projected climate change impacts • Working in situations that do not need detailed documentation
adaptationworkbook.org www.adaptationworkbook.org	A comprehensive set of climate change considerations and detailed step-by-step instructions for using the adaptation process, as well as links to regionally relevant information and resources	• Comfortable working with an online tool • First-time or repeat users of the workbook • Working on relatively small projects, such as a small property or single management unit

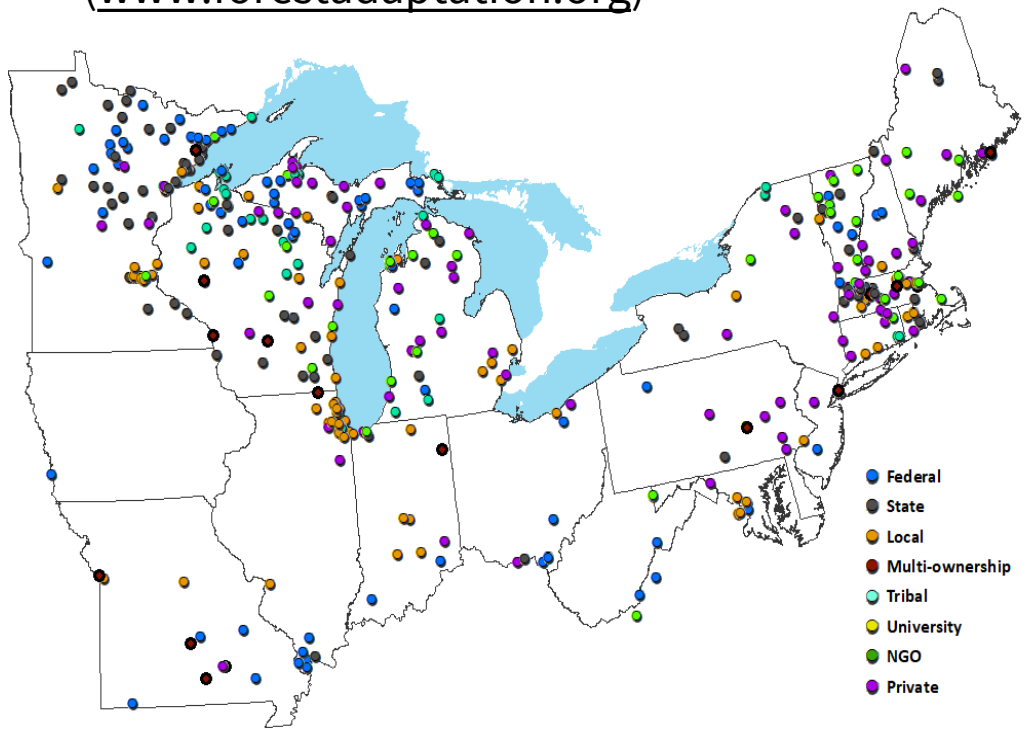




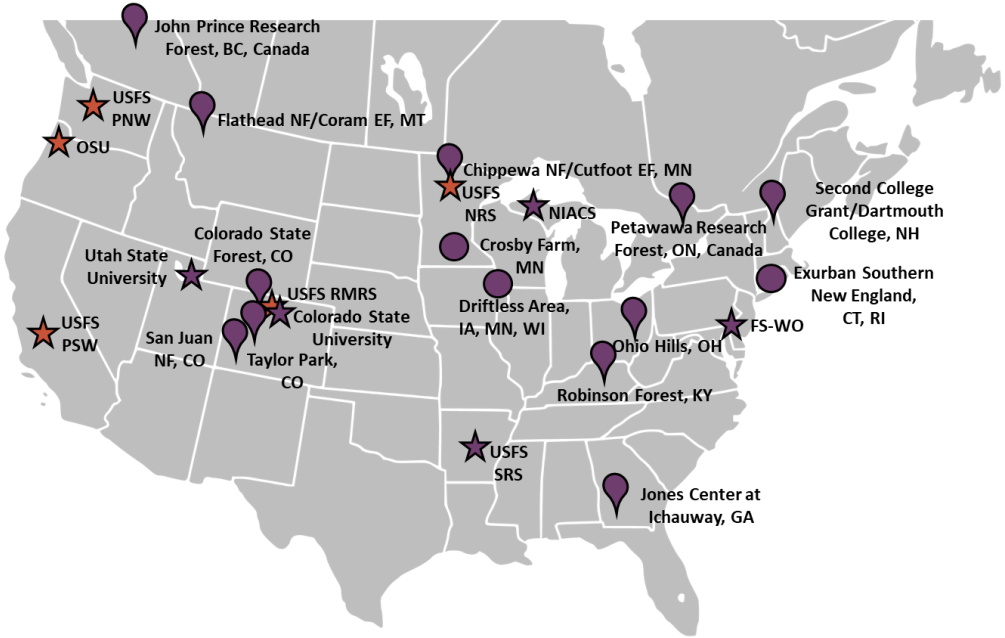
It Works! Adaptation Projects & Installations

Climate vulnerability information and Adaptation Workbook were used to incorporate climate change considerations into planning and decision-making.

Adaptation Demonstrations – 500+ examples of climate-informed management via the Climate Change Response Framework (www.forestadaptation.org)

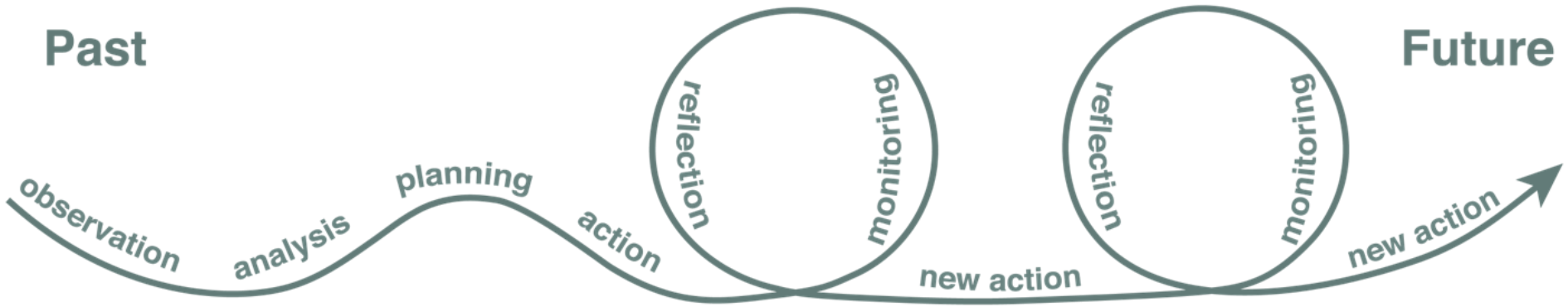


Silvicultural Trials – Experimental trials testing adaptation treatments at 11 core sites via Adaptive Silviculture for Climate Change Network (www.adaptivesilviculture.org)



Final Thoughts

- There is no single answer for how to respond to climate change. Actions will depend upon where you are working and what you are trying to achieve.
- Science and management can inform each other.
  - Top-down: global/regional information “downscaled” to management scales
  - Bottom-up: place-based expertise & need informs action



Thank you!

Climate Hubs
www.climatehubs.oce.usda.gov

Tree Atlas
www.fs.fed.us/nrs/atlas/

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ForestAdaptation.org
AdaptationWorkbook.org