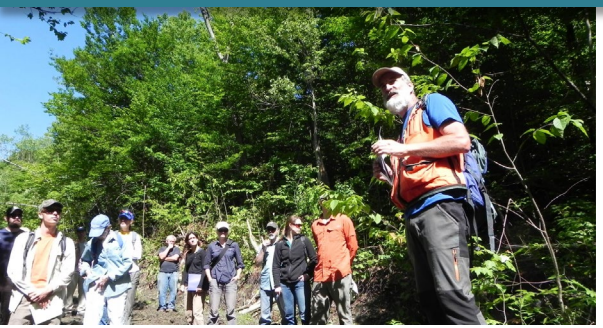
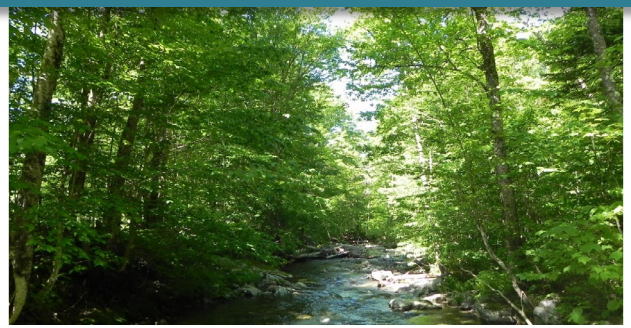
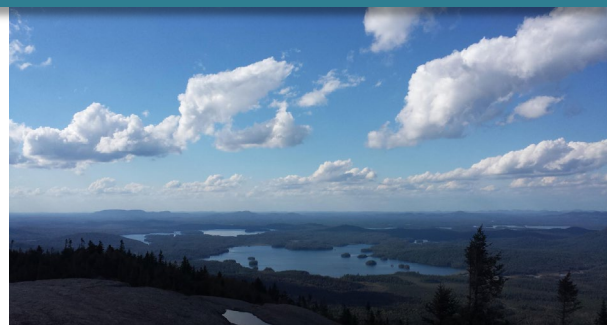
Adaptation Concepts

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2019 Northern Forests Climate Hub Liaison, Northern Institute of Applied Climate Science
www.niacs.org / www.forestadaptation.org

How do we respond to climate change?

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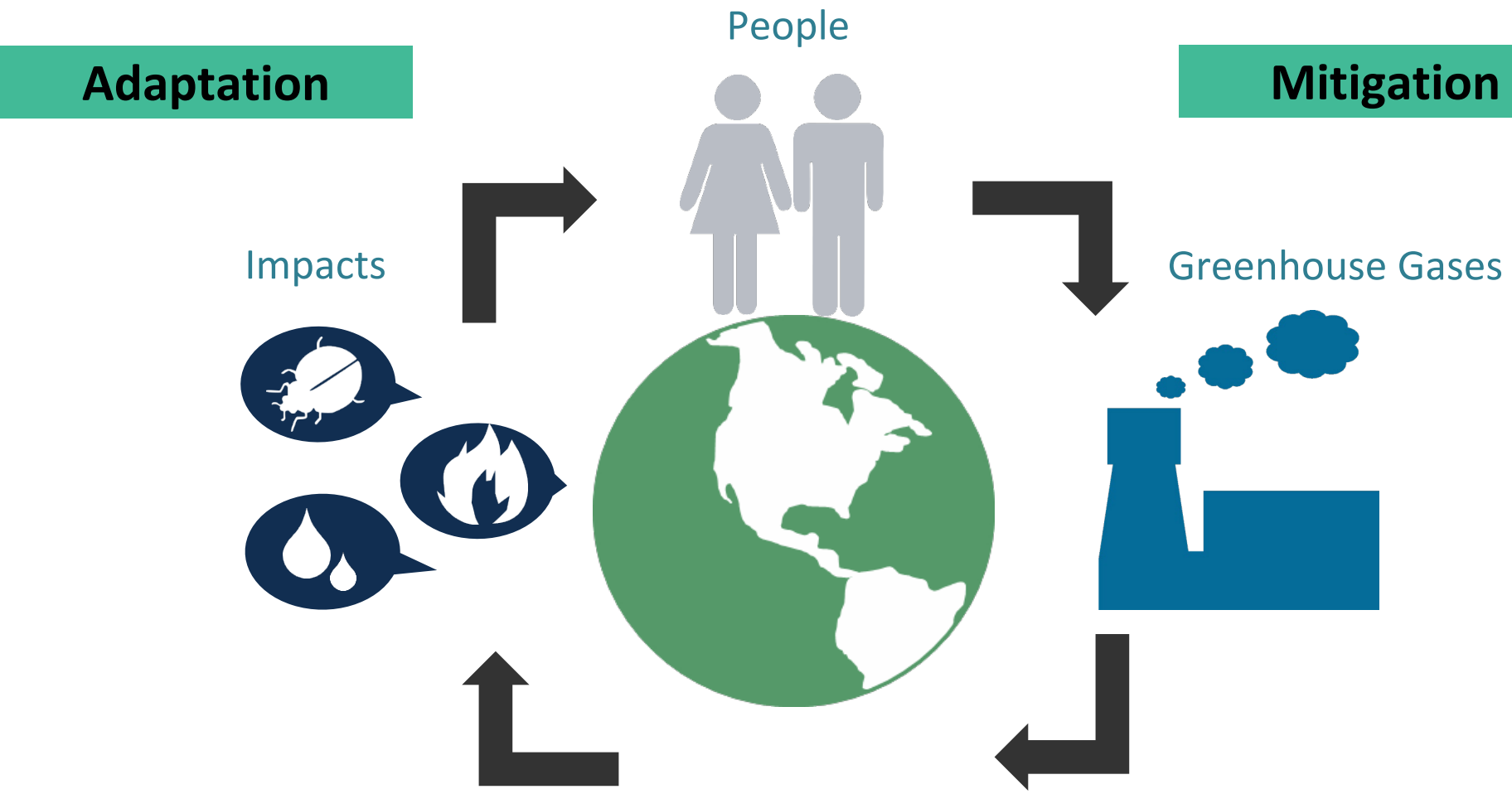

Adaptation is the adjustment of systems in response to climate change.




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
Landowner Objectives
Timber Sale Revenue
Forest Health
Past Management History
Wildlife Habitat
Disturbance: Past + Future
Management Plan Requirements
Climate Change
Deer
And more!!

Helping Managers to Respond

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



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

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“It depends”

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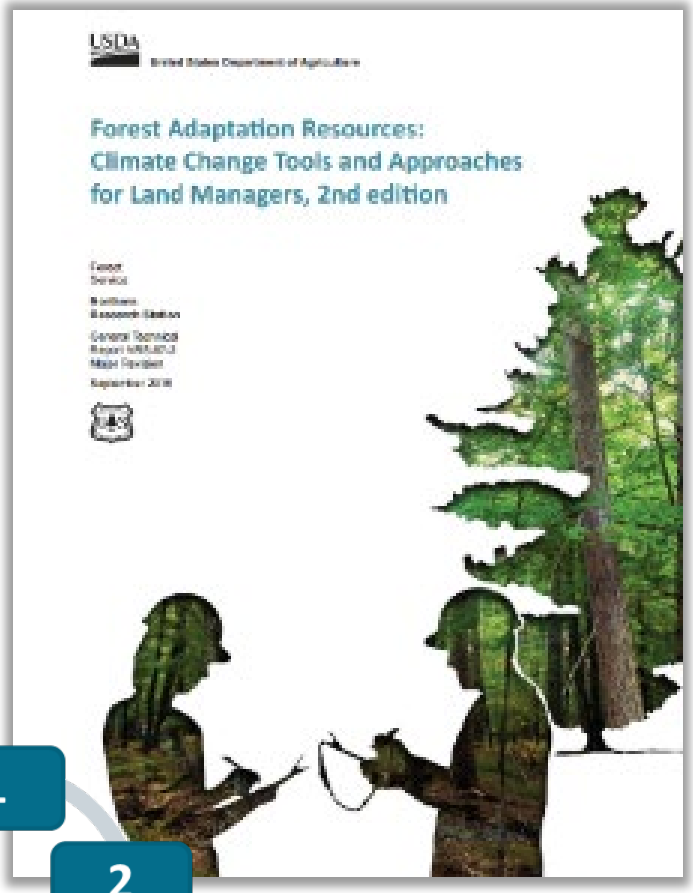
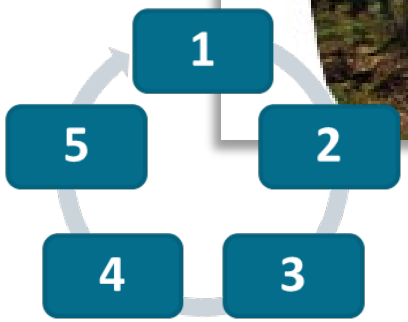
It depends on **where** you are working and **what** you’re trying to achieve.

Forest Adaptation Resources

A flexible workbook and menu to address diverse needs

- Designed for a variety of land owners with diverse goals
- Does not make recommendations
- Includes:
  - Menu of adaptation strategies and approaches for forest management
  - Adaptation Workbook

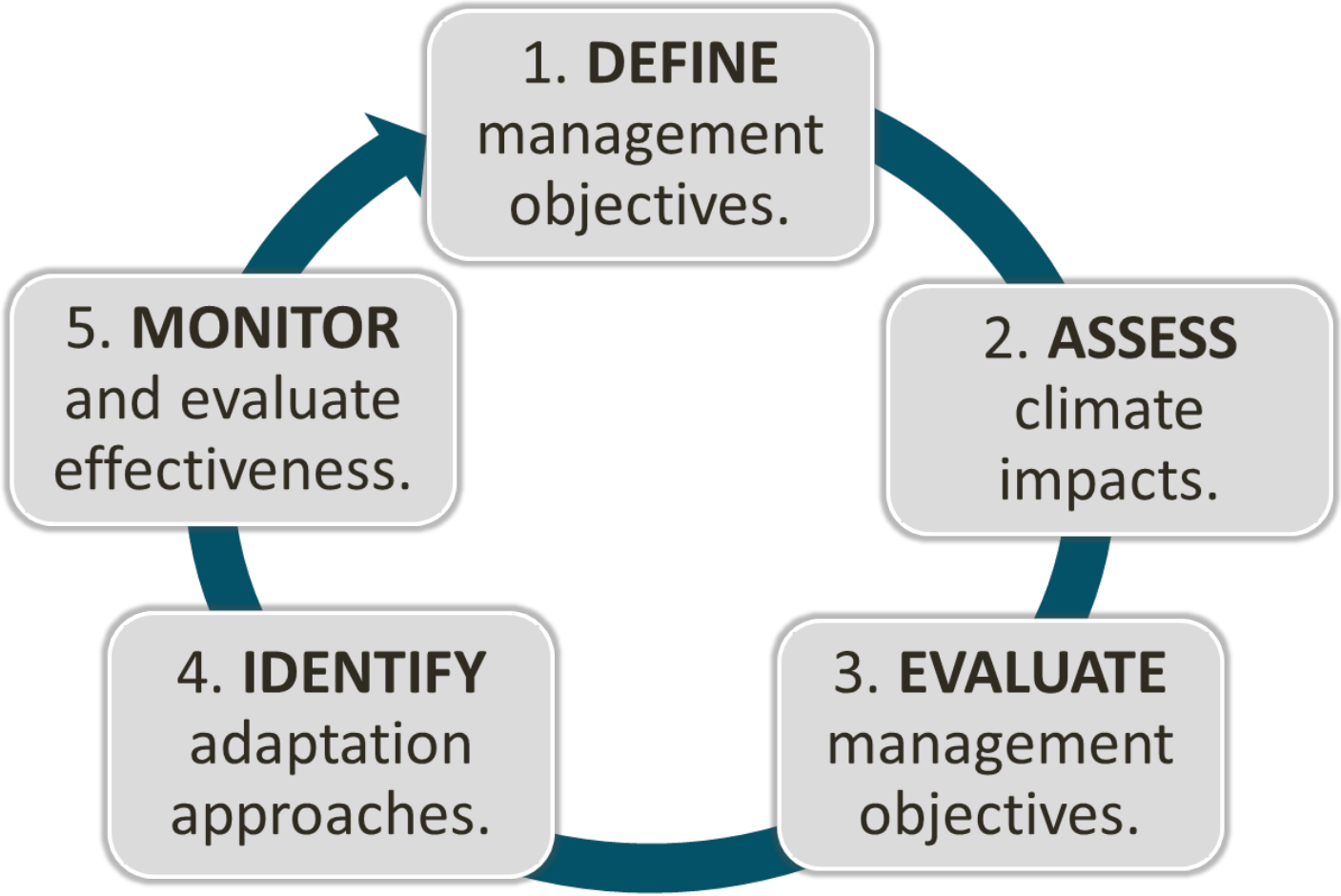




Swanston et al. 2016 (2nd edition); www.treesearch.fs.fed.us/pubs/52760

Adaptation Workbook

A workbook process provides "structured flexibility"



Adaptation “Menus”

Published:

- Forestry
- Urban Forestry
- Agriculture
- Forested Watersheds
- Tribal Perspectives

In Preparation:

- Wetlands
- Wildlife Management
- Coastal Ecosystems
- Forest Carbon Management
- Recreation

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		Sauces	
Rigatoni Semolina, All-Purpose Flour, Olive Oil	14	**Marinara** San Marzano tomatoes, Garlic, White Wine, Basil, Chili	
Cavatelli All-Purpose Flour, Durum Flour, Eggs, Ricotta	15	**Arrabiata** All-Purpose Flour, Durum Flour, Eggs, Ricotta	+1
Tagliatelle All-Purpose Flour, Durum Flour, Eggs	15	**Broken Meatball** House Tomato Sauce with the Addition of Broken Meatballs	+4
Gluten-Free Rigatoni Gluten-Free All-Purpose Flour, Olive Oil, Eggs	16	**Sunday Sauce** House Tomato Sauce with Short Rib, Sausage, Veal	+4
Spaghetti Semolina, Durum Flour, Olive Oil	15	**Roasted Garlic Pecorino** Semolina, Durum Flour, Olive Oil	+2
Four Cheese Herb Ravioli Fontal, Ricotta, Parmesan, Pecorino	18	**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

www.forestadaptation.org/strategies

Options

Resist Change

Enhance Resilience

Promote a Transition

Strategies

1: Sustain fundamental ecological functions.

2: Reduce existing biological stressors.

3: Reduce impacts of severe disturbances.

4: Maintain or create refugia.

5: Enhance species and structural diversity.

6: Promote ecosystem redundancy.

7: Increase landscape connectivity.

8: Enhance genetic diversity.

9: Facilitate species transitions.

10: Realign after disturbance.

www.forestadaptation.org/strategies

Getting from Goals to Action

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

Adaptation Options (Millar et al. 2007)

Manage for Persistence:
Ecosystems are still the same

Manage for Change:
Ecosystems have fundamentally changed

Adaptation Options

RESISTANCE

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

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

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

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

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

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

Adaptation Actions

Sustain fundamental ecological functions

Adaptation Actions

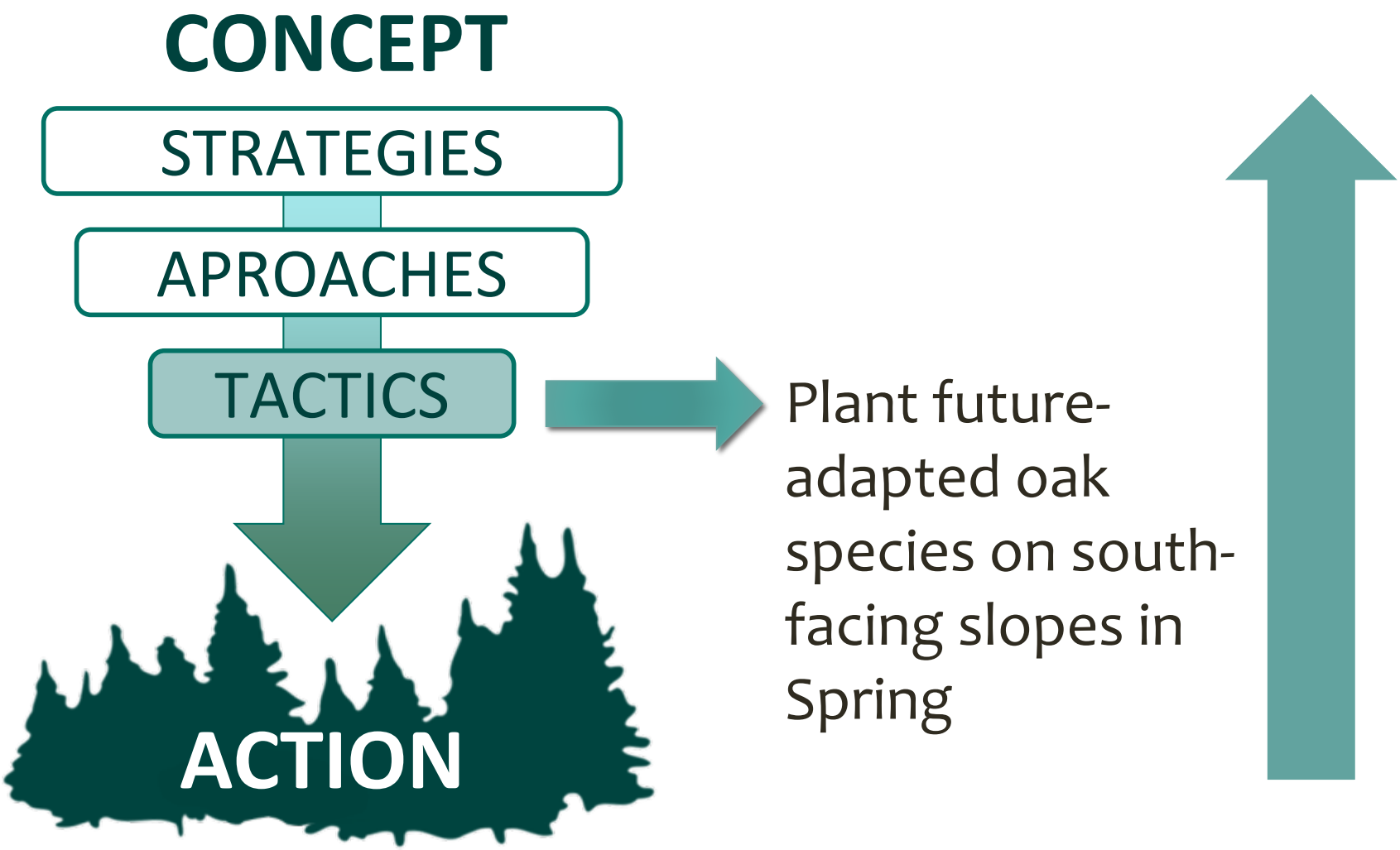
Maintain or restore soil quality and nutrient cycling

Adaptation Actions

Delay operations to coincide with frozen ground to minimize disturbance

Will also evaluate benefits, drawbacks, practicability and time frame associated with tactic

Adaptation Actions



Adaptation Actions

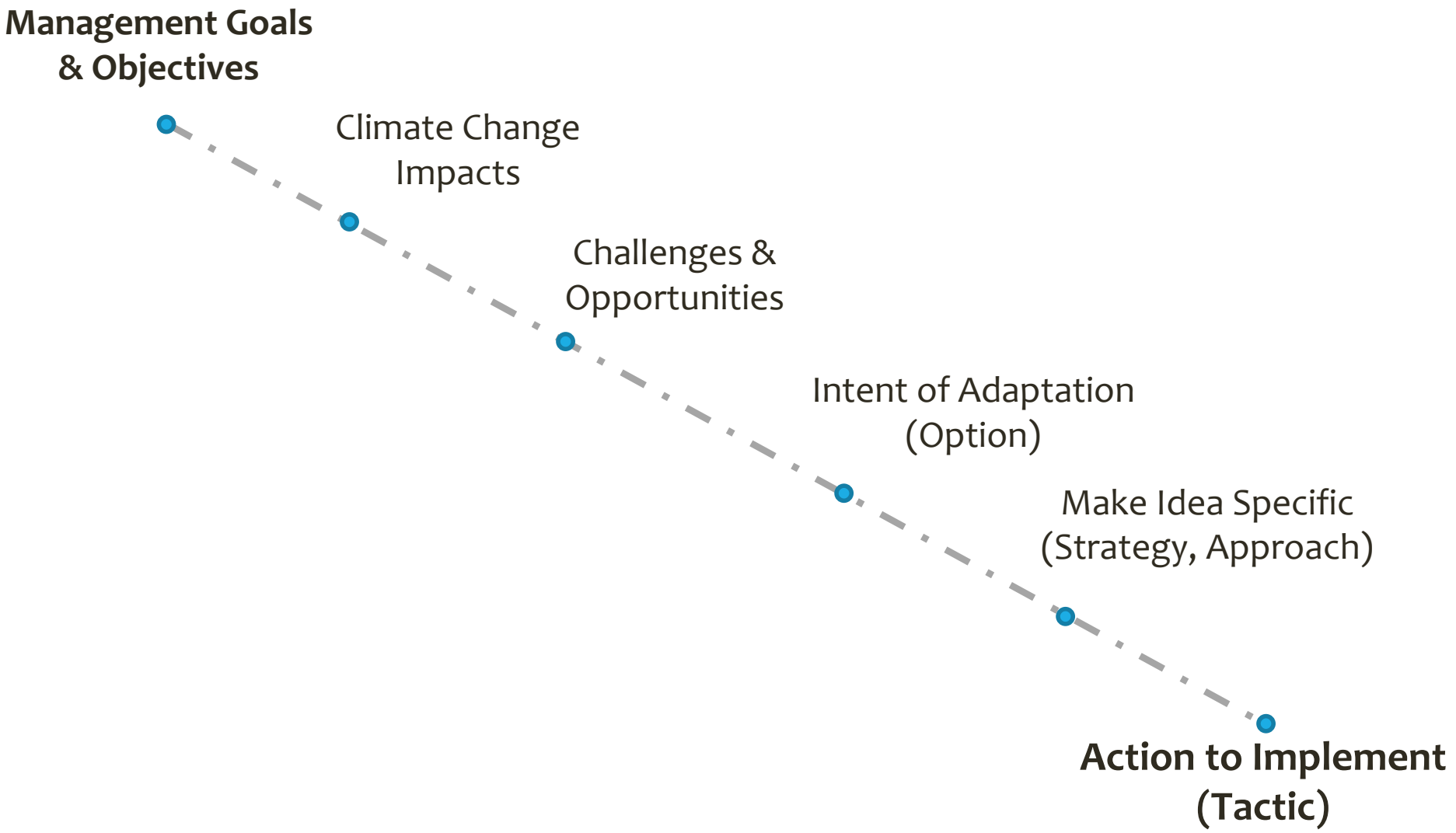
Emphasize drought- and heat-tolerant species & populations

Adaptation Actions

Option: Transition
(facilitate change)

Facilitate community adjustments through species transitions

Menu + Workbook

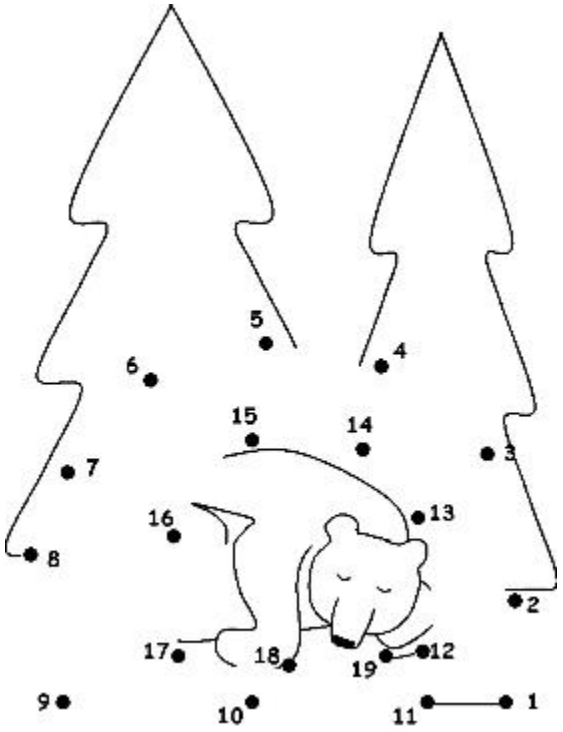


Actions for Adaptation

*…are **intentional***

Connect the dots!

- What are your management goals and objectives?
- How might your ecosystem be uniquely affected by climate change?
- How are your goals challenged? Are they still feasible?
- What specific actions can you take to address specific impacts?



Actions for Adaptation

*…are **intentional***

…but not always different

"Climate-informed" decisions still reflect

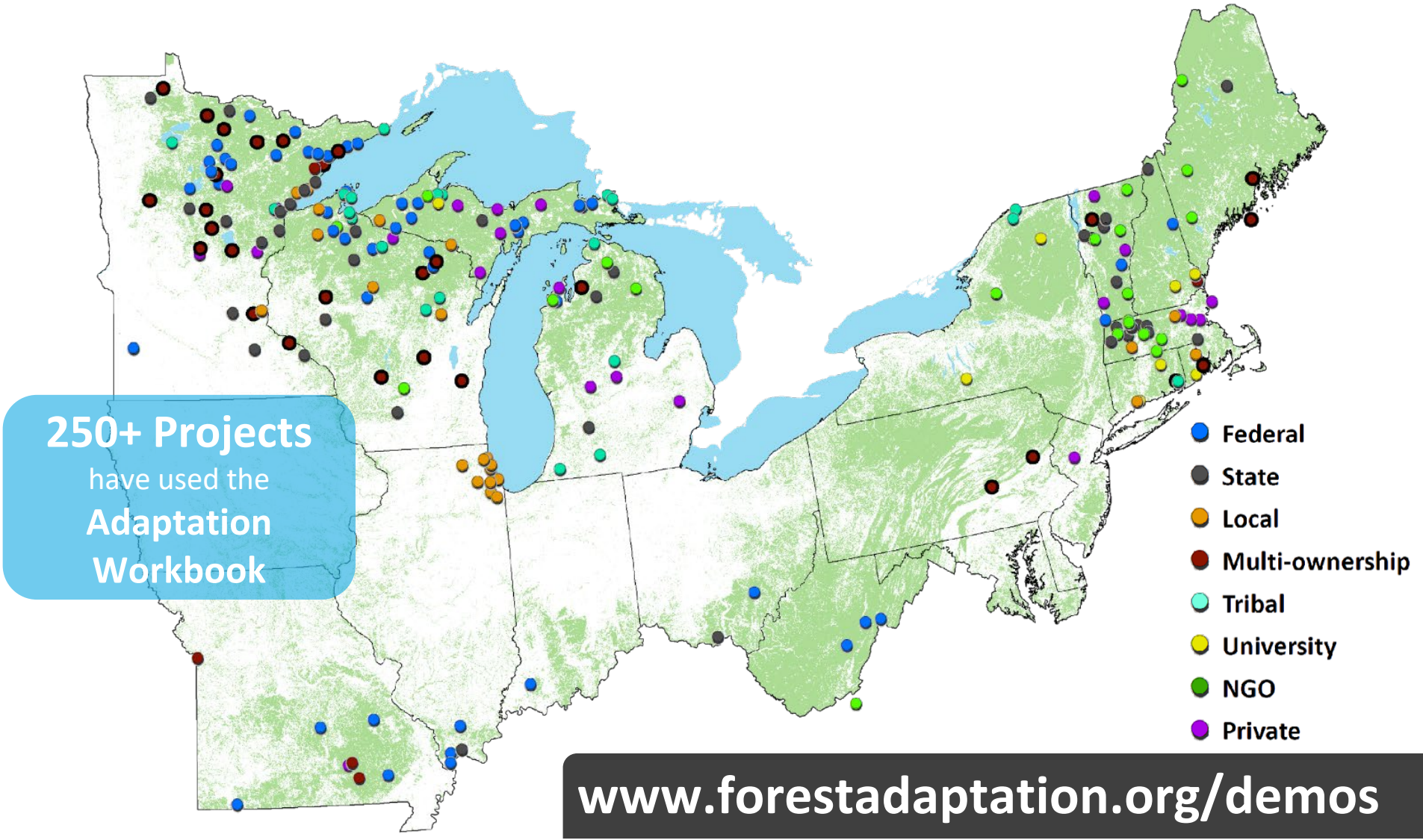
- Restrictive mandates, plans, laws, etc.
- Public perception
- Costs
- Values
- Other barriers to change

Re-cap

- Best management principles, but applied in the context of climate change
- Hierarchy helps organize and justify adaptation actions
- Menu allows user to pick and choose actions that are relevant to their situation
- Managers design tactics to suit particular needs

Adaptation Demonstrations

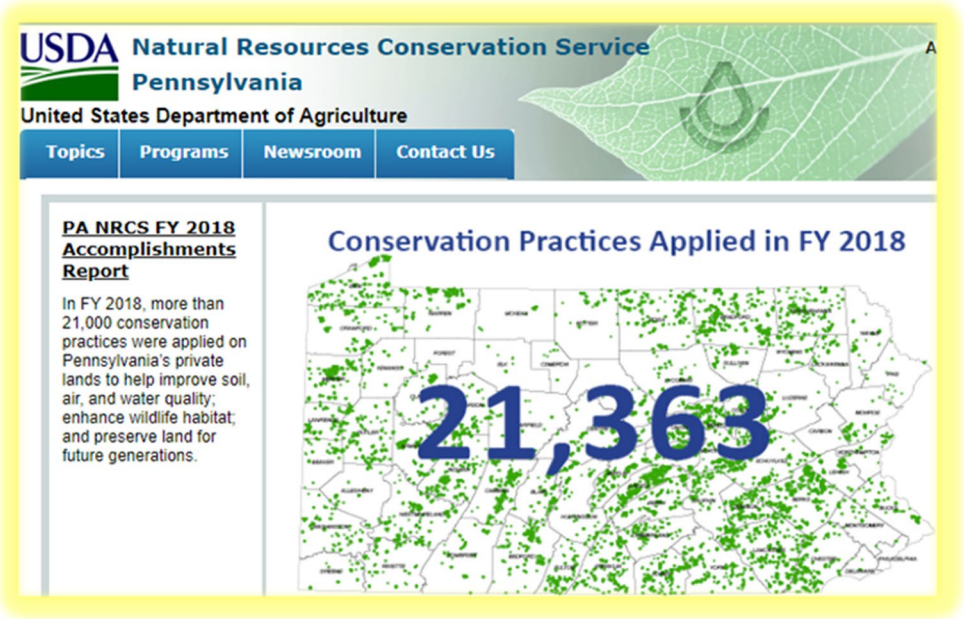
Real-world examples of climate-informed management



www.forestadaptation.org/demos

NRCS

Technical and Financial Assistance



- Conservation Stewardship Program (CSP)
- Environmental Quality Incentives Program (EQIP)

https://www.nrcs.usda.gov/wps/portal/nrcs/main/pa/programs/financial/

Conservation + Adaptation

EXAMPLES:

OBJECTIVE: Improve degraded plant communities

ADAPTATION STRATEGIES: Sustain fundamental ecological functions, Maintain and enhance species and structural diversity.

NRCS CONSERVATION PRACTICE: Forest Stand Improvement

OBJECTIVE: Increase Native Plants

ADAPTATION STRATEGIES: Maintain and enhance genetic diversity, Facilitate community adjustments through species transitions.

NRCS CONSERVATION PRACTICE: Tree/Shrub Establishment

Conservation + Adaptation

EXAMPLES (cont.):

OBJECTIVE: Mimic natural disturbances

ADAPTATION STRATEGIES: Sustain fundamental ecological functions, Reduce the risk and long-term impacts of severe disturbances.

NRCS CONSERVATION PRACTICE: Prescribed Burning

OBJECTIVE: Reduce Invasive Species

ADAPTATION STRATEGIES: Sustain fundamental ecological functions, Reduce the impact of biological stressors

NRCS CONSERVATION PRACTICE: Brush Management

Management GOALS

- Enhance wildlife habitat
- Maintain wetland function
- Minimize invasive species

Stand 1: Dry to Dry-Mesic Mixed Forest

- Increased pests, diseases, drought stress
- Deer herbivory
- Decreased snowpack and boreal species

Stand 2: Northern Hardwoods Swamp (black ash)

- Increased susceptibility to flooding, soil erosion, oxidation
- Loss of wetland habitat and function

Adaption APPROACHES

2017: **$ EQIP: Forest Stand Improvement**

- Reduce competition for moisture, nutrients, and light.
- Maintain or improve the ability of forests to resist pests and pathogens.

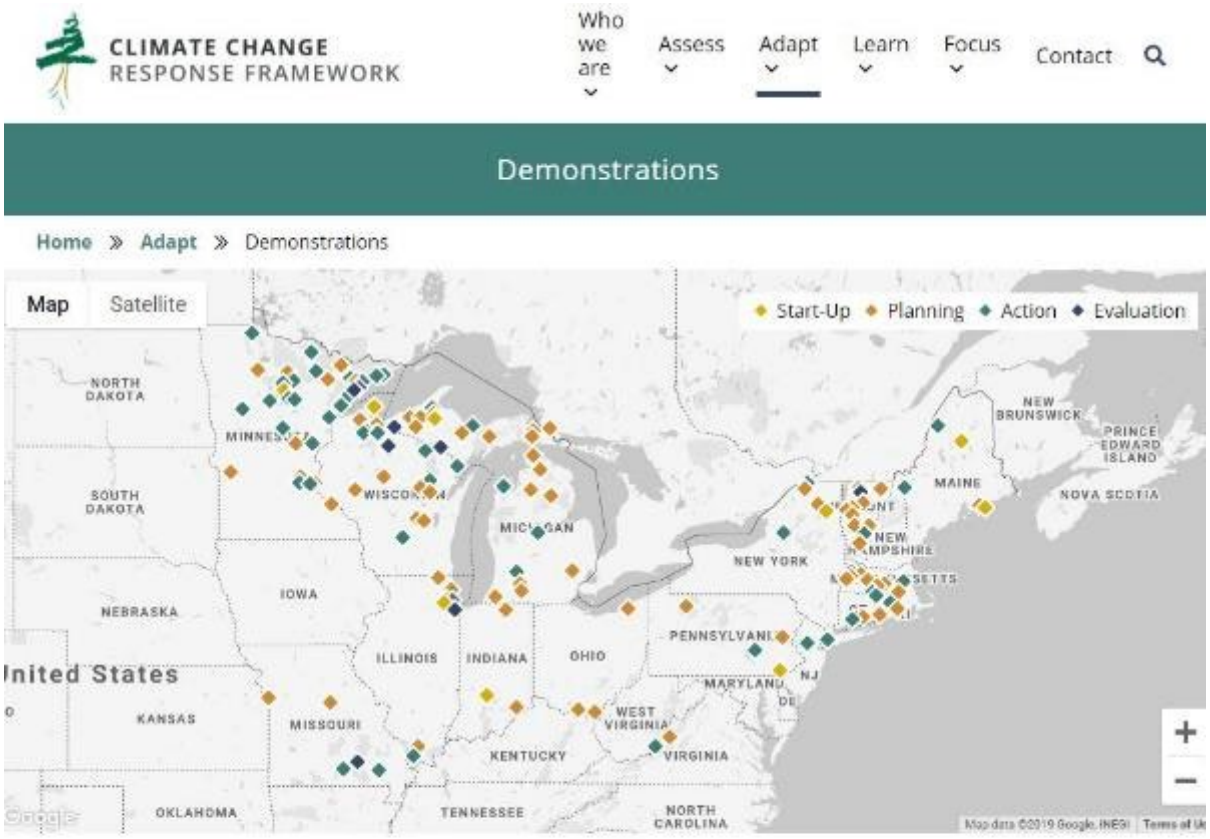
2018-2019 **$ EQIP: Brush Management**

- Prevent the introduction and establishment of invasive plant species and remove existing invasive species.

2020 **$ EQIP: Tree/Shrub Establishment**

- Manage herbivory to promote regeneration of desired species.
- Protect future-adapted seedlings and saplings.
- Introduce species that are expected to be adapted to future conditions.

Questions?



Adaptation demonstration projects are real-world examples of how managers have integrated climate considerations into land management planning and activities.

https://forestadaptation.org/node/716

Additional Resources

- Tree Species Handouts: www.forestadaptation.org/pa
- Climate Change Resource Center: Climate Data https://www.fs.usda.gov/ccrc/library/climate-data
- Seedlot Selection Tool https://seedlotselectiontool.org/sst/
- *Assessing Potential Climate Change Pressures across the Conterminous United States: Mapping Plant Hardiness Zones, Heat Zones, Growing Degree Days, and Cumulative Drought Severity throughout this Century https://www.fs.usda.gov/treesearch/pubs/55870.
- The Office of Sustainability and Climate (OSC)
  - Drought Gallery https://usfs.maps.arcgis.com/apps/PublicGallery/index.html?appid=a2a9bef1ca3249e0b4f6c6c4354bc69d
  - Climate Gallery https://usfs.maps.arcgis.com/apps/PublicGallery/index.html?appid=a36acbdfdf1a41c28cba918758872504