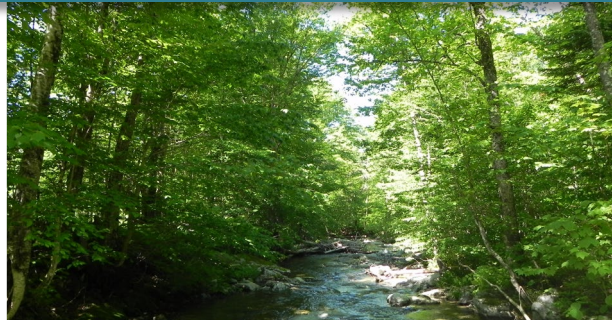


Adaptation Concepts



Patricia Leopold pleopold@mtu.edu

Northern Institute of Applied Climate Science

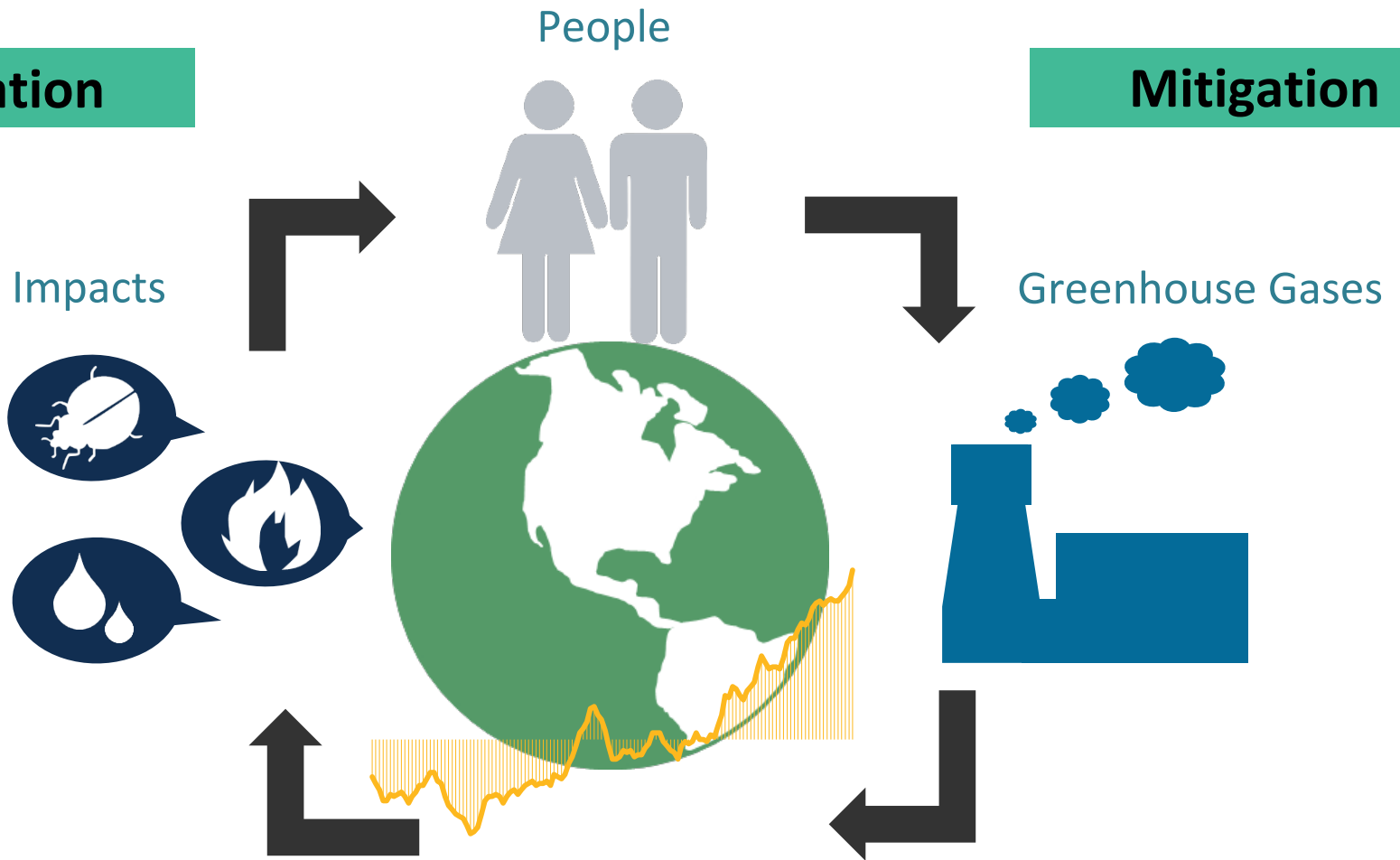
www.niacs.org / www.forestadaptation.org

How do we respond to climate change?

How do we respond to climate change?

Adaptation

Mitigation



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**

And more!!

Deer



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

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

“It depends”

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

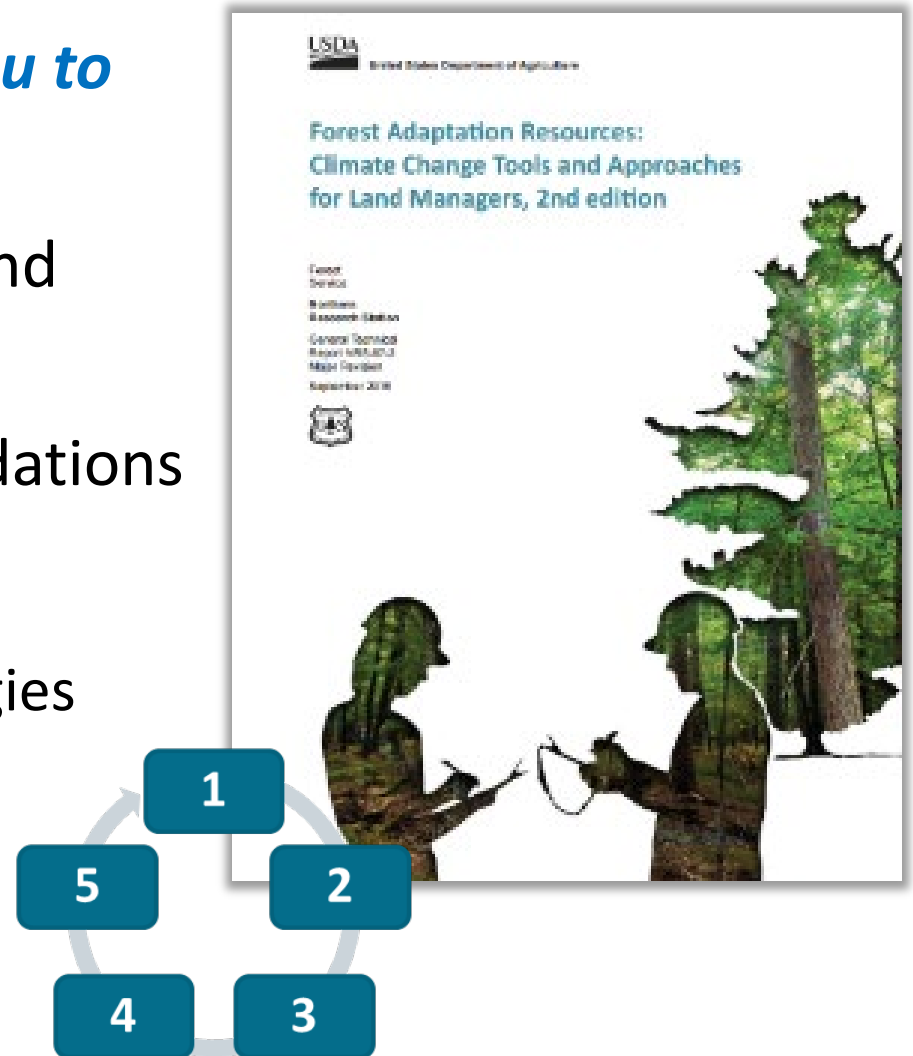
“It depends”

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

Forest Adaptation Resources

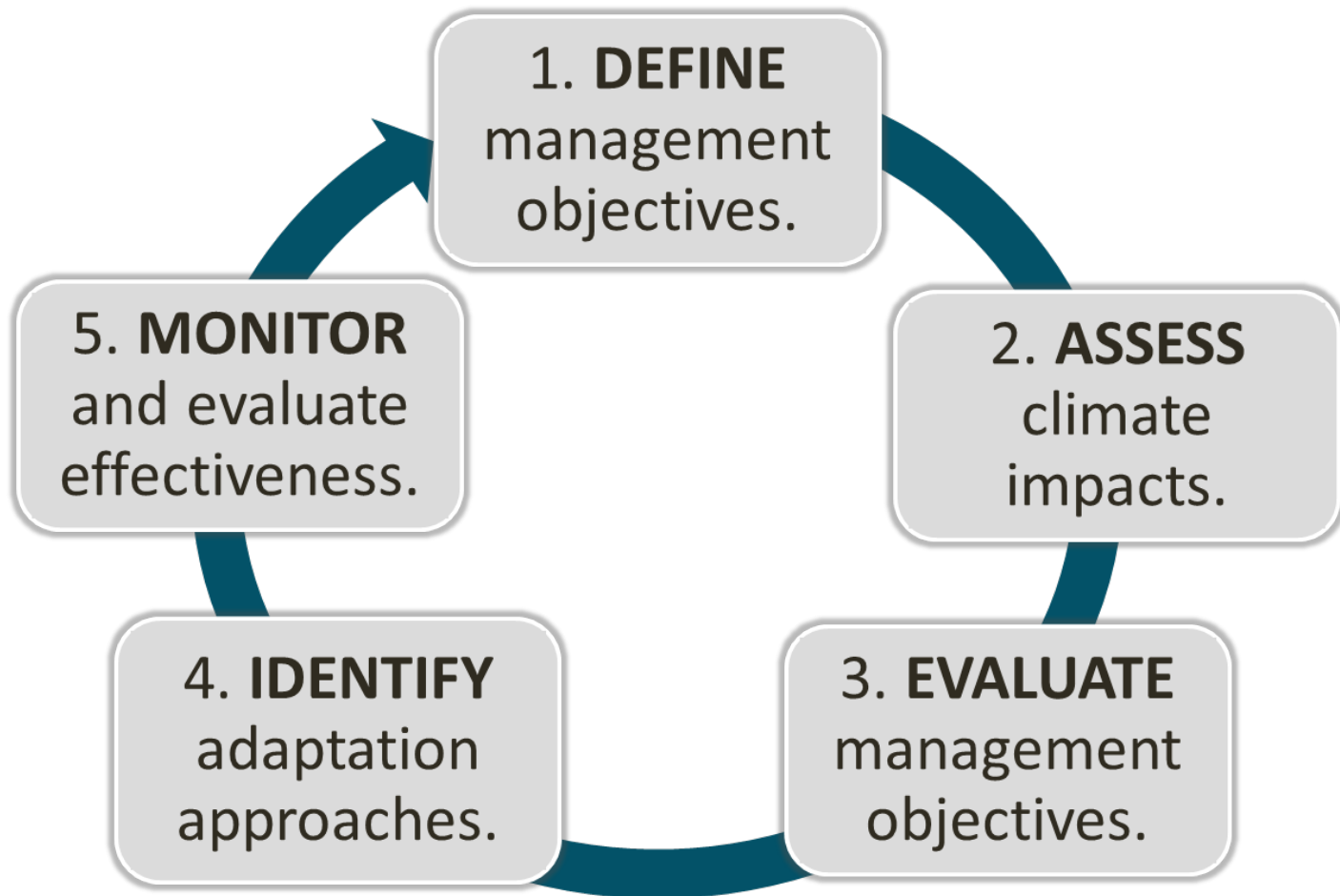
A flexible workbook and menu to address diverse needs

- 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



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

<i>Shapes</i>		<i>Sauces</i>	
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

Options

**Resist
Change**

**Enhance
Resilience**

**Promote a
Transition**

Strategies

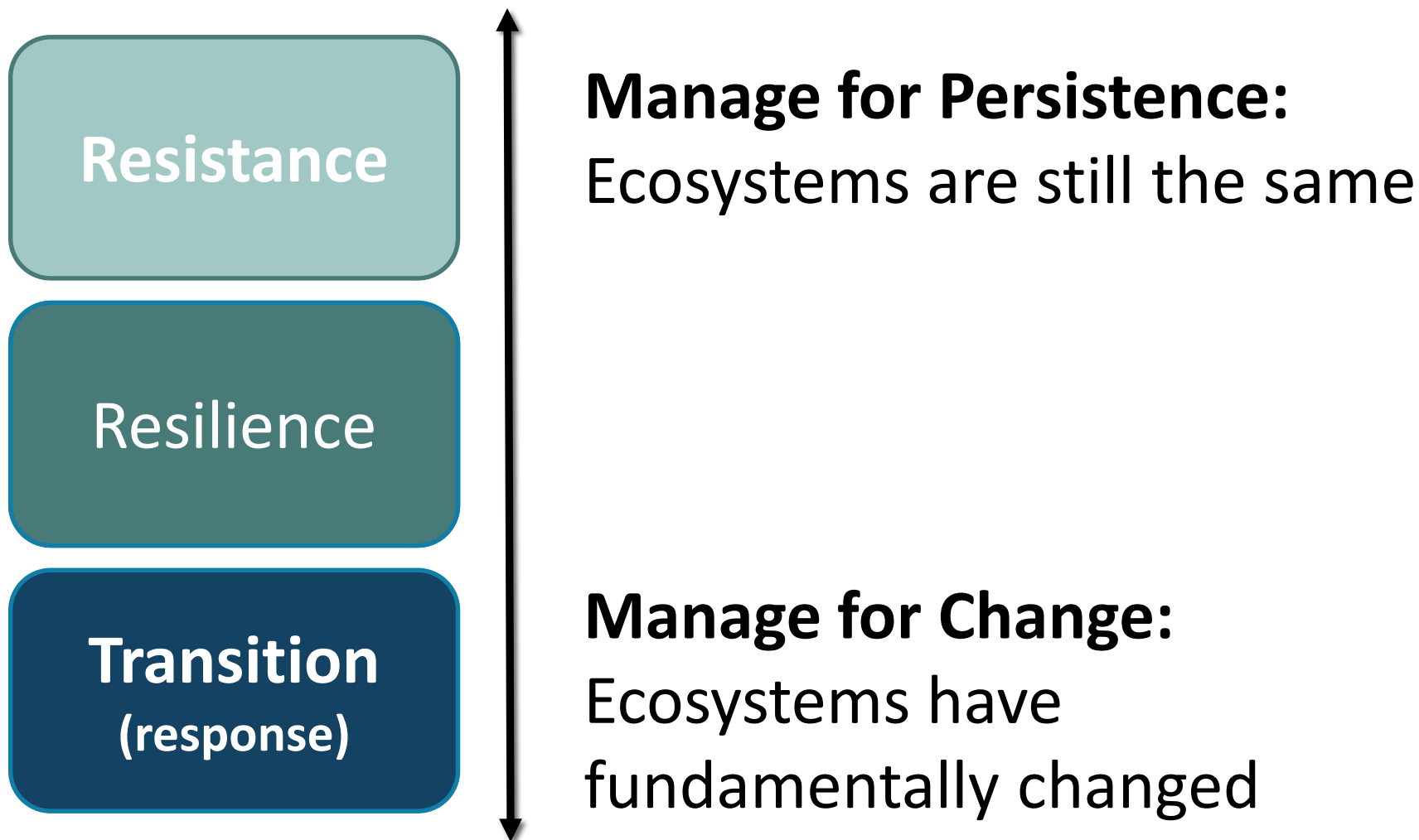
-
- 1: Sustain fundamental ecological functions.
 - 2: Reduce existing biological stressors.
 - 3: Reduce impacts of severe disturbances.
 - 4: Maintain or create refugia.
 - 5: Enhance species and structural diversity.
 - 6: Promote ecosystem redundancy.
 - 7: Increase landscape connectivity.
 - 8: Enhance genetic diversity.
 - 9: Facilitate species transitions.
 - 10: Realign after disturbance.

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)



Adaptation Options

RESISTANCE



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

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

Adaptation Options

RESISTANCE



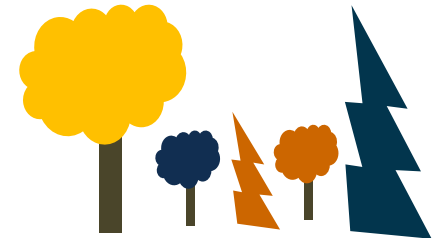
- Improve defenses of forest against change and disturbance
- Maintain relatively unchanged conditions

RESILIENCE



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

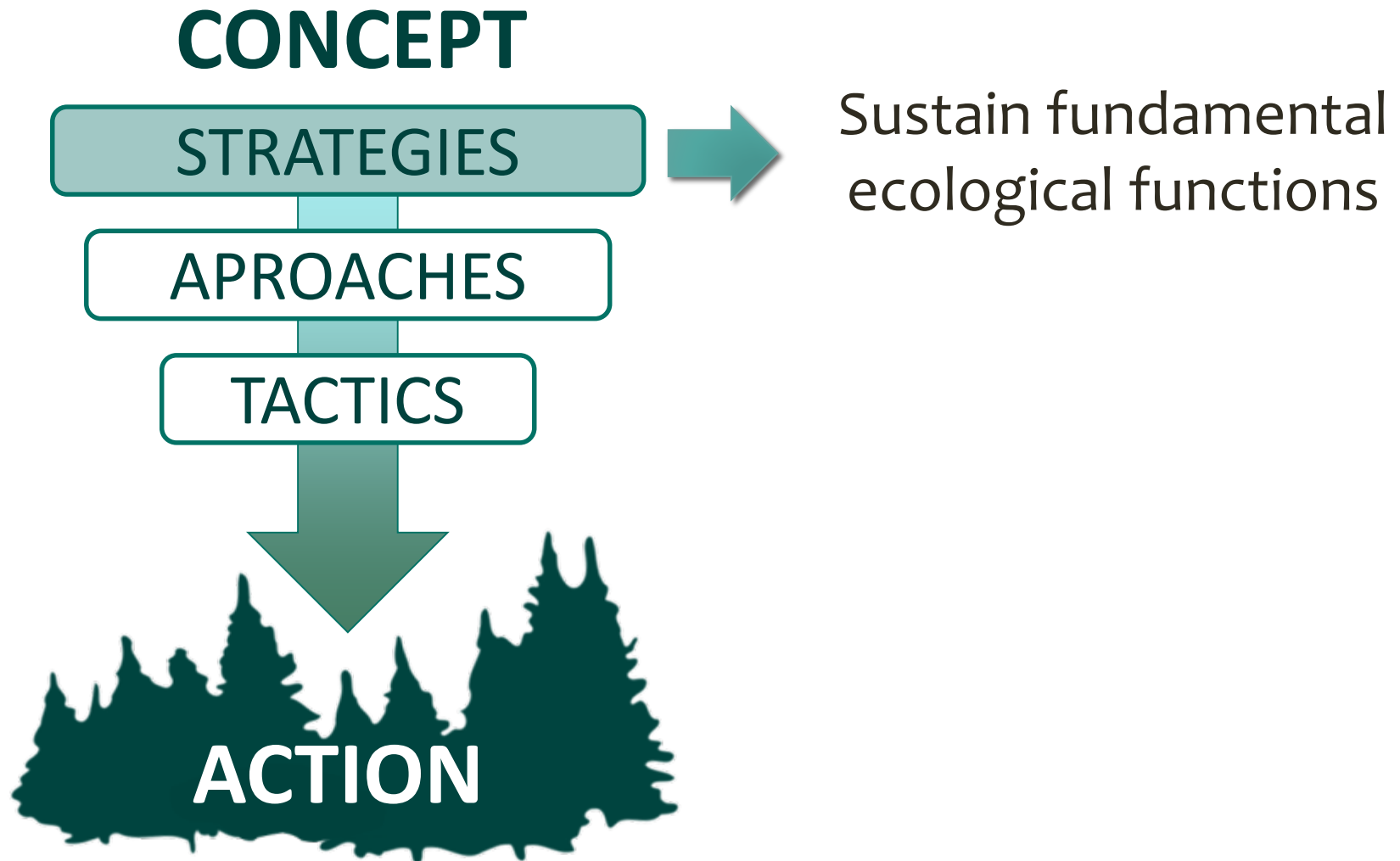
TRANSITION



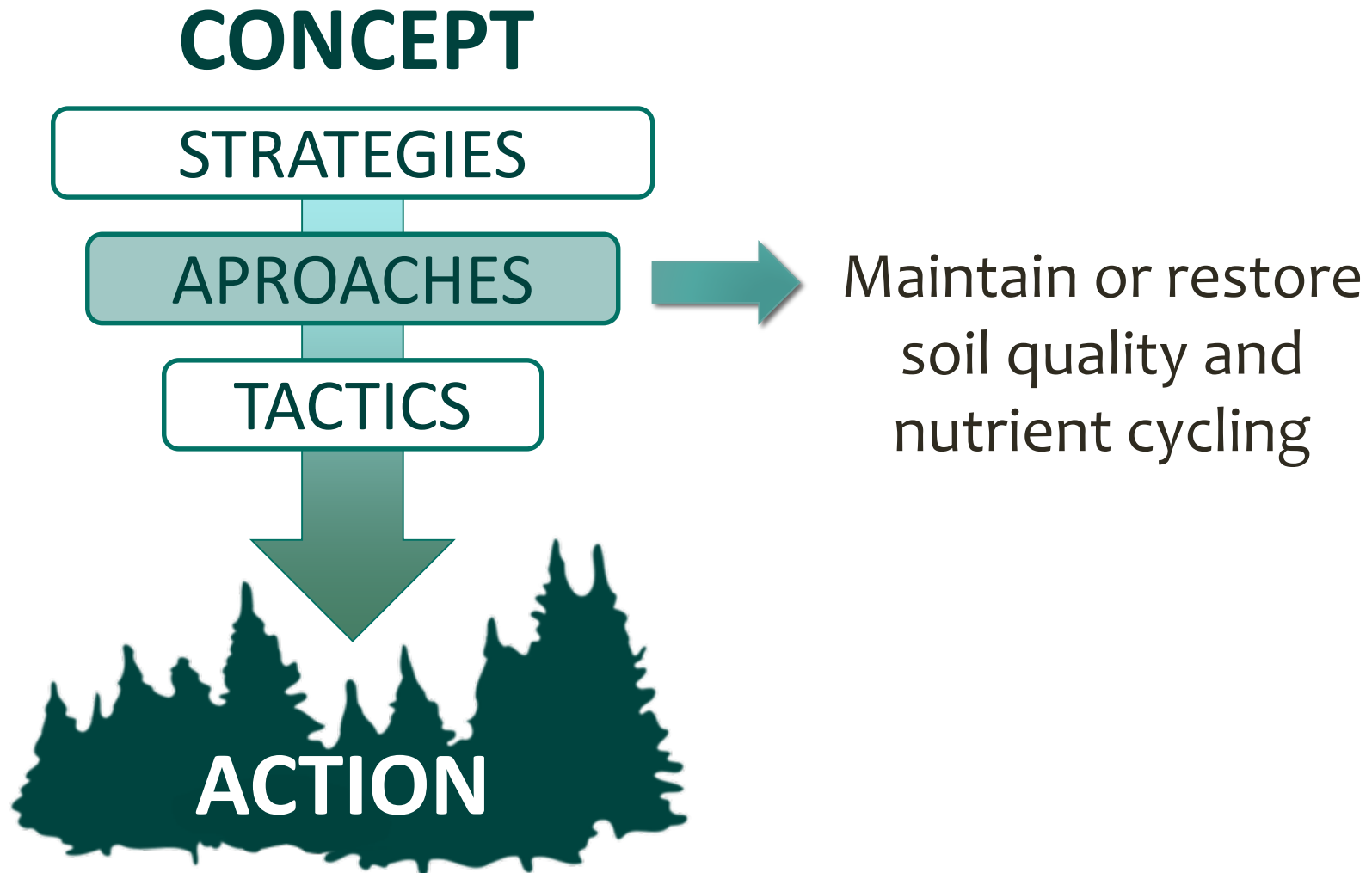
- Intentionally facilitate change
- Enable ecosystem to respond to changing and new conditions



Adaptation Actions



Adaptation Actions



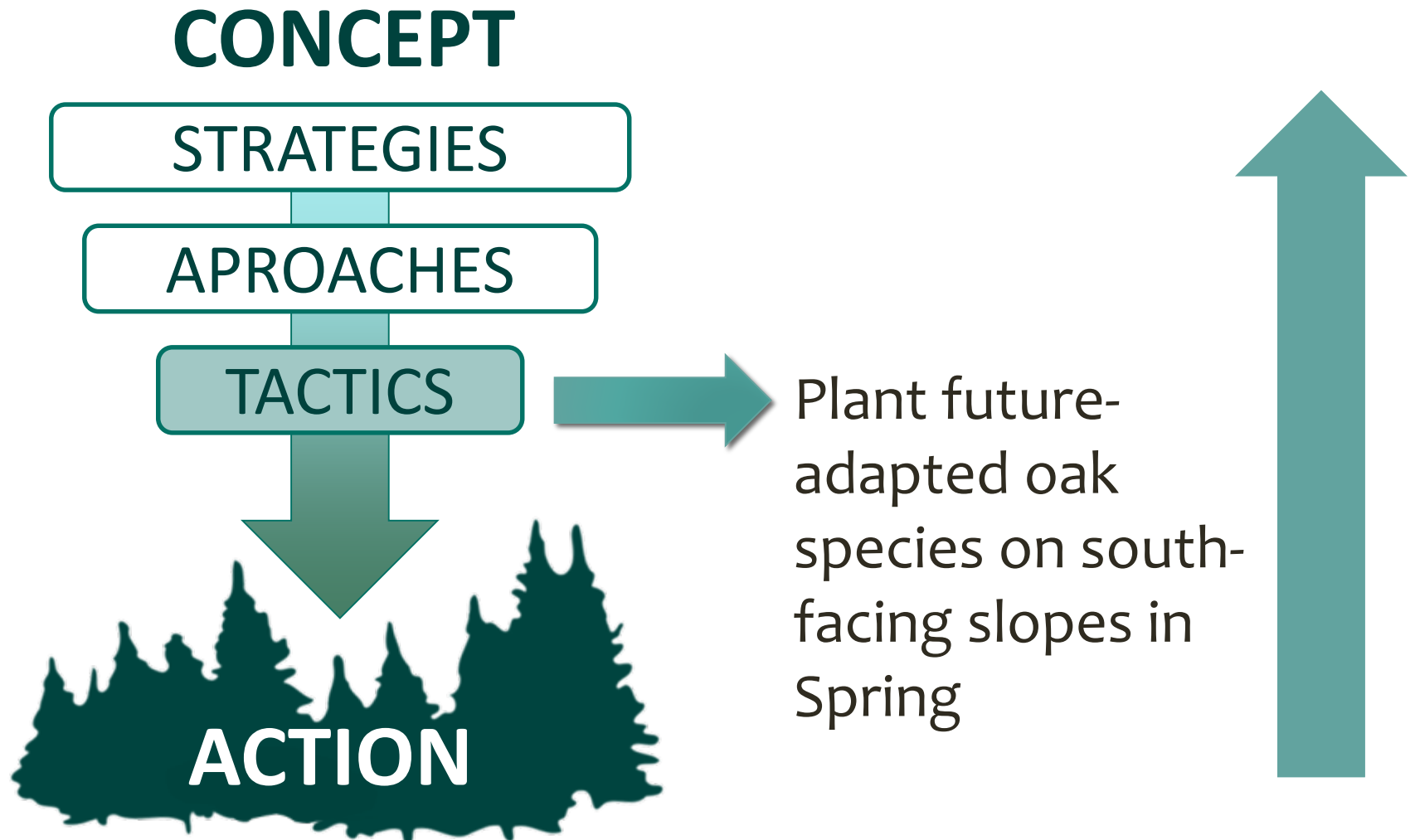
Adaptation Actions



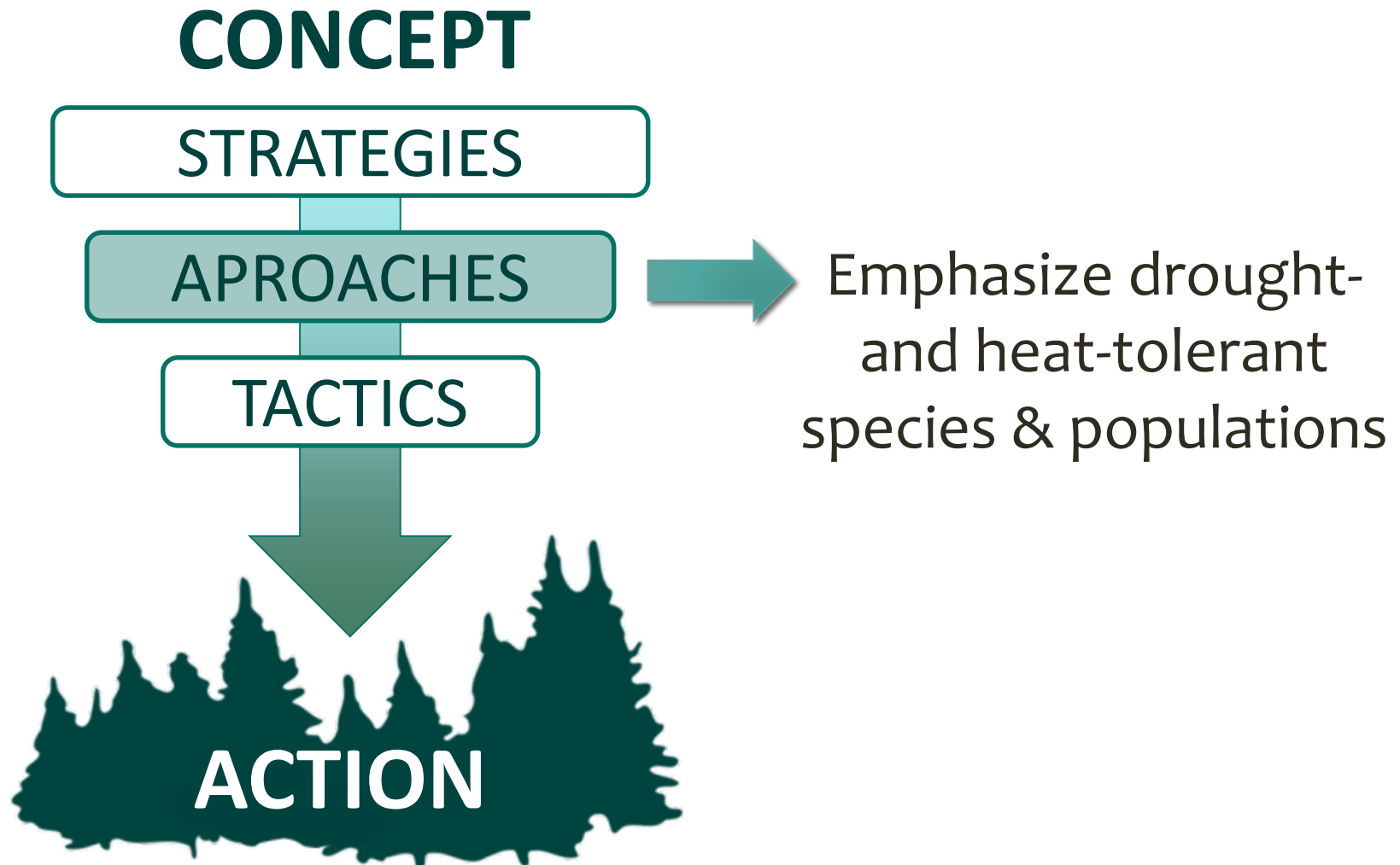
Delay operations to coincide with frozen ground to minimize disturbance

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

Adaptation Actions



Adaptation Actions



Adaptation Actions



Option: Transition
(facilitate change)

Facilitate community
adjustments through
species transitions

Menu + Workbook

**Management Goals
& Objectives**

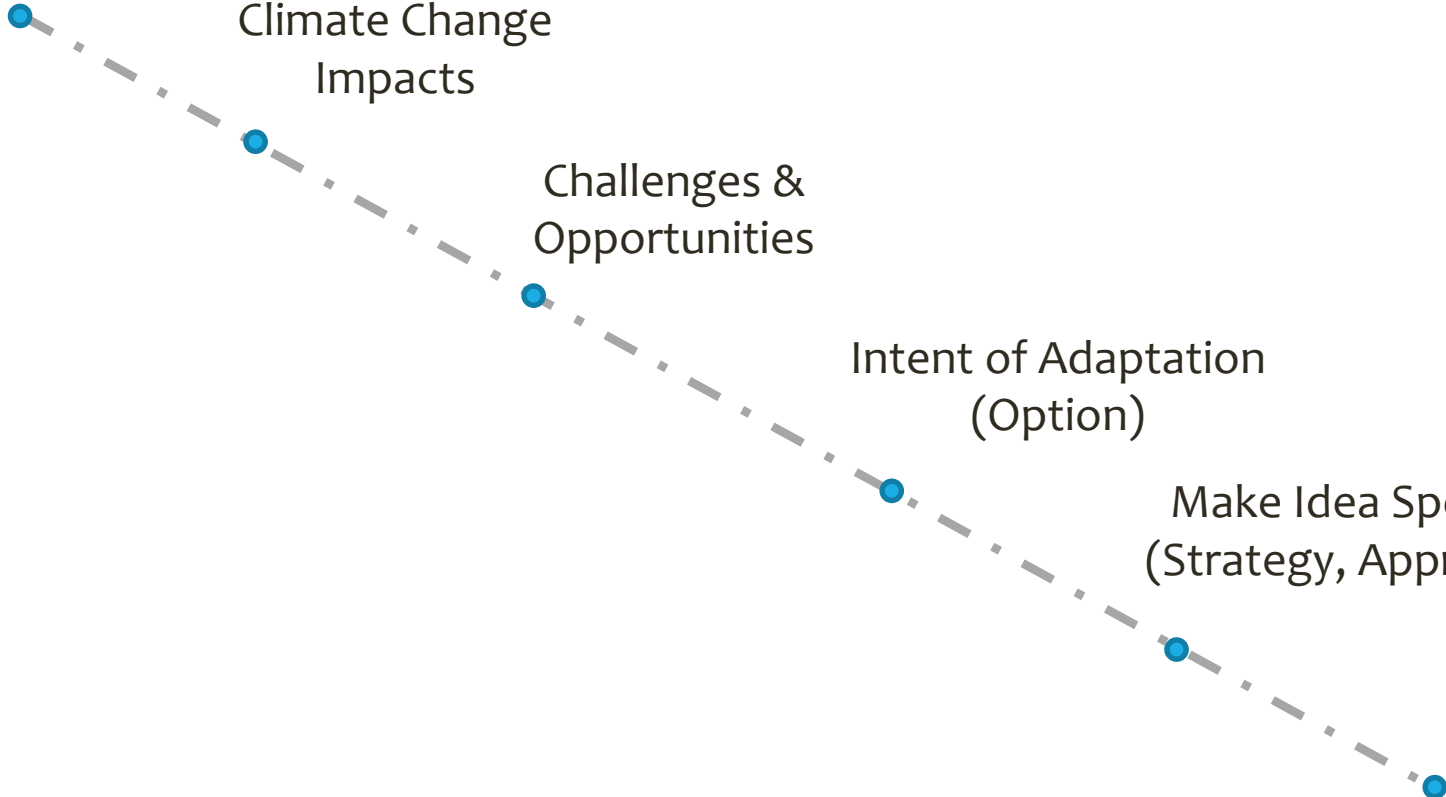
Climate Change
Impacts

Challenges &
Opportunities

Intent of Adaptation
(Option)

Make Idea Specific
(Strategy, Approach)

**Action to Implement
(Tactic)**

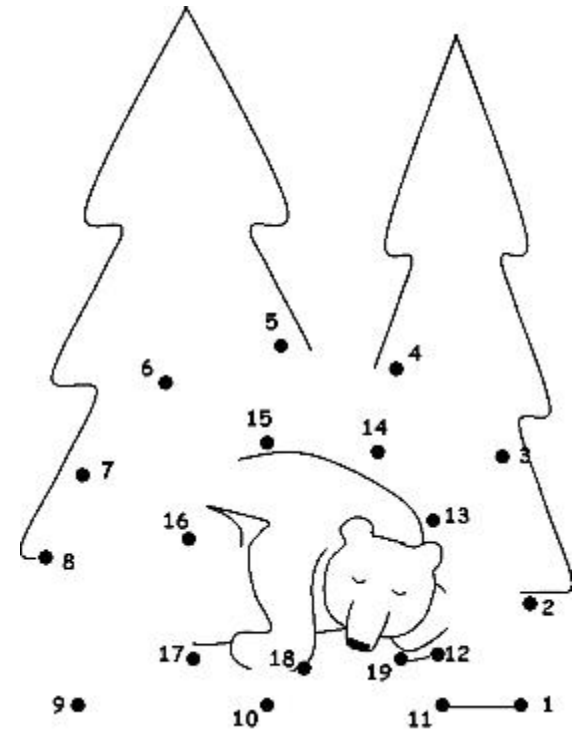


Actions for Adaptation

...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

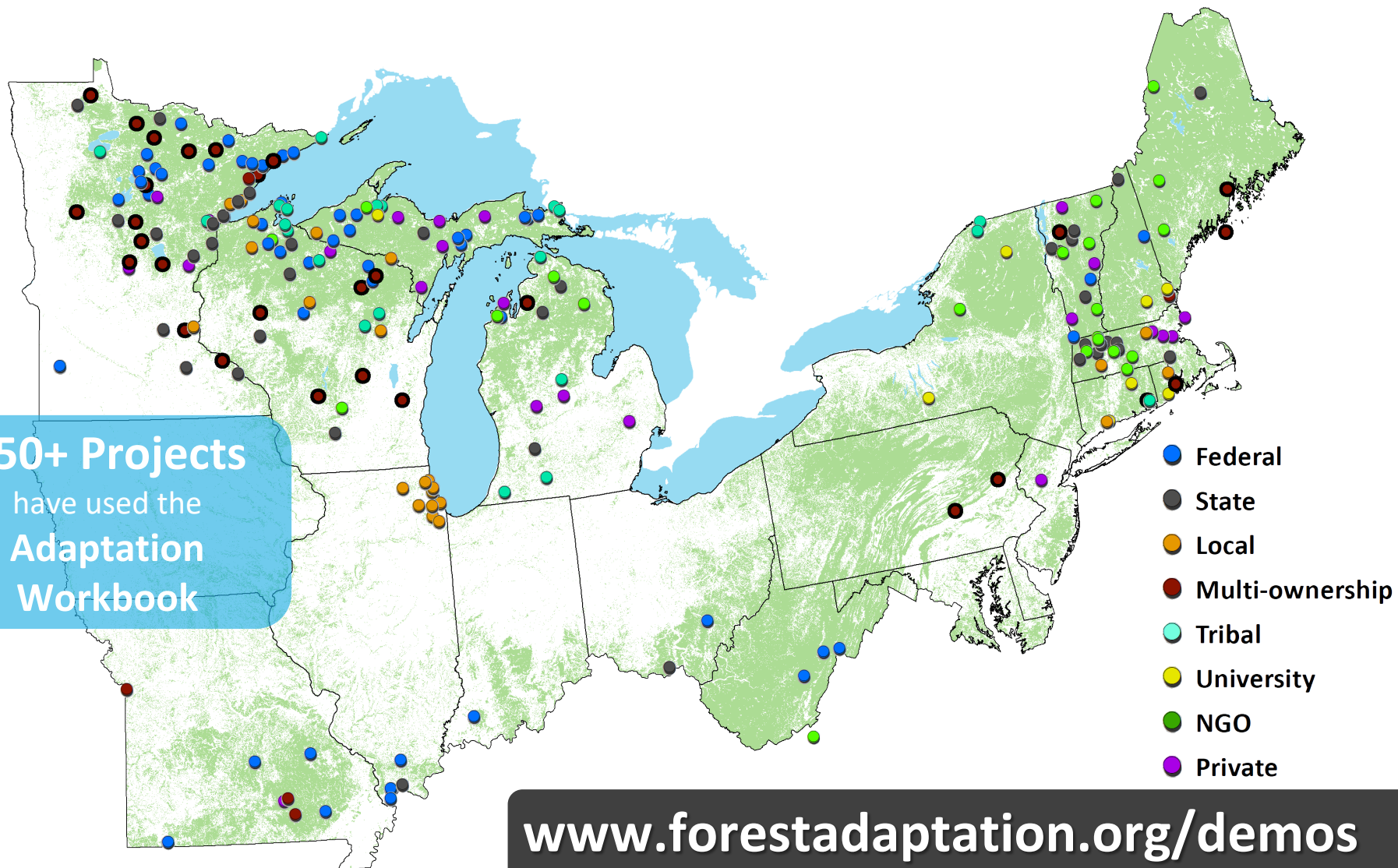


Re-cap

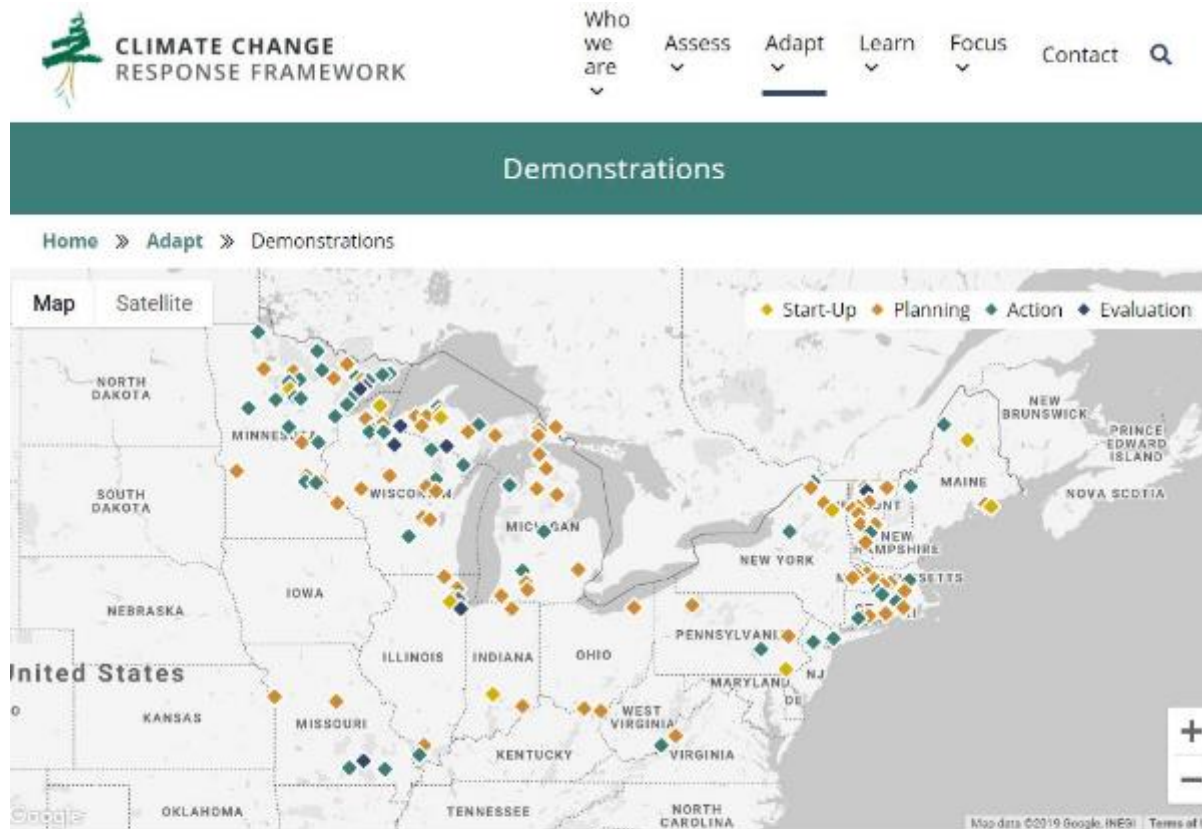
- Best management principles, but applied in the context of climate change
- Hierarchy helps organize and justify adaptation actions
- Menu allows user to pick and choose actions that are relevant to their situation
- Managers design tactics to suit particular needs

Adaptation Demonstrations

Real-world examples of climate-informed management



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>