

Kaibab Fire & Climate Change Adaptation Workshop



February 11 – 13, 2020

Elks Lodge, 2101 N San Francisco St, Flagstaff, AZ 86001

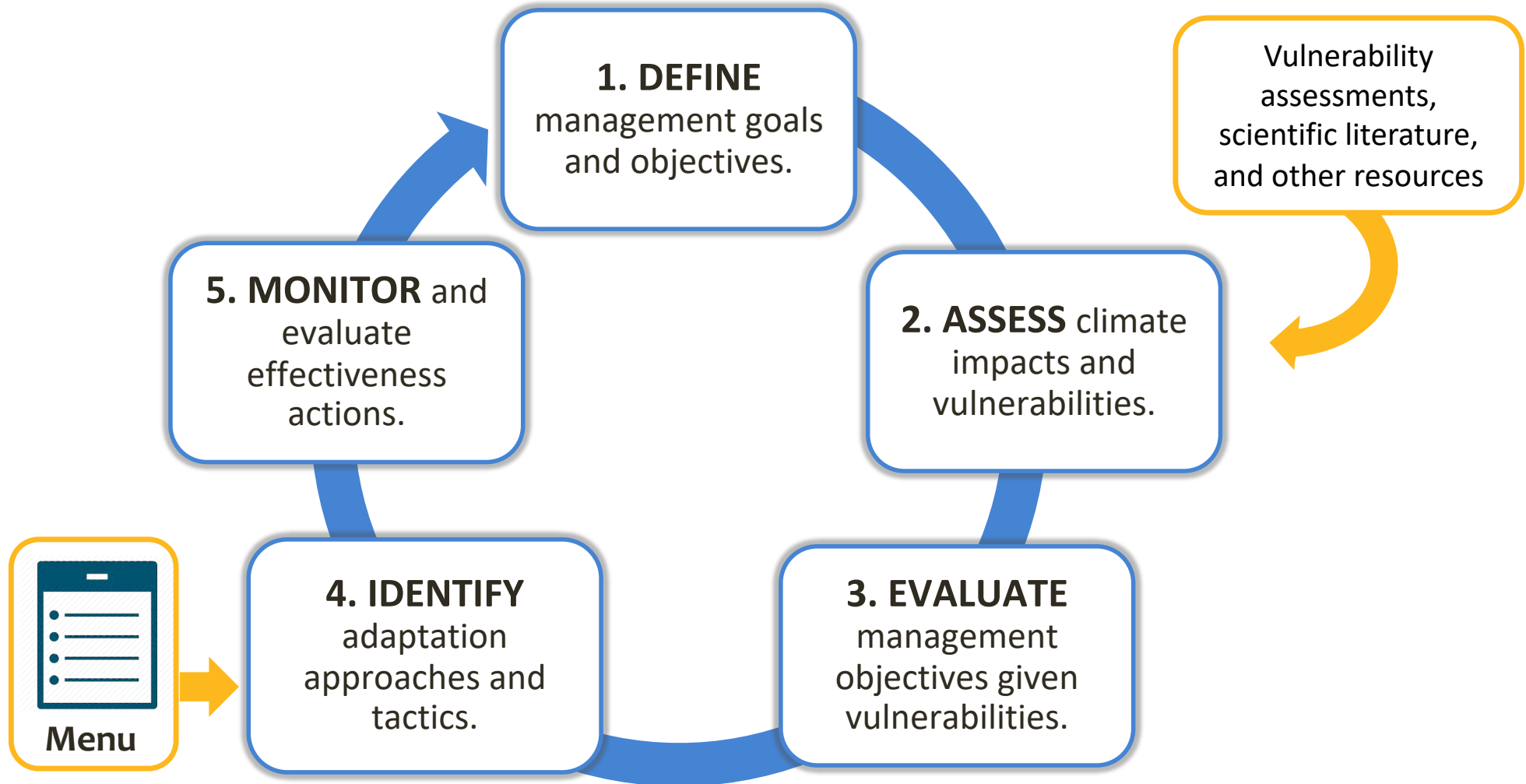


Workshop Goals

- Review regional and local effects of climate change on fire in forest ecosystems
- Explore resources and tools that can be used to integrate climate change into management
- Understand adaptation concepts and principles in the context of sustainable forest and fire management
- Identify challenges and opportunities for fire managers
- **Develop actionable steps to adapt forests to changing fire regimes**



Agenda Overview



Adaptation Workbook

Structured process to identify adaptation actions

Step 1

Forest Action Plan Theme	Forest Type(s)/Key Species	Management Goals	Management Objectives	Time Frames

Step 4

Adaptation Actions			Benefits	Drawbacks/Barriers	Recommend Tactic?
Strategy/Approach (From Chapter 3)	Tactic	Time Frame			

Worksheets! Worksheets! Worksheets! Worksheets!

Intentionality

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



Introductions!

- Name
- Organization
- What is one thing you are hoping to get out of the workshop?



Northern Institute of Applied Climate Science (aka NIACS)

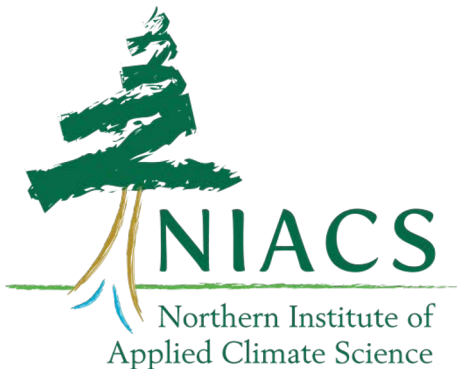
**Chartered by USDA Forest Service, universities,
non-profit and tribal conservation organizations**

Climate and carbon services

- Climate impacts modeling
- Vulnerability assessment
- Climate adaptation
- Carbon biogeochemistry
- Carbon management

20 staff members (Forest Service/universities)

- 9 climate outreach specialists
- 6 research scientists
- 2 web specialists
- 3 GIS/lab specialists



Michigan
Technological
University



AMERICAN FORESTS



The
UNIVERSITY
of VERMONT



College of Food, Agricultural
and Natural Resource Sciences
UNIVERSITY OF MINNESOTA



Climate Change Response Framework

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

- 
- **Forests**
 - **Urban forest**
 - **Forested watersheds**
 - **Tribal perspectives**
 - **Wildlife**
 - **Wetlands**
 - **Carbon**
 - **Agriculture**

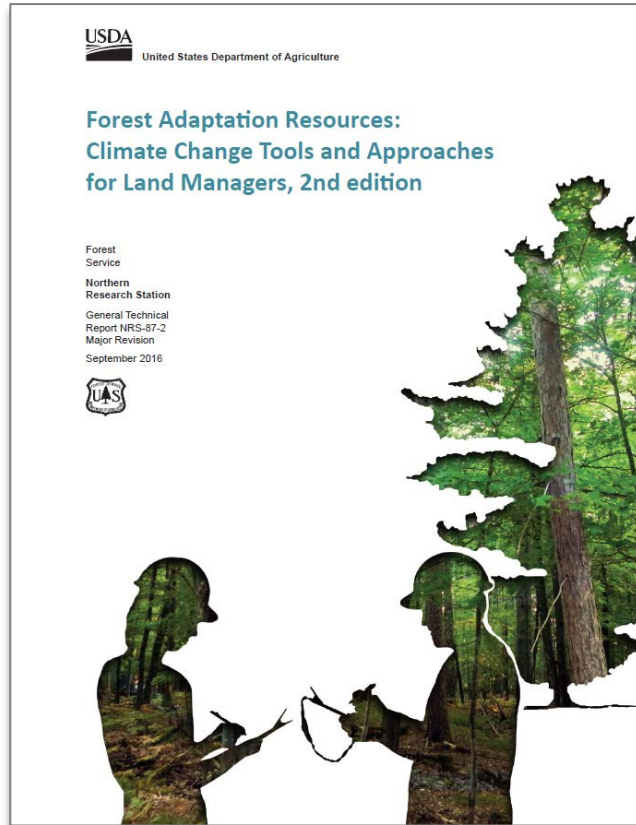
Impacts: Forest Ecosystem Vulnerability Assessments



- Written for land managers
- Focus on forest ecosystems
- **Assess vulnerability of**
 - Tree species
 - Forest/natural communities
- Examine a range of future climates

Does not make recommendations
Place based, model-informed,
expert-driven, transparent

Adaptation Planning Framework



Swanston et al. 2016 (2nd edition)
www.nrs.fs.fed.us/pubs/52760
(First edition, 2012)

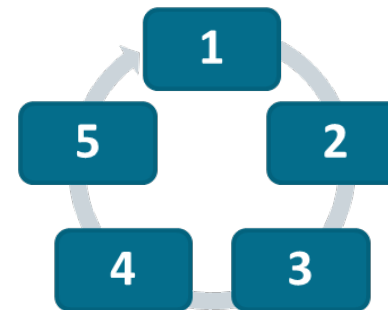
Strategies & Approaches Menus

Menu of adaptation actions



Adaptation Workbook

Structured process to
integrate climate
change considerations
into management.



Also online: AdaptationWorkbook.org



Fire
Menu

Tools for Climate Adaptation: Helping Managers Connect the dots

Management
Goals & Objectives

Climate Change
Impacts

Challenges &
Opportunities

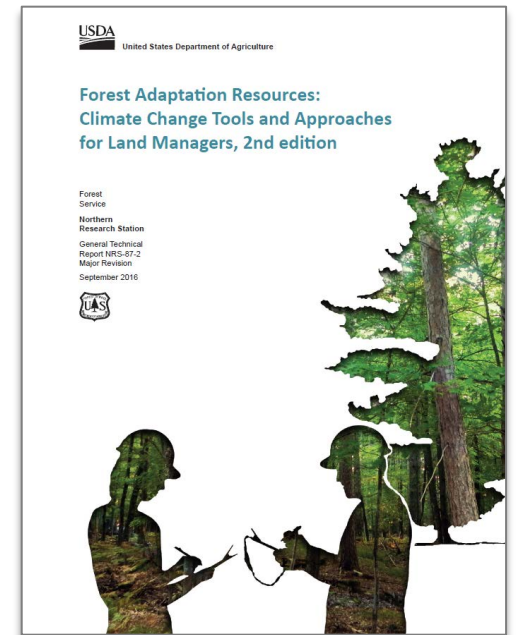
Intent of Adaptation
(Option)

Make Idea Specific
(Strategy, Approach)

Action to Implement
(Tactic)

Monitor
Effectiveness

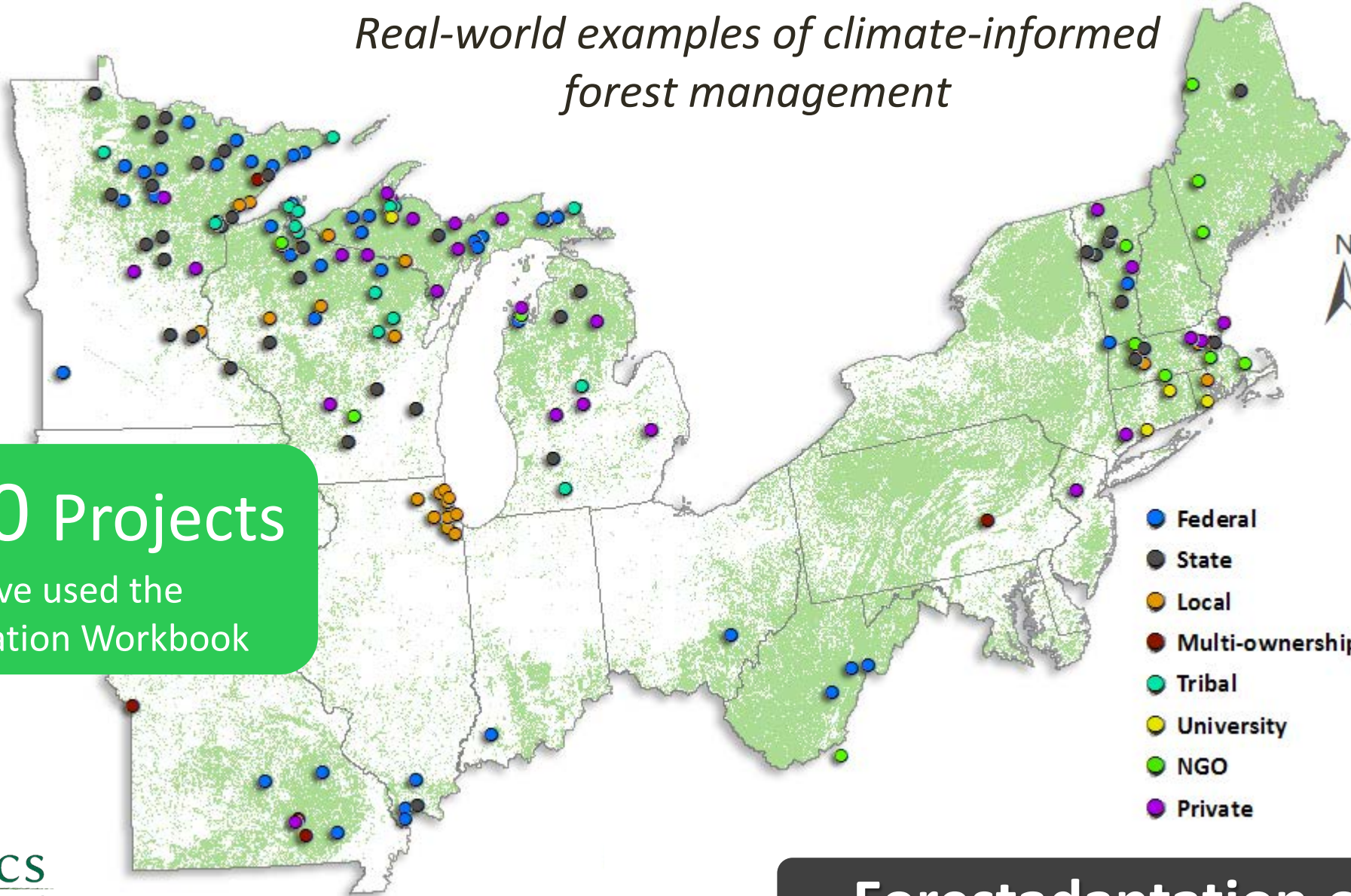
Why it's important:
Helps connect the dots
from **broad concepts** to
specific actions for
implementation.



Forest Adaptation Resources & Workbook
<https://www.nrs.fs.fed.us/pubs/52760>

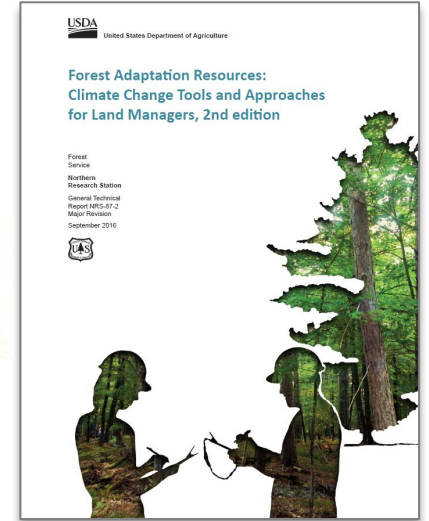
Local examples of adaptation

*Real-world examples of climate-informed
forest management*



+250 Projects

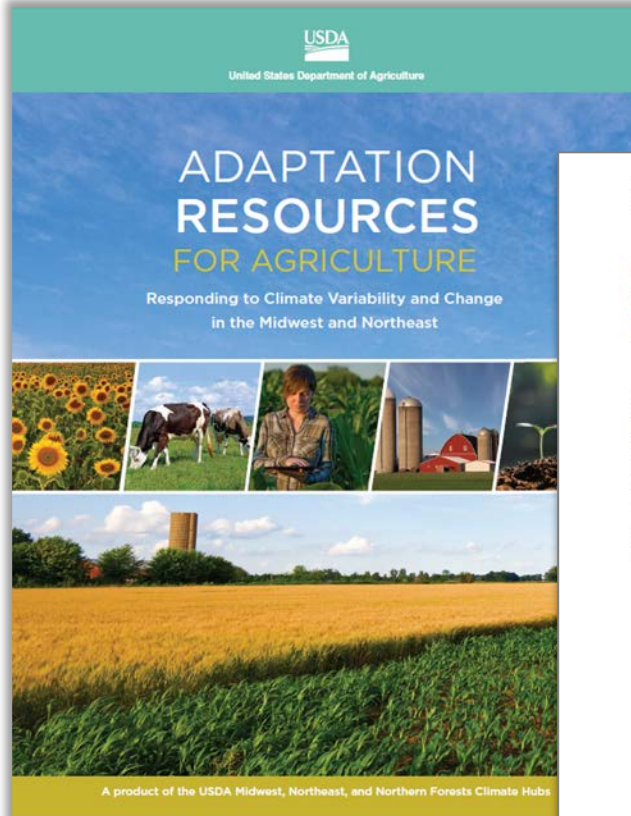
have used the
Adaptation Workbook



Adaptation Workbook

Adaptation Resources: Not just forests...

Expanding to more resource areas



Currently available:

- Forests
- Urban forests
- Agriculture
- Forested watersheds
- Tribes & cultural perspectives
- Forest Carbon management (in review)

In development:

- Wildlife Management
- Coastal habitats
- Grasslands



Step 1: DEFINE area of interest, management goals and objectives, and time frames.

Step 1: DEFINE location, project, and time frames.

Key Question:

- Where are you working?
- What are your desired future conditions, management goals, and objectives for this area?
- What is the timeframe?

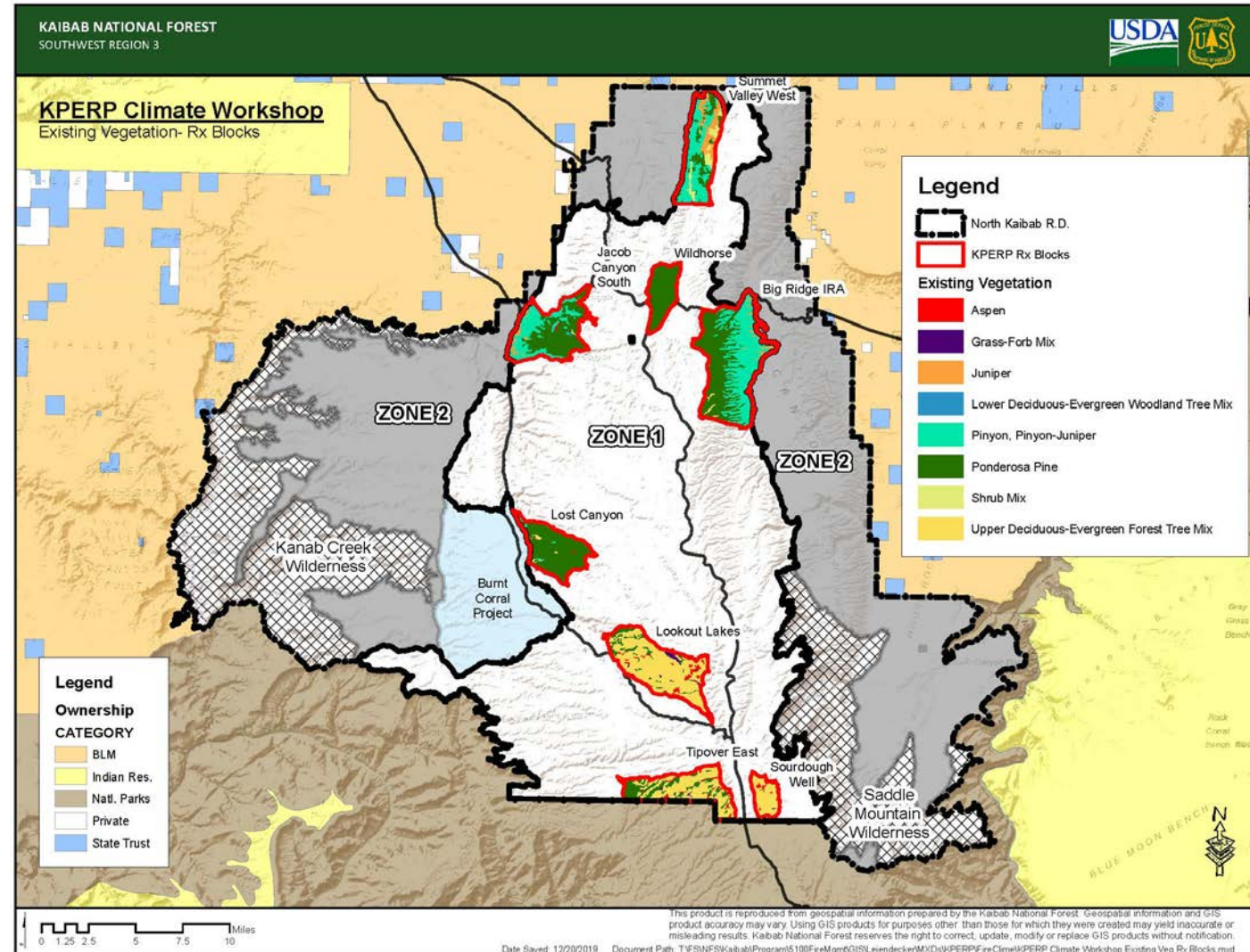
KEY DEFINITIONS (SAF DICTIONARY OF FORESTRY, 2018)

- **Management Goal** = a broad, general statement, usually not quantifiable, that expresses a desired state or process to be achieved
 - *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**
- **Management Objectives:** 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**

Step 1: Define Area of Interest

Implementation Units:

- Big Ridge IRA
- Wildhorse
- Lost Canyon
- Lookout Lakes
- Tipover East
- Sourdough Well
- Optional: Summit Valley West



Step 1: DEFINE location, project, and time frames.

Example:

Property or Project Area:		Jerktail Mountain glade and woodland	
Location:		Jerktail Mountain management unit, Pioneer Forest and Ozark National Scenic Riverway, 9 miles northeast of Eminence, Shannon County, Missouri	
Forest Type	Management Goals	Management Objectives	Timeframes
<ul style="list-style-type: none">▪ Woodland	<ul style="list-style-type: none">▪ Restore woodland to more natural conditions.	<ul style="list-style-type: none">▪ Reduce eastern redcedar encroachment.▪ Increase component of fire-tolerant species▪ Use variable intensity prescribed fire▪ Reduce stand density	<ul style="list-style-type: none">▪ Prescribed burns 3-4 years initially▪ Harvest every 20-30 years



Step 2: ASSESS site-specific climate change impacts & vulnerabilities

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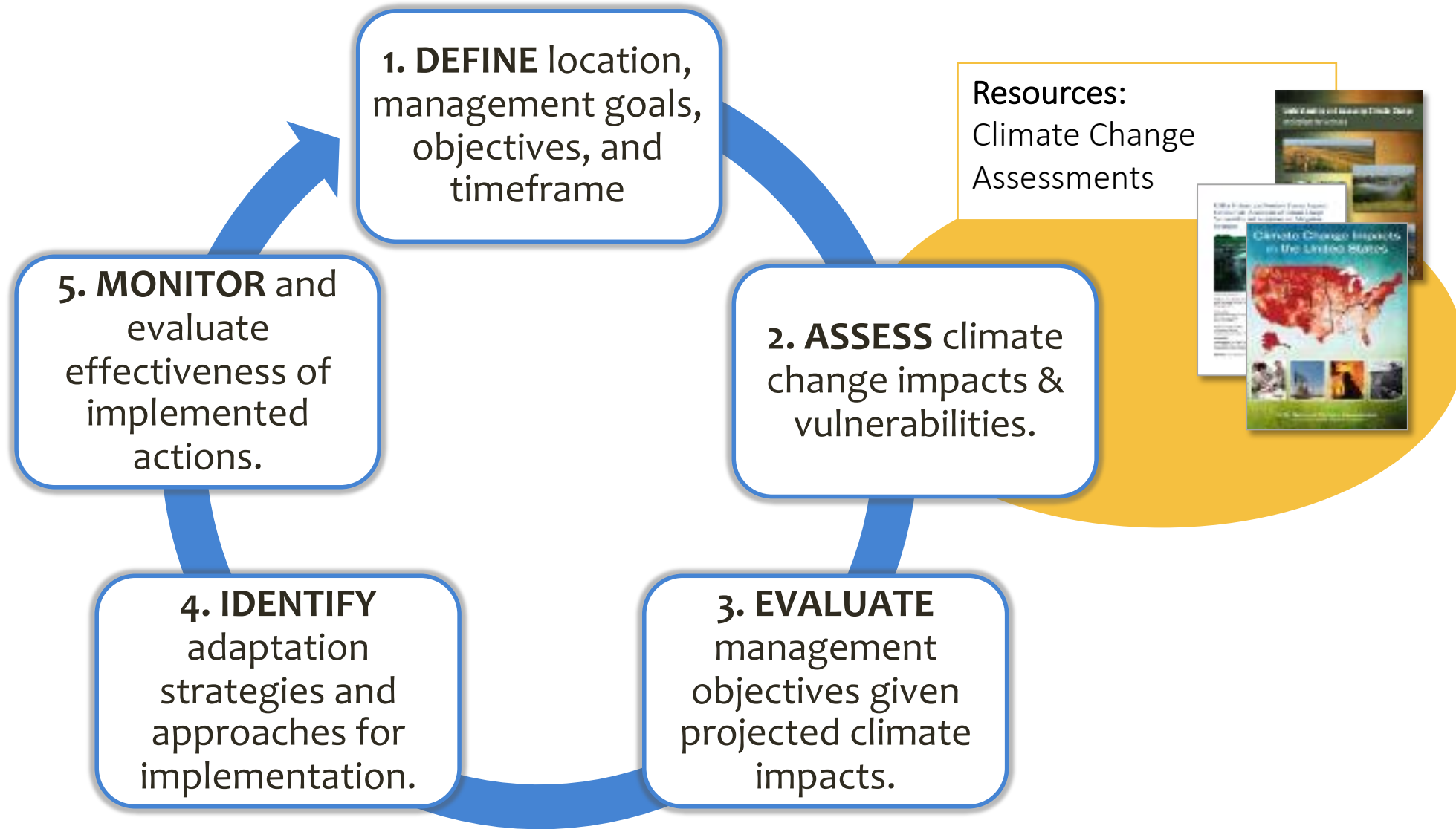
Purpose:

- Consider how climate change may specifically affect the project area

Key Questions:

- How might the area be uniquely affected by climatic change and subsequent impacts?
- How might regional impacts be different in the project area?

Workbook Cycle: Step 2



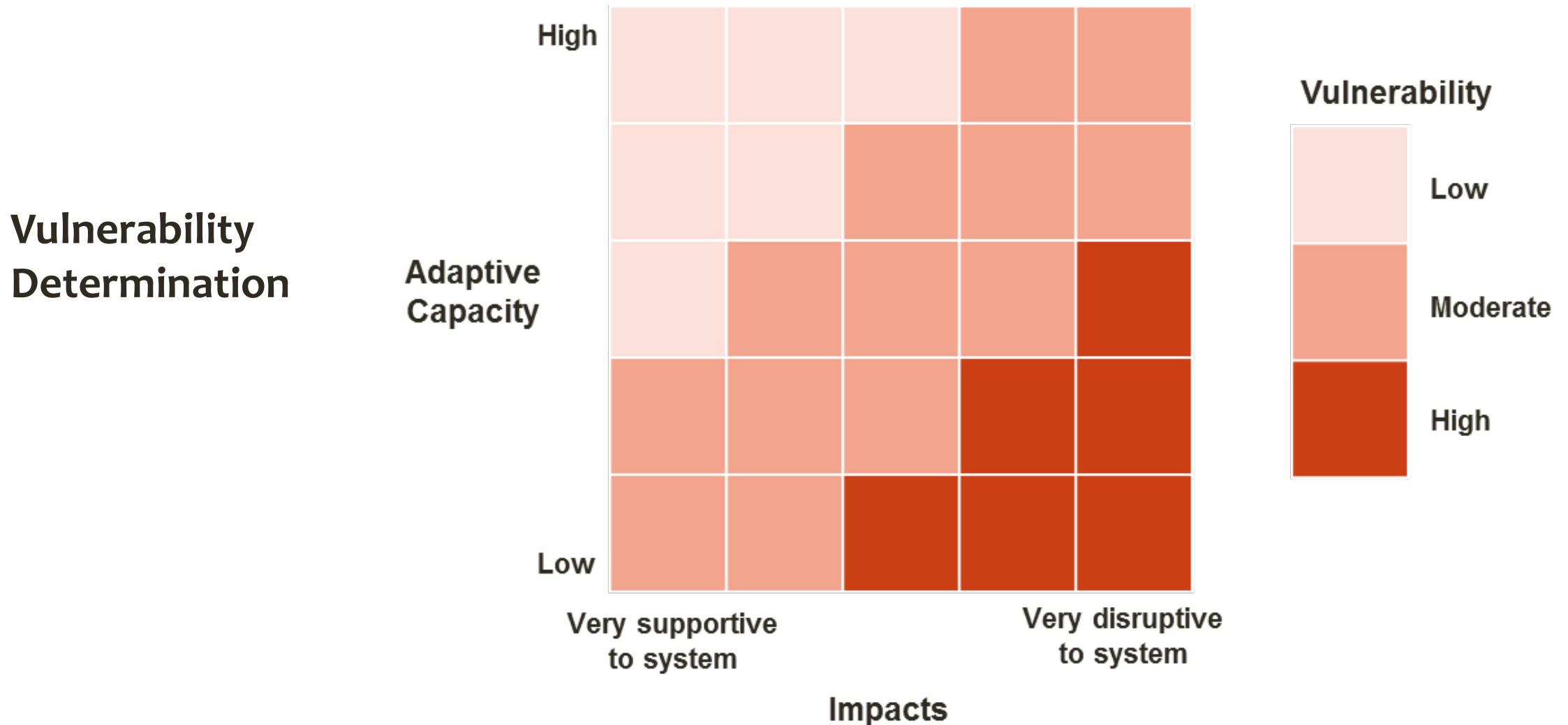
Step 2: ASSESS site-specific climate change impacts and vulnerabilities.

Regional Climate Change Impacts and Vulnerabilities

- From regional vulnerability assessments

Mgmt. Unit or Topic	Climate Change Impacts and Vulnerabilities	
	Regional	For the Property or Project Area
	<i>From vulnerability assessments</i>	<i>Based on your knowledge of the site</i>
Southwest	Increases in insect pests and forest pathogens	<i>Ips</i> bark beetle outbreaks in ponderosa pine could increase with warmer temperatures and longer growing seasons
	Changing fire regimes and fuel conditions	Longer than historical fire return intervals in both ponderosa pine and mixed-conifer forests on the Kaibab Plateau

Step 2: ASSESS site-specific climate change impacts and vulnerabilities.



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Example – Jerktail Mountain

Mgmt. Unit or Topic	Climate Change Impacts and Vulnerabilities	
	Regional	For the Property or Project Area
Woodland	Mean annual temperature increases from 2°F to 7 °F.	Common species, such as black, red, and scarlet oak are expected to be affected by drier summers. Some tree species are better adapted to warm and dry conditions, such as shortleaf pine and post oak.
	Increased precipitation in winter and spring and potential declines in summer.	
	Increased frequency and severity of wildfire.	Woodlands adapted to frequent, low-intensity fire, but not severe fire.

Step 2: Individual Work Time

- Read through impacts individually (add more if you have them)
- Write down local considerations that may make your area more less/vulnerable for each selected impact
- **You have 20 points.** Assign based on which would have the greatest impact to your project area.

Step #2 (Activity): Assess climate change impacts and vulnerabilities for the Kaibab Plateau.

General Climate Change Impacts and Vulnerabilities	Climate Change Impacts and Vulnerabilities on the Kaibab Plateau	Points (20 Total)
<i>General climate change impacts across the Southwest:</i>	<i>How might broad-scale impacts and vulnerabilities be affected by conditions in the <u>project area</u>?</i>	
Warmer temperatures (annual and seasonal)		
Increase in nighttime winter temperatures		
More days with extreme heat		
Fewer days with extreme cold		
Variable to decreased annual average precipitation		

Step 2: Small Group Discussion

- Work in your small groups to discuss which factors would have the greatest impact your project area based on point allocation
- Discuss local factors that led to your conclusion
- We will pass out 20 dots to represent your points
- All impacts are written on post-its.
- Decide on how as a group to assign your 20 points and place dots on the corresponding impact

Discussion

- What were some local considerations you discussed?
- How much did your group agree/disagree on what were the greatest impacts?
- Why did you think those were the most important impacts?
- How might these impacts differ between the short and long term?



Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.

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Purpose:

- Realistically assess the ability to meet goals and objectives under current management.

Key Question:

- What management challenges or opportunities might occur?
- Can current management meet management goals?
- Do goals need to change?

Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.

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

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

****Focus on challenges within control of your management (not global markets, policies, etc.)**

Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.

Feasibility – Can you meet your management objectives using current (business-as-usual) management actions?

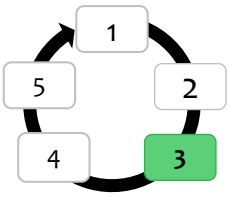
- **High:** We can do it!

Opportunities > Challenges

- **Low:** We'll need more resources or effort.

Challenges > Opportunities

Other Considerations – Social, financial, or other factors that also affect your ability to meet objectives.



Step 3: EVALUATE management goals given projected impacts and vulnerabilities.

Evaluate the feasibility of meeting your goals and objectives using current management.

Determine feasibility

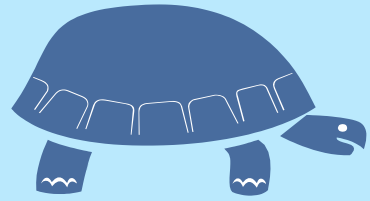
- Short term (10 yrs)
- Long term (50-100yrs)

High feasibility = Existing management options can overcome the challenges presented by climate change. **Opportunities likely outweigh challenges.**

Moderate feasibility = Some challenges have been identified, but challenges can likely be overcome using existing management options. **Additional resources or enhanced efforts may be necessary** to counteract key challenges or promote new opportunities.

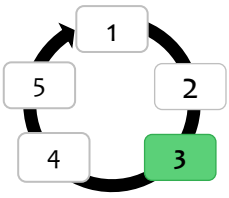
Low feasibility = Existing management may not be sufficient to overcome challenges presented by climate change. **Additional resources or enhanced efforts will be necessary** to counteract key challenges or promote new opportunities.

Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.

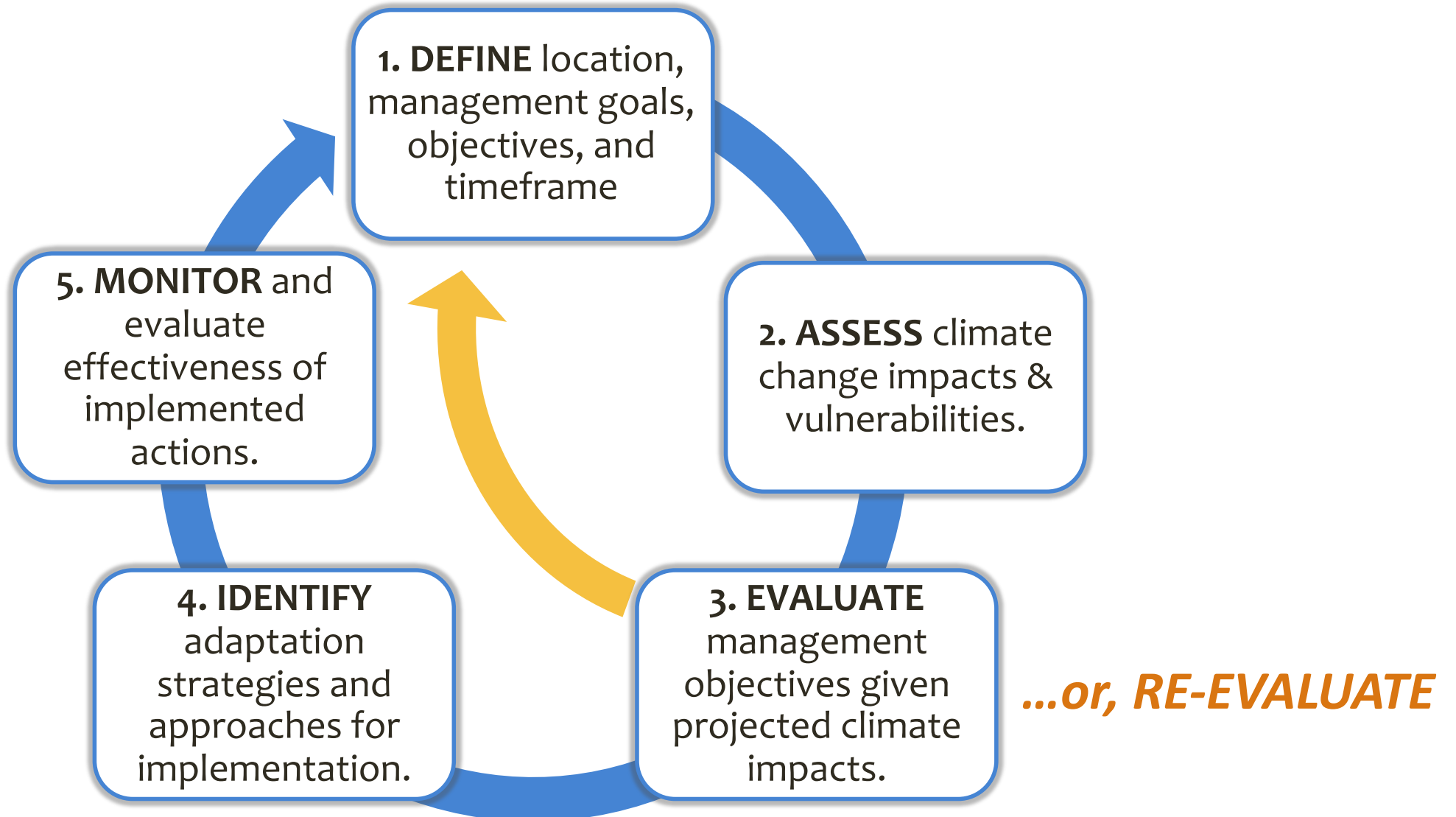


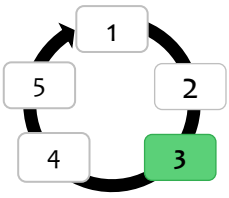
Slow down!

Are you going to continue with the management goals and objectives that you have identified?

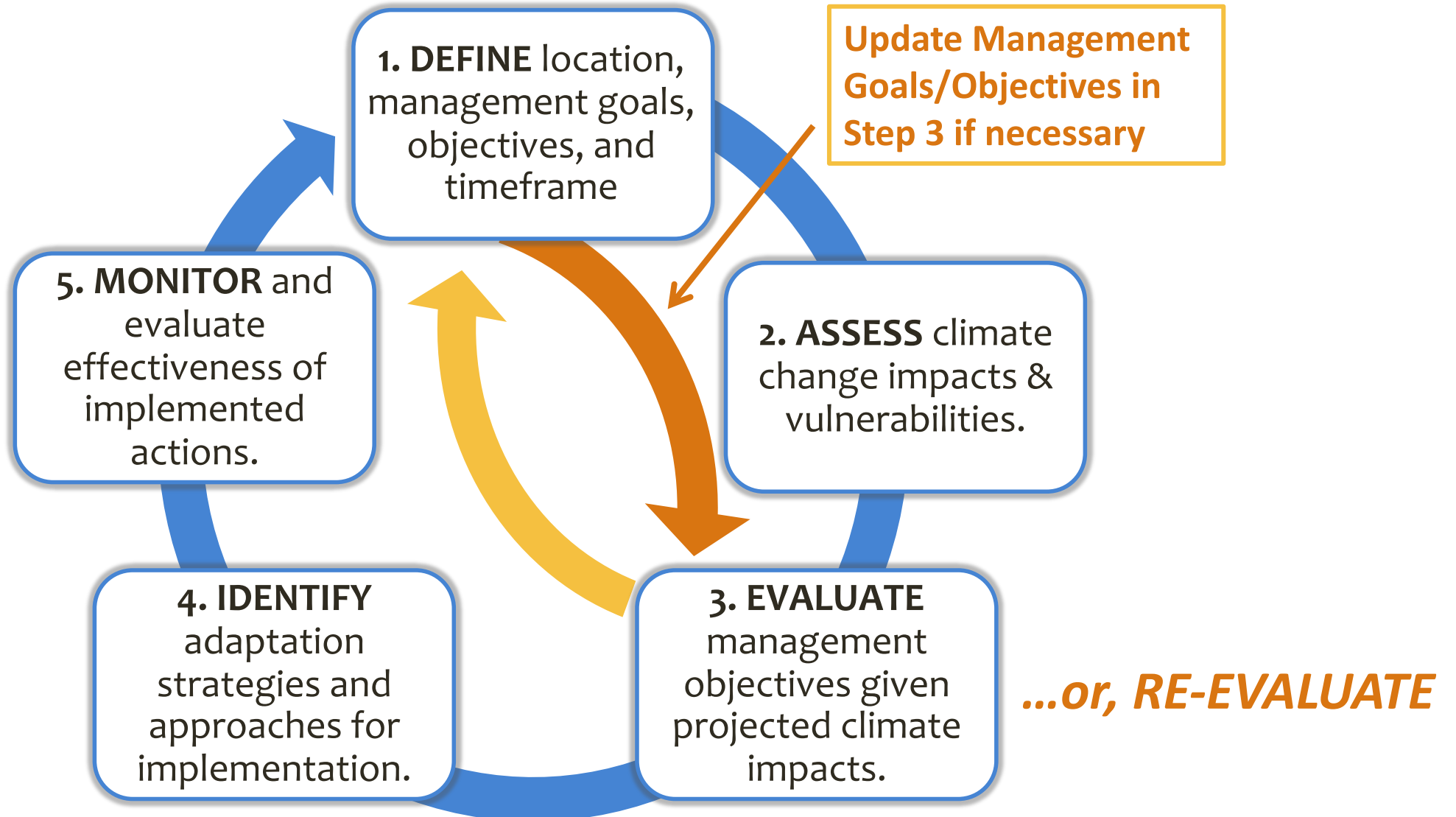


Step 3: EVALUATE management goals given projected impacts and vulnerabilities.





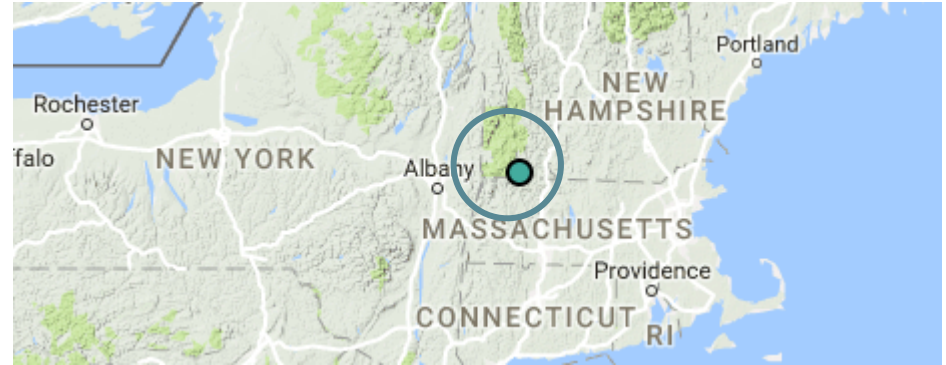
Step 3: EVALUATE management goals given projected impacts and vulnerabilities.



ADAPTATION EXAMPLE: TROUT UNLIMITED

North River Watershed

- 93 sq miles
 - 83% forest, 13% agricultural lands, and 4% urban
- Land owners:
 - State, land trusts, and private
- Current management issue:
 - Priority habitat and fisheries site that is vulnerable to destabilization and erosion.



Trout Unlimited & partners are working to help riparian forests and coldwater streams adapt to climate change.



Takemefishing.org

Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.

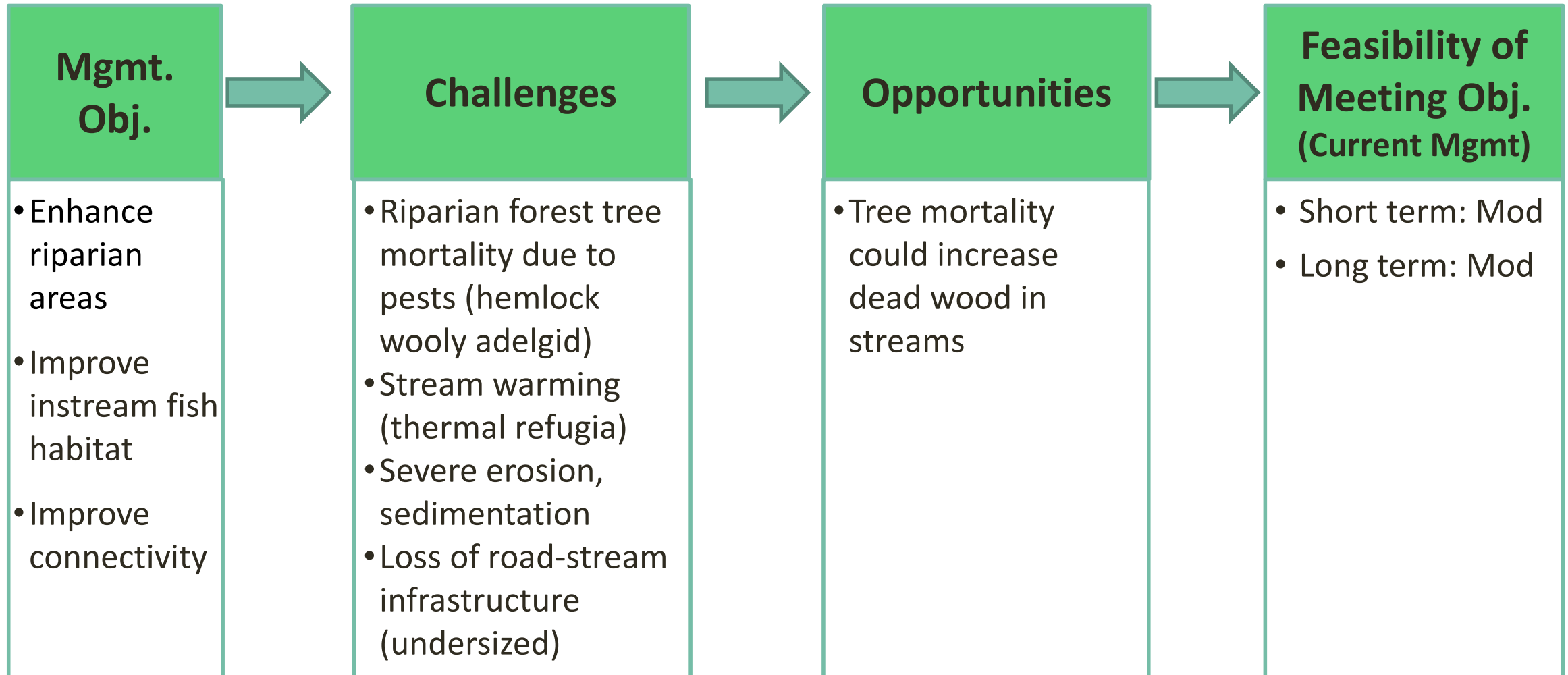


Goals

- Maintaining healthy and productive forests
- Maintaining and improving the integrity of the waters in the North River Watershed
- Improving stream connectivity and habitat quality for trout and other aquatic organisms
- Increasing the ability of streams and infrastructure to accommodate extreme precipitation events

More information: forestadaptation.org/tu-ne

Step 3: EVALUATE management objectives given projected impacts and vulnerabilities.



Activity

- *What are the 3 biggest challenges that you see for meeting your management objectives? (red stickies)*
- *What are the 3 biggest opportunities? (green stickies)*



Photo Credit: Josh Kragthorpe, USFS



Photo Credit: Wilfred Previant, CSFS

Feasibility Activity



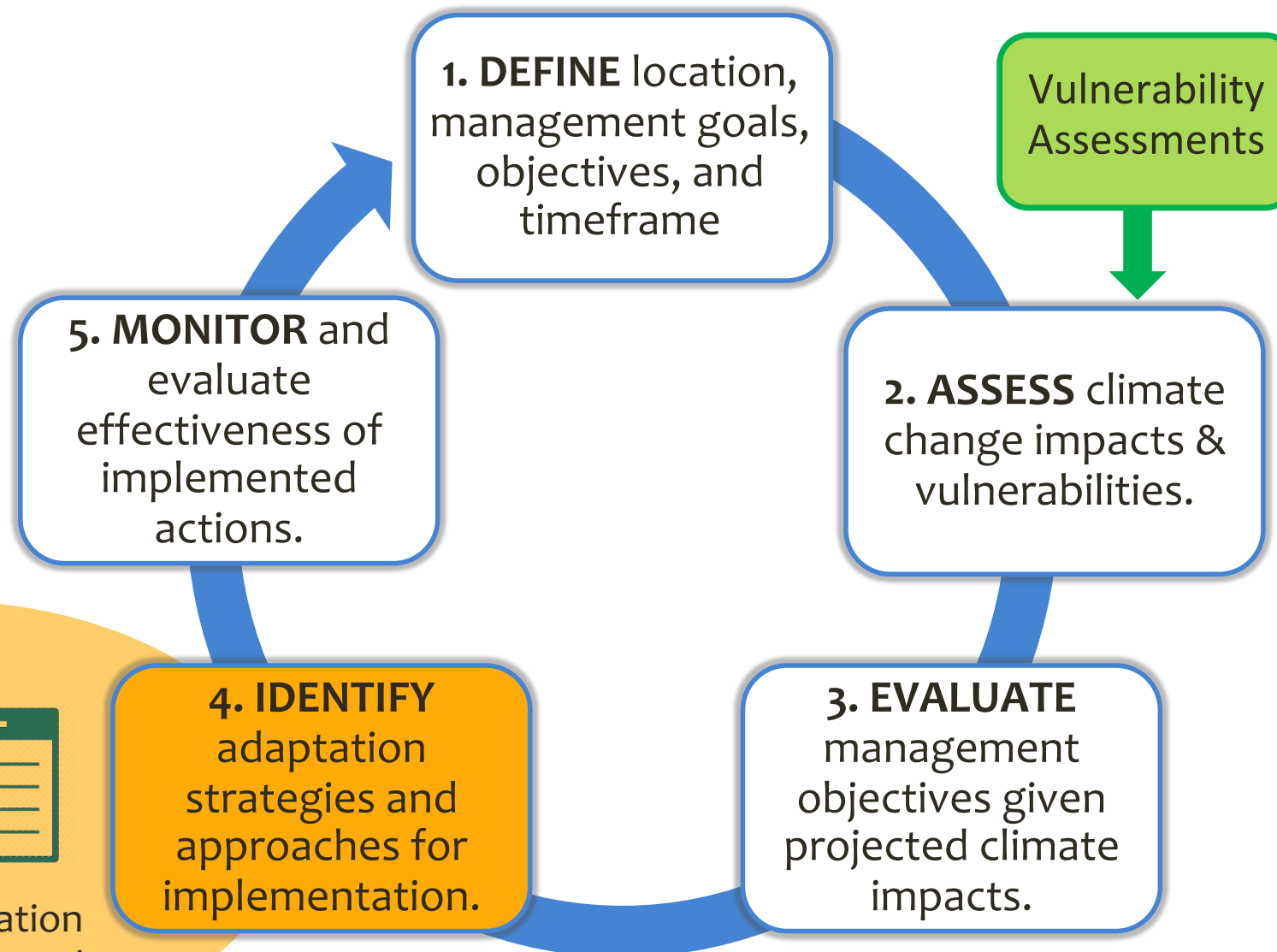
Low feasibility

High feasibility

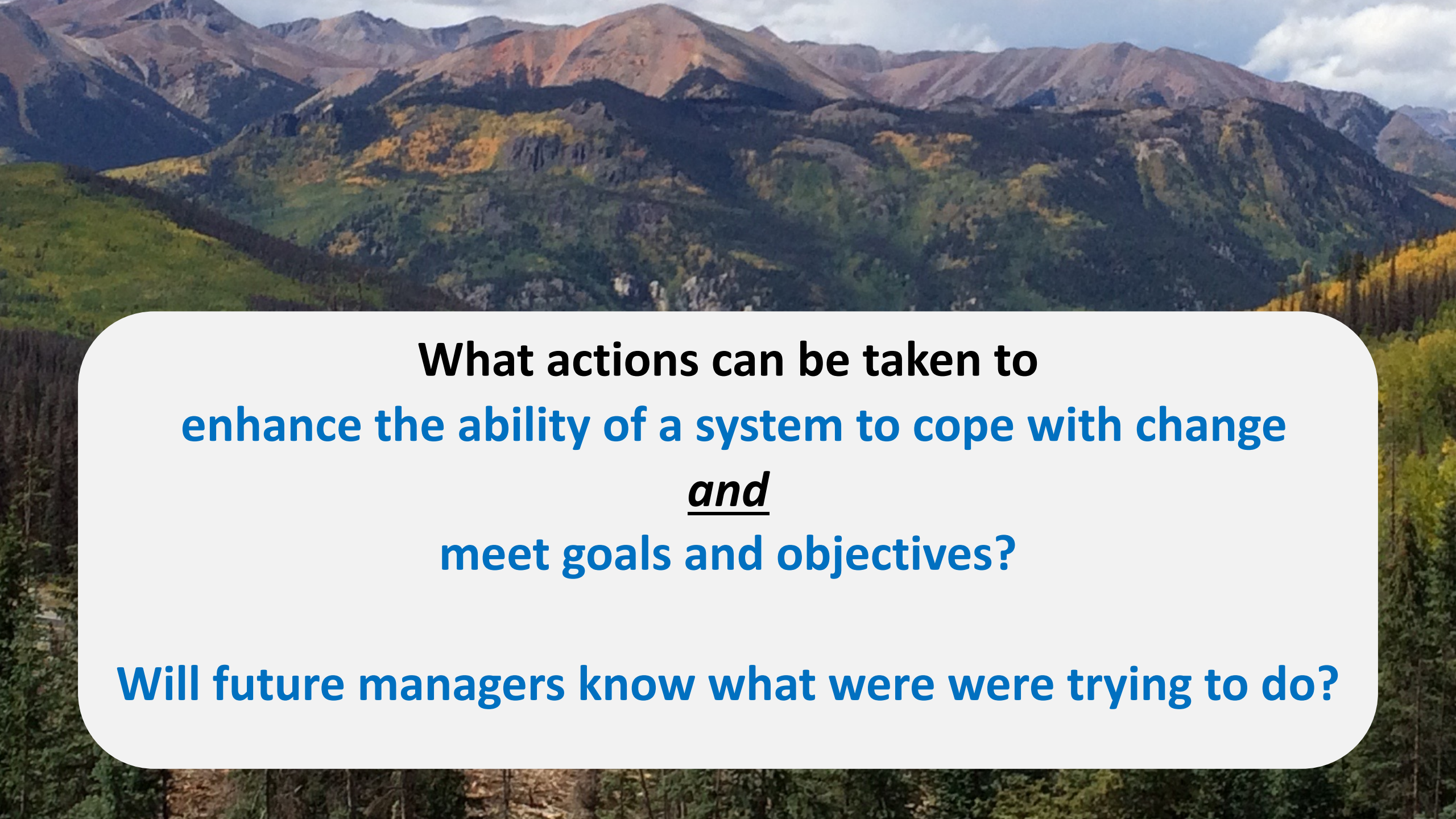


Step 4: Identify adaptation approaches and tactics for implementation

Adaptation Workbook Process



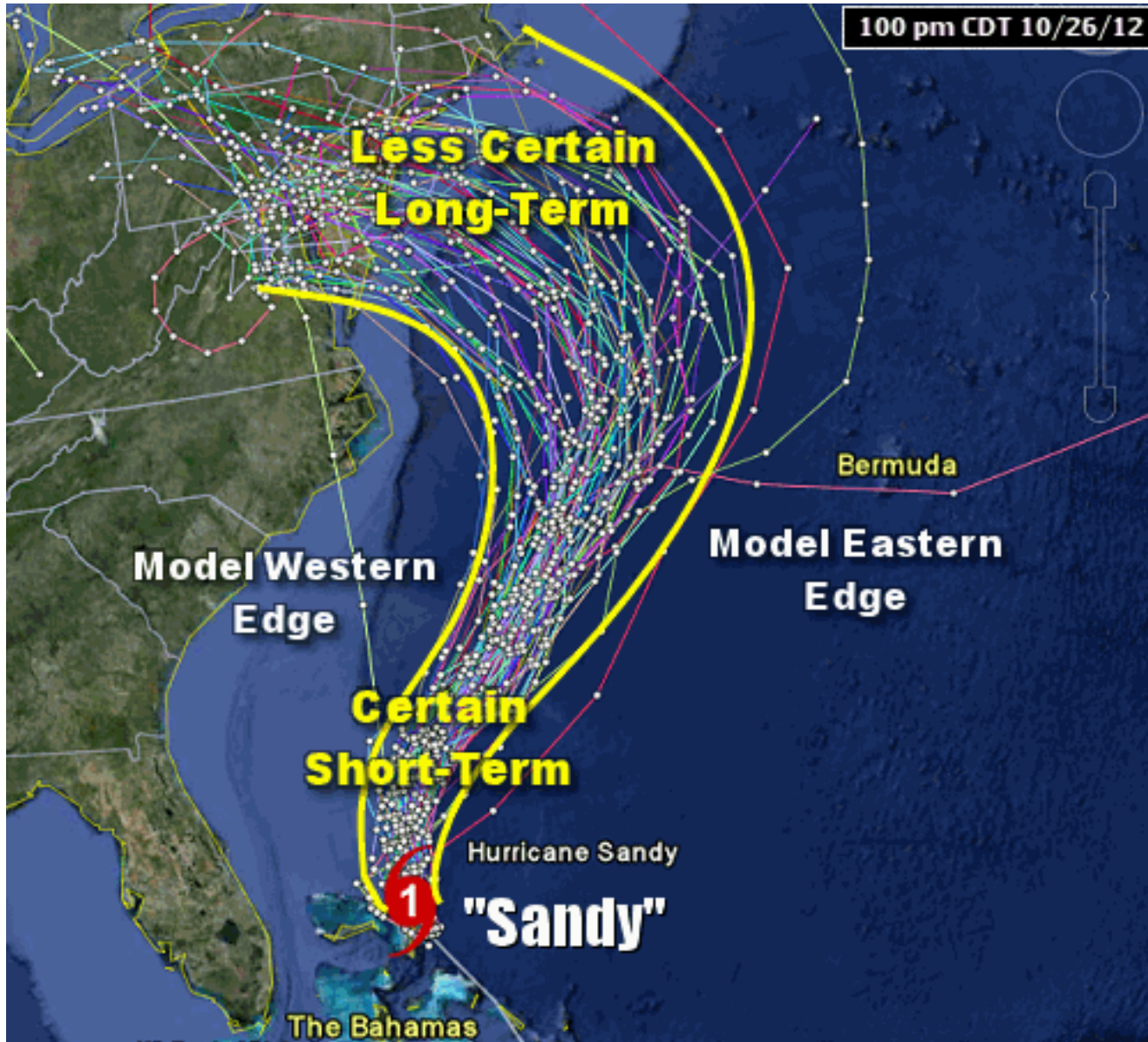
Resource: Adaptation Strategies & Approaches



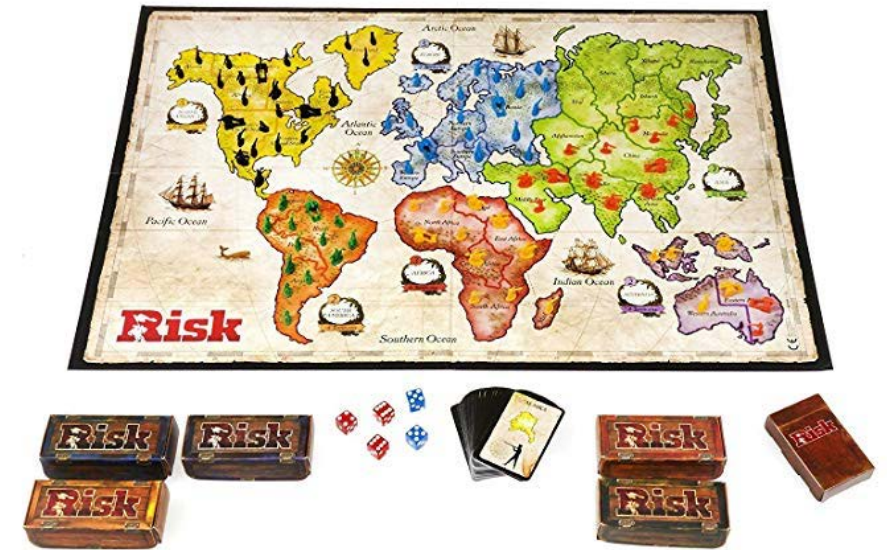
**What actions can be taken to
enhance the ability of a system to cope with change
and
meet goals and objectives?**

Will future managers know what we were trying to do?

We already deal with uncertainty!

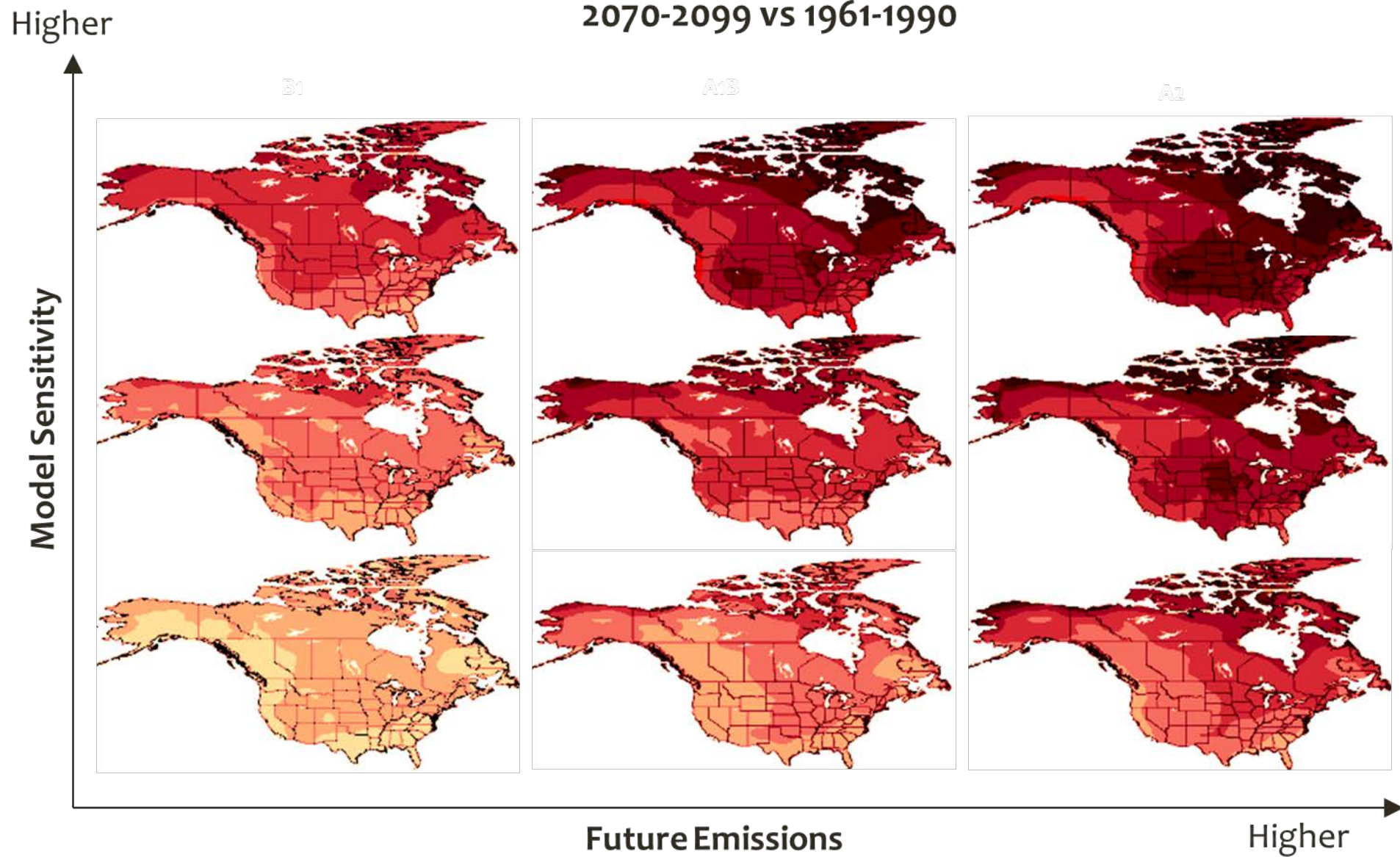


What is your risk tolerance?



“Plausible climate futures”

Change in Mean Monthly Temperature (° C)
2070-2099 vs 1961-1990

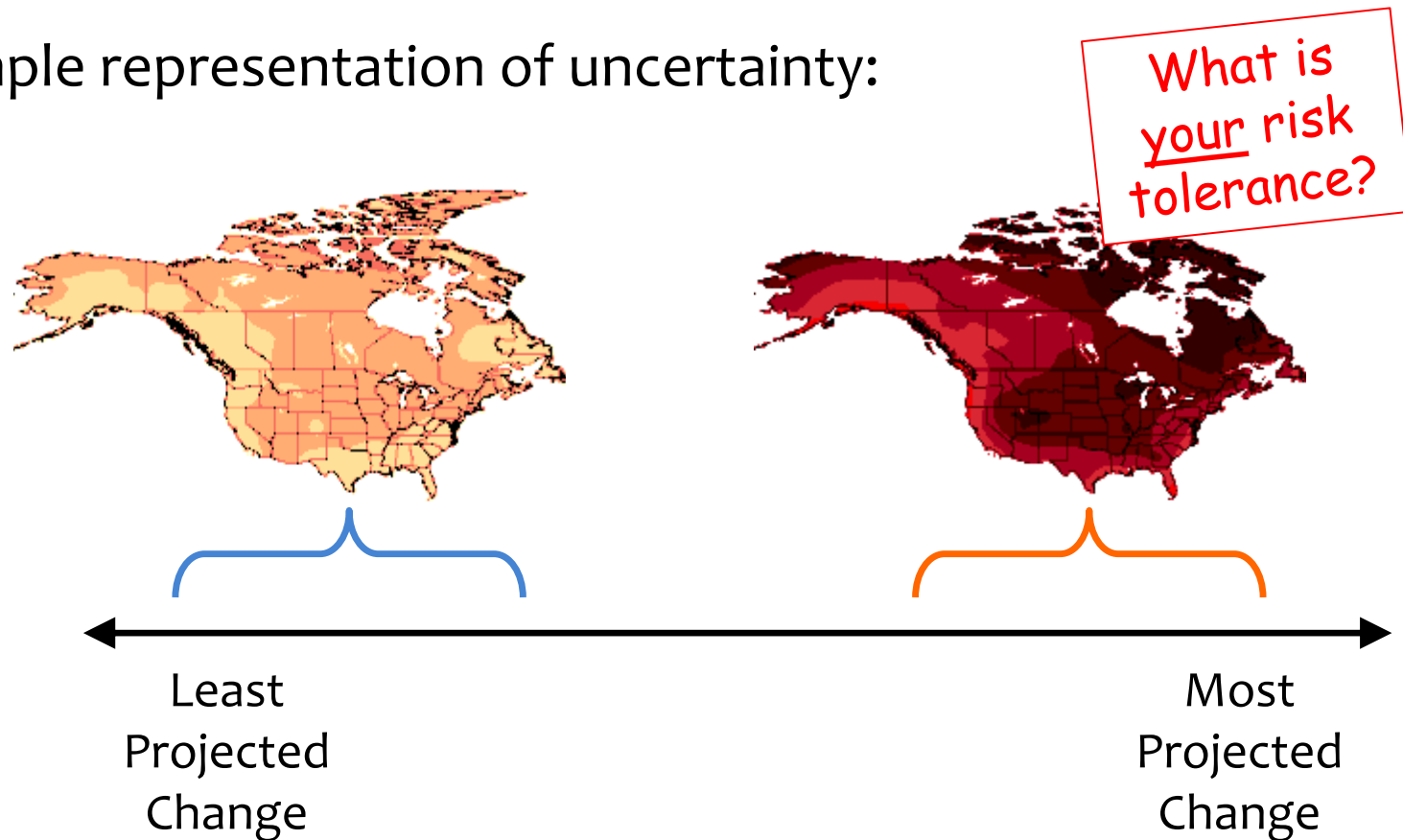


Uncertainty & Climate Scenarios

Certainty is a myth.

Embrace uncertainty and manage risk.

Simple representation of uncertainty:



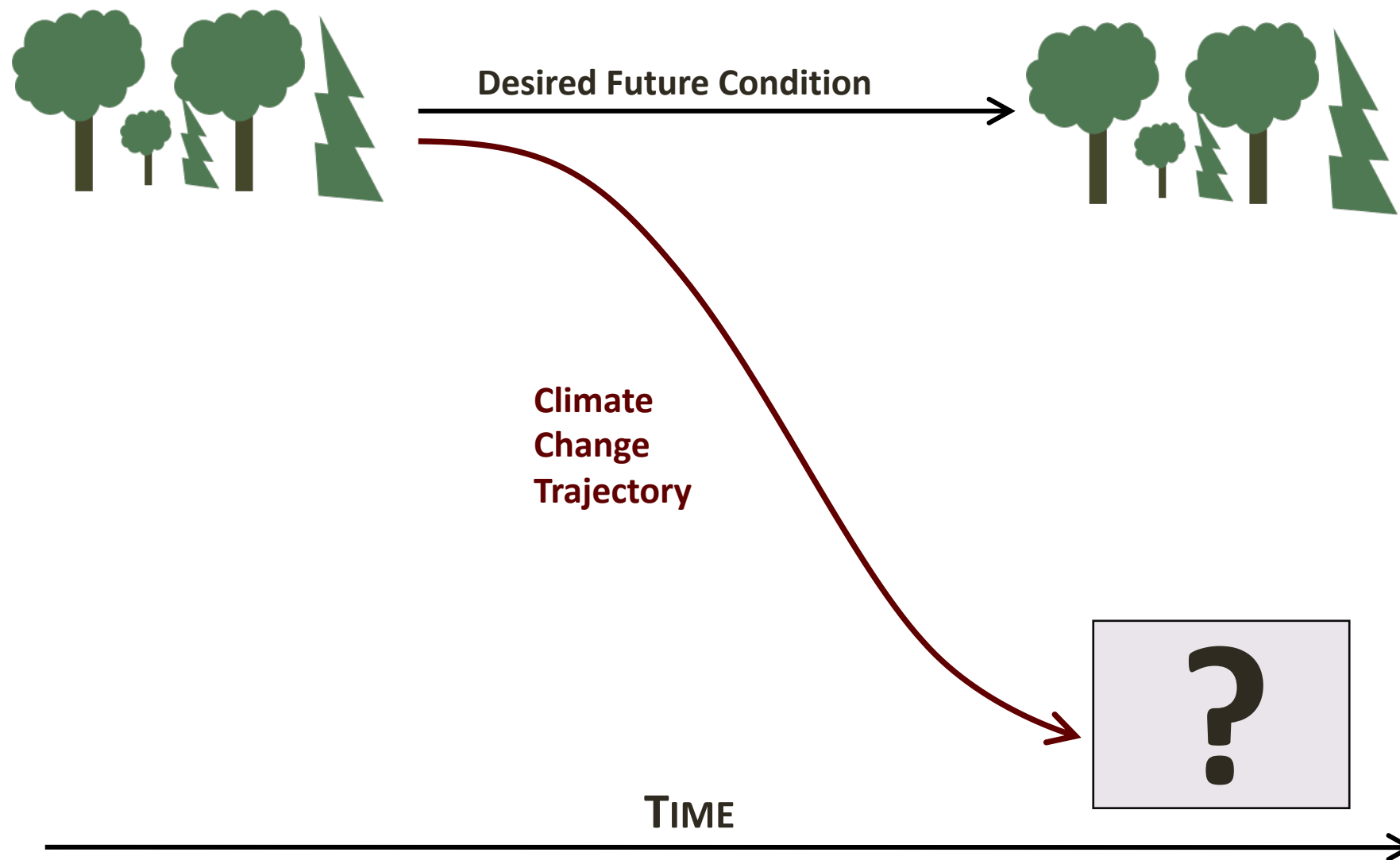
Adaptation - the adjustment of systems in response to climate change.



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

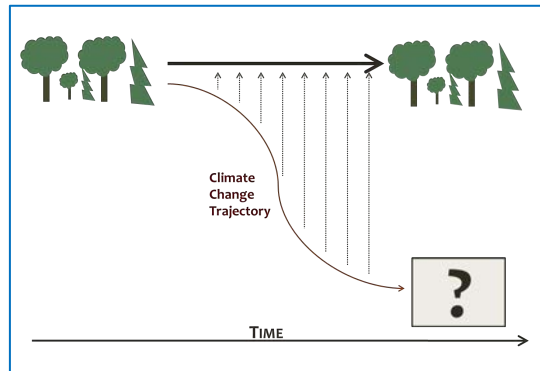


Adaptation Options

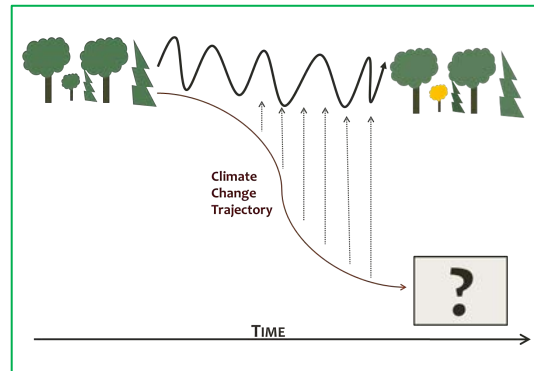
Manage for Persistence:

Ecosystems are still recognizable as being the same system (character)

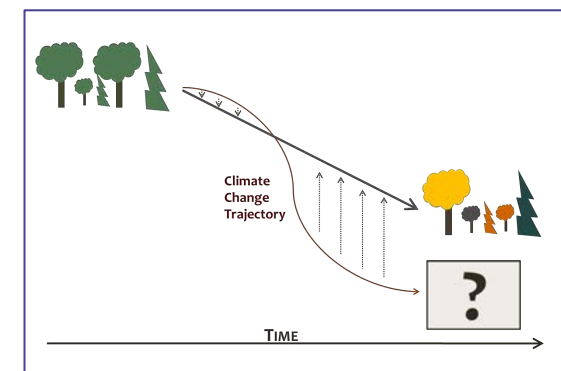
RESISTANCE



RESILIENCE



TRANSITION



Reduce impacts/ Maintain
current conditions

Forward-looking/
Promote change

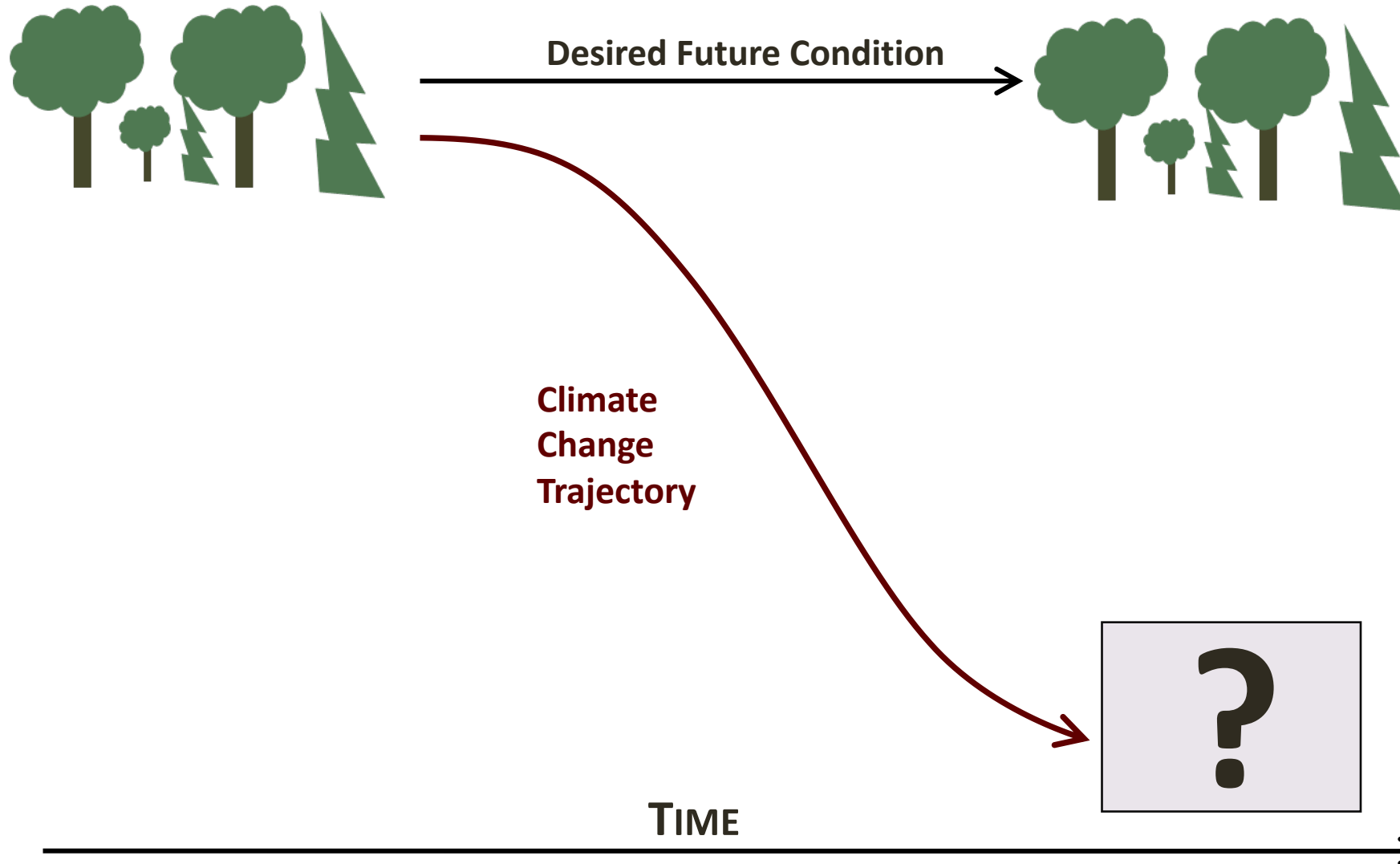


Option #1: Resistance

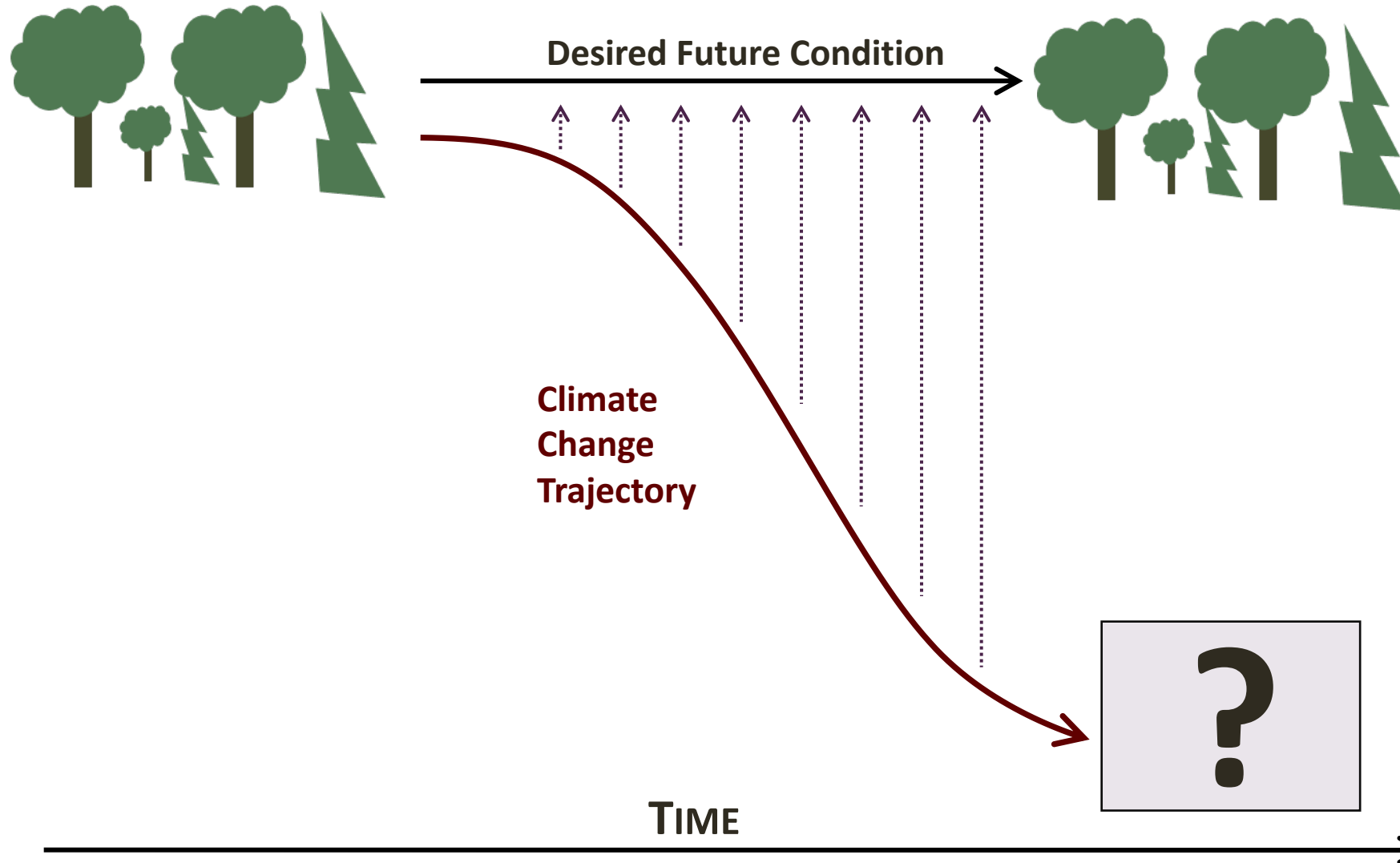
Improve the defenses of the forest against anticipated changes or directly defend the forest against disturbance in order to maintain relatively unchanged conditions

- Short-term
- High-value

Option #1: Resistance



Option #1: Resistance

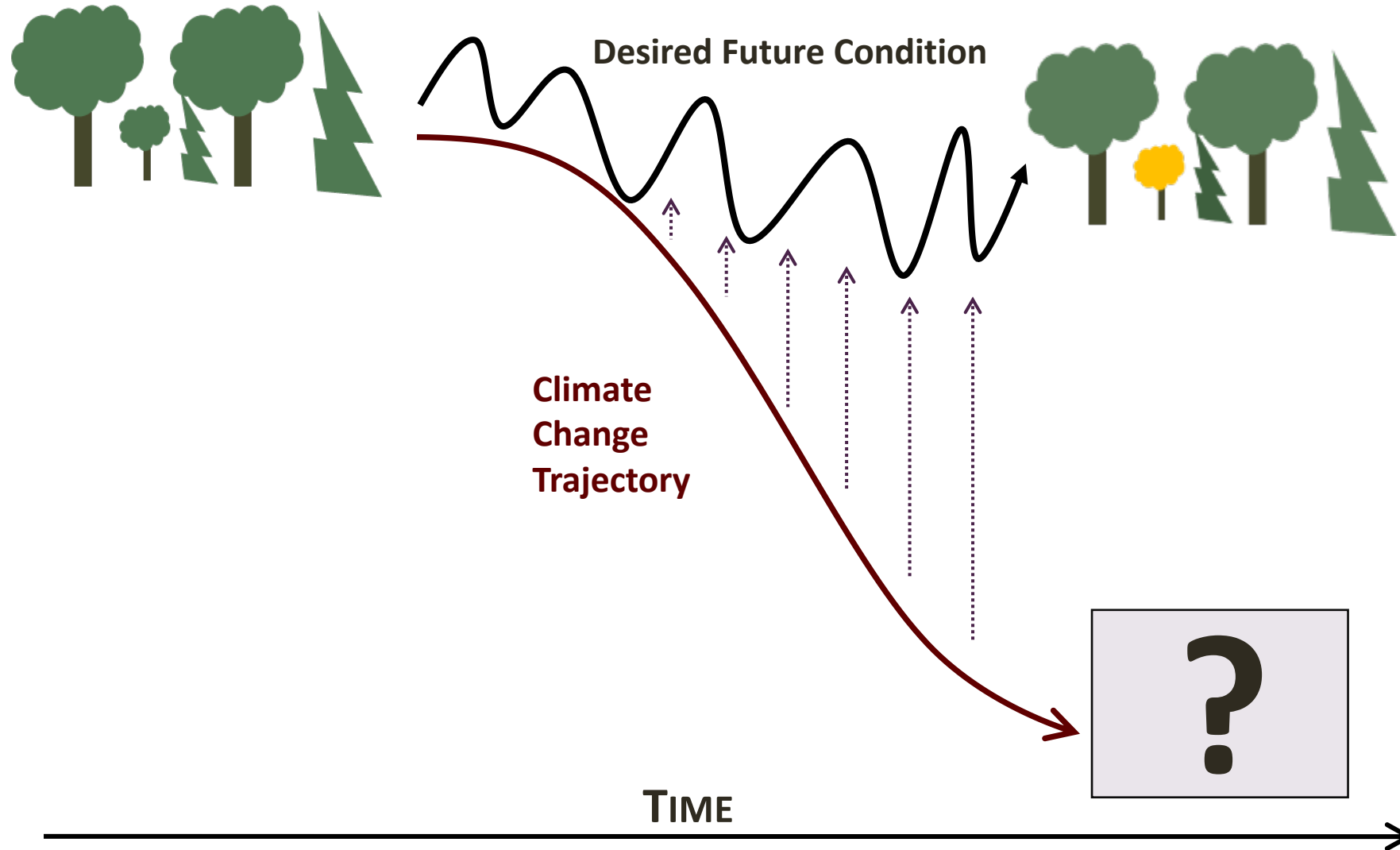


Option #2: Resilience

Accommodate some degree of change, but encourage a return to a prior condition after disturbance



Option #2: Resilience

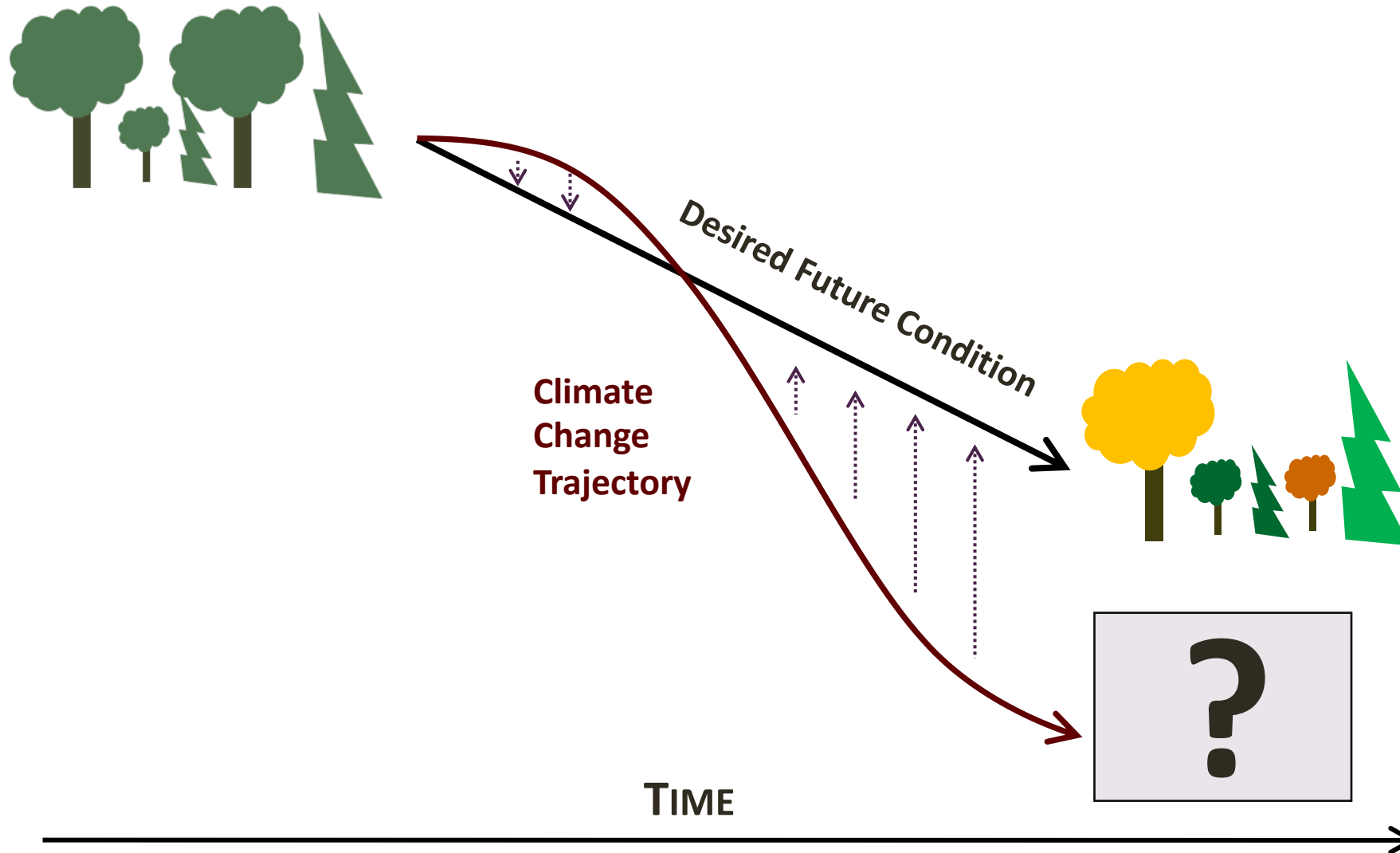


Option #3: Transition (Response)

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

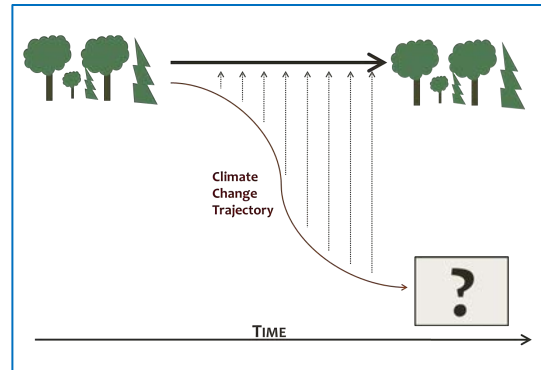


Option #3: Transition (Response)

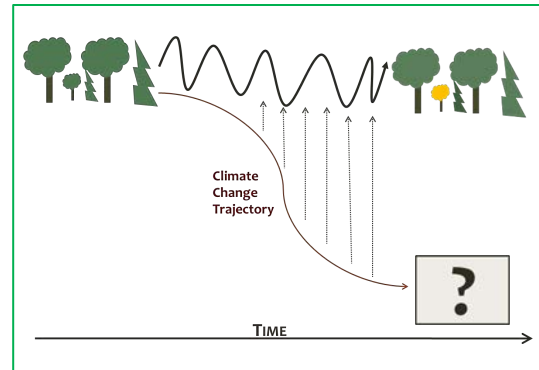


Manage Risk

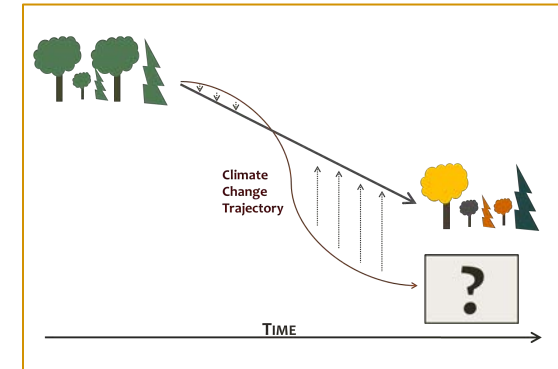
RESISTANCE



RESILIENCE



TRANSITION



Design actions that are **robust across a range of potential future conditions**

Intentionality

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



Adaptation Strategies & Approaches

Management Goals
& Objectives

Climate Change
Impacts

Challenges &
Opportunities

Intent of Adaptation
(**Option**)

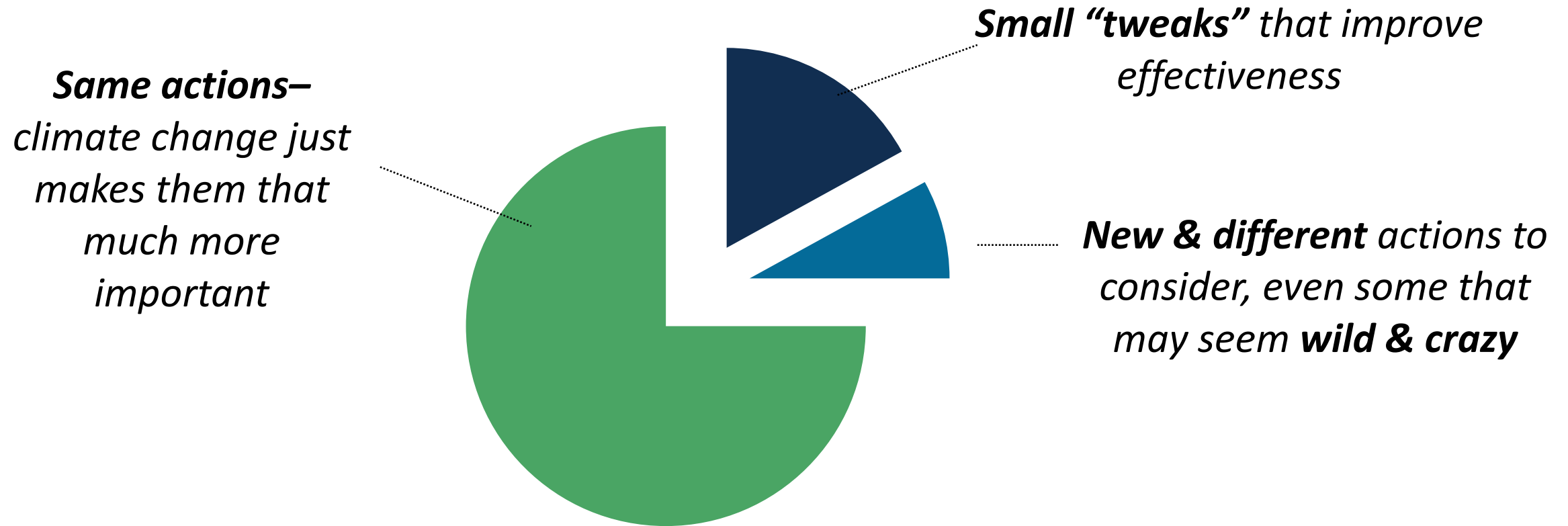
Make Idea Specific
(**Strategy, Approach**)

Action to Implement
(**Tactic**)

Why it's important:
Helps connect the dots
from broad concepts
to specific actions for
implementation.

One last thought....

Adaptation actions may not look that different from current management actions, especially in the near term.



**individual results will vary*

NIACS Menu

Menu of Adaptation Strategies and Approaches
Developed for forests

Strategy 1: Sustain fundamental ecological functions.

- 1.1. Sustain or restore hydrology.
- 1.2. Maintain or restore riparian areas.
- 1.3. Maintain or restore riparian areas.
- 1.4. Reduce competition for moisture, nutrients, and light.
- 1.5. Reduce 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 to severity of wildfire.
- 3.2. Establish fuelbreaks to reduce severity or extent of wildfire.
- 3.3. Alter forest structure to reduce severity or extent of wind and ice damage.
- 3.4. Promote revegetation after disturbance.

Strategy 4: Maintain or create refugia.

- 4.1. Identify and maintain unique sites.
- 4.2. Identify and maintain refugia of at-risk species or communities.
- 4.3. Establish artificial refugia 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 enhance ecosystem diversity.
- 5.3. Establish reserves to maintain ecosystem diversity.
- 5.4. Establish reserves to maintain ecosystem diversity.

Strategy 6: Increase ecosystem redundancy across the landscape.

- 6.1. Manage habitats over a range of uses and conditions.
- 6.2. Expand the boundaries of reserves to increase diversity.

Strategy 7: Promote landscape connectivity.

- 7.1. Establish and maintain habitat corridors through restoration or restoration.
- 7.2. Maintain and create habitat corridors through restoration or restoration.

Strategy 8: Maintain and enhance genetic diversity.

- 8.1. Use seeds, gametes, and other genetic material from across a greater geographic range.
- 8.2. Favor existing genotypes that are better adapted to future conditions.
- 8.3. Favor existing genotypes that are better adapted to future conditions.

Strategy 9: Facilitate community adjustments through species transitions.

- 9.1. Use seeds, gametes, and other genetic material from across a greater geographic range.
- 9.2. Establish or encourage new mixes of native species.
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- 9.4. Establish or encourage new mixes of native species.
- 9.5. Establish or encourage new mixes of native species.
- 9.6. Establish or encourage new mixes of native species.
- 9.7. Establish or encourage new mixes of native species.
- 9.8. Establish or encourage new mixes of native species.
- 9.9. Establish or encourage new mixes of native species.
- 9.10. Establish or encourage new mixes of native species.

Strategy 10: Redesign ecosystems after disturbance.

- 10.1. Promptly reestablish native species and communities.
- 10.2. Alter for areas of natural regeneration to meet expected future conditions.
- 10.3. Redesign significantly damaged ecosystems to meet expected future conditions.

Swenson et al. 2016. Forest Adaptation Resources: climate change tools and approaches for land managers. 2nd edition. <http://www.forestadaptation.org/forestadaptation-resources>



Menu of Adaptation Strategies and Approaches
Developed for Urban Forests

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- 4.2. Identify and maintain refugia of at-risk species or communities.
- 4.3. Establish artificial refugia 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 enhance ecosystem diversity.
- 5.3. Establish reserves to maintain ecosystem diversity.
- 5.4. Establish reserves to maintain ecosystem diversity.

Strategy 6: Increase ecosystem redundancy across the landscape.

- 6.1. Manage habitats over a range of uses and conditions.
- 6.2. Expand the boundaries of reserves to increase diversity.

Strategy 7: Promote landscape connectivity.

- 7.1. Establish and maintain habitat corridors through restoration or restoration.
- 7.2. Maintain and create habitat corridors through restoration or restoration.

Strategy 8: Maintain and enhance genetic diversity.

- 8.1. Use seeds, gametes, and other genetic material from across a greater geographic range.
- 8.2. Favor existing genotypes that are better adapted to future conditions.
- 8.3. Favor existing genotypes that are better adapted to future conditions.

Strategy 9: Facilitate community adjustments through species transitions.

- 9.1. Use seeds, gametes, and other genetic material from across a greater geographic range.
- 9.2. Establish or encourage new mixes of native species.
- 9.3. Establish or encourage new mixes of native species.
- 9.4. Establish or encourage new mixes of native species.
- 9.5. Establish or encourage new mixes of native species.
- 9.6. Establish or encourage new mixes of native species.
- 9.7. Establish or encourage new mixes of native species.
- 9.8. Establish or encourage new mixes of native species.
- 9.9. Establish or encourage new mixes of native species.
- 9.10. Establish or encourage new mixes of native species.

Strategy 10: Redesign ecosystems after disturbance.

- 10.1. Promptly reestablish native species and communities.
- 10.2. Alter for areas of natural regeneration to meet expected future conditions.
- 10.3. Redesign significantly damaged ecosystems to meet expected future conditions.

Swenson et al. 2016. Forest Adaptation Resources: climate change tools and approaches for land managers. 2nd edition. <http://www.forestadaptation.org/forestadaptation-resources>



Culturally relevant tribal adaptation menu: Strategies 1-3

Strategy 1: Consider cultural practices and seek spiritual guidance

Strategy 2: Learn through careful and respectful observation (gikinawaabi)

Strategy 3: Support tribal engagement in the environment

The first several strategies and approaches in the Tribal Adaptation Menu describe how cultural & spiritual knowledge and tribal engagement can help support climate adaptation.

Courtney can share a copy
(not for distribution)

Indicate how you are (or would like to) incorporate these ideas into your management plan.

Adaptation Strategies & Approaches



Translating broad **concepts** to **actions**

Options (concepts):

- Resistance, Resilience, Transition

Strategies:

- Regionally specific conditions

Approaches:

- Actions for a specific ecosystem

Tactics:

- Prescriptions for local conditions and mgmt. objectives

Example: Fire Menu

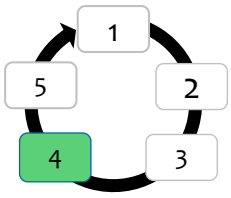
Strategy 5: Maintain and enhance structural, species, and community diversity.



Approach 5.2: Maintain or increase structural diversity at the landscape scale.



Tactics 5.2.2: Employ techniques such as variable-density treatments or irregular fire return intervals in order to encourage the development of multiple age cohorts.

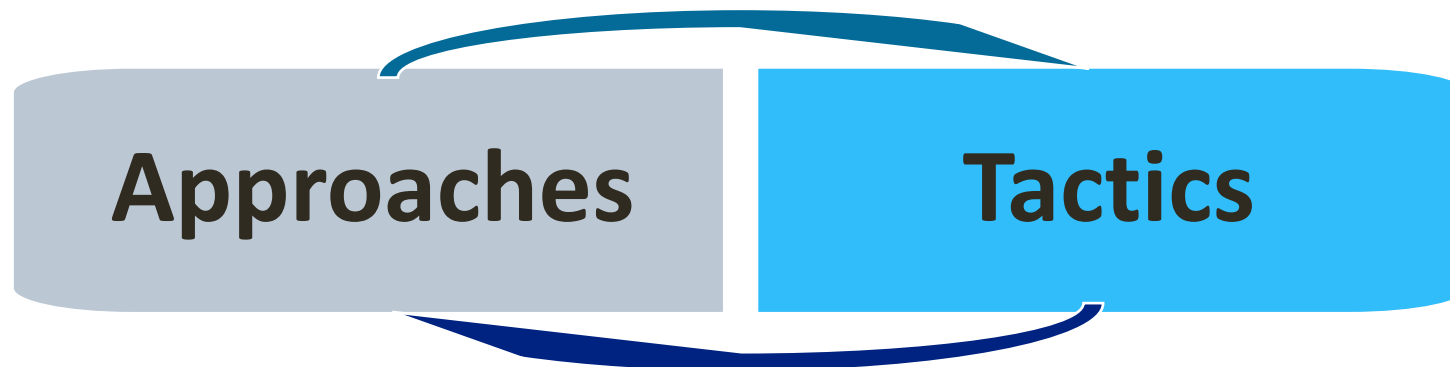


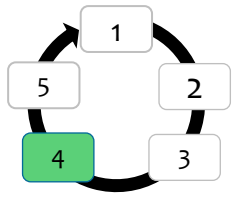
Step 4: IDENTIFY adaptation strategies, approaches, and actions for your management plan.

Approach – think about specific tactics/actions for on-the-ground management pertaining to your FAP Theme that relate to the list of strategies and approaches.

Tactic – Describe a specific action you can take. Identify management actions that can help prepare Colorado’s forests for changing conditions given risk ratings discussed yesterday.

These details should ideally answer **what, where, and how** you will implement the actions.



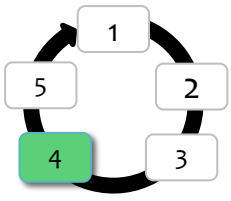


Step 4: IDENTIFY adaptation strategies, approaches, and actions for your management plan.

Use this step to rigorously define tactics you think are suitable given the vulnerabilities to climate change, and choose to “not recommend.” This can help provide context for the future and document your thought process and actions.

Don’t forget to denote the approach number you use.





Step 4: IDENTIFY adaptation strategies, approaches, and actions for your management plan.

Timeframe – Specify when you will implement the tactic.

For example:

- Summer 2016
- Winter 2016-7
- Within 3 years of...
- After...

Benefits – Describe why the tactic is good.

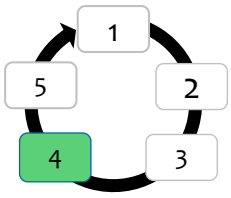
For example:

- addresses biggest or multiple challenges
- is cheap and easy
- has co-benefits
- is likely to succeed

Drawbacks and Barriers – Describe why it's not so good.

For example:

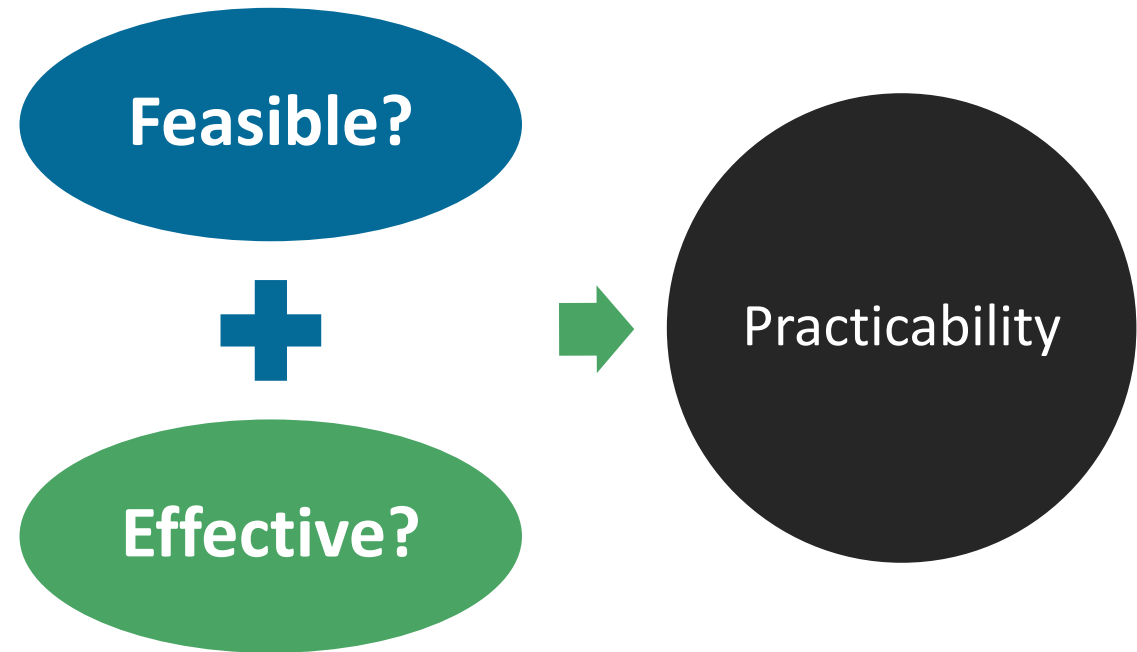
- it may have negative side effects,
- Requires high cost or effort
- may not be successful
- has social, financial, or other barriers

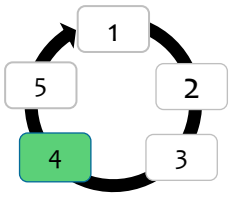


Step 4: IDENTIFY adaptation strategies, approaches, and actions for your management plan.

Practicability – Is it both *effective* (will meet desired intent) and *feasible* (capable of being implemented)?

- **High:** Yes to both!
- **Moderate:** Yeah, but it will take some additional effort or planning...
- **Low:** No, the barriers/drawbacks seem too big or the benefits too small.





Step 4: IDENTIFY adaptation strategies, approaches, and actions for your management plan.

Recommend Tactic— Given all this, is this tactic likely to be helpful?

Also consider: trade-offs, urgency, likelihood of success, cost, and effort...

Yes: look to integrate into plan, prescription, or other activities

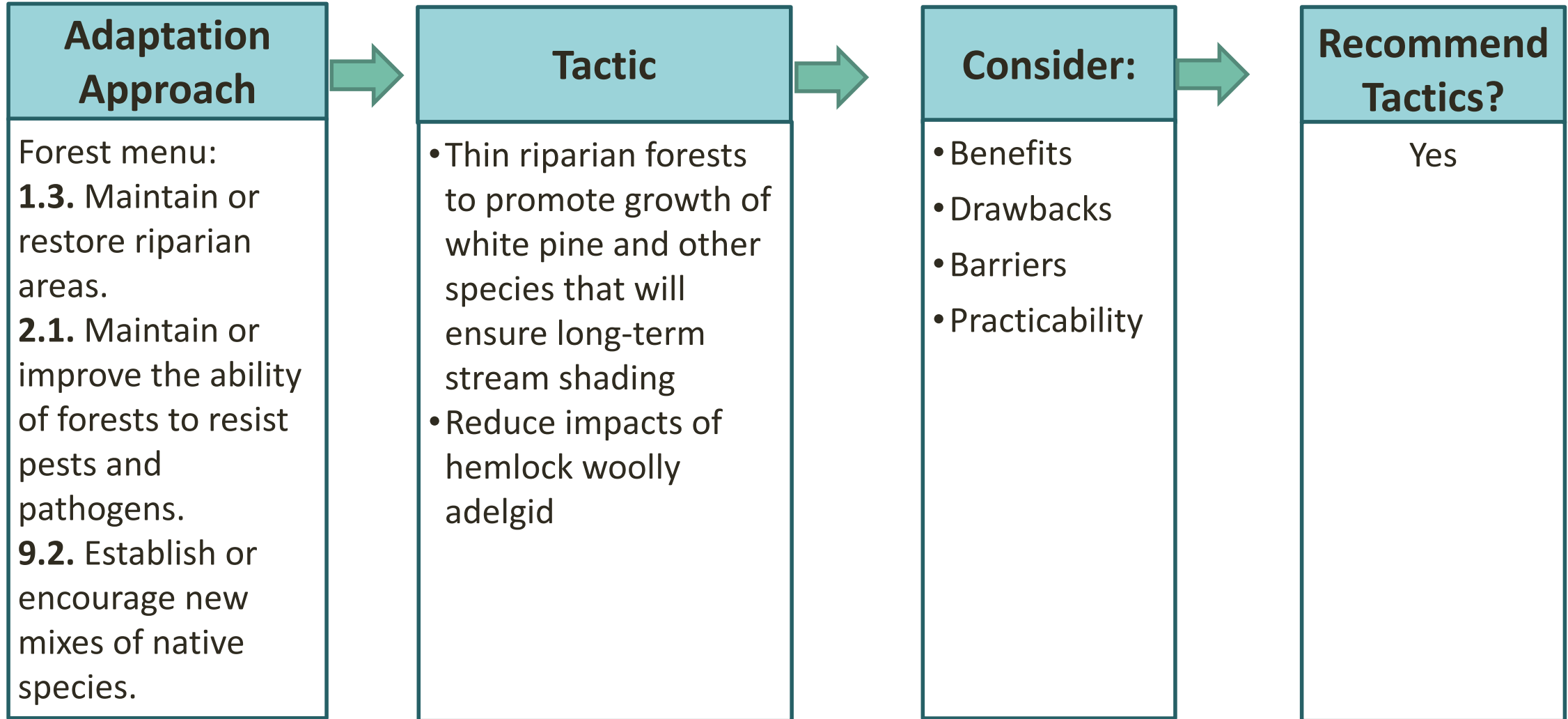
No: not useful at this time

Key Questions:

- What actions can enhance the ability of the ecosystem to adapt to anticipated changes *and* meet management goals?
- Will future managers know what we were trying to do?

Step 4: Trout Unlimited example

Area/Topic: **Riparian forests**



More information: forestadaptation.org/tu-ne

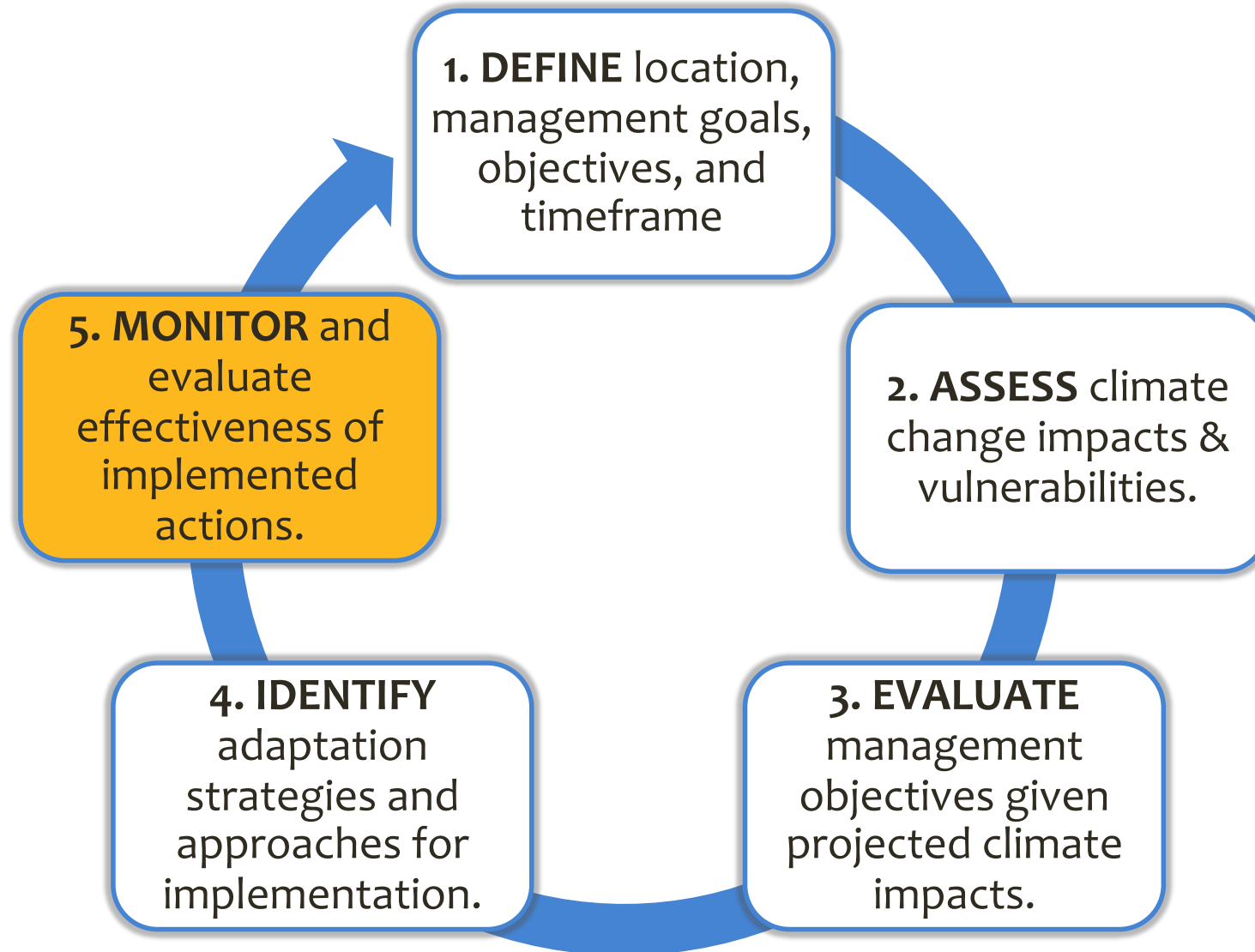


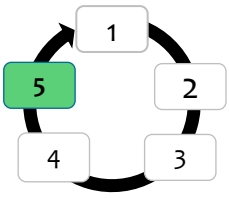
BREAK!



Step 5: MONITOR and evaluate effectiveness of implemented actions.

Workbook Cycle: Step 5





Step 5: MONITOR and evaluate effectiveness of implemented actions.

Purpose:

- Practice adaptive management

How do we know if the selected actions were effective?

What can we learn from these actions to inform future management?

A Few Thoughts About Monitoring...

- Learning about our actions is useful
- Our track record is not very good



A Few Thoughts About Monitoring...

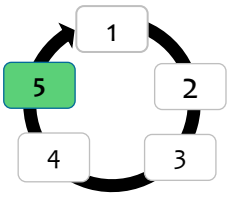
- Be VERY CLEAR about your information needs and the kind of monitoring that might help you get that information:
 - **Implementation monitoring** = Did we do the action?
 - **Surveillance/impact monitoring** = What change is occurring over time?
 - **Effectiveness/adaptation monitoring** = Did our action actually have the desired effect?

A Few Thoughts About Monitoring...

- Be VERY CLEAR about your information needs and the kind of monitoring that might help you get that information:
 - **Implementation monitoring** = Did we do the action?
 - **Surveillance/impact monitoring** = What change is occurring over time?
 - **Effectiveness/adaptation monitoring** = Did our action actually have the desired effect?
 - **Scientific research** = Is this outcome statistically significant compared to a control? Could we expect similar results elsewhere?

“Climate change monitoring”

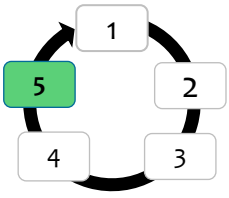
- Are you going to monitor climate change?
 - Nope.
- Are you going to monitor climate change impacts?
 - Not necessarily.
- Are you going to monitor the success of your management?
 - That's the ticket!
 - You're already doing that (or trying).
- “Climate change monitoring” is not climate science



Step 5: MONITOR and evaluate effectiveness of implemented actions.

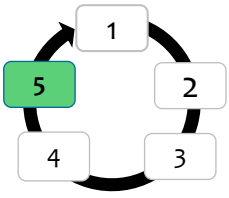
OUTCOME:

Realistic and feasible monitoring scheme that can be used to help determine whether **management** should be **altered in the future to account for new information and observations.**



Step 5: MONITOR and evaluate effectiveness of implemented actions.

- **Adaptation Monitoring Variable** – What you will measure?
 - *Items that can tell you whether you have achieved your **management goals & objectives**.*
- **Criteria for Evaluation** – a value or threshold that is meaningful for assessing effectiveness or informing future decisions
 - ***What is success?***
 - *What you're monitoring or measuring: **What are the units on your data?***
- **Monitoring Implementation** – How you will gather the information
 - *How, and when the monitoring will actually get done.*
 - ***Take advantage of existing monitoring when possible!***



Step 5: MONITOR and evaluate effectiveness of implemented actions.

Adaptation Monitoring Variable – What you will measure?

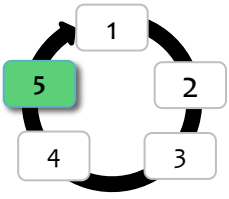
- *Planted seedling survival at 1, 2, 5, and 10 years after planting*

Criteria for Evaluation – a value or threshold that is meaningful for assessing effectiveness or informing future decisions

- 60% survival of non-local genotypes
- Eradication of invasive species

Monitoring Implementation– How you will gather the information

- *Regular post-planting stocking surveys.*
- *Supplemental surveys at 10 years.*



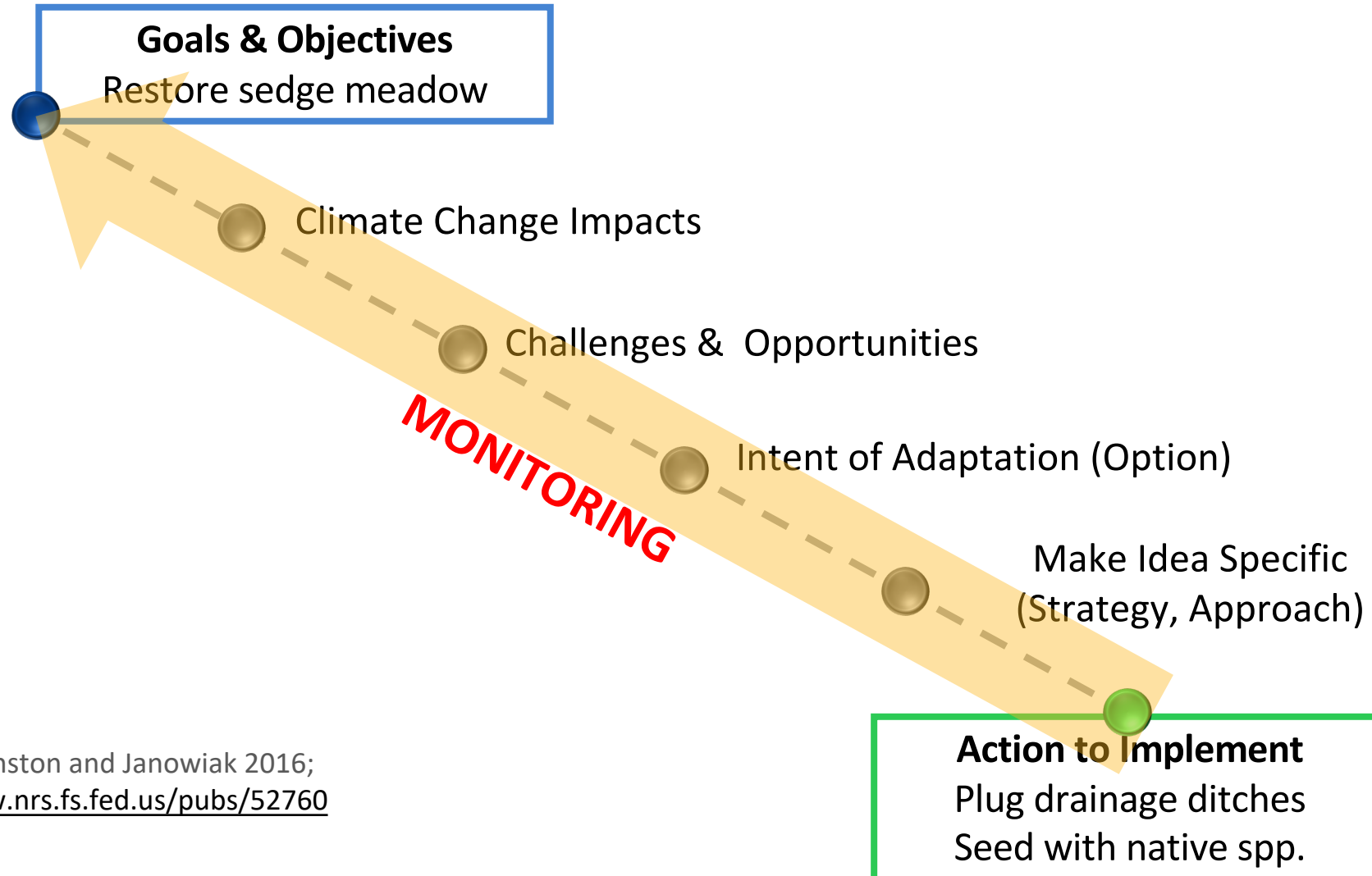
Step 5: MONITOR and evaluate effectiveness of implemented actions.

Example – Jerktail Mountain Woodland

Adaptation Monitoring Variable	Criteria for Evaluation	Monitoring Implementation
Fuel loads	reduce fuel loads; reduce leaf litter depth by 50% by first year after second burn	Use the National Park Service Fire Monitoring Handbook (FMH) plot design: 2 plots. Baseline monitoring and return first and second growing season after burn.
Tree basal area, growth, and composition	Increase in shortleaf pine, white oak, and chinkapin oak, and achievement of woodland structure.	Permanent inventory plots to be established
Shortleaf pine regeneration	Presence of shortleaf pine seedlings and saplings	Qualitative observation

Connecting the Dots

A clear train of thought shows *intentionality*



Monitoring Brainstorm

- What are some things you could monitor from your projects to assess the effectiveness of your adaptation actions?

Adaptation Monitoring Variable	Criteria for Evaluation	Monitoring Implementation



Telling Your Adaptation Story

- Describe your project area
- Who is your audience?
- Goals/objectives
- Key climate change impacts
- Key adaptation strategies/approaches to meet your goals/objectives
- One idea on measuring effectiveness/monitoring





YOU MADE IT!
(Congrats!)

To-do list:

Y'all:

Evaluations (please!)

Can we have a copy of your Workbook?

Keep moving these ideas forward!

Follow up with questions or ideas

Can we share your idea on www.ForestAdaptation.org?

NIACS:

- Share contact list & presentations from today

- Check in soon!

- Other ideas?

Thanks everyone!



Questions?

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