


A Menu of Adaptation Strategies and Approaches for Managing Fire in a Changing Climate

Prescribed Fire for Forest Management Webinar Series
July 10, 2024

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Acknowledgements


The Fire Menu is a product of Southwest FireCLIME, a regional initiative that applied the principles of science–management partnership and the co-production of knowledge to identify information needs related to climate–fire–ecosystem dynamics within the management community and enhance the relevance of research results. The team included 17 scientists and managers from universities, U.S. federal agencies, and non-governmental organizations (NGOs) in Arizona and New Mexico with expertise in fire ecology, climate science, and land management.

Sample, M.; Thode, A.E.; Peterson, C.; Gallagher, M.R.; Flatley, W.; Friggs, M.; Evans, A.; Loehman, R.; Hedwall, S.; Brandt, L.; et al. Adaptation Strategies and Approaches for Managing Fire in a Changing Climate. *Climate* **2022**, *10*, 58. <https://doi.org/10.3390/cli10040058>



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USDA Northern Forests Climate Hub



Mission:
To develop and deliver science-based, region-specific information and technologies, to help **natural resource managers** and **woodland owners** integrate climate change information into **planning, decision-making, and management activities** in order to sustain the diverse benefits from forests in a changing climate.

The Northern Forests Climate Hub provides additional capacity to two USDA Regional Climate Hubs—the **Northeast and Midwest Hubs**—and works within their broader scope and organization.

Website: www.climatehubs.usda.gov/hubs/northern-forests

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Northern Institute of Applied Climate Science

Climate
Carbon

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.

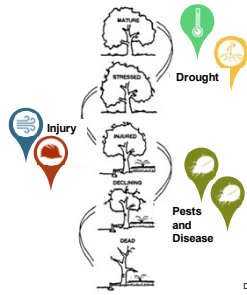
NIACS is a collaborative partnership of Federal, forest sector, conservation, higher education, and tribal organizations led and supported in part by the USDA Forest Service.



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A Changing Climate Poses Risks to Forests (and the Carbon they Sequester)

- Altered climate
- Extreme weather
- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species
- Altered habitat suitability



Drawing: Barlett Tree Experts

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Disturbances Will Interact

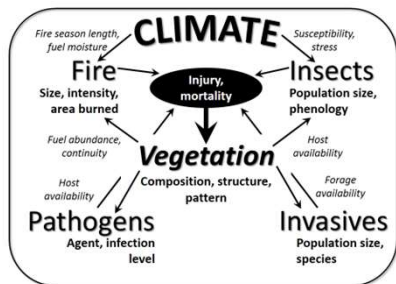



Figure by R. Loehman

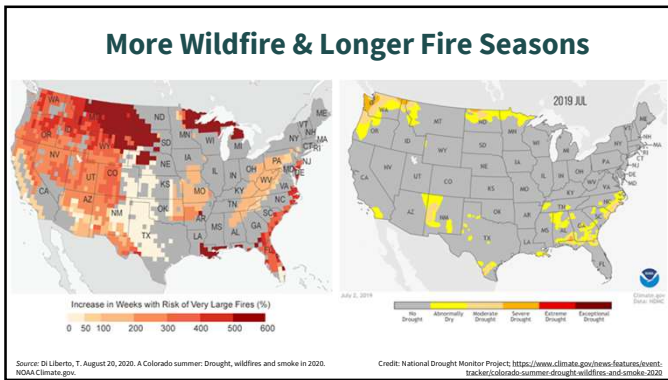
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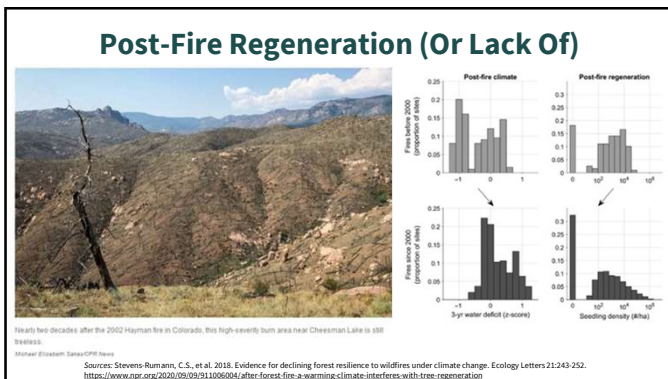
Climate Change is Increasing Wildfire Intensity & Frequency

- Changes in **fire frequency** and **effects**
- **Fire risk increasing** with climate and vegetation changes
- **Shortened fire return interval** in higher elevations
- Change in **fire regimes** in forest types

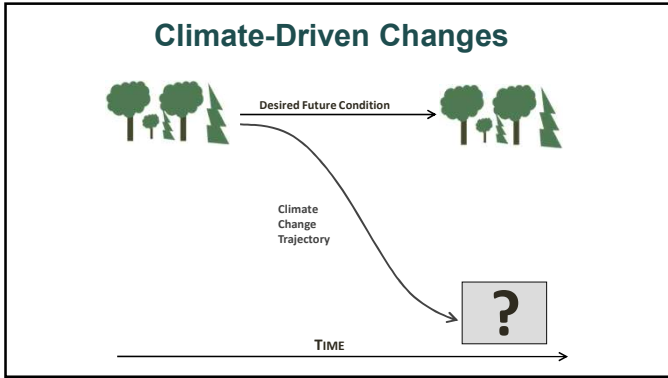
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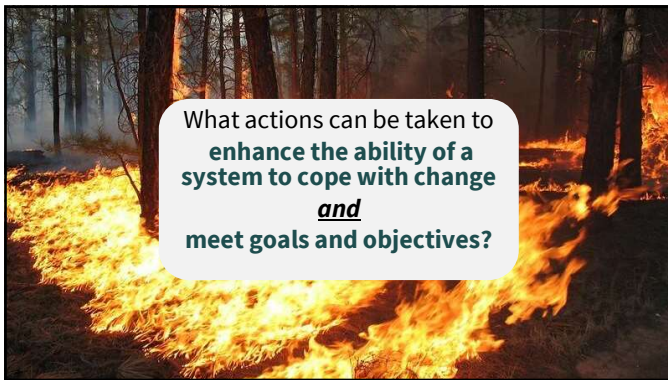
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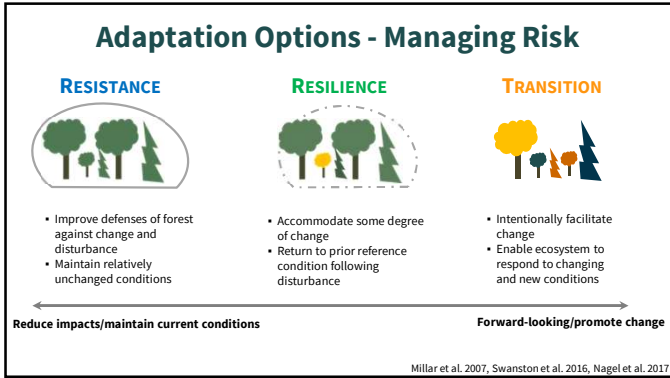
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Adaptation - the adjustment of systems in response to climate change.

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

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

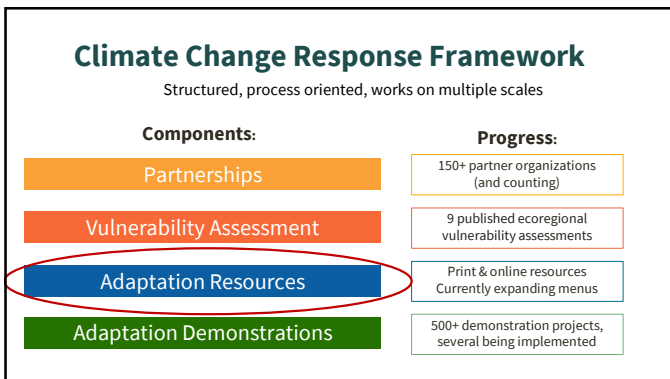
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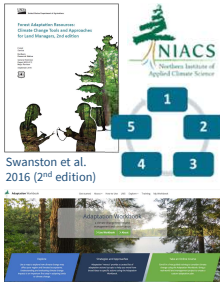
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Climate Adaptation Workbook and Adaptation Resources

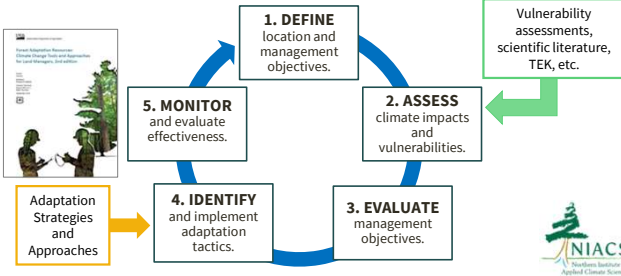
- Flexible workbook designed for a variety of land owners with diverse goals
- Works at project-level
- Centers around manager's expertise, and judgement
- Adaptation resources and **menus of possible actions** to help you create **clear rationale** for your actions by connecting them to **broader adaptation ideas**
- **Does not make recommendations**



Download at: www.nrs.fs.fed.us/pubs/40543 or use online at www.AdaptationWorkbook.org

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Adaptation Workbook



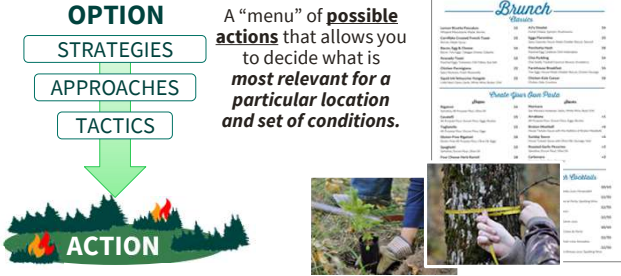
Download at: <https://doi.org/10.2737/NRS-GTR-87-2> or use online at www.AdaptationWorkbook.org

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Adaptation Menus of Strategies and Approaches

OPTION
STRATEGIES
APPROACHES
TACTICS

A "menu" of **possible actions** that allows you to decide what is **most relevant for a particular location and set of conditions.**



Adaptation menus available at: www.forestadaptation.org/strategies

Brunch Menu		
Apple Pancakes	\$4.99	Apple Pancakes
French Toast	\$4.99	French Toast
Waffles	\$4.99	Waffles
...

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Adaptation Menus of Strategies and Approaches

Published:

- 2012: **Forestry**
- 2016: **Urban Forestry**
- 2016: **Agriculture**
- 2019: **Forested Watersheds**
- 2019: **Recreation**
- 2019: **Non-Forested Wetlands**
- 2019: **Inland Glacial Lake Fisheries**
- 2019: **Tribal Perspectives**
- 2020: **Forest Carbon Management**
- 2022: **Fire-Adapted Ecosystems**
- 2022: **Wildlife Management**
- 2022: **Great Lakes Coastal Ecosystems**

In Preparation:

- Grasslands
- Ocean Coastal Ecosystems
- Arid Grassland Ecosystems




Adaptation menus available at: www.forestadaptation.org/strategies

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Adaptation Menu: Benefits

Address challenges in implementing adaptation:


1. Connecting broad ideas to specific actions
2. Making actions intentional
3. Communicating your ideas
4. Boosting creativity



www.AdaptationWorkbook.org/strategies

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Translating broad concepts to specific actions



www.adaptationworkbook.org/niacs-strategies

Options:

- **Foundational adaptation concepts:**
- Resistance, Resilience, Transition

Strategies:

- Broad adaptation responses that consider:
 - Regional ecological conditions
 - Overarching management goals

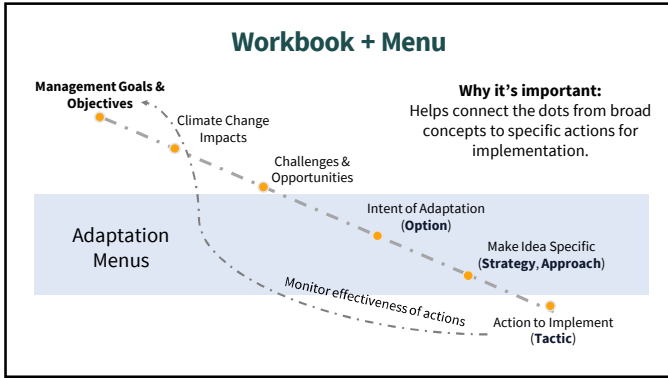
Approaches:

- More detailed responses that consider:
 - Site-level conditions
 - Site-level management objectives

Tactics:

- Prescriptive actions designed for:
 - Specific site conditions
 - Specific management objectives

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A "Working" Workshop

- Southwest FireCLiME convened a workshop to test the Fire Adaptation Menu
- Audience: Natural resource professionals & partners from the Kaibab Plateau
- 3 days of hands-on activities
- **Final product: tiered adaptation actions for adapting management to changing fire regimes**

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Fire Adaptation Menu Pilot Test

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**

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Fire-Adapted Ecosystems Adaptation Menu



Fire-Adapted Ecosystems Adaptation Menu

Southwest FireCLIME

swfireclimate.org/fire-climate-adaptation-tools/; forestadaptation.org/fire-adapted-ecosystems-menu/; or <https://doi.org/10.3390/cli10040058>

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Fire Menu Strategies & Approaches

Strategy 1: Sustain fire as a fundamental ecological process

- Approach 1.1: Restore or maintain fire in fire-adapted ecosystems
- Approach 1.2: Develop fire use strategies in altered or novel ecosystems where fire can play a beneficial role

Strategy 2: Reduce the effects of biotic and abiotic stressors affecting fire regimes

- Approach 2.1: Remove and prevent establishment of non-native invasive species that alter fuel regimes
- Approach 2.2: Maintain or improve the ability of forests to resist pests and pathogens that may alter fuel regimes
- Approach 2.3: Limit, selectively apply, and monitor land uses that increase fire risk or threaten fire resilience

Strategy 3: Reduce the risk of unacceptable fire

- Approach 3.1: Protect fire-sensitive and vulnerable ecosystems from fire
- Approach 3.2: Alter forest structure and composition to reduce the risk and spread of unacceptable fire
- Approach 3.3: Establish or maintain fuel breaks to stop the spread of unacceptable fire



Photo: Susan Blain, US Forest Service

Photo: Sam Beale, Ecosystem Community Forest, Northwest Region, Department of Natural Resources

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Fire Menu Strategies & Approaches

Strategy 4: Limit the effects of unacceptable fire and promote post-fire recovery

- Approach 4.1: Promote habitat connectivity and increase ecosystem redundancy
- Approach 4.2: Maintain or create fire refugia
- Approach 4.3: Stabilize and enhance the physical fire footprint
- Approach 4.4: Promote recovery of native vegetation and habitat

Strategy 5: Maintain and enhance structural, community, and species diversity using fire and fuels treatments

- Approach 5.1: Maintain or increase structural diversity from stand to landscape scales
- Approach 5.2: Promote diversity within and among communities to enhance fire resilience

Strategy 6: Identify, promote, and conserve fire- and climate change-adapted species and genotypes

- Approach 6.1: Promote native species and genotypes that are better adapted to future climate and fire regimes, disfavor species that are distinctly maladapted
- Approach 6.2: Use plant materials from regional areas that have current climate and fire regimes similar to anticipated future conditions




Photo: California State Forestry

Photo: Andy Wilson, USDA Forest Service

Photo: David C. Johnson, Oregon Department of Forestry

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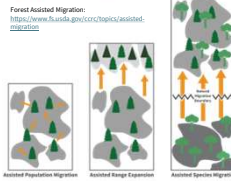
Fire Menu Strategies & Approaches

Strategy 7: Facilitate ecosystem adaptation to expected future climate and fire regimes

- Approach 7.1: Facilitate the movement of species that are expected to be adapted to future climate and fire regimes
- Approach 7.2: Use fire as a tool to align existing vegetation communities with changing climate and fire regimes

Strategy 8: Use fire events as opportunities for ecosystem realignment

- Approach 8.1: Revegetate burned areas using fire-tolerant and drought-adapted species and genotypes
- Approach 8.2: Allow for areas of natural regeneration to test for future-adapted species
- Approach 8.3: Maintain ecosystems that have undergone post-fire type conversion or realignment



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Fire Menu Strategies & Approaches

Strategy 9: Promote organizational and operational flexibility

- Approach 9.1: Develop adaptive staffing and budgeting strategies
- Approach 9.2: Explicitly consider changing climate and fire regimes during the planning process and adaptive management cycle
- Approach 9.3: Engage and incorporate values of Indigenous communities in fire management decisions

Strategy 10: Promote fire-adapted human communities

- Approach 10.1: Increase fuel reduction treatments in the wildland-urban interface (WUI)
- Approach 10.2: Actively promote broad social awareness and increase education about anticipated effects of climate change on fire regimes



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Example: Fire Adaptation Menu

OPTION

➔ Option: Resistance (forestall change)

STRATEGIES

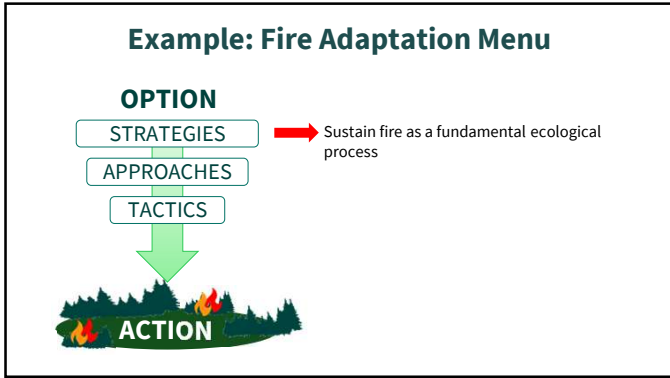
APPROACHES

TACTICS

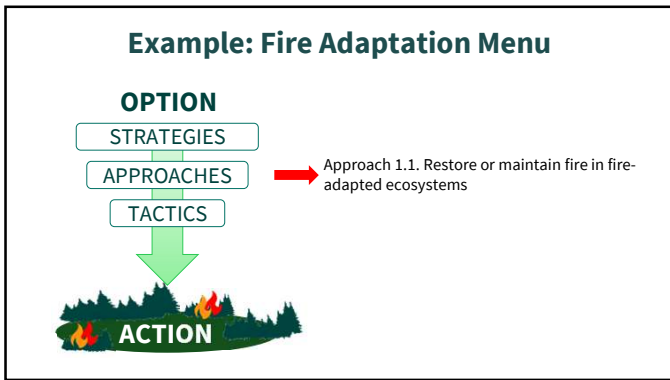
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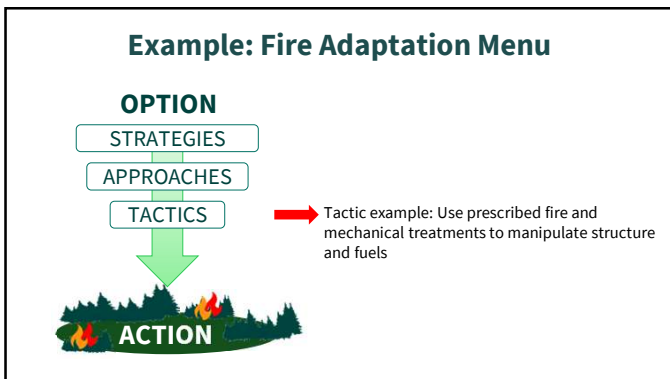
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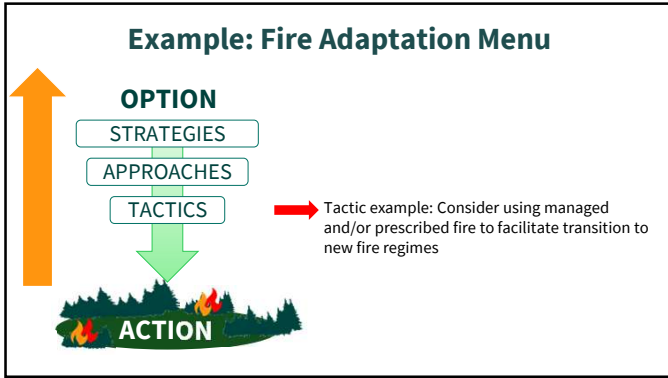
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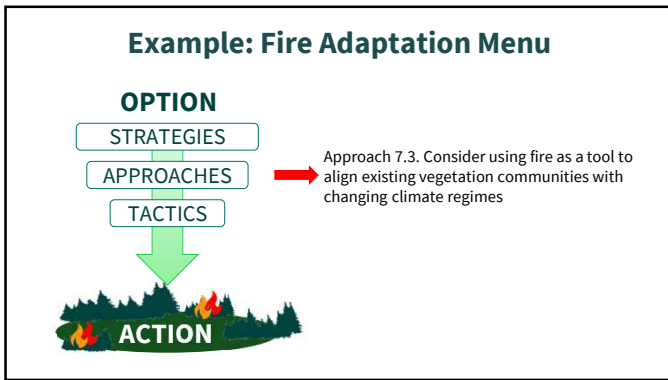
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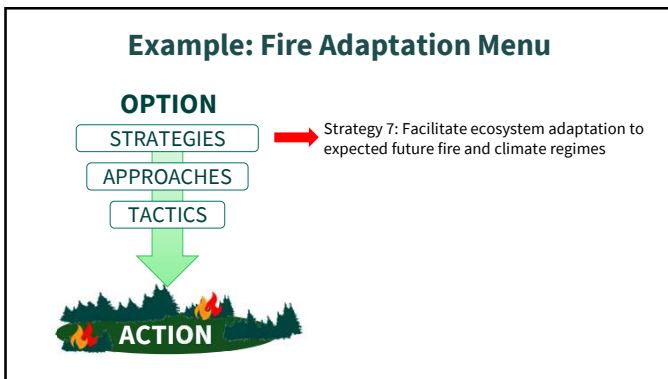
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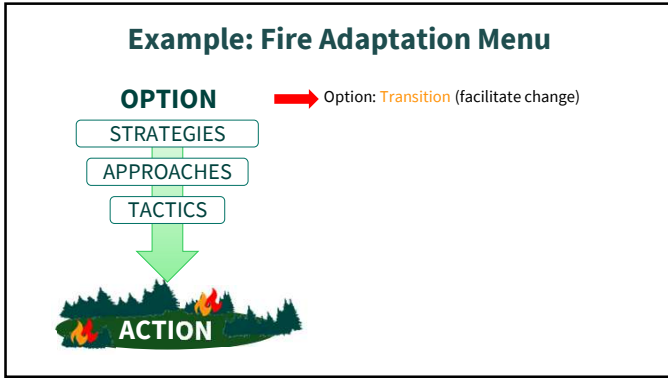
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Kaibab Plateau Ecological Restoration Project

1. DEFINE
management goals/objectives

2. ASSESS
climate impacts

3. EVALUATE
management objectives.

Goals:

- Restoring natural fire regimes
- Maintaining resilient forests by reducing the risk of high intensity wildfire
- Protecting the wildland urban interface
- Promoting heterogeneity

Climate considerations:

- Variable burn windows could create conflicts with hunting season and goshawk nesting season, and the potential to move out of prescription on hotter, drier days
- Capacity issues may occur trying to match the workforce with treatment needs with longer fire seasons
- Changing fire regimes may result in a loss of the mesic mixed conifer ecosystems

Photos: <https://www.fs.usda.gov/whats/kaibab/>

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Example: Kaibab Plateau Restoration Project

Fire Menu Approaches Examples	Adaptation Tactics (Developed by Workshop Participants)
1.1: Restore or maintain fire in fire-adapted ecosystems	<ul style="list-style-type: none"> Use prescribed fire and mechanical treatments to manipulate structure and fuels Increase intentional use of wildfires whenever possible
5.2: Maintain or increase structural diversity at the landscape scale	<ul style="list-style-type: none"> Identify keystone species and roles in fire adapted systems, maintain or restore where possible Use silvicultural treatments to promote and enhance diverse regeneration of native species
7.2: Consider using fire as a tool to align vegetation communities with changing climate regimes	<ul style="list-style-type: none"> Shift prescribed burn seasons to align with projected climatic changes Consider using managed and/or prescribed fire to facilitate transition to new fire regimes Consider increasing acreage treated with prescribed fire in the short-term in areas where current regeneration responses are desirable (and future regeneration trends are uncertain)

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Fire-Adapted Ecosystems Adaptation Menu

swfireclimate.org/fire-climate-adaptation-tools/; forestadaptation.org/fire-adapted-ecosystems-menu;
or https://doi.org/10.3390/cli10040058

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Thank you!

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Concluding Thoughts

- Certainty is a myth – plan for a range of futures
- Tools are helpful – your judgement is critical
- Climate-informed choices are not always ideal
- Be clear about values and intent
- Learn by doing

Thank you!
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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)

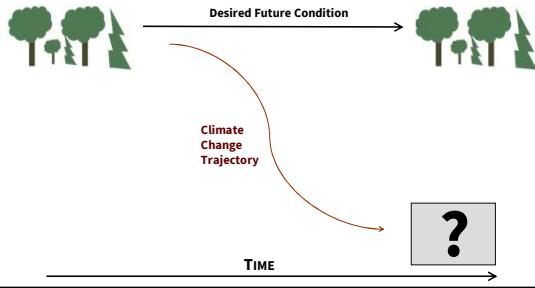


Invasive species management (USFS)

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

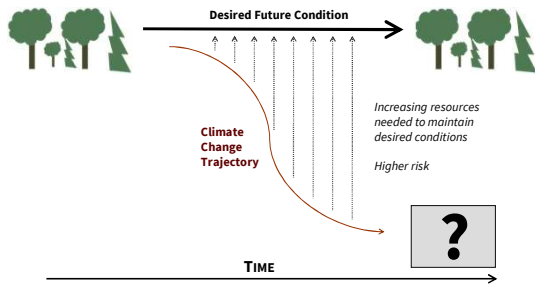
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Resistance



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Resistance




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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



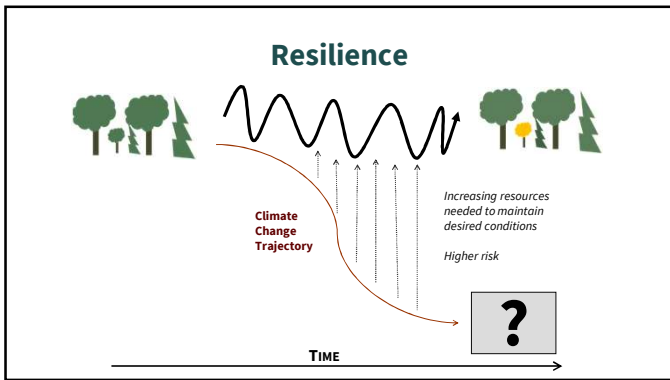
Reducing overstocked stands (Tahoe NF)



Increasing setbacks to allow for fluctuating water levels

Holling 1973, Millar et al. 2007, Swanston et al. 2016
See also - Moser et al. 2019

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Transition

Intentionally encourage change, help ecosystems respond in a targeted fashion.

- Foster well-adapted native species
- Relocate visitor and recreation infrastructure



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



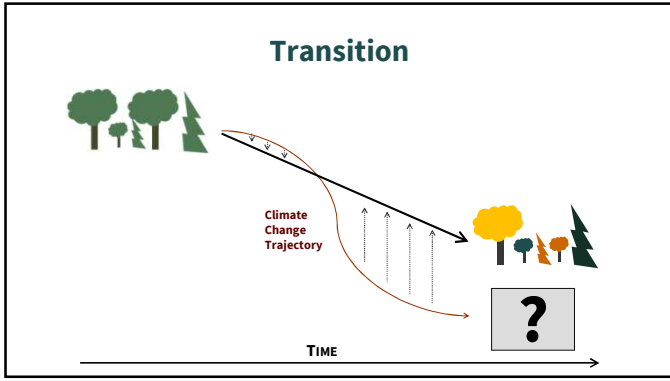
Relocate existing infrastructure to areas with less risk (P-Tom Hillen)



River & riparian area restoration in agricultural fields (P-Joanne Kline)

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

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