



# DESIGNING FOREST ADAPTATION TREATMENTS AT ROBINSON FOREST THROUGH MANAGER-SCIENTIST PARTNERSHIPS



Robinson Forest; Jacob Muller

Adaptive Silviculture for Climate Change (ASCC)  
Robinson Forest Workshop  
November 1, 2, &3, 2022



# Land Acknowledgement

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*The University of Kentucky (UK) rests on the dispossessed lands of the Cherokee, Chickasaw, Osage, and Shawnee people. With recognition and respect, we live and work in these ancestral lands, as well as those of the Delaware, Mosopelea, Wyandot, and Yuchi people.*

<https://education.uky.edu/edl/diversity/>





# Introductions

- Name
- Organization
- One thing you are looking forward to in this workshop

# Workshop Goals

- Engage managers and scientists in the Adaptive Silviculture for Climate Change (ASCC) co-development framework to create a suite of adaptive experimental silvicultural treatments in mixed mesophytic forest sites on the Robinson Forest in Kentucky that will be part of the ASCC Network;
- Develop specific management, research, and monitoring questions that can be addressed through the ASCC project.



Photo: Daniel Bowker, Robinson Forest



# Adaptive Silviculture for Climate Change (ASCC) Network



## Project Goals:

- 1) Introduce managers to tools and approaches to integrate climate change into silvicultural decision making that meets management goals and objectives
- 2) Co-develop robust, operational examples of how to integrate climate change adaptation into silvicultural planning and on-the-ground actions to foster resilience to the impacts of climate change and enable adaptation to uncertain futures

# Adaptive Silviculture for Climate Change Network



**Linda Nagel, Lead PI**  
Professor and Department Head  
Colorado State University



**Courtney Peterson, ASCC Coordinator**  
Colorado State University  
NIACS



**Chris Swanston, Co-PI**  
USFS, Director  
Office of Sustainability and Climate



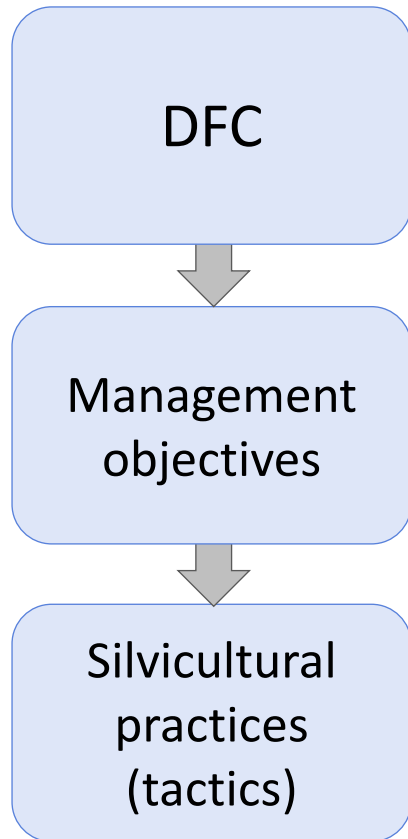
**Maria Janowiak, Co-PI**  
USFS, Northern Research Station  
Director, NIACS, NRS



# ASCC Collaborative Workshop

*Developing the Experimental Treatments*

For each experimental treatment  
(Resistance, Resilience, Transition):



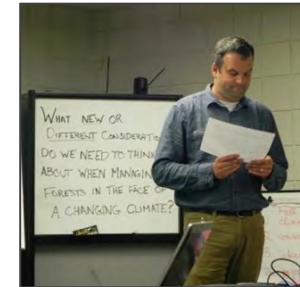
**What is the desired structure and function (*desired future condition*)?**

**Keep in mind key variables/outcomes:**

- Species composition
- Forest health
- Forest productivity
- Response to disturbance

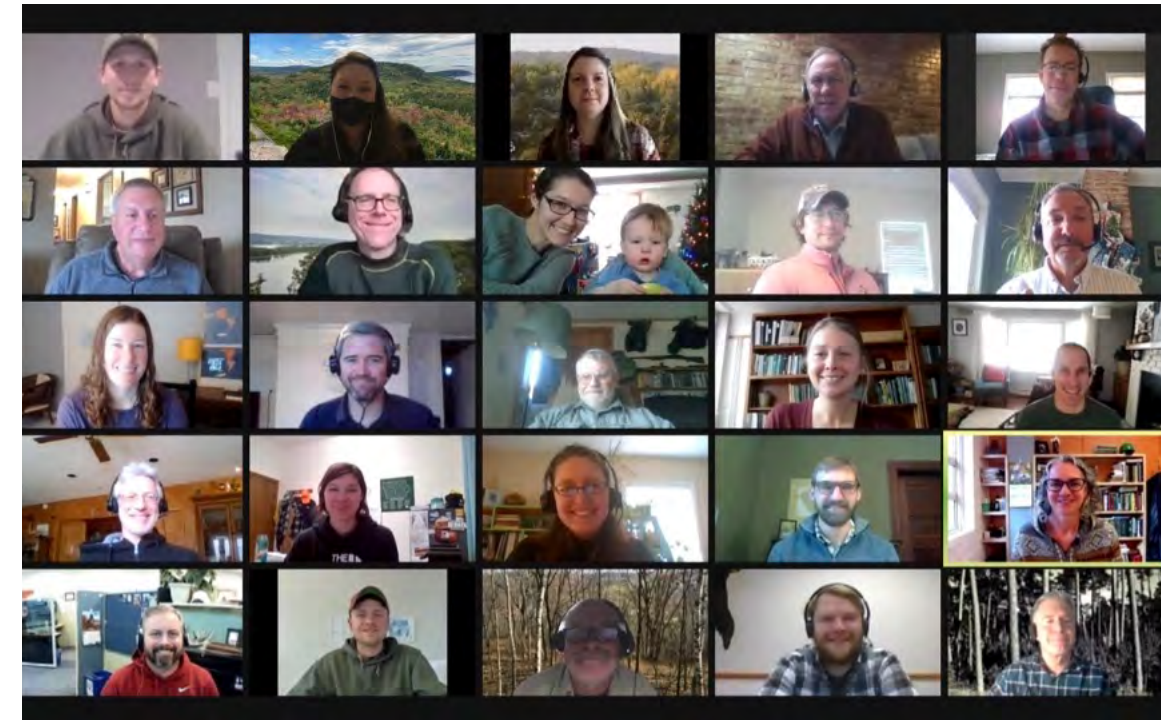
**For each silvicultural practice (tactic):**

- Timeframes
- Benefits
- Drawbacks and Barriers
- Practicality



First workshop: MN, June 2013

Most recent workshop: Driftless Area, Dec. 2021



# Workshop Agenda – Day 1, Tuesday, Nov. 1

- |              |  |             |   |
|--------------|--|-------------|---|
| <b>8:00</b>  | <b>Welcome &amp; Introductions</b> - Jacob Muller, John Lhotka, & John Reinstetle (UK)                                       | <b>1:15</b> | <b>Adaptation Concepts &amp; Developing an ASCC Study Site Presentation</b> - Courtney Peterson & Maria Janowiak (ASCC/NIACS) |
| <b>8:15</b>  | <b>ASCC Overview &amp; Workshop Agenda</b> - Courtney Peterson & Maria Janowiak (ASCC/NIACS)                                 | <b>2:00</b> | <b>Develop <i>Resistance</i> Treatment for Robinson Forest ASCC Site (in breakout groups)</b>                                 |
| <b>8:45</b>  | <b>Silvics, Forest Ecology, &amp; Disturbance of Mixed Mesophytic Forests</b> - John Lhotka (UK)                             | <b>3:00</b> | <b>Report Out on <i>Resistance</i> &amp; Group Discussion</b>   |
| <b>9:15</b>  | <b>Ecosystem Vulnerabilities of Mixed Mesophytic Forests to Climate Change</b> - Jacob Muller (UK)                           | <b>3:45</b> | <b>Develop <i>Resilience</i> Treatment for Robinson Forest ASCC Site (in breakout groups)</b>                                 |
| <b>9:45</b>  | <b>Break (15 min)</b>  | <b>4:30</b> | <b>Flash Report-outs on Resilience to larger group (continue in field next day)</b>   |
| <b>10:00</b> | <b>Climate Change Considerations for Managing Mixed Mesophytic Forests</b> - Courtney Peterson & Maria Janowiak (ASCC/NIACS) |             |   |
| <b>10:45</b> | <b>Management and Values of Mixed Mesophytic Forests on the Robinson Forest</b> - John Reinstetle (UK)                       |             |   |
| <b>11:15</b> | <b>Hydrology &amp; Climate Change</b> – Mac Cherry (USFS)  |             |   |
| <b>11:30</b> | <b>Discussion of Climate Change Impacts on Robinson Forest Goals &amp; Objectives</b>  |             |   |
| <b>12:15</b> | <b>Lunch</b> (provided by University of Kentucky)  |             |   |

## Worksheets!

# Workshop Agenda – Day 2, Wednesday, Nov. 2

- 8:00** Meet at University of KY and Caravan to Robinson Forest for ASCC Site Field Visit (Drive Time ~2 hours)
- 10:30** ASCC Site Field Visit – Robinson Forest
- 12:30** Lunch (Provided sack lunches in the field)
- 1:00** Facilitated Discussion Revisiting Resistance and Resilience - Courtney Peterson & Maria Janowiak (ASCC/NIACS)
- 1:30** Develop Transition Treatment for Robinson Forest ASCC Site (in breakout groups)
- 2:15** Report Out on *Transition* & Group Discussion
- 3:00** Finalize any lingering parking lot items; Drive back to University of Kentucky
- 5:00** Arrive back at UK; Adjourn for the Day



# Workshop Agenda – Day 3, Thursday, Nov. 3

- **8:30** Recap of Previous Two Days
- **8:45** Review Draft Silvicultural Treatments
- **10:15** Break
- **10:30** Next Steps, Evaluations, & Close-Out
  - What research or management questions are you excited about based on the ASCC treatments?
- **11:30** Large Group Adjourn
- **11:30** (*ASCC Site Leads*) Identify key implementation and monitoring next steps

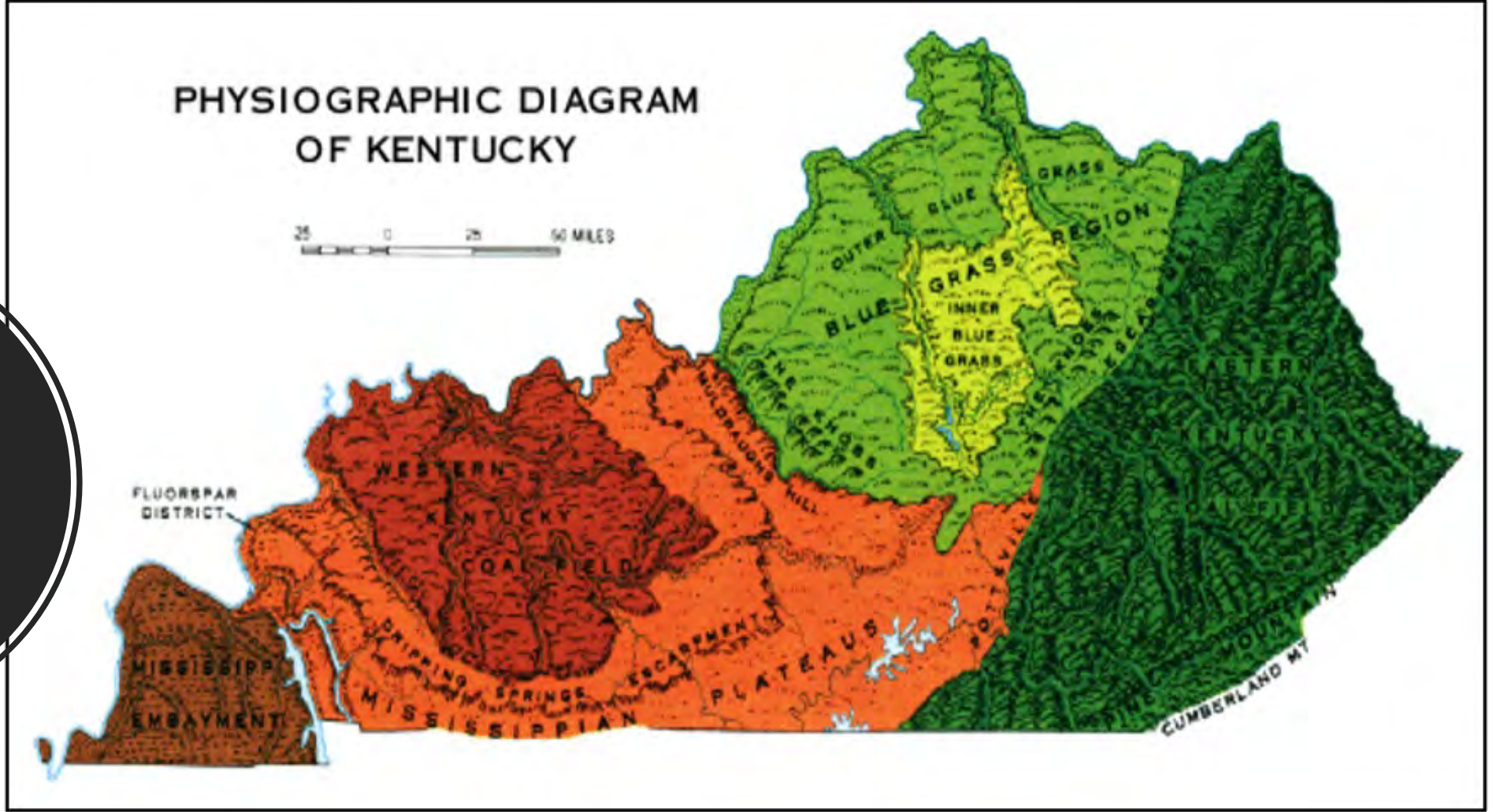


# Workshop Guidelines

- Focus on what matters
- Contribute your thinking and experience
- Listen to understand
- Connect ideas
- Listen together for patterns, insights and deeper questions
- Honor everyone's time
- Equal airtime - all participate, no one dominate
- Be present - mentally and physically



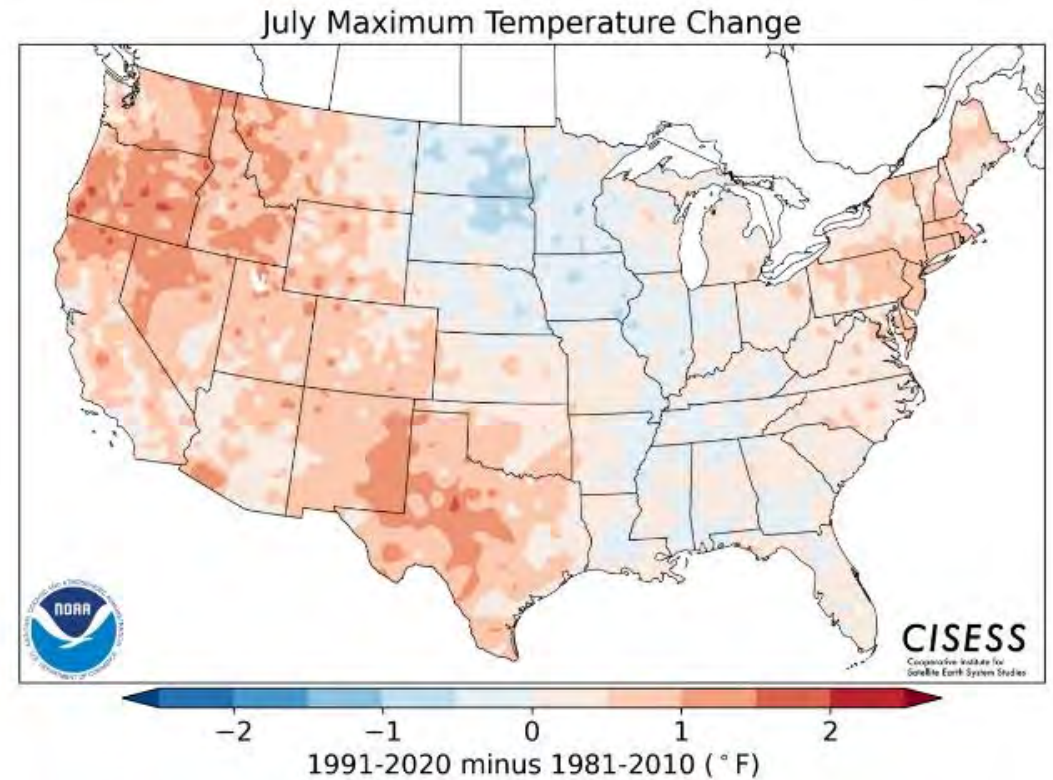
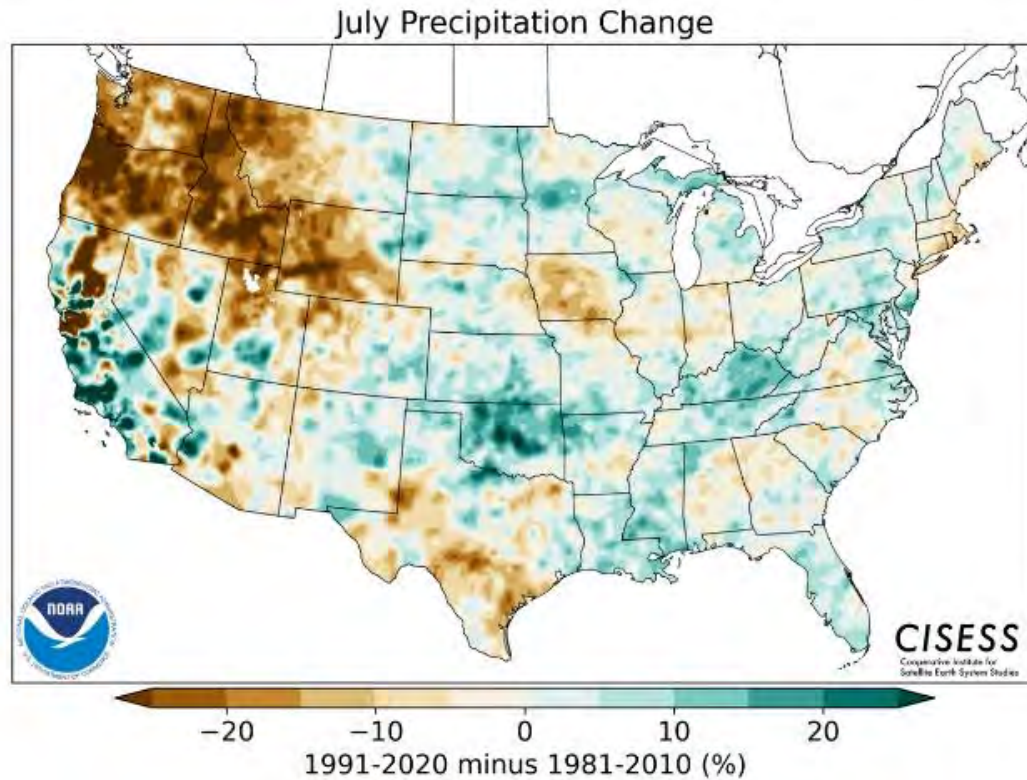
Silvics, Forest Ecology, & Disturbance of Mixed Mesophytic Forests



John Lhotka (University of Kentucky)

# Ecosystem Vulnerabilities of Mixed Mesophytic Forests to Climate Change

Jacob Muller (University of Kentucky)



# Activity: Climate Change Considerations for Managing Mixed Mesophytic Forests

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What new or different considerations do we need to think about when managing forests in the face of climate change?





# Management and Values of Mixed Mesophytic Forests on the Robinson Forest

John Reinstetle (University of Kentucky, Robinson Forest)



# Hydrology & Climate Change

Alex (Mac) Cherry,  
USDA Forest Service

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# Robinson Forest Goals for ASCC Workshop

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1. Manage for a compositionally and structurally diverse, sustainable ecosystem.
2. Consider visual aesthetics where timber harvesting is recommended.
3. Support Kentucky's timber industry by promoting important commercial species, such as white oak.
4. Protect and maintain key archeological sites and cultural resources.
5. Mitigate risks of invasive species establishment or spread.
6. Mitigate risks associated with wildfire.
7. Sustain and promote wildlife diversity across the forest.
8. Employ all applicable Kentucky best management practices (BMPs) during timber harvest.
9. Support demonstration and science delivery.

# Activity: Impacts of Climate Change on Management Goals for the Ohio ASCC Site

**Challenges to Meeting Management Objectives with Climate Change:** Things that will make it harder to achieve the management objectives due to climate change.

**Opportunities to Meeting Management Objectives with Climate Change:** Things that will make it easier to achieve the management objectives due to climate change.

*\*\*Focus on challenges that can be addressed through forest management (not global markets, policies, etc.)*



Lunch –  
Reconvene at  
1:15

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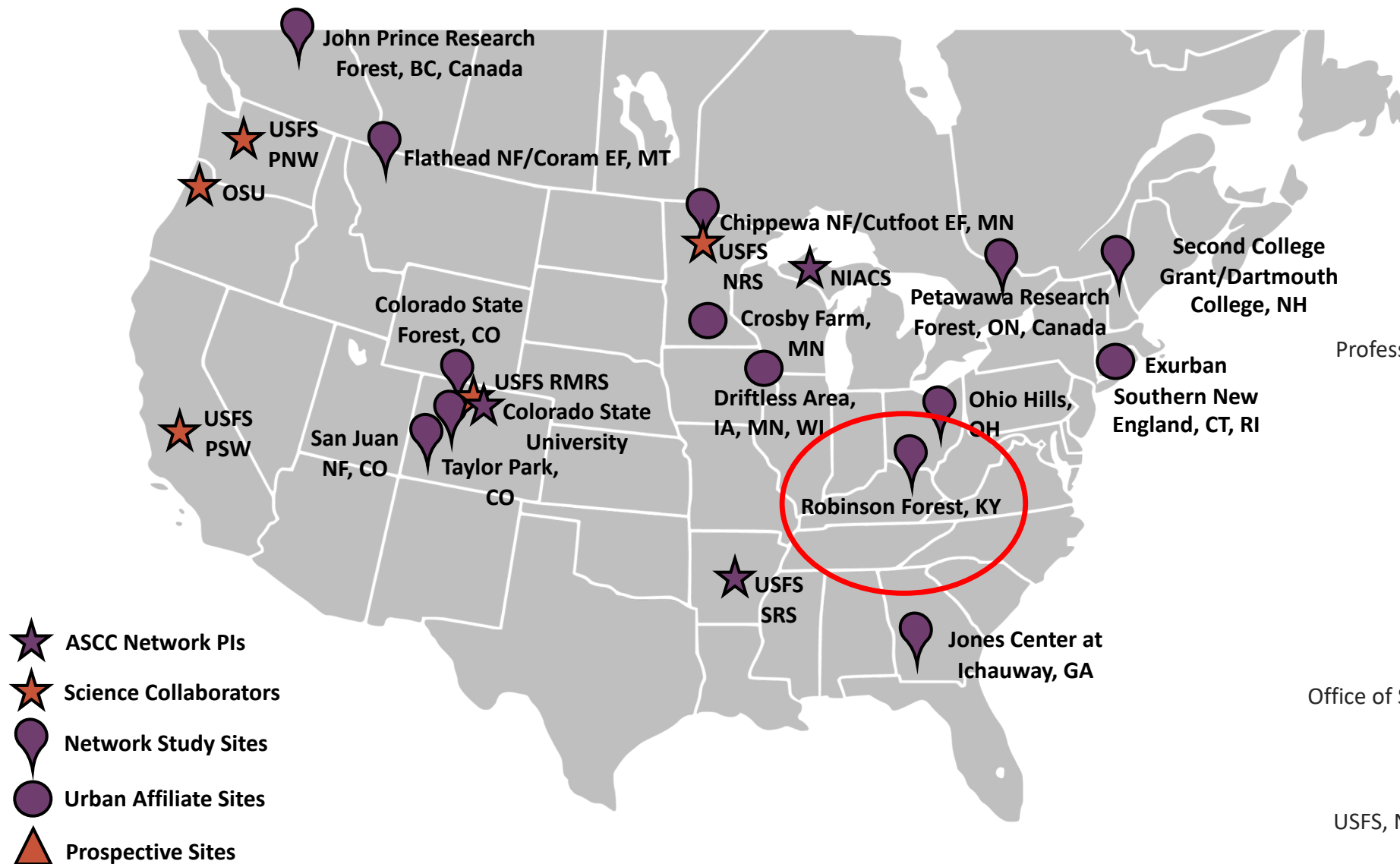
# Adaptive Silviculture for Climate Change (ASCC) Network



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- 2) Co-develop robust, operational examples of how to integrate climate change adaptation into silvicultural planning and on-the-ground actions to foster resilience to the impacts of climate change and enable adaptation to uncertain futures

# Adaptive Silviculture for Climate Change Network



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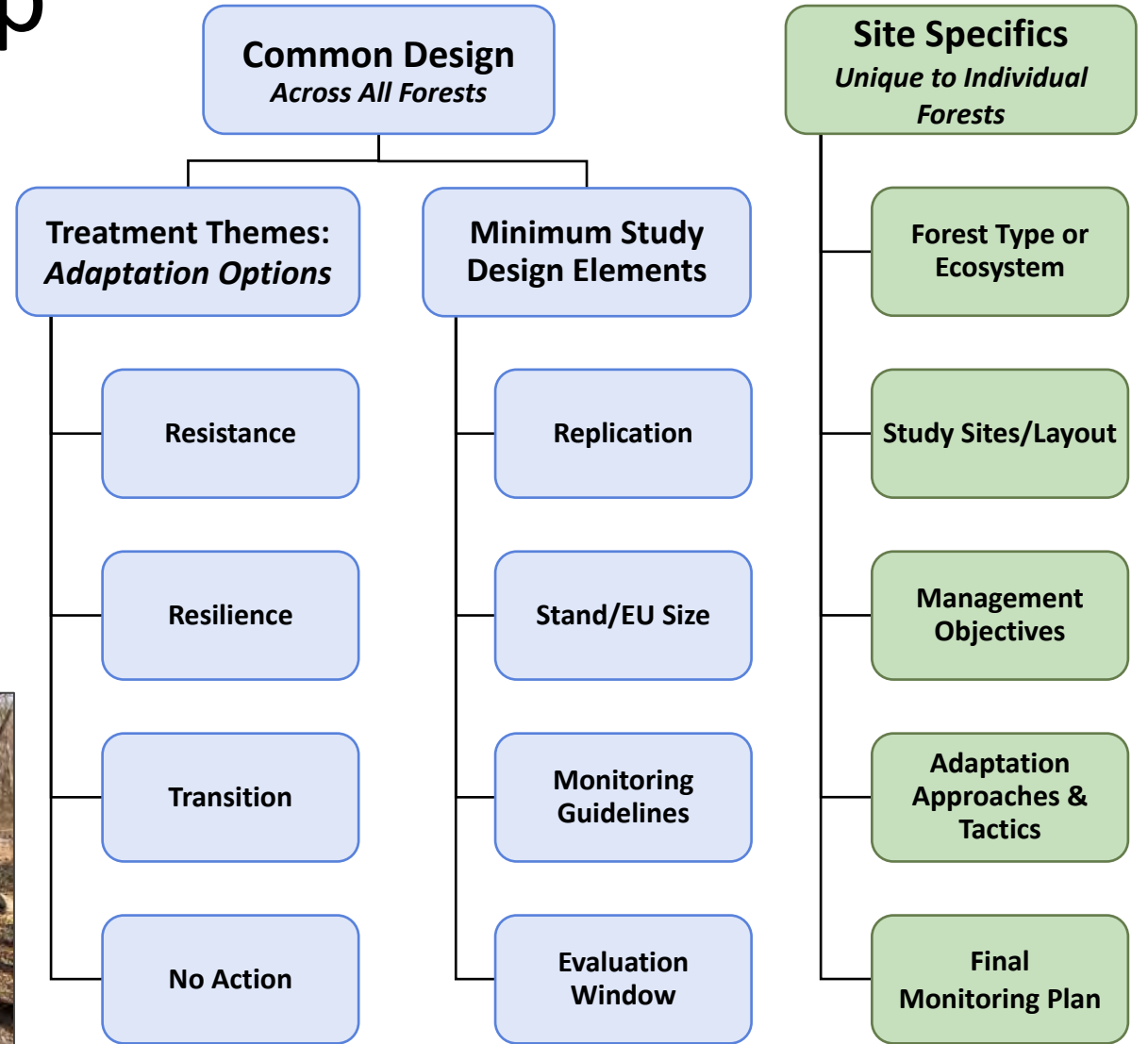
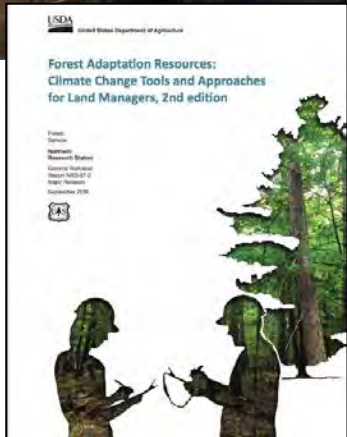
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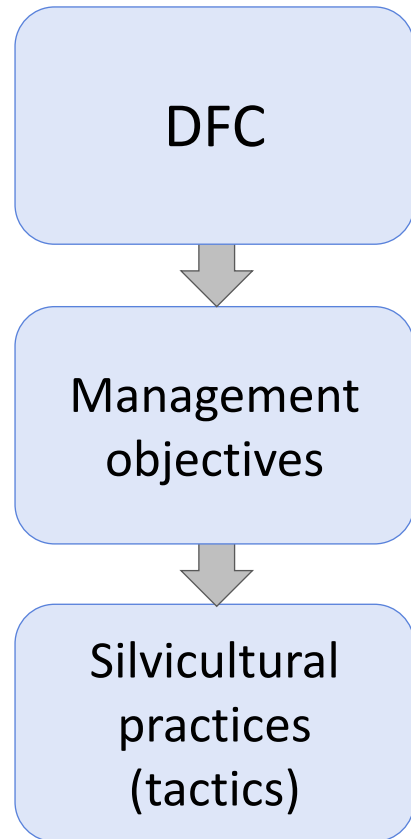
# ASCC Study Design and Collaborative Workshop



# Collaborative Workshop

*Developing the Experimental Treatments*

For each experimental treatment  
(Resistance, Resilience, Transition):



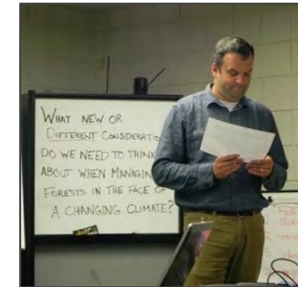
**What is the desired structure and function (*desired future condition*)?**

**Keep in mind key variables/outcomes:**

- Species composition
- Forest health
- Forest productivity
- Response to disturbance

**For each silvicultural practice (tactic):**

- Timeframes
- Benefits
- Drawbacks and Barriers
- Practicality



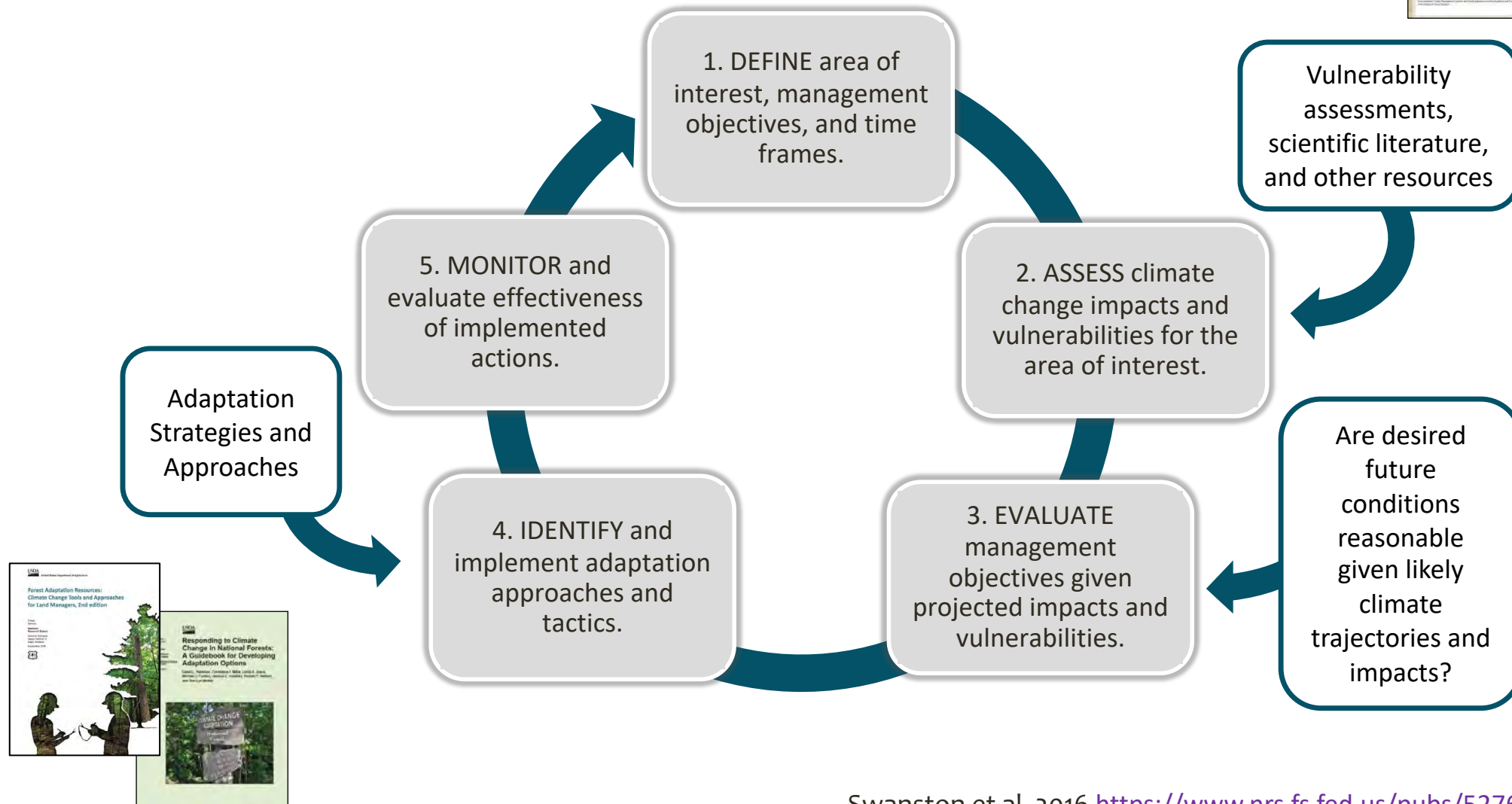
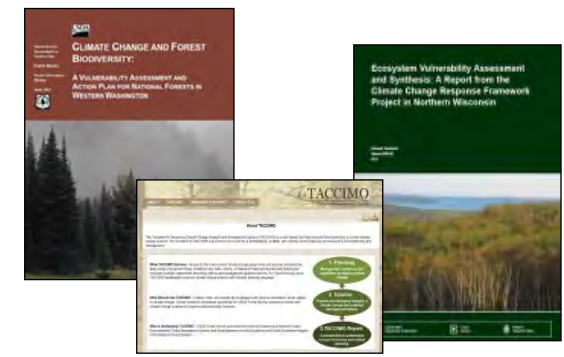
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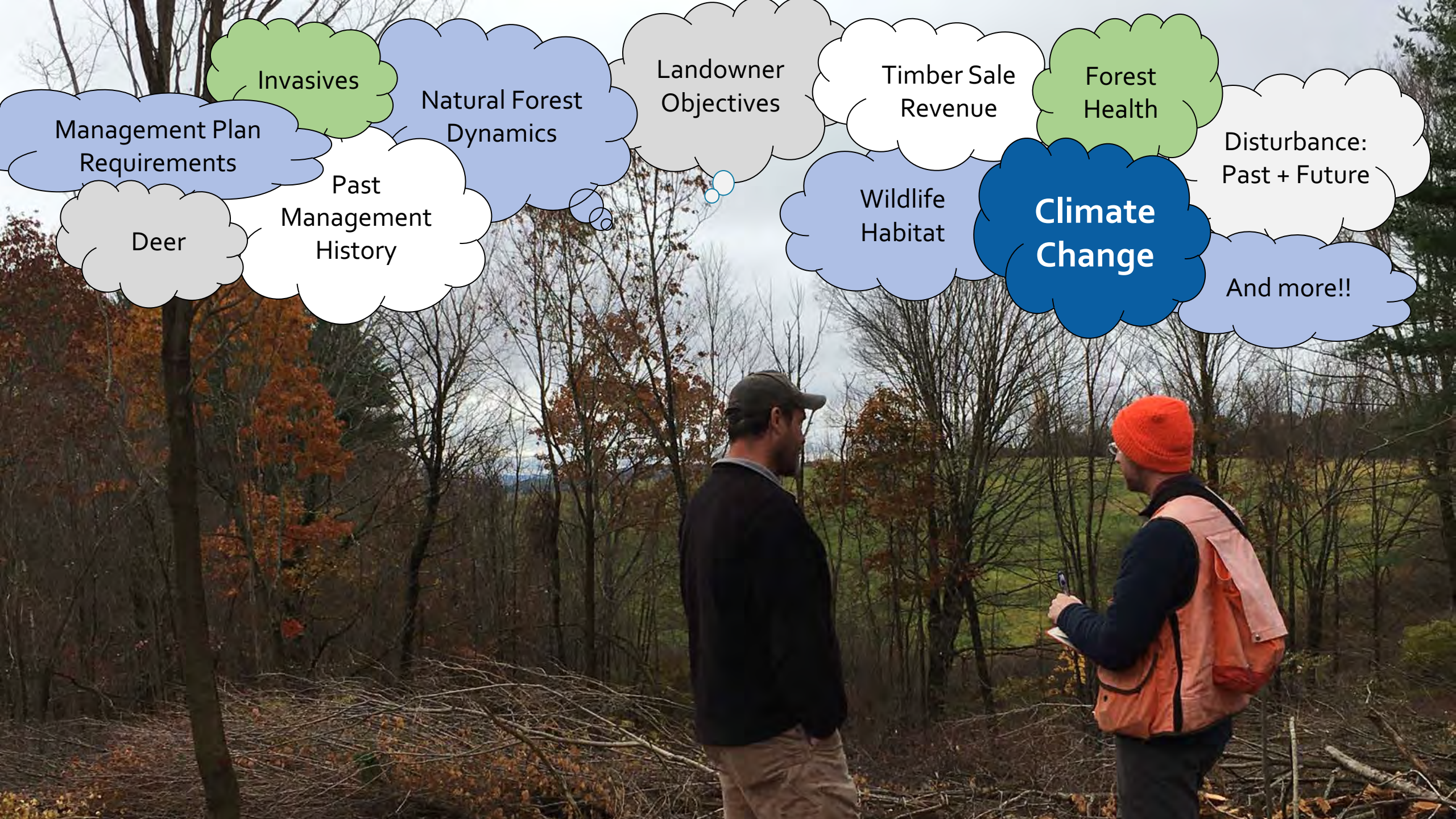
# Identifying Adaptation Tactics

## Forest Adaptation Resources: Climate Change Tools & Approaches for Land Managers



# Adapting to Climate Change





Invasives

Natural Forest Dynamics

Landowner Objectives

Timber Sale Revenue

Forest Health

Disturbance: Past + Future

Management Plan Requirements

Past Management History

Deer

Wildlife Habitat

**Climate Change**

And more!!

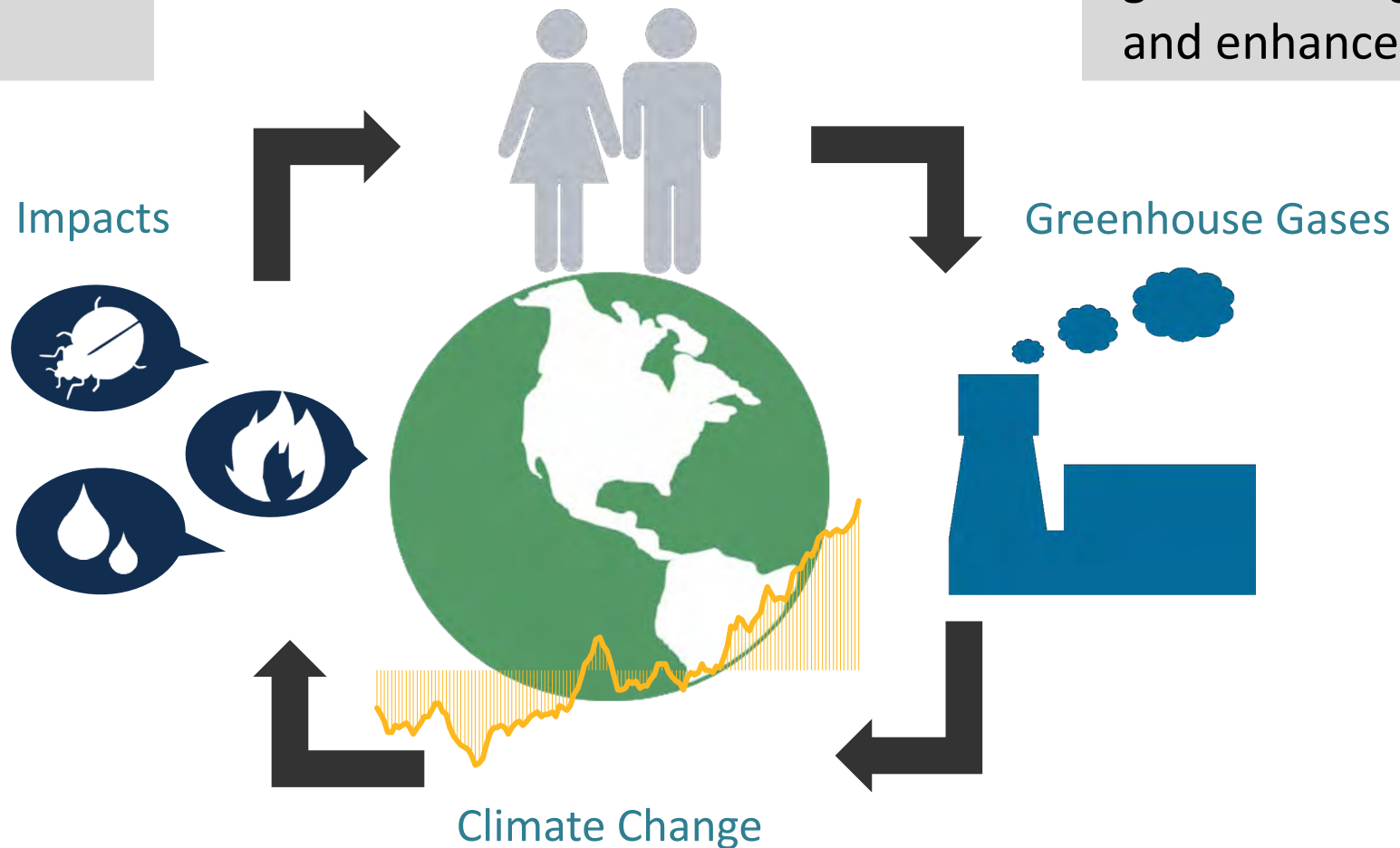
# How can we respond to climate change?

## Adaptation

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

## Mitigation

Actions that reduce greenhouse gas emissions and enhance carbon sinks.



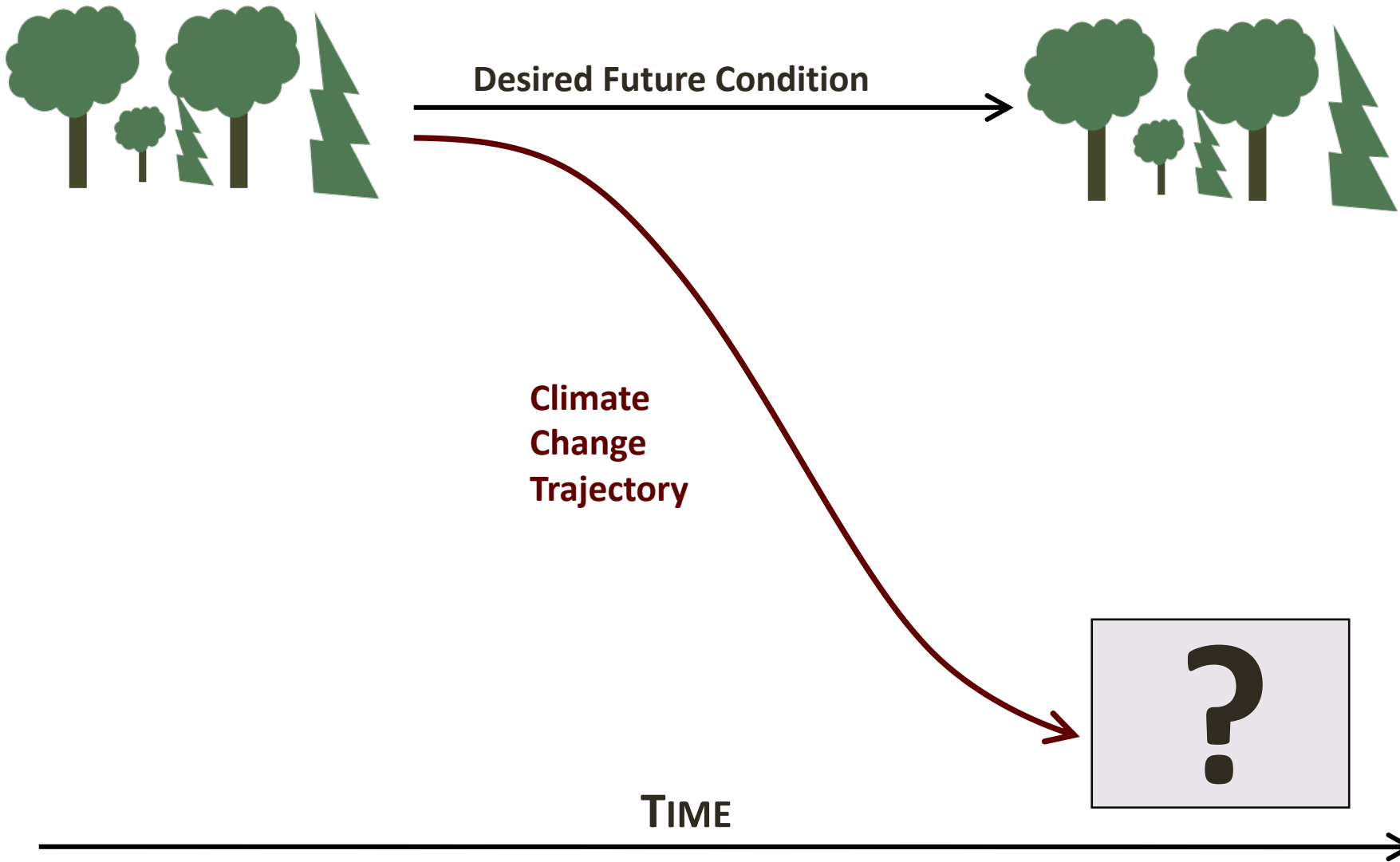
**Adaptation** - the adjustment of systems in response to climate change.

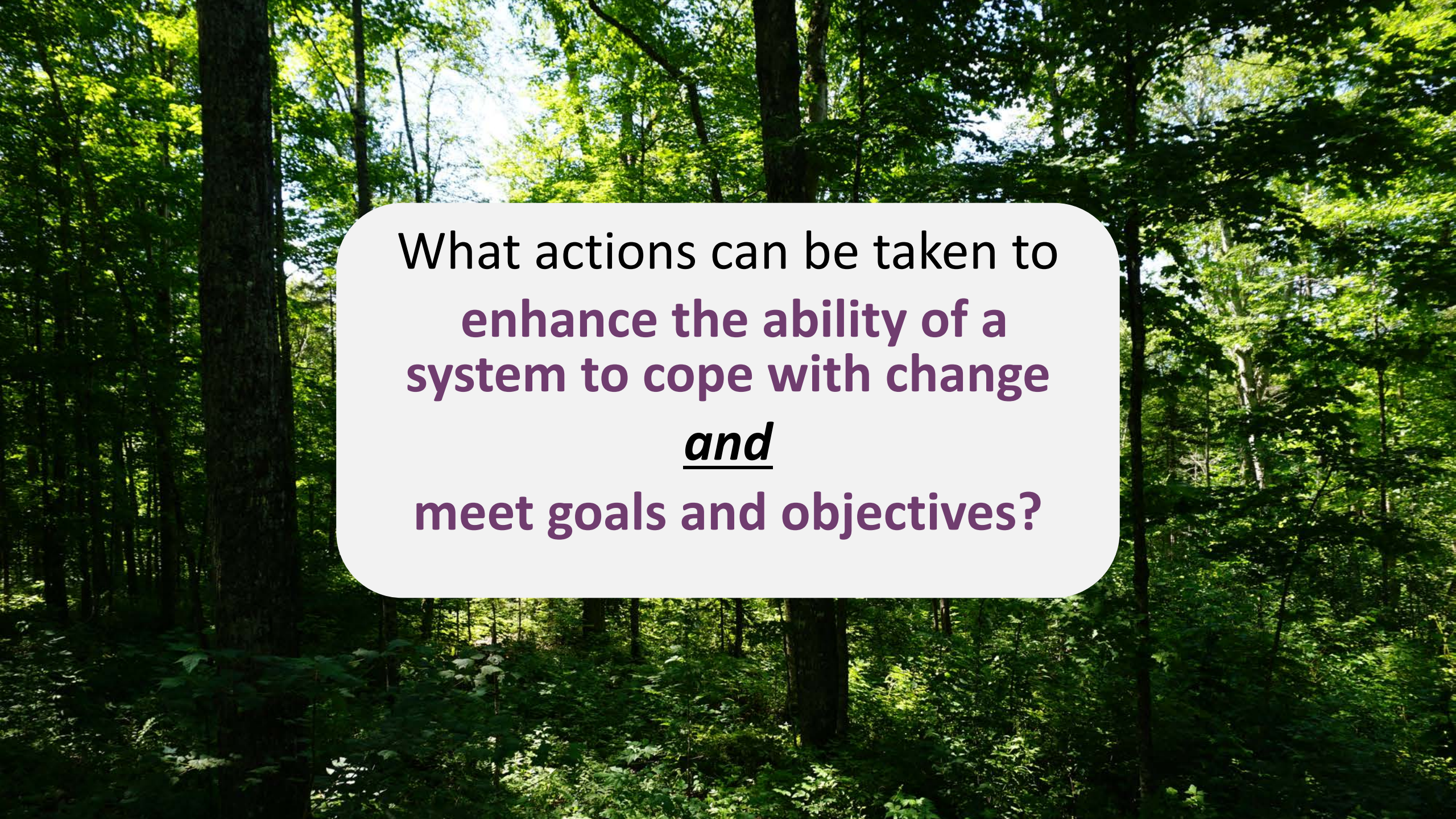


Ecosystem-based adaptation activities build on **sustainable management, conservation, and restoration.**

- What do you **value**?
- How much **risk** are you willing to tolerate?

# Climate-Driven Changes





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

# Adaptation Options

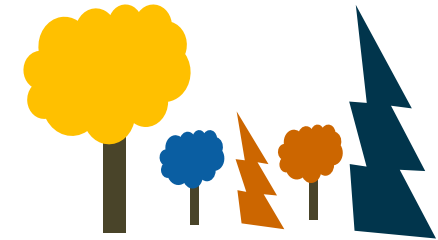
## RESISTANCE



## RESILIENCE



## TRANSITION



Identify and implement actions that are  
**robust across a range of potential future conditions**

# Resistance

Improve the defenses of the system against anticipated changes or directly defending against disturbance in order to maintain relatively unchanged conditions.



*Road crossings that can withstand flood events (USFS, Monongahela NF)*



*Threatened Dwarf lake iris (FWS)*



*Invasive species management (USFS)*

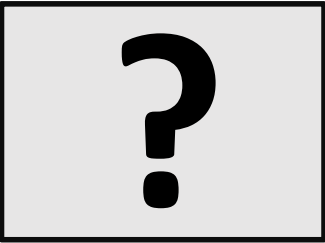
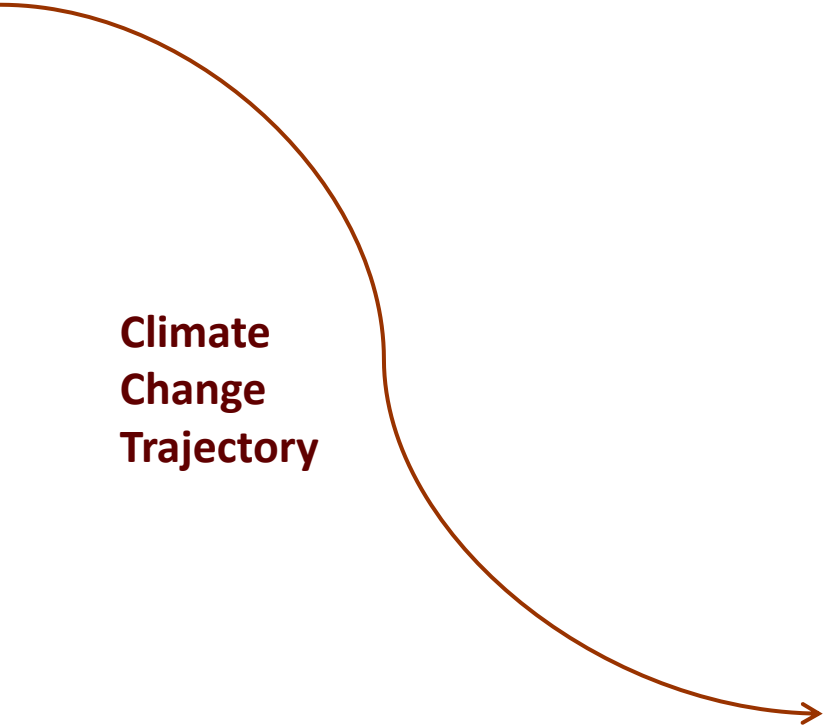
# Resistance



Desired Future Condition



Climate Change Trajectory



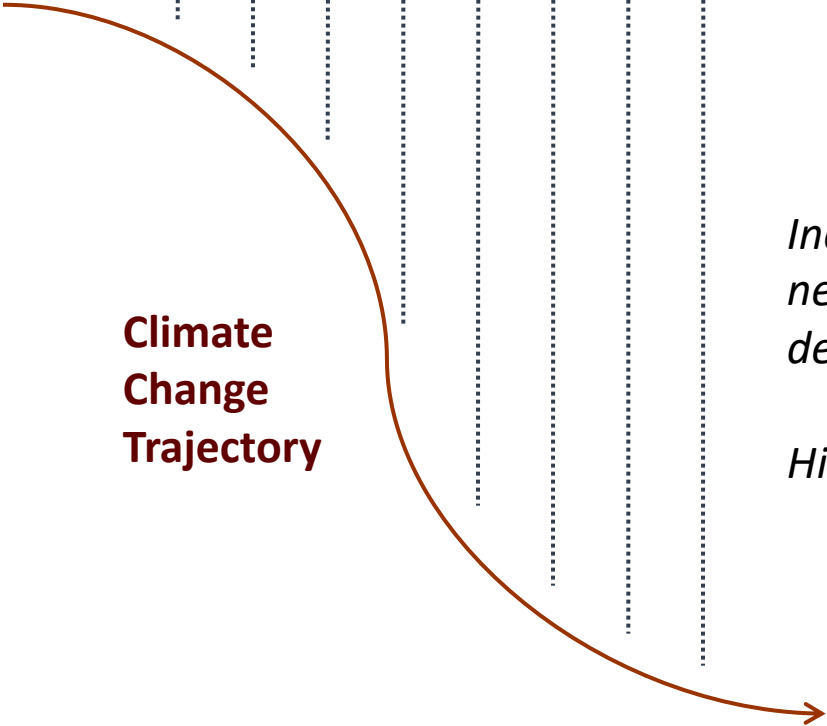
TIME



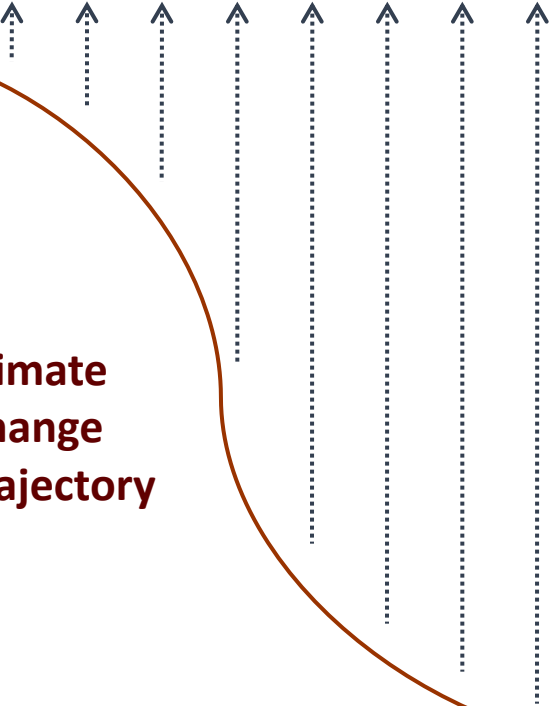
# Resistance



Desired Future Condition →



**Climate  
Change  
Trajectory**



*Increasing resources  
needed to maintain  
desired conditions*

*Higher risk*



TIME →



# Resilience

Accommodate some degree of change or disruption, but be able to return to a similar condition after disturbance.

- Improve overall health & vigor
- Management of vegetation following disturbance



*Prescribed burning to regenerate fire-adapted species*

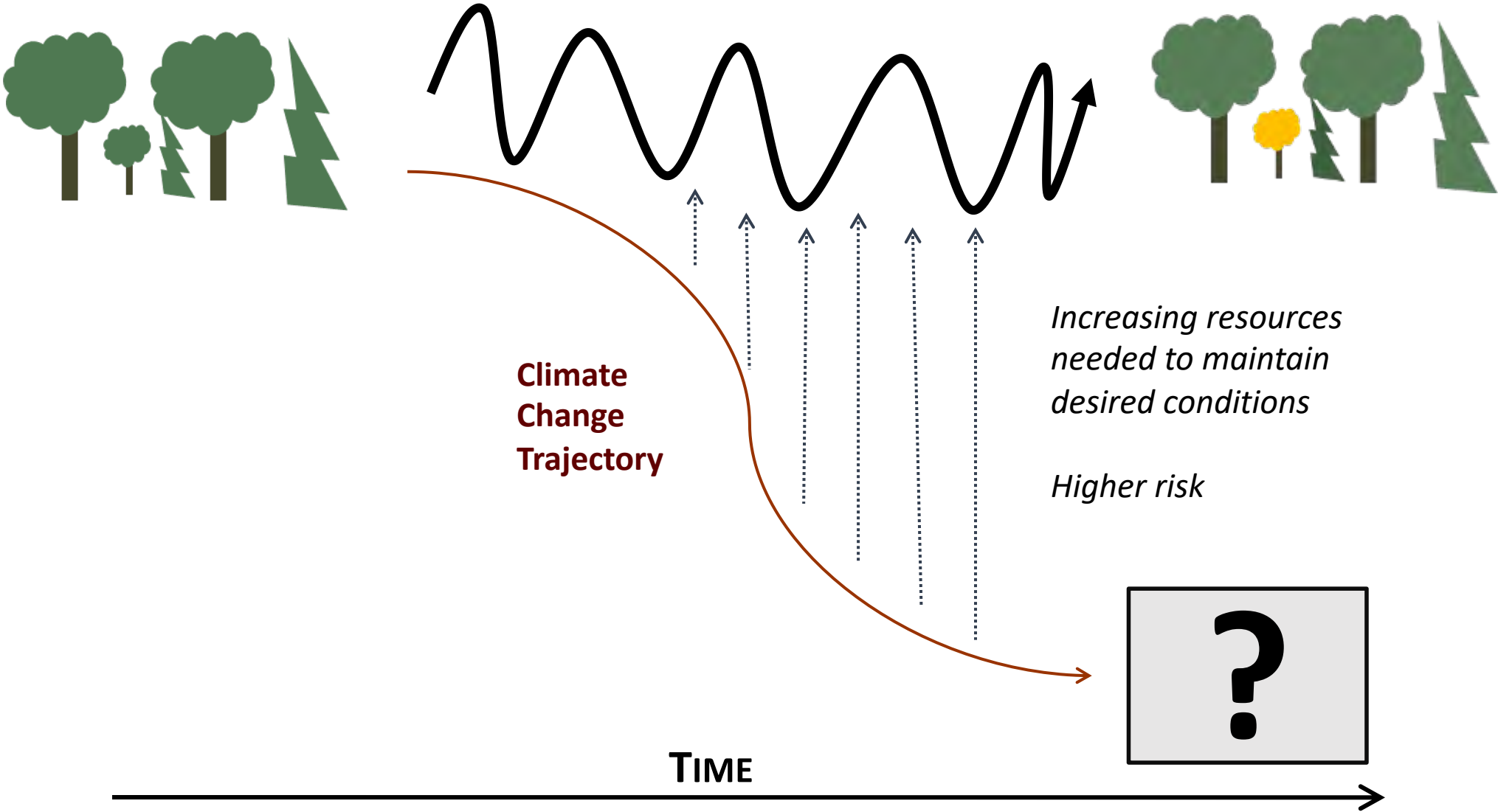


*Reducing overstocked stands (Tahoe NF)*



*Increasing setbacks to allow for fluctuating water levels.*

# Resilience



# Transition

Intentionally accommodate change and enable ecosystems to adaptively respond to changing and new conditions

- Foster well-adapted native species
- Relocate visitor and recreation infrastructure
- Accommodate new & altered hydrologic processes



*Favoring native species that are expected to be adapted to future conditions.*

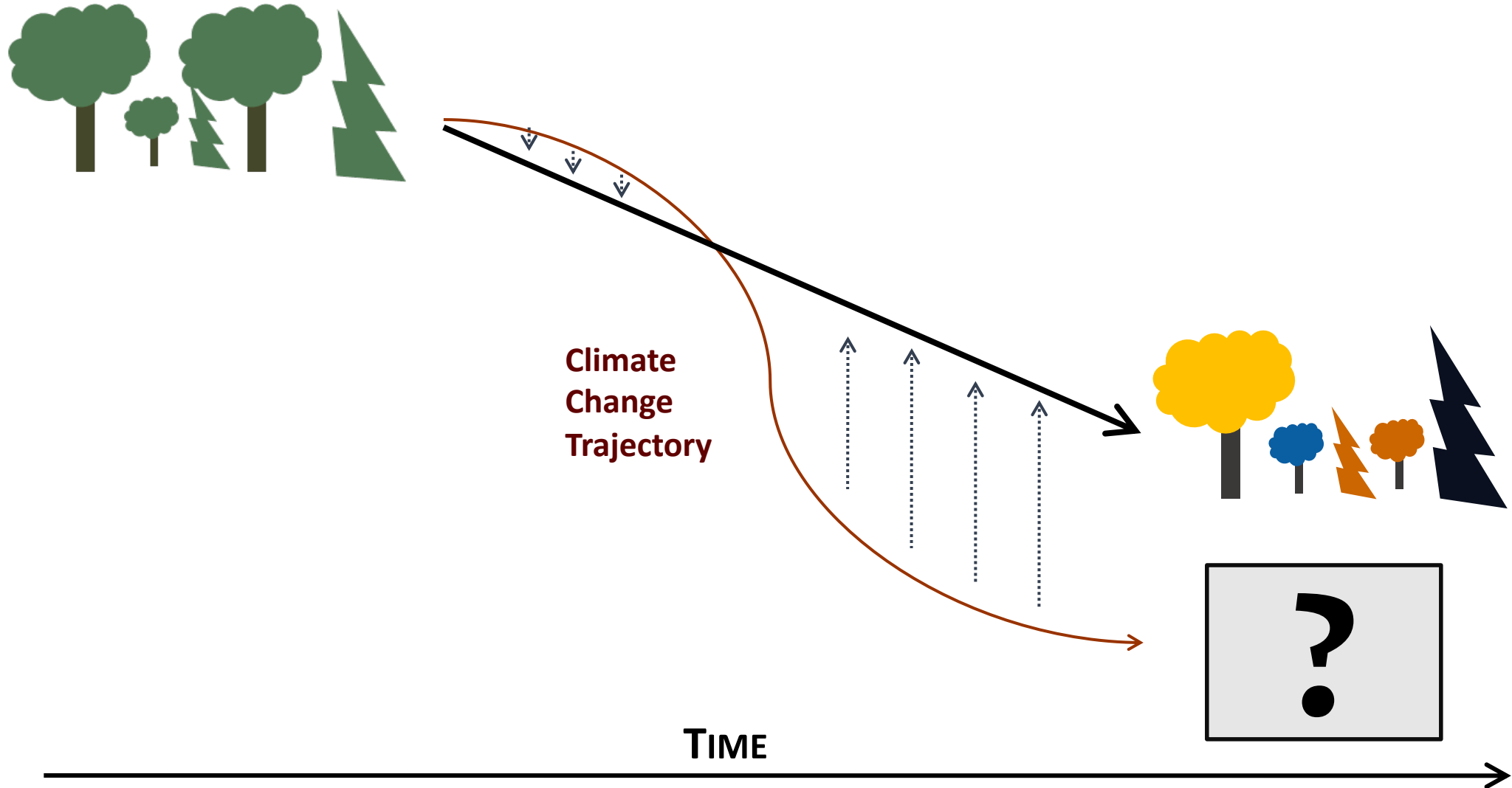


*Relocate existing infrastructure to areas with less risk (P:Tom Hilton)*



*River & riparian area restoration in agricultural fields (P:Joann Kline)*

# Transition



# ASCC is testing a spectrum of adaptation options

## RESISTANCE



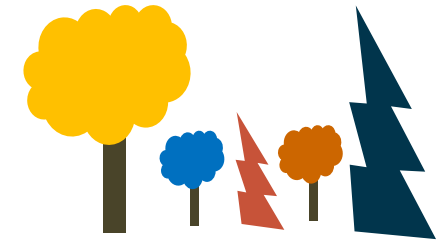
- Improve defenses of forest against change and disturbance
- Maintain relatively unchanged conditions

## 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

← Reduce impacts/maintain current conditions

→ Forward-looking/promote change

# Intentionality

- Explicitly consider and address climate change
- Sure we might get lucky...
- Intentionally assessing risk and vulnerabilities **makes our plans more robust!**



# Experimental Treatment Definitions

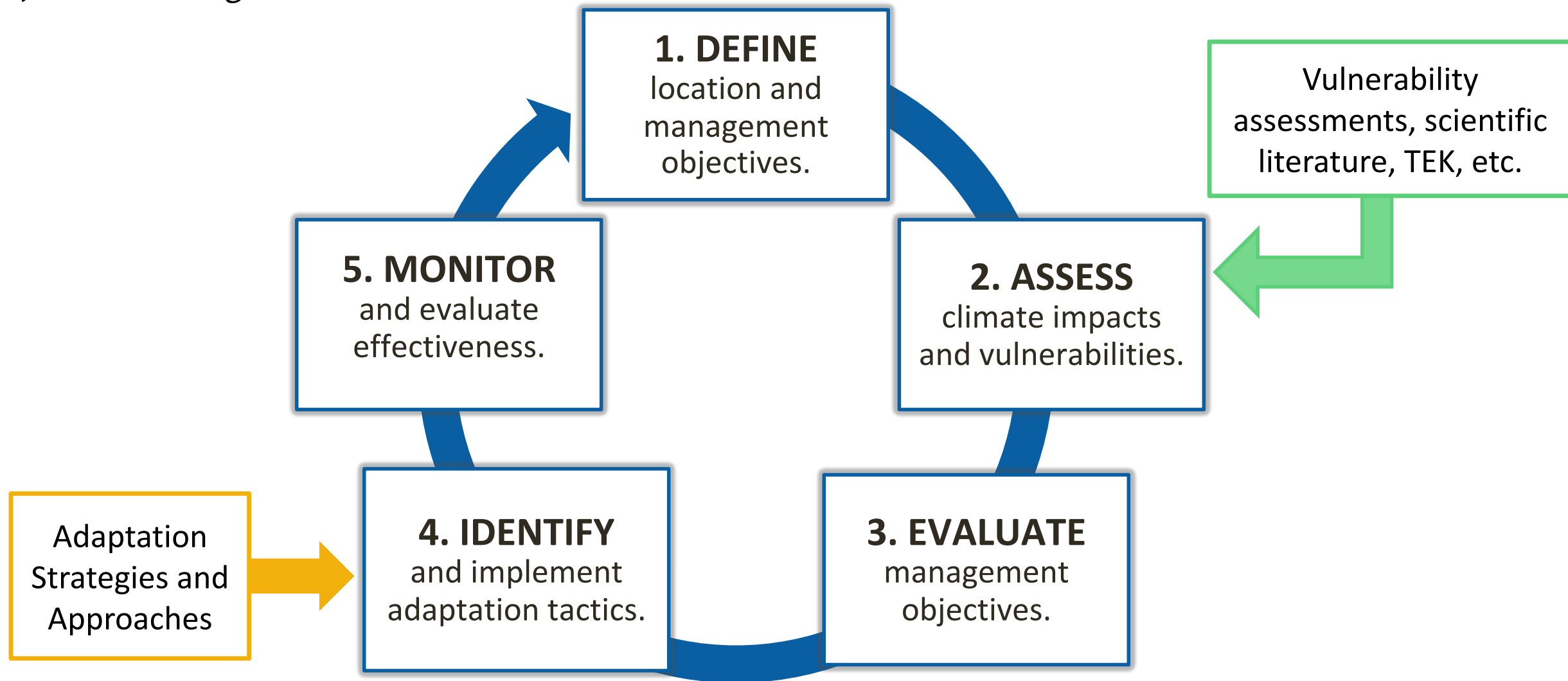
Treatment Name	Experimental Treatment Definition
RESISTANCE	Actions that improve the defenses of the forest against anticipated change or directly defend the forest against disturbance in order to maintain relatively unchanged conditions.
RESILIENCE	Actions that accommodate some degree of change, but encourage a return to a prior condition or desired reference conditions following disturbance.
TRANSITION	Actions that intentionally accommodate change and enable ecosystems to adaptively respond to changing and new conditions.
NO ACTION	Since climate change impacts all forests globally, we cannot maintain a true “control”. With this in mind, we consider an approach in which forests are allowed to respond to climate change in the absence of direct silvicultural intervention as an appropriate baseline for many questions.

# Experimental Treatment Goals

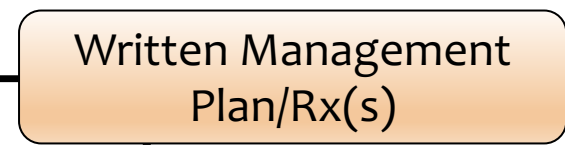
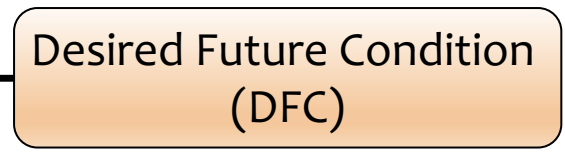
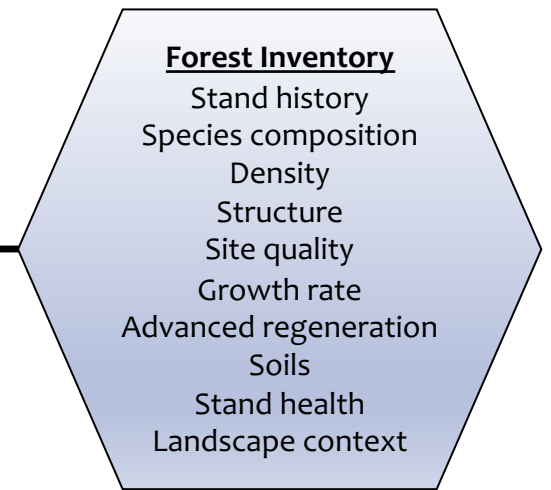
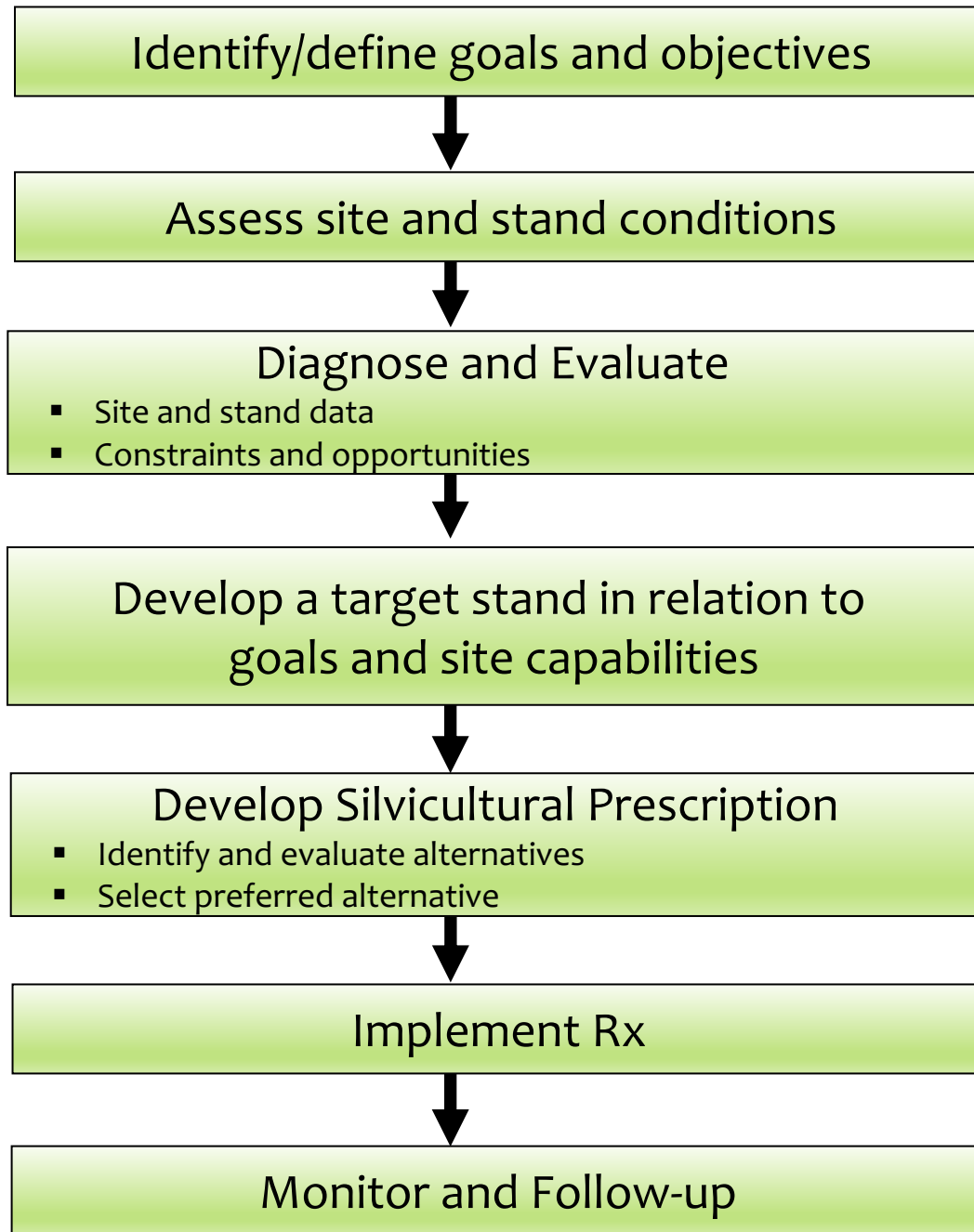
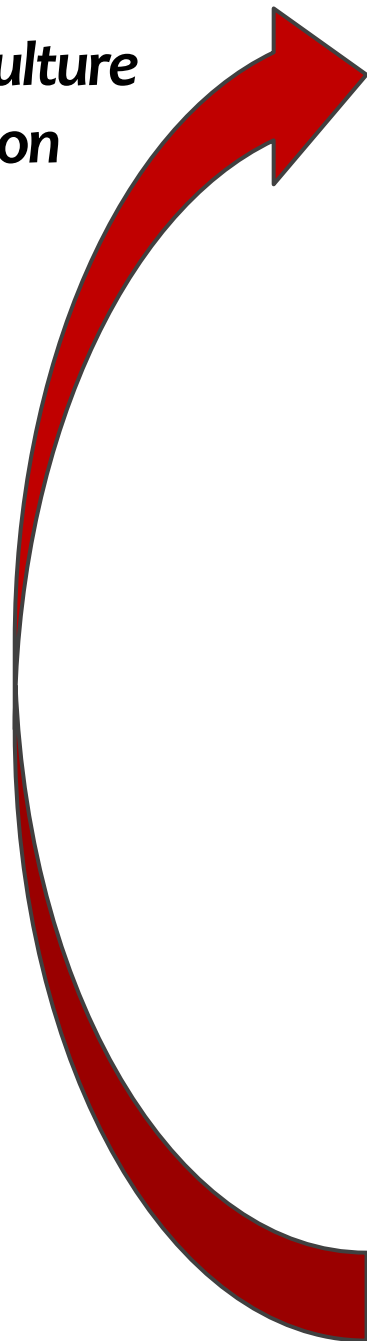
<b>Treatment Name</b>	<b>Experimental Treatment Goals</b>
RESISTANCE	Maintain relatively unchanged conditions over time
RESILIENCE	Allow some change in current conditions, but encourage an eventual return to reference conditions
TRANSITION	Actively facilitate change to encourage adaptive responses
NO ACTION	Allow forests to respond to climate change without direct management intervention

# Identifying Adaptation Tactics

Forest Adaptation Resources: Climate Change Tools & Approaches for Land Managers



# The Silviculture Prescription Process



# Key Definitions (SAF Dictionary of Forestry, 2018)

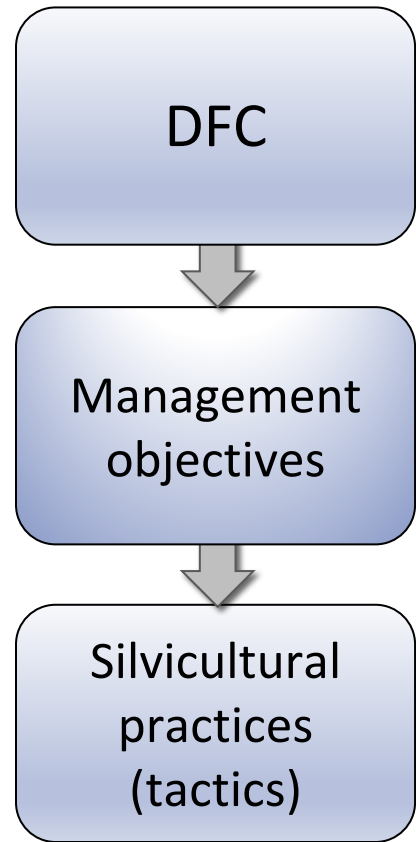
- **Goal** = A broad, general statement, usually not quantifiable, that describes the desired outcomes of each adaptation treatment (*resistance, resilience, transition, no action*).
  - *note* – normally, a management **goal** is stated in terms of purpose, often not attainable in the short term, and provides the context for more specific **objectives**
- **Objective** = A concise, time-specific statement of measurable planned results that correspond to pre-established **goals** in achieving a desired outcome
  - *note* – an **objective** commonly includes information on resources to be used, forms the basis for further planning to define the precise steps to be taken and the resources to be used and assigned responsibly in achieving the identified **goals**

# Key Definitions (SAF Dictionary of Forestry, 2018)

- **Desired Future Condition (DFC)** = a description of the land or resource conditions that are believed necessary to fully meet the *goals* and *objectives* of each adaptation treatment
- **Prescription** = a set of management *practices* and intensities scheduled for application on a specific area to satisfy *multiple uses* or other *goals* and *objectives*
- **Practice** = a specific activity, measure, course of action, or treatment undertaken on a forest ownership
- **Practice = Tactic**

# Developing the Experimental Treatments

For each experimental treatment  
(Resistance, Resilience, Transition):



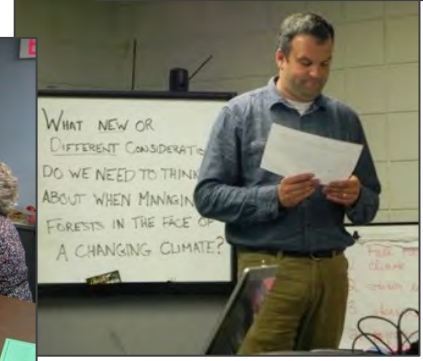
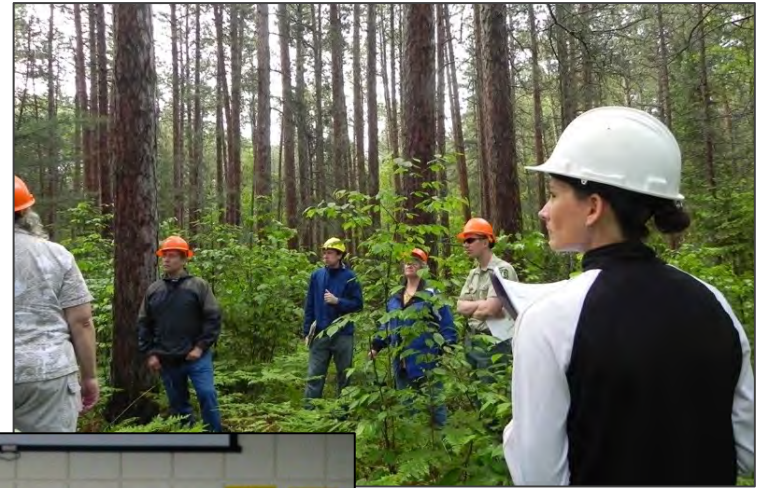
What do you want the stand to be and look like?

Keep in mind key variables/outcomes:

- Species composition
- Forest health
- Forest productivity
- Response to disturbance

For each silvicultural practice (tactic):

- Timeframes
- Benefits
- Drawbacks and Barriers
- Practicality
- Recommend tactic?





# Ohio Hills ASCC Example

## Ohio Hills, OH, USA

- Located within southeastern Ohio's Interagency Forestry Team's Collaborative Oak Management Region
- ~115 ft<sup>2</sup>/acre
- Dry to mesic forests dominated by White Oak, Black Oak, Chestnut Oak, Red Maple, Yellow Poplar, and Sugar Maple
- Variation in understory based on aspect



**Site Leads:** Bryce Adams, USFS NRS; Todd Hutchinson, USFS NRS; Alex Royo, USFS NRS; Gregg Guess, Ohio Division of Forestry



### Climate Concerns:

- warming temperatures
- increasing precipitation in the fall and spring occurring in more frequent heavy precipitation events
- increasing drought stress
- invasive plants, pests, and pathogens



## Zaleski & Vinton Furnace Goals for Ohio Hills ASCC Site

1. Manage for a compositionally and structurally diverse sustainable oak ecosystem.
2. Consider visual aesthetics where timber harvesting is recommended.
3. Support Ohio's timber industry by promoting important commercial species such as white oak.
4. Mitigate risks of invasive species establishment or spread.
5. Sustain and promote organismal and functional diversity.
6. Protect known or discovered archaeological resources.
7. Employ all applicable water quality best management practices during timber harvest.
8. Support and provide recreational opportunities, hunting and wildlife watching, through diversifying forest age and structure (e.g., early-successional habitat for hunting).
9. Support demonstration and science delivery.

# Ohio Hills, OH, USA

## Draft Treatments

**RESISTANCE** Maintain relatively unchanged conditions over time

DFC/Goal (near-term)

Maintain an oak-dominated stand where understory matches overstory composition

Protect state endangered and threatened wildlife species (bats, birds, rattlesnakes)

Resistant to disease (oak wilt, Phytophthora, future novel diseases)

Tactics

- Lower stand density to ~70% relative density
- Overstory thin as needed
- Promote advanced regen of oak-hickory component & prepare for future recruitment
- Prescribed burn to favor oaks



# Ohio Hills, OH, USA

## Draft Treatments

**Resilience** Allow some change in current conditions, but encourage an eventual return to reference conditions

### DFC/Goal

Multi-cohort stand with diversity of ages, structures, species, and light conditions within natural range of variation

Natural regeneration

Tactics: Expanding gap / irregular shelterwood with variable retention (two entries)

- Range of gap sizes based on desired species: 1/10th ac to 1/2 ac (~20% of stand)
- Thin the matrix
- Prescribed burn following harvest
- Natural regeneration of oak-hickories; accept tulip poplar, sassafras, and others in gaps



Photo: Tara Keyser, Appalachian Femelschlag Implementation in NC

# Ohio Hills, OH, USA

## Draft Treatments

**Transition** Actively facilitate change to encourage adaptive responses

### DFC/Goal

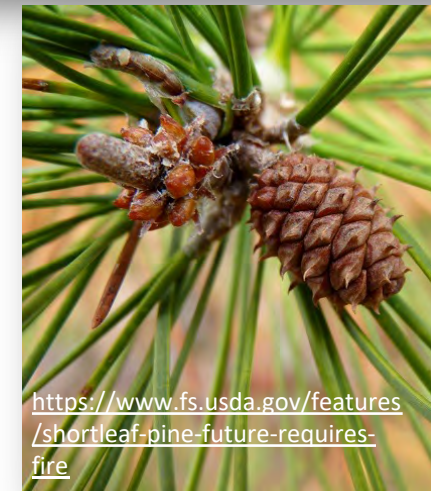
Complex, multi-aged, variable structure

Native and novel future-adapted, drought-tolerant species

Maintain productive forests that align with future conditions

Tactics: Patch clearcuts with residuals in clumps

- 10 acres in gaps that are 1 acre in size (50% gaps, 50% matrix)
- Prescribe burn
- Chemical site prep
- Plant mix of conifers and xeric deciduous species in clusters
  - Based on shade tolerance (silvics) in a grid across stand (openings, edges, and matrix)
  - Seed sourcing from Missouri and Arkansas to match Ozark-like projections
- Plant C4 grasses mix from Ozarks & consider shrubs for wildlife habitat

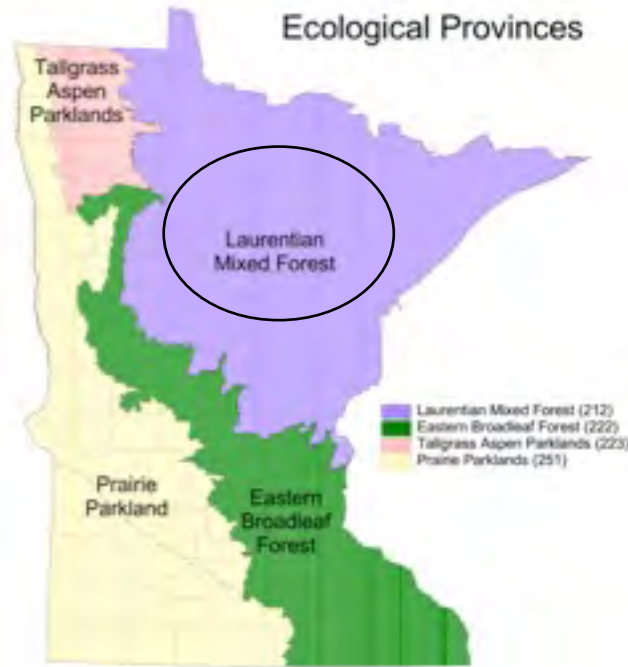


# Red Pine ASCC

- Chippewa National Forest, MN
- Cutfoot Experimental Forest
- Workshop: June 25-27, 2013
- Follow-up@Climate Change Summit
- First ASCC site implemented (2014)



**USDA Forest Service  
Northern Research  
Station**



**ASCC**  
Adaptive Silviculture for Climate Change



UNIVERSITY OF MINNESOTA



The University of Vermont



**FOREST AND RANGELAND  
STEWARDSHIP  
COLORADO STATE UNIVERSITY**



**USGS**  
science for a changing world



**UK** College of Agriculture,  
Food and Environment  
*Forestry and Natural Resources*

# Cutfoot Experimental Forest, MN, USA

## RESISTANCE



**Uniform (free) thin**  
100-120 ft<sup>2</sup>/ac (23-28 m<sup>2</sup>/ha)  
Maintain RP, current spp

## RESILIENCE



**Variable density thinning**  
20% gaps / 20% reserves / matrix 110 ft<sup>2</sup>/ac (25 m<sup>2</sup>/ha)  
Keep RP dominant  
Future-adapted native spp

## TRANSITION



**Irregular shelterwood**  
20% gaps / matrix 60-80 ft<sup>2</sup>/ac (13-18 m<sup>2</sup>/ha)  
Heterogeneity spp and structure  
Future-adapted native and *novel* spp

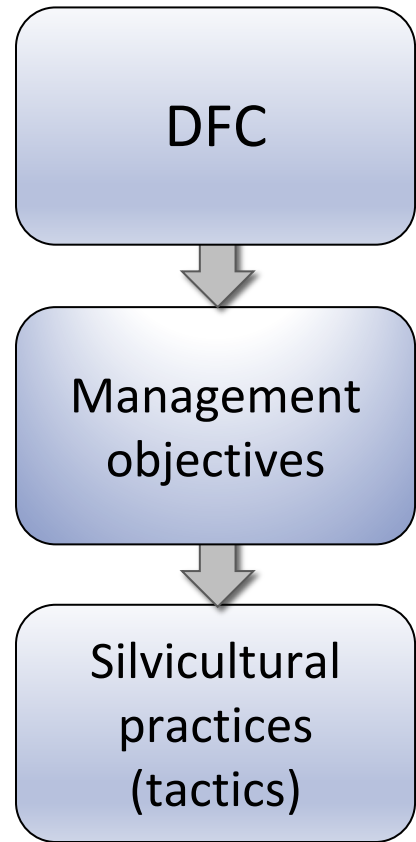


Reduce impacts/ maintain current conditions

Forward-looking/ promote change

# Developing the Experimental Treatments

For each experimental treatment  
(Resistance, Resilience, Transition):



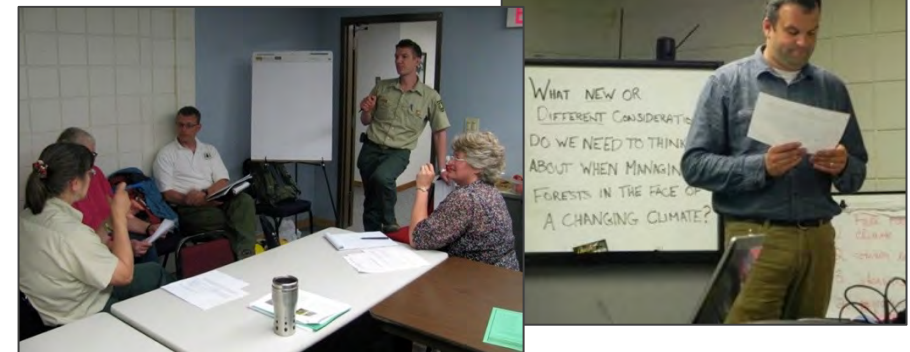
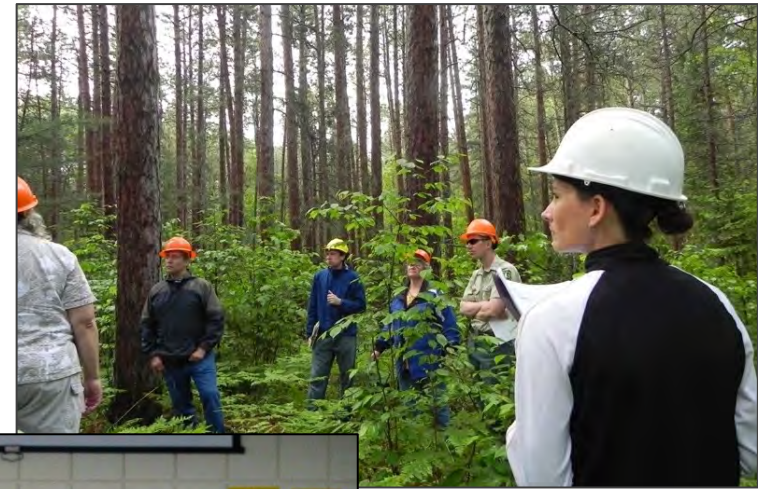
What do you want the stand to be and look like?

Keep in mind key variables/outcomes:

- Species composition
- Forest health
- Forest productivity
- Response to disturbance

For each silvicultural practice (tactic):

- Timeframes
- Benefits
- Drawbacks and Barriers
- Practicality
- Recommend tactic?



# Workshop Guidelines

- Focus on what matters
- Contribute your thinking and experience
- Listen to understand
- Connect ideas
- Listen together for patterns, insights and deeper questions
- Honor everyone's time
- Equal airtime - all participate, no one dominate
- Be present - mentally and physically



# Breakout Groups

Group 1	Group 2	Group 3
Jacob Muller - Facilitator	Maria Janowiak – Facilitator	Courtney Peterson – Facilitator Logan Baker – Co-facilitator /notes
Mary Arthur/Ellen Crocker	John Lhotka*	John Reinstetle*
Sybil Gotsch	Lynne Rieske-Kinney	Lance Vickers
Ryle Benke	Billy Thomas	Steve Price
Logan Nutt	Jared Calvert	Jake Royse
Carrie Pike	Mac Cherry	Claudia Cotton
Jeff Lewis*	Hagan Wonn	Bill Knott
Robert Bean	John Shultz	Katie Wilding

A photograph of a forest with several large, mature trees and a path leading through the woods. The trees are tall and have thick trunks, with dense green foliage. The path is a narrow dirt road that winds through the forest. The overall scene is a lush, green forest.

In the Field Tomorrow:

**Think about the climate change impacts that are likely to affect dry/mesic oak forests, and what management challenges and opportunities this creates.**



# DESIGNING FOREST ADAPTATION TREATMENTS AT ROBINSON FOREST THROUGH MANAGER-SCIENTIST PARTNERSHIPS



Robinson Forest; Jacob Muller

Adaptive Silviculture for Climate Change (ASCC)  
Robinson Forest Workshop  
November 1, 2, &3, 2022



# Workshop Agenda – Day 3, Thursday, Nov. 3

- **8:30** Recap of Previous Two Days
- **8:45** Review Draft Silvicultural Treatments
- **10:15** Break
- **10:30** Next Steps, Evaluations, & Close-Out
  - What research or management questions are you excited about based on the ASCC treatments?
- **11:30** Large Group Adjourn
- **11:30** (*ASCC Site Leads*) Identify key implementation and monitoring next steps





What research or management questions are you excited to ask based on the ASCC treatments?



Thank you for  
your  
participation!  
We appreciate  
your  
feedback!



# ASCC Data Collection and Implementation Timeline



Photo Credit: Tony D'Amato

# GUIDING PRINCIPLES

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- ASCC is a multi-site project
- ASCC's primary experimental objectives and core study questions apply to every site
  - Some level of standardization is required for basic sampling
- Additional, system-specific or regionally-specific experimental objectives and questions are encouraged at individual sites
  - Some relevant data may be collected to address primary experimental objectives
  - Additional data may be needed to answer secondary questions
- The core study design has some flexibility, but general principles should be maintained across all sites

# Core Management Questions

Concept-Driven



Will adaptation approaches and treatments work in a real-world context to **meet local management goals** and objectives?



How **feasible** are the treatments silviculturally, as well as in terms of financial, social, or other management constraints?



How does our **idea of desired future conditions (DFCs) change with each treatment type?**



What does it mean to deliberately create a future-adapted ecosystem, and **why would a manager choose to do this?**



**What tradeoffs exist** between achievement of adaptation objectives and other common objectives for a given region and ecosystem type?

# Core Scientific Questions

Hypothesis-Driven



Do the treatments create significant changes to forest conditions over time at a particular site, and **how do treatments compare across sites?**



How do hypothesized treatment responses (DFCs) compare with actual **responses observed in the future?**



Do these treatments achieve what they were designed for?



What **criteria** emerge to enable managers to identify which treatments perform best?



Does one type of treatment (resistance, resilience, transition, or no action) consistently **perform better across all sites?**

# KEY MONITORING VARIABLES ACROSS THE NETWORK

Key Response Variables to be collected at each ASCC site

	<b>Species Composition</b>	<b>Forest Health</b>	<b>Productivity</b>
<b>Overstory</b>	Species richness Species diversity Relative density Relative dominance	Mortality Crown density Crown dieback Live crown ratio Tree damage (DSI)	Biomass increment Basal area increment
<b>Midstory</b>	Species richness Species diversity Relative density Relative biomass	Relative density or biomass of invasive species	Biomass increment
<b>Ground Layer</b>	Species richness Species diversity Percent cover by species	Percent cover of invasive species	Biomass increment

## Other Suggested Variables for Monitoring:

- Leaf area index (plot center)
- Down woody debris
- Archived soil cores
- Forest floor samples
- Wildlife



Photo Credit: Chris Woodall

# ASCC Plot Design

## Small Tree Plot (Adv Regen) (3)

0.004 ha (1/100<sup>th</sup> ac)

Radius 3.59 m (11.8 ft)

Measuring  $\geq 30$ cm tall to  $\leq 8.9$  cm dbh  
( $\geq 1$  ft tall to  $\leq 3.5$  in dbh)

\*8m from plot center at 0, 120 and 240°

Class I 1 – 4.5 ft in ht

Class II > 4.5 ft ht – 0.5 in DBH

Class III 0.6 – 1.5 in DBH

Class IV 1.6 – 2.5 in DBH

Class V 2.6 – 3.5 in DBH

## Shrub Plot (2)

5 m<sup>2</sup>

Radius 1.26 m (4.13 ft)

Tally by species

LAI and Photos

## Ground Layer Plot (3)

1 m<sup>2</sup>

Measuring herbaceous and woody spp  
< 30 cm (1 ft) tall

\*4m from plot center at 60, 180, and 300°

## Mid-Tree Plot (Sapling) (1)

0.04 ha (1/10<sup>th</sup> ac)

Radius 11.34 m / 37.2 ft

Measuring 8.9 to 12.6 cm dbh  
(3.5 to 7.4 in dbh)

## Annular Plot (1)

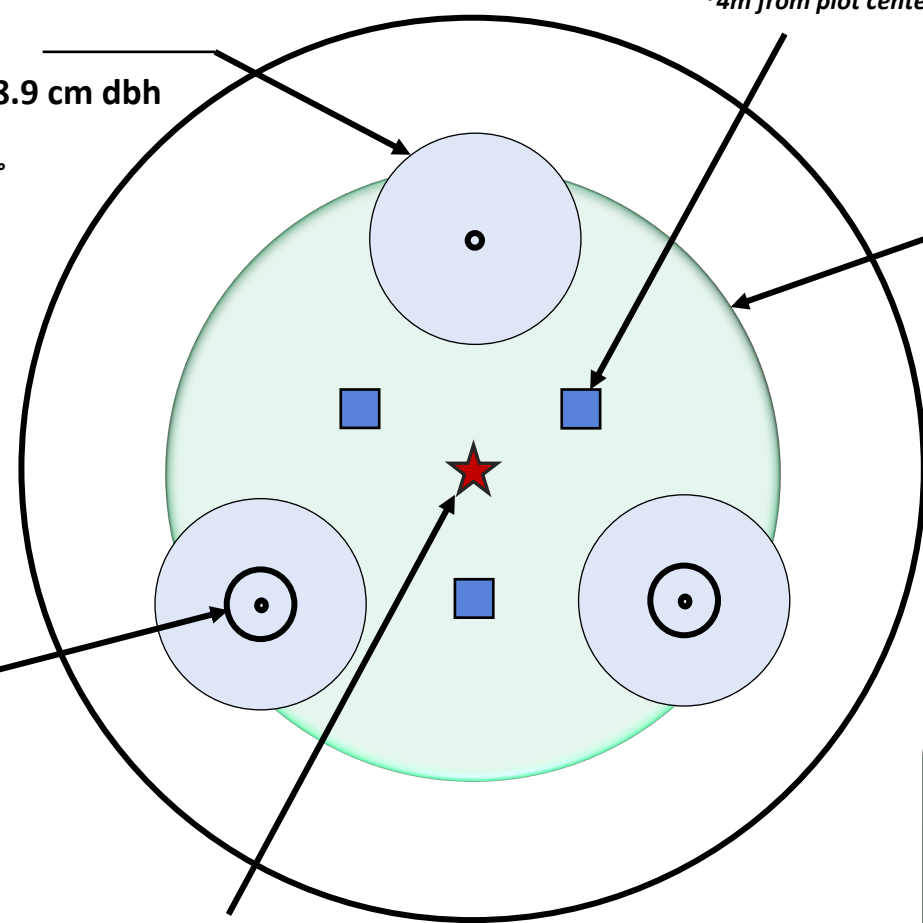
0.08 ha (1/5<sup>th</sup> ac)

Radius 16.1 m / 52.7 ft

Measuring  $\geq 12.7$  cm / 7.5 in dbh  
*\*Species, Ht, DBH, snags + decay class, forest health metrics*

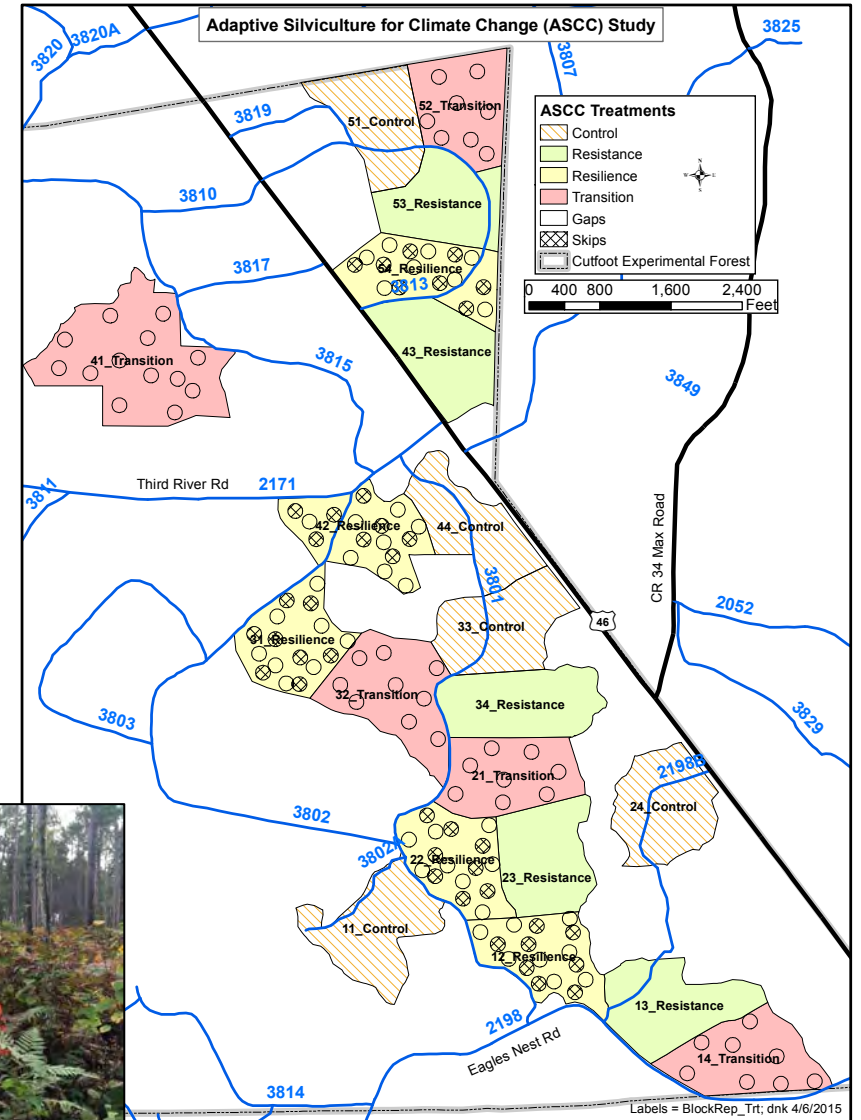
## Key Response Variables Monitored Across All Sites (Overstory and Understory):

- Species composition, density, diversity, etc.
- Forest health (mortality, local indices)
- Productivity (increment, biomass)



# Cutfoot Experimental Forest, MN

- 4 treatments
  - ~10 ha each, 202 ha total (500 ac)
- 5 replicated blocks
- 170 vegetation plots
  - No Action and Resistance: 7 each
  - Resilience: 3 gaps, 3 skips, 5 matrix
  - Transition: 3 gaps, 6 matrix
- 40 microclimate plots
- 4 predominant overstory conditions
  - Skips, High residual BA thinned, Low residual BA thinned, Gaps
- 9 species planted (resilience gaps and throughout entire transition treatment)



# MEASUREMENT FREQUENCY

Variable	ASCC Suggestion	Group Ideas
Overstory Layer	1, 3, 5, 10, 15, 20, etc.	
Sapling Layer	1, 3, 5, 10, 15, 20, etc	
Shrub & Seedling Layers	1, 3, 5, 10, 15, 20, etc	
Ground Layer	1, 2, 3, 5, 10, 15, 20, etc	
Forest Health Indicators	1, 2, 3, 5, 10, 15, 20, etc	
LAI	1, 5, 10, 15, 20, etc	

**Note:** Times listed indicate post-treatment measurements.

A pre-treatment measurement may also be required for many variables.

# ASCC PROJECT TIMELINE – KEY EVENTS

Event	Timeframe
Finalize ASCC treatment details	
Is pre-treatment data needed at this stage?	
Select final treatment locations	
Assign treatments to locations	
Develop formal prescriptions	
Environmental assessments	
Order tree seedlings	
Finalize monitoring details	
Pre-treatment sampling (research focus)	
Implement silvicultural treatments (detail steps)	
Year 1 post-treatment sampling	