Forest Adaptation for an Uncertain Climate Future

SFI Climate Smart Forestry Approaches
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Linda Nagel
Dean and Professor
S.J. & Jessie E. Quinney College of Natural Resources
Utah State University
Logan, UT

Maria Janowiak
Director, Northern Forests Climate Hub
Director, Northern Institute of Applied Climate Science
USDA Forest Service

Northern Institute of Applied Climate Science

The Northern Institute of Applied Climate Science (NIACS) develops synthesis products, fosters communication, pursues science, and provides technical assistance in climate change adaptation and carbon management.

Climate Change Adaptation

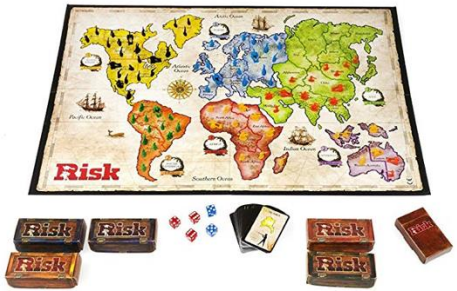
Forest Carbon Management

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

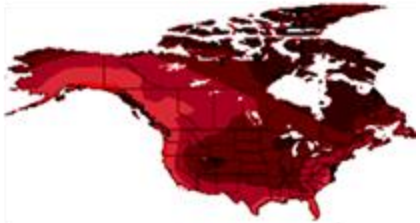
Uncertainty and Climate Scenarios

Certainty is a myth.
Embrace uncertainty and manage risk.

What is your risk tolerance?



Manage for a range of plausible futures:



Insensitive model
Low emissions (SSP2-4.5)

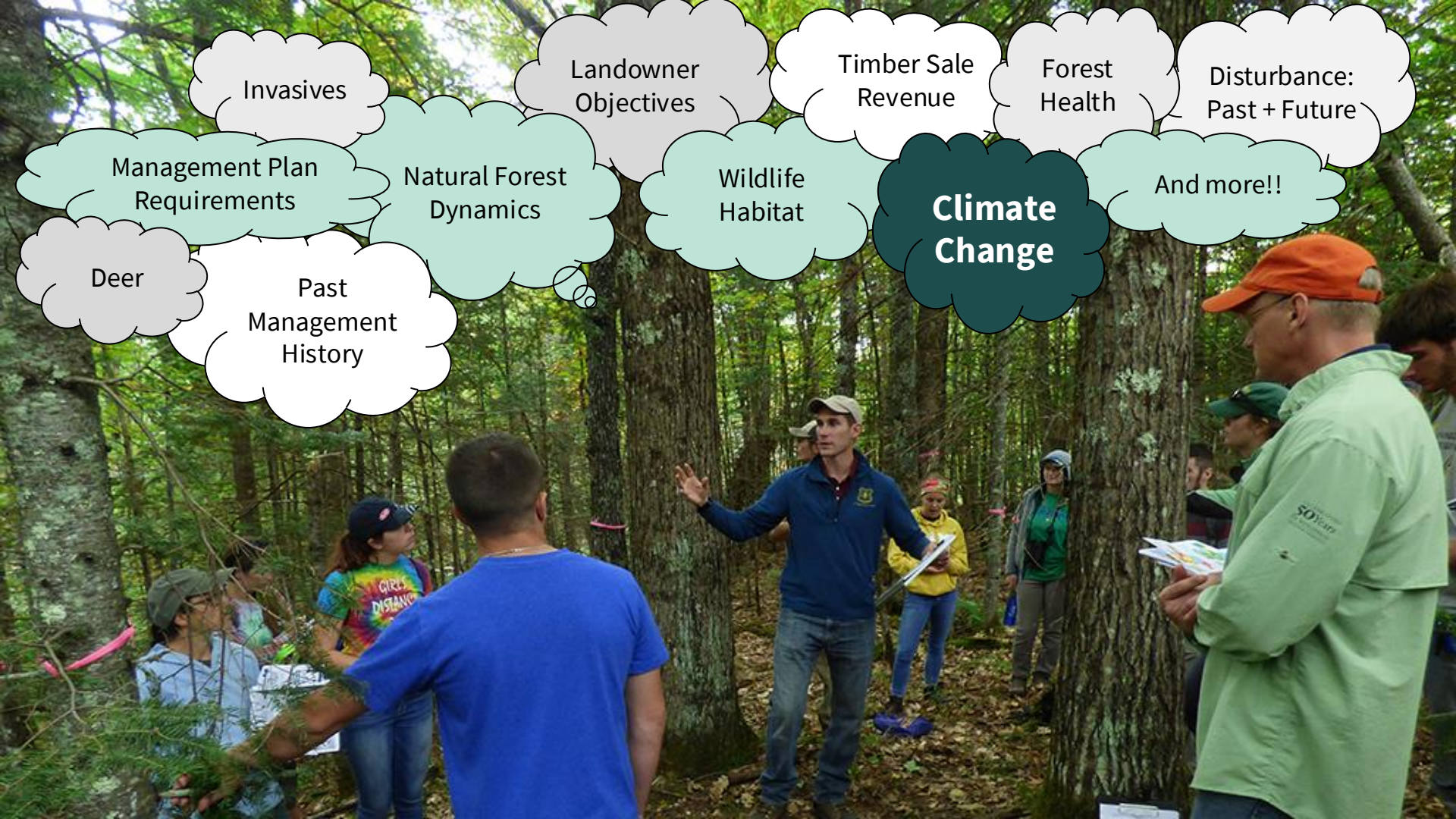
Sensitive model
High emissions (SSP3-7.0)

Least Projected Change

Most Projected Change

https://www.amazon.com/Hasbro-Gaming-Risk-Game-Domination/dp/B004MRZGC4

IPCC 2021, AR6


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

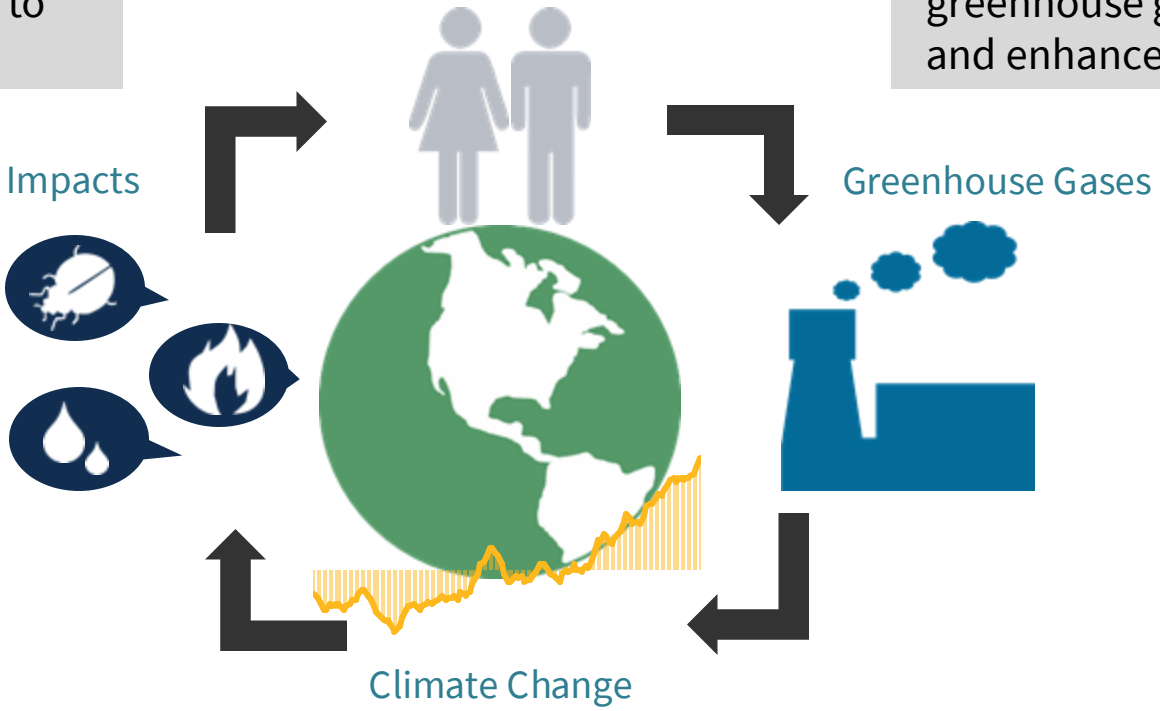
How can we respond to climate change?

Adaptation

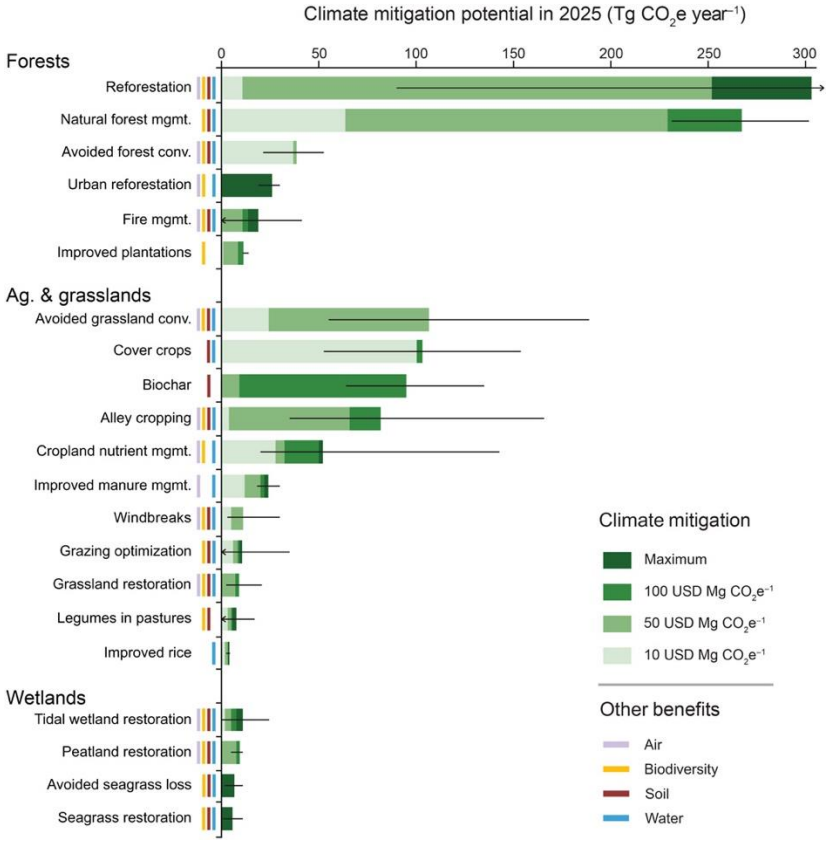
Actions to reduce the vulnerability of systems to climate change effects.

Mitigation

Actions that reduce greenhouse gas emissions and enhance carbon sinks.



Climate mitigation potential of 21 Natural Climate Solutions in the U.S.



A changing climate puts those forests *and the carbon they sequester* at risk

Janowiak et al. 2018:
www.nrs.fs.fed.us/pubs/55635

Joseph E. Fargione et al. Sci Adv 2018;4:eaat1869

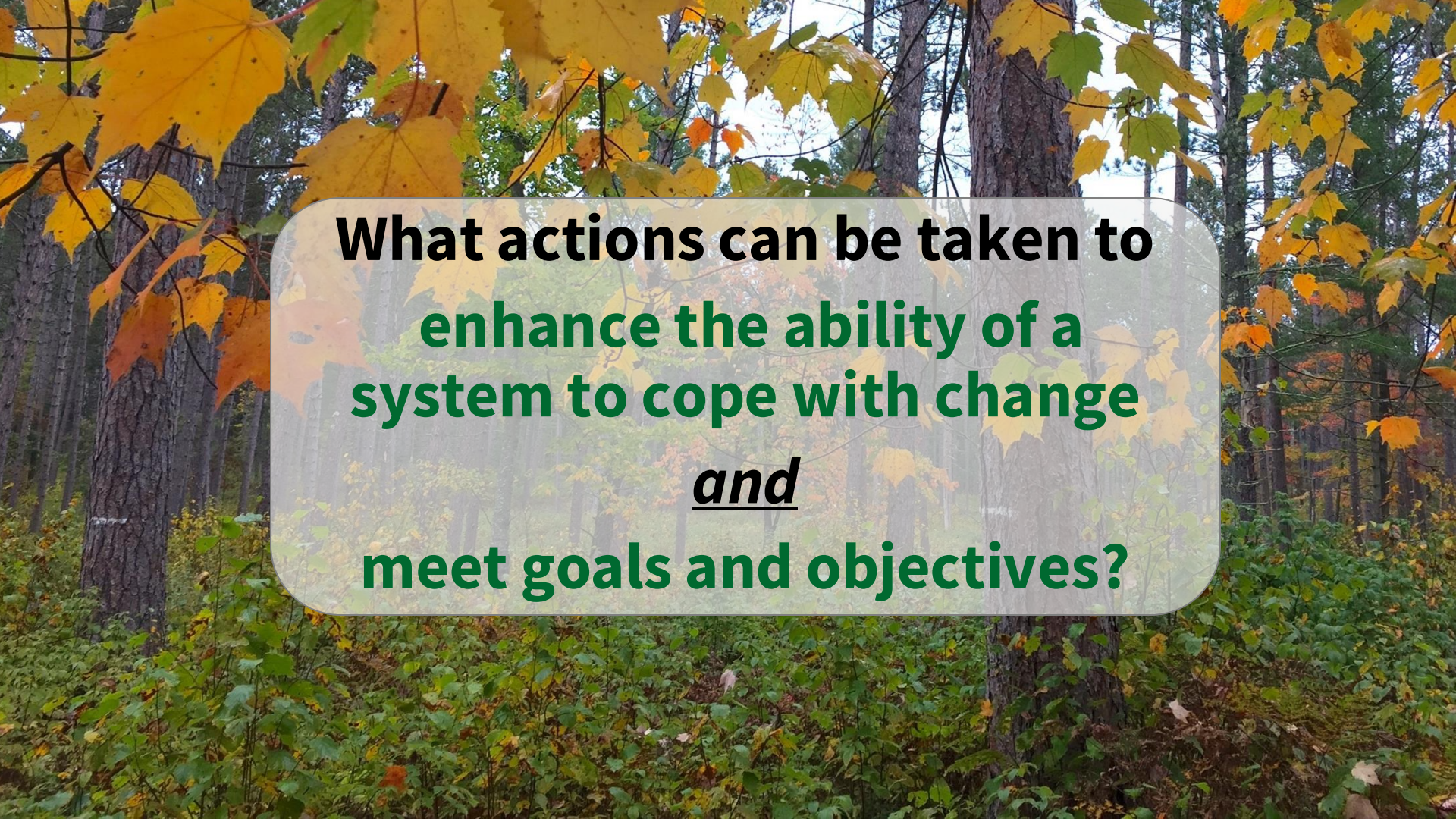
ScienceAdvances AAAS

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?


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

Adaptation Workbook

1. DEFINE location and management objectives.

2. ASSESS climate impacts and vulnerabilities.

Vulnerability assessments, scientific literature, traditional knowledge, etc.

3. EVALUATE management objectives.

4. IDENTIFY and implement adaptation tactics.

Adaptation Strategies and Approaches

5. MONITOR and evaluate effectiveness.

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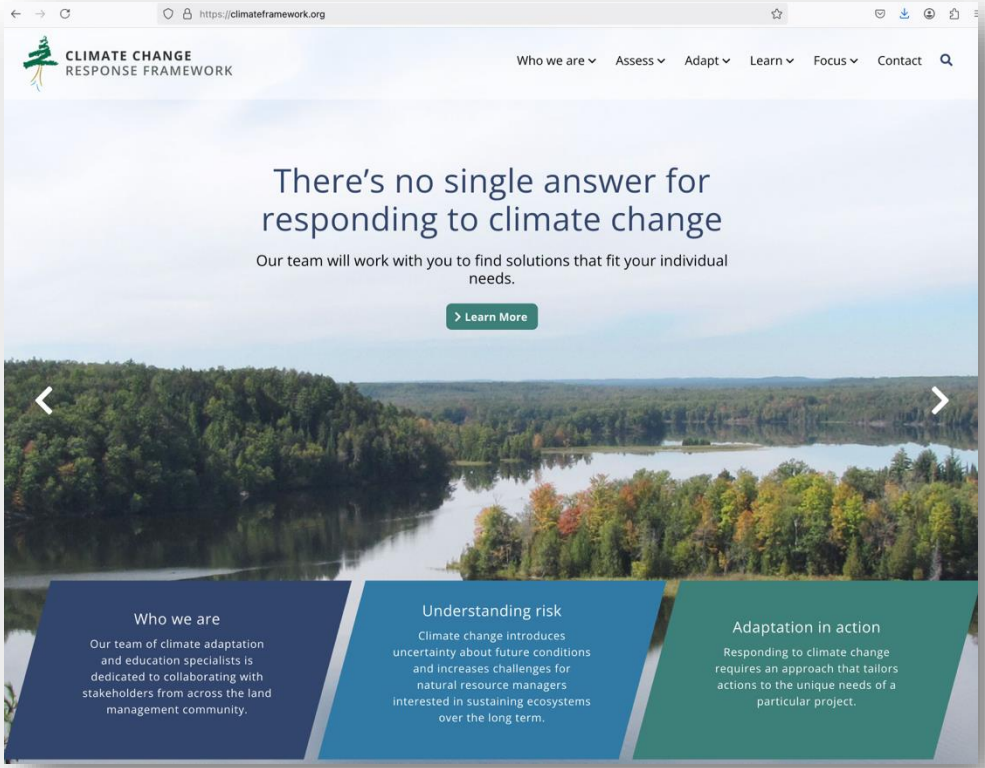
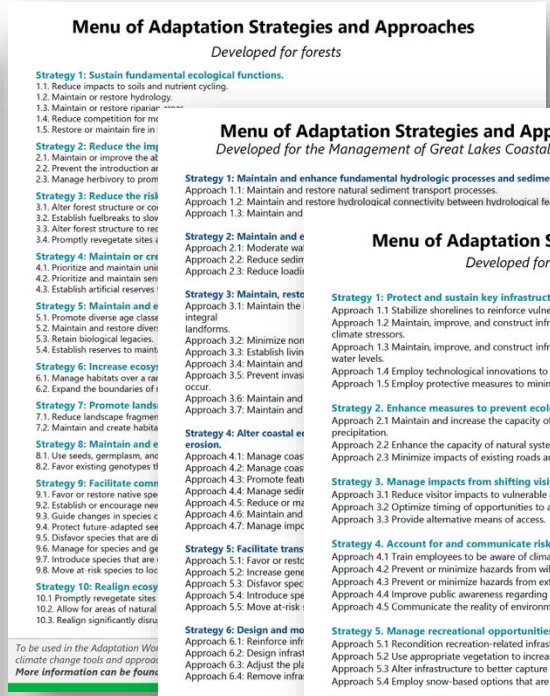
Download at: https://research.fs.usda.gov/treesearch/52760 or use online at www.AdaptationWorkbook.org

Climate Change Response Framework ~ Tools




Menu of Adaptation Strategies and Approaches

Developed for forests

Strategy 1: Sustain fundamental ecological functions.

1.1. Reduce impacts to soils and nutrient cycling.
1.2. Maintain or restore hydrology.
1.3. Maintain or restore riparian
1.4. Reduce competition for
1.5. Restore or maintain fire in

Strategy 2: Reduce the im

2.1. Maintain or improve the ab
2.2. Prevent the introduction a
2.3. Manage herbivory to prom

Strategy 3: Reduce the ris

3.1. Alter forest structure or co
3.2. Establish fuelbreaks to slow
3.3. Alter forest structure to re
3.4. Promptly revegetate sites

Strategy 4: Maintain or cr

4.1. Prioritize and maintain uni
4.2. Prioritize and maintain ser
4.3. Establish artificial reserves

Strategy 5: Maintain and e

5.1. Promote diverse age classe
5.2. Maintain and restore diver
5.3. Retain biological legacies.
5.4. Establish reserves to maint

Strategy 6: Increase ecosy

6.1. Manage habitats over a ra
6.2. Expand the boundaries of

Strategy 7: Promote lands

7.1. Reduce landscape fragmen
7.2. Maintain and create habita

Strategy 8: Maintain and e

8.1. Use seeds, germplasm, and
8.2. Favor existing genotypes th

Strategy 9: Facilitate comm

9.1. Favor or restore native spe
9.2. Establish or encourage new
9.3. Guide changes in species c
9.4. Protect future-adapted see
9.5. Disfavor species that are di
9.6. Manage for species and ge
9.7. Introduce species that are
9.8. Move at-risk species to loc

Strategy 10: Realign ecosy

10.1 Promptly revegetate sites.
10.2. Allow for areas of natural
10.3. Realign significantly disru

To be used in the Adaptation Wo
climate change tools and approa
More information can be found

Menu of Adaptation Strategies and Approaches

Developed for the Management of Great Lakes Coastal Ecosystems

Strategy 1: Maintain and enhance fundamental hydrologic processes and sediment dynamics.

Approach 1.1: Maintain and restore natural sediment transport processes.
Approach 1.2: Maintain and restore hydrological connectivity between hydrological features.
Approach 1.3: Maintain and

Strategy 2: Maintain and e

Approach 2.1: Moderate wa
Approach 2.2: Reduce sedim
Approach 2.3: Reduce loadi

Strategy 3: Maintain, resto

Approach 3.1: Maintain the
integral
landforms.
Approach 3.2: Minimize non
Approach 3.3: Establish livin
Approach 3.4: Maintain and
Approach 3.5: Prevent invasi
occur.
Approach 3.6: Maintain and
Approach 3.7: Maintain and

Strategy 4: Alter coastal ec
erosion.

Approach 4.1: Manage coas
Approach 4.2: Manage coas
Approach 4.3: Promote feat
Approach 4.4: Manage sedi
Approach 4.5: Reduce or ma
Approach 4.6: Maintain and
Approach 4.7: Manage impo

Strategy 5: Facilitate trans

Approach 5.1: Favor or restc
Approach 5.2: Increase gene
Approach 5.3: Disfavor spec
Approach 5.4: Introduce spe
Approach 5.5: Move at-risk

Strategy 6: Design and mo

Approach 6.1: Reinforce infr
Approach 6.2: Design infras
Approach 6.3: Adjust the pla
Approach 6.4: Remove infra

***Citation**: Schmitt, K.; Krska, R.; D*
Magee, M.R.; Mayne, G.; Nelson,
T.; and Swanston, C. 2022. Strate
Houghton, MI: U.S. Department o

**A supplemental topic to be used*
Adaptation Resources: climate ch
GTR-87-2

Menu of Adaptation Strategies and Approaches

Developed for Outdoor Recreation

Strategy 1: Protect and sustain key infrastructure

Approach 1.1 Stabilize shorelines to reinforce vulnerable infrastructure.
Approach 1.2 Maintain, improve, and construct infrastructure using materials that can withstand a range of climate stressors.
Approach 1.3 Maintain, improve, and construct infrastructure using designs that reduce impacts from variable water levels.
Approach 1.4 Employ technological innovations to maintain the viability of developed winter recreation areas.
Approach 1.5 Employ protective measures to minimize damage from disturbance events.

Strategy 2. Enhance measures to prevent ecological damage from variable precipitation

Approach 2.1 Maintain and increase the capacity of stormwater infrastructure to accommodate variable precipitation.
Approach 2.2 Enhance the capacity of natural systems to accommodate variable precipitation.
Approach 2.3 Minimize impacts of existing roads and trails that are compromised by changing conditions.

Strategy 3. Manage impacts from shifting visitation and use trends

Approach 3.1 Reduce visitor impacts to vulnerable areas.
Approach 3.2 Optimize timing of opportunities to align with changing conditions.
Approach 3.3 Provide alternative means of access.

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Strategy 4. Account for and communicate risks to human well-being

Approach 4.1 Train employees to be aware of climate-exacerbated risks to public safety.
Approach 4.2 Prevent or minimize hazards from wildland fire.
Approach 4.3 Prevent or minimize hazards from extreme heat events.
Approach 4.4 Improve public awareness regarding climate change and climate-exacerbated risks.
Approach 4.5 Communicate the reality of environmental change.

Strategy 5. Manage recreational opportunities to address impacts of expected conditions

Approach 5.1 Recondition recreation-related infrastructure located in vulnerable areas.
Approach 5.2 Use appropriate vegetation to increase resilience of recreation settings to climate-related stressors.
Approach 5.3 Alter infrastructure to better capture and use natural and man-made snow.
Approach 5.4 Employ snow-based options that are functional in low-snow conditions.

Strategy 6. Alter recreational opportunities to accommodate expected conditions

Approach 6.1 Increase four-season and non-skiing recreation opportunities at winter sports areas.
Approach 6.2 Relocate existing infrastructure and opportunities to areas with less risk of climate-exacerbated damage.
Approach 6.3 Integrate long-term siting and climate considerations into recreation management.
Approach 6.4 Use materials and designs that are impermanent.
Approach 6.5 Remove or decommission vulnerable infrastructure.

Source: O'Toole, et al. (2019). Climate Change Adaptation Strategies and Approaches for Outdoor Recreation. Sustainability, 11(24), 7030. http://dx.doi.org/10.3390/su11247030. ***More information:*** *forestadaptation.org/recreation*

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

https://climateframework.org/

National Advanced Silviculture Program

- Module 1: Ecological Systems
- Module 2: Inventory and Decision Support
- Module 3: Landscape Ecology
- Module 4: Advanced Silviculture
- Module 5: Regional Modules & panel defense

USDA

FOREST SERVICE
DEPARTMENT OF AGRICULTURE

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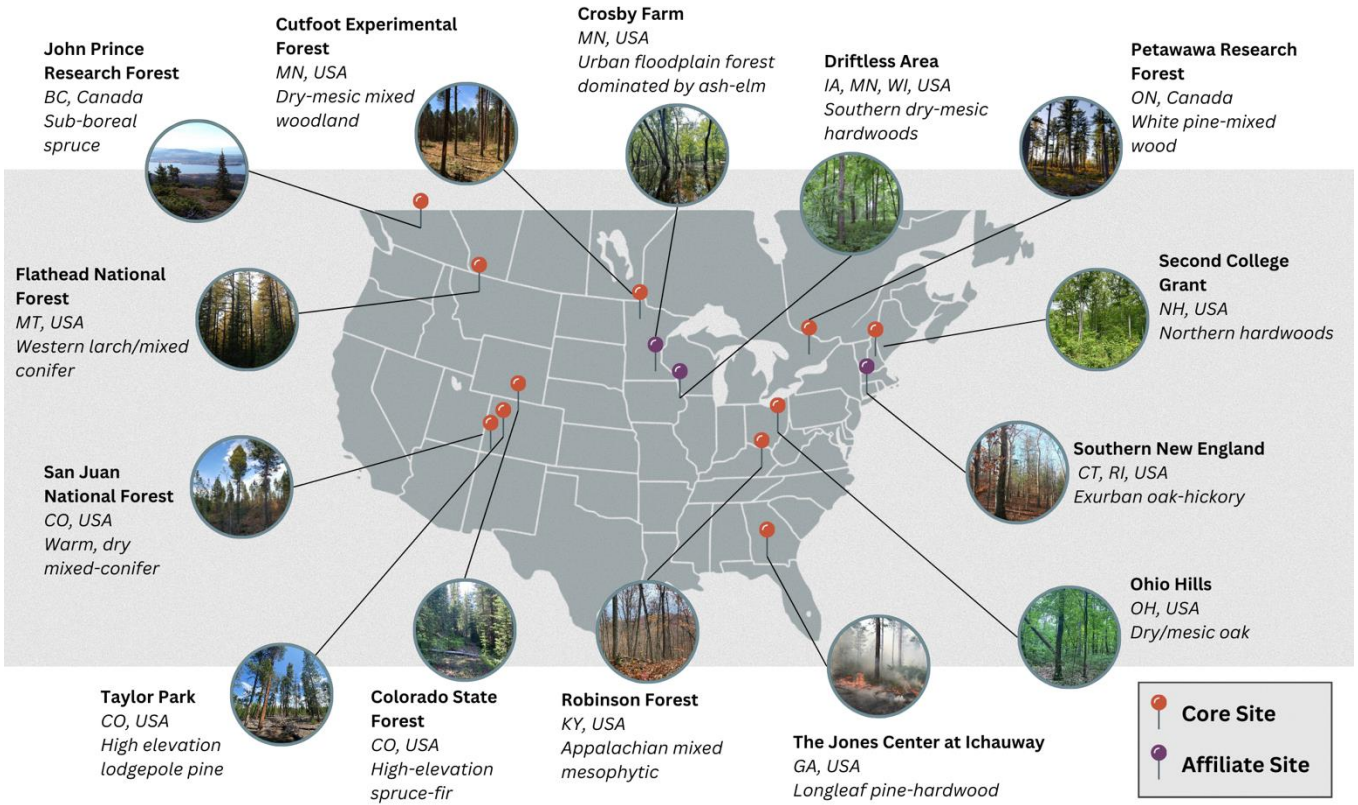
Adaptive Silviculture for Climate Change Network



Linda Nagel, Lead PI
Professor and Dean
Utah State University

Maria Janowiak, Lead PI
USDA Forest Service
Northern Research Station
Director, NIACS, NFCH

Courtney Peterson
ASCC Program Manager
Colorado State University
NIACS, SWCH

Maria Vicini
ASCC Coordinator
Colorado State University
NIACS, SWCH

Chris Swanston, Lead PI
USDA Forest Service
Associate Deputy Chief
Research and Development

ASCC Network Website: www.adaptivesilviculture.org

2025: 11 core sites, 3 affiliate sites

ASCC is Testing a Spectrum of Adaptation Options

RESISTANCE

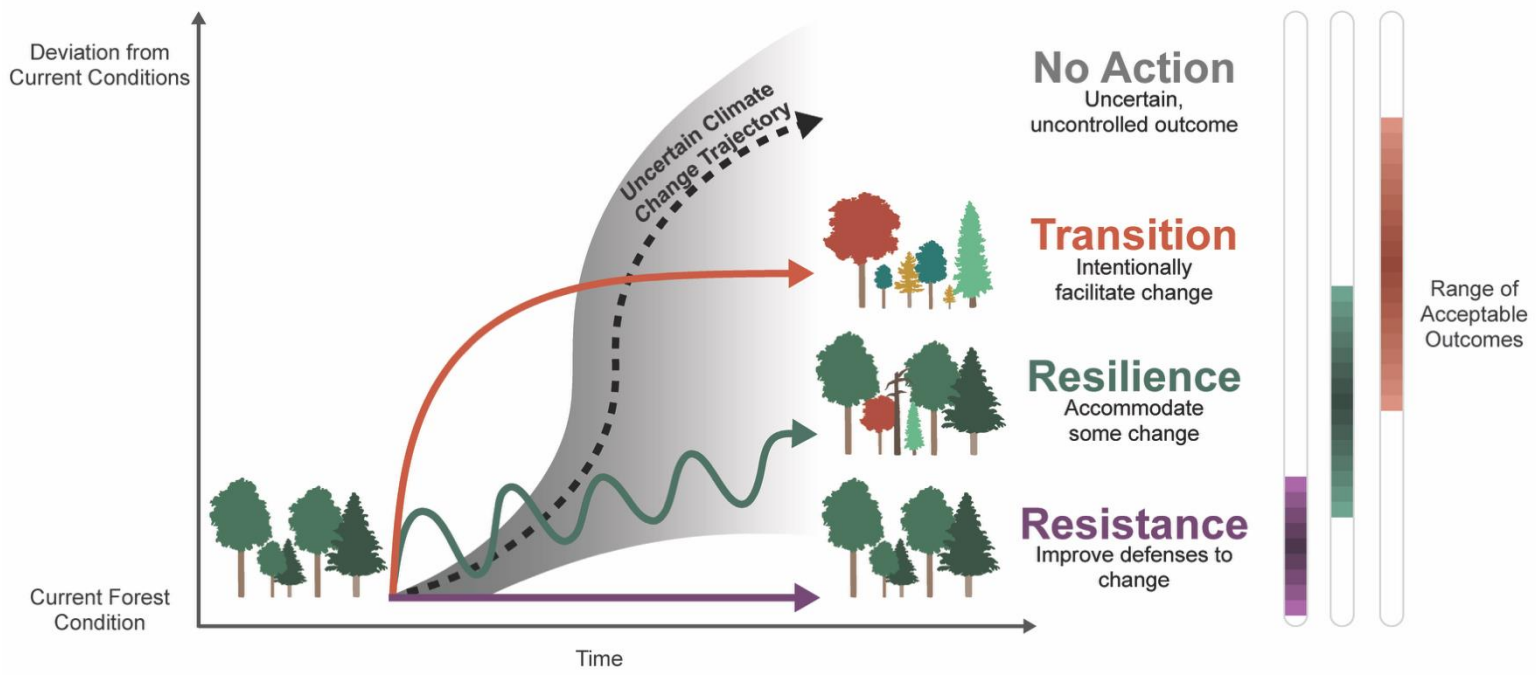
RESILIENCE

TRANSITION

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

Millar et al 2007, Swanston et al 2016, Nagel et al 2017, www.adaptivesilviculture.org

ASCC is Testing a Spectrum of Adaptation Options



Millar et al 2007, Swanston et al 2016, Nagel et al 2017, www.adaptivesilviculture.org

ASCC Network Goals

- ✓ **Develop and implement an experimental framework** testing a suite of climate-adaptive management actions with practical, real-world relevance
- ✓ **Evaluate and compare intentionally designed silvicultural treatments** of resistance, resilience, and transition to identify forest adaptation interventions
- ✓ **Foster diverse, collaborative science-management partnerships**, which leads to more direct actionable science delivery and implementation of adaptation actions
- ✓ **Provide valuable insights to the broader community** of researchers, managers, and others actively responding to climate change

Top Left: Art displayed at the "Transition" plots at Crosby Farm. Art By Willard Malebear, North Hennepin Community College.

ASCC Impact

- **The largest experimental silviculture program focused on climate adaptation in the North America** including 14 statistically robust, operational, and diverse experimental sites, with 12+ years of existing data at our oldest site
- **Over 500 natural resource professionals have been directly trained** in applying climate-adaptive silviculture using ASCC site examples through the Forest Service's National Advanced Silviculture Program
- **Over 200 management and science collaborators are sharing lessons learned from ASCC** to train and advise FS staff and partners on climate-informed management.
- **The RRT Framework approach directly informs larger-scale land management policies and implementation** (*eg*, FS Adaptation Plan, reforestation and assisted migration plans, adaptation guidance for NEPA)



Thank you!

For more information: www.adaptivesilviculture.org
Linda Nagel: Linda.Nagel@usu.edu
Professor and Dean
S.J. & Jessie E. Quinney College of Natural Resources
Utah State University, Logan, UT, USA

ASCC