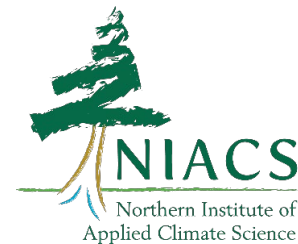


Climate Adaptation Tools for Forest and Watershed Management



Michigan
Technological
University



Danielle Shannon
(dshannon@mtu.edu)

December 12, 2023

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.**



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.

Forest Ecosystem Vulnerability Assessments

Climate Change Response Framework

For land managers, created by land managers & scientists

- Focus on **forest** ecosystems
- Observed climate
- Future projected climate
- Impacts on forests & vulnerability
- Implications for management

Does not make recommendations

Place based, model-informed, expert-driven, transparent

MID-ATLANTIC REGION



PIEDMONT (SUBREGION 5)



COASTAL PLAIN (SUBREGION 6)

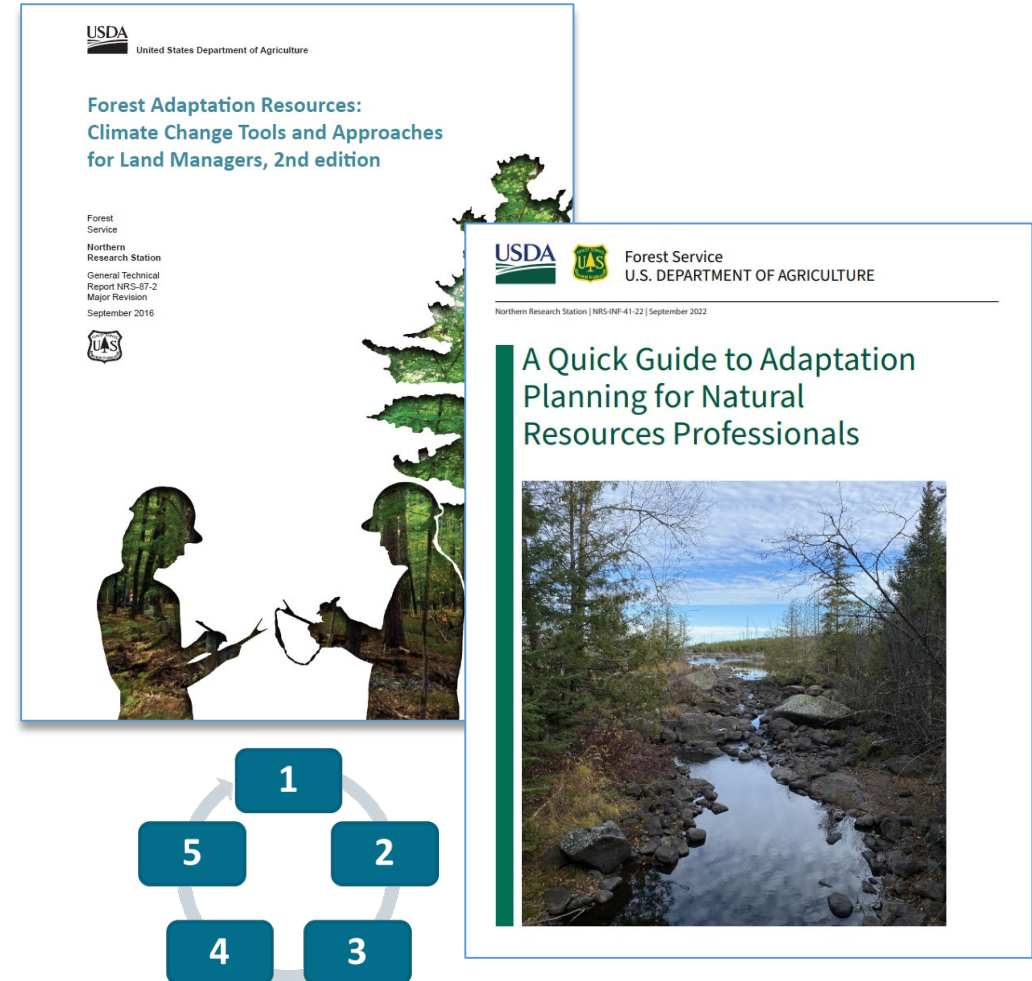


Forestadaptation.org/Mid-Atlantic

Adaptation Resources: Flexible, not prescriptive

Process to intentionally consider climate in planning, and to customize adaptation actions


- Designed to be flexible to accommodate: *diverse goals, values, landscapes, ownership*
- Works intuitively at the project level
- Centers on manager expertise and judgement
- Does not make recommendations



Download at: forestadaptation.org/adaptation-workbook


Practical tools you can use!


Video presentations



United States Department of Agriculture

Mid-Atlantic Forest Ecosystem
Vulnerability Assessment and Synthesis:
A Report from the Mid-Atlantic Climate Change
Response Framework Project



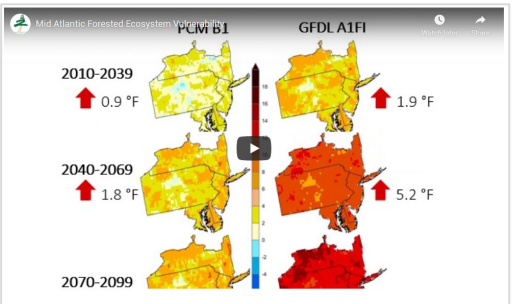
 Forest Service

Northern
Research Station

General Technical
Report NRS-181

October 2018

Assessments



Story Map

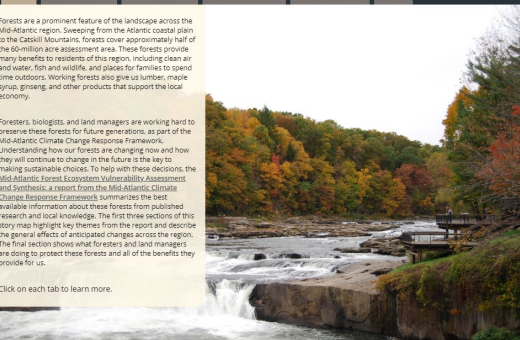
Climate Change and Adaptation: Mid-Atlantic Forests

Home Changing Climate Effects on Forests Forest Vulnerability Adaptation Stories Credits

Forests are a prominent feature of the landscape across the Mid-Atlantic region. Sweeping from the Atlantic coastal plain to the Catoctin Mountains, forests cover approximately half of the 40-million-acre assessment area. These forests provide many benefits to residents of this region, including clean air and water, fish and wildlife, and places for families to spend time outdoors. Working forests also give us lumber, maple syrup, ginseng, and other products that support the local economy.

Foresters, biologists, and land managers are working hard to preserve these forests for future generations as part of the Mid-Atlantic Climate Change Response Framework. Understanding how our forests are changing now and how they will continue to change in the future is the key to making sustainable choices. To help with these decisions, the Mid-Atlantic Forest Ecosystem Vulnerability Assessment and Synthesis, a report from the Mid-Atlantic Climate Change Response Framework, summarizes the best available information about these forests from published research and local knowledge. The first three sections of this story map highlight key themes from the report and describe the general effects of anticipated changes across the region. The final section shows what foresters and land managers are doing to protect these forests and all of the benefits they provide for us.

Click on each tab to learn more.



Tree projections & Adaptation tools

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES
MID-ATLANTIC REGION

The region's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in the Mid-Atlantic region (Butler-Leopold et al. in review). This report includes information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest types. This handout is summarized from the full assessment.

TREE SPECIES INFORMATION:
This assessment uses two climate scenarios to "bracket" a range of possible futures. These future climate projections were used with two forest impact models (Tree Atlas and LANDIS) to provide information about how individual tree species may respond to a changing climate. More information on the climate and forest impact models can be found in the assessment. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Remember that models are just tools, and they're not perfect. Model projections don't account for some factors that could be modified by climate change, like droughts, wildfire activity, and invasive species. If a species is rare or confined to a small area, Tree Atlas results may be less reliable. These factors, and others, could cause a particular species to perform better or worse than a model projects. Human choices will also continue to influence forest distribution, especially for tree species that are projected to increase. Planting programs may assist the movement of future-adapted species, but this will depend on management decisions.

Despite these limits, models provide useful information about future expectations. It's perhaps best to think of these projections as indicators of possibility and potential change. The model results presented here were combined with information from published reports and local management expertise to draw conclusions about potential risk and change in the region's forests.

SPECIES	ADDITIONAL CONSIDERATIONS - 30 MOST COMMON SPECIES
MAY INCREASE	
American basswood	Tolerates shade, susceptible to fire
American beech	Susceptible to beech bark disease, very shade tolerant
Bigtooth aspen	Early successional colonizer, susceptible to drought
Black cherry	Susceptible to insects and fire, mildly drought tolerant
Eastern hemlock	Hemlock woody adelgid causes mortality
Eastern white pine	Good disperser, but susceptible to drought and insects
Quaking aspen	Early successional colonizer, susceptible to heat & drought
Servicberry	Competitive colonizer, susceptible to drought
Striped maple	Shade tolerant, easily established, susceptible to drought
Sugar maple	Grows across a variety of sites, tolerates shade
Sweet birch	Susceptible to drought, fire, topkill, and insects
Yellow birch	Good disperser, susceptible to fire, insects, and disease
NO CHANGE	
American hornbeam	Tolerates shade, susceptible to fire and drought
Eastern hophornbeam	Grows across a variety of sites, tolerates shade
Pitch pine	Early successional colonizer, susceptible to insect

SPECIES	ADDITIONAL CONSIDERATIONS - 30 MOST COMMON SPECIES
MIXED MODELS RESULTS	
Chestnut oak	Establishes from seed or sprout, adapted to fire
Red maple	Competitive colonizer, tolerant of disturbance
Scarlet oak	Seeds and sprouts, susceptible to fire and disease
Tulip tree	Competitive colonizer tolerant of diverse sites
White ash	Emerald ash borer causes mortality
MAY INCREASE	
American elm	Susceptible to Dutch elm disease
Black locust	Early successional colonizer, susceptible to insect pests
Black oak	Drought tolerant, susceptible to insect pests & diseases
Blackgum	Shade tolerant, fire adapted
Flowering dogwood	Shade tolerant
Northern red oak	Susceptible to insect pests
Pignut hickory	Susceptible to insect pests and drought

Real stories of people making climate-informed decisions

CLIMATE CHANGE RESPONSE FRAMEWORK

MENU


ILLINOIS INDIANA OHIO MARYLAND NJ
MISSOURI KENTUCKY WEST VIRGINIA VIRGINIA
ARKANSAS TENNESSEE NORTH CAROLINA SOUTH CAROLINA

Map data ©2020 Google, INEGI Terms of Use

Start-up Planning Action Evaluation

Climate-informed reforestation in urban riparian forests and floodplain areas.

The purpose of this project is to utilize the reforestation priority area GIS analysis to determine where to best utilize fee-in-lieu funds to reforest areas and enhance floodplain depression projects. This area is a highly active stream valley park with an interconnecting trail system in the suburbs of DC. It is a heavily used and disturbed area with a large amount of infrastructure (sewer, water, gas) and surrounding development. The plan is to be used by the Parks Department, Planning Department, and citizens and the major management goals are to improve water quality, enhance forest quality, and increase biodiversity.



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



Adaptation actions are designed intentionally to meet goals and objectives

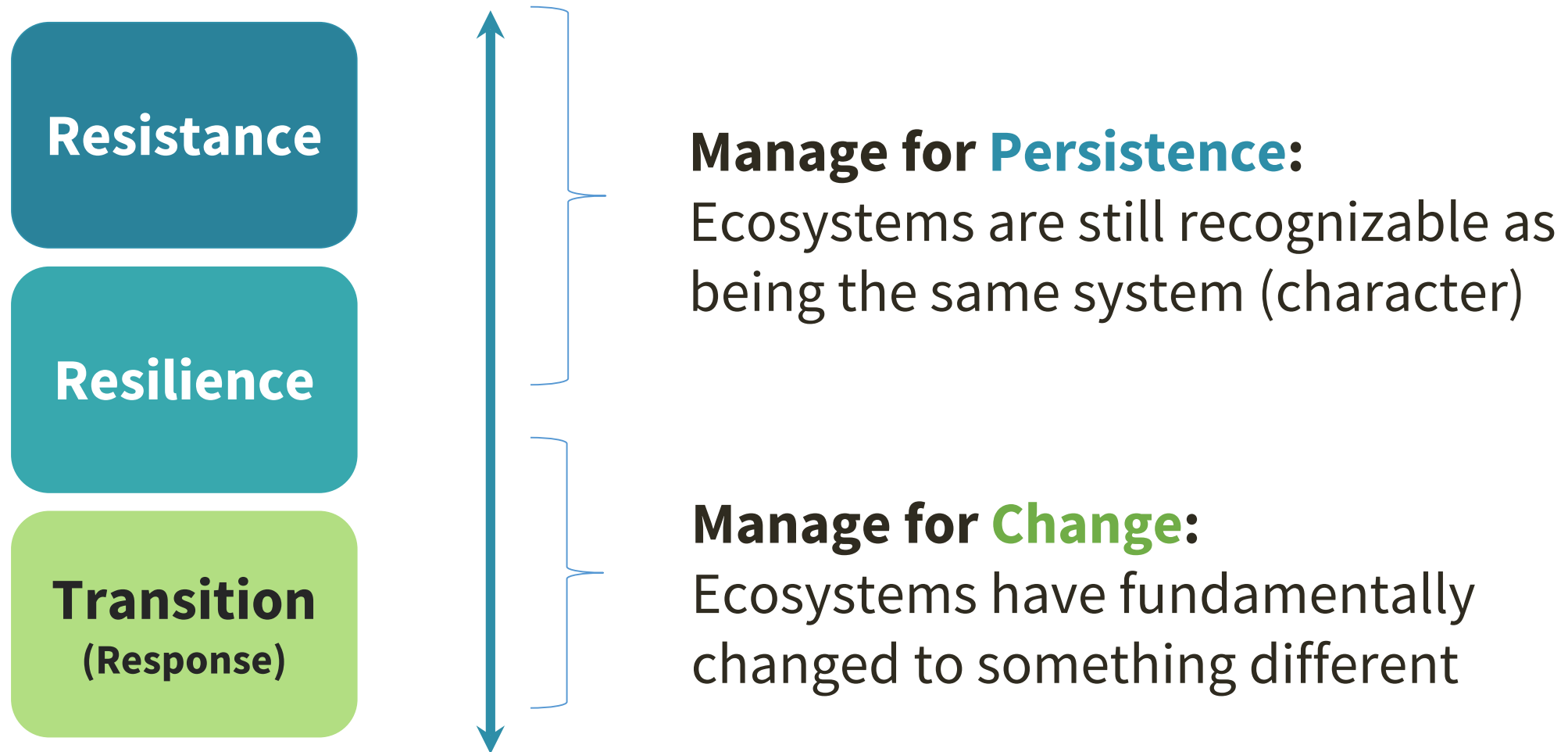
Adaptation is the adjustment of systems in response to climate change.



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

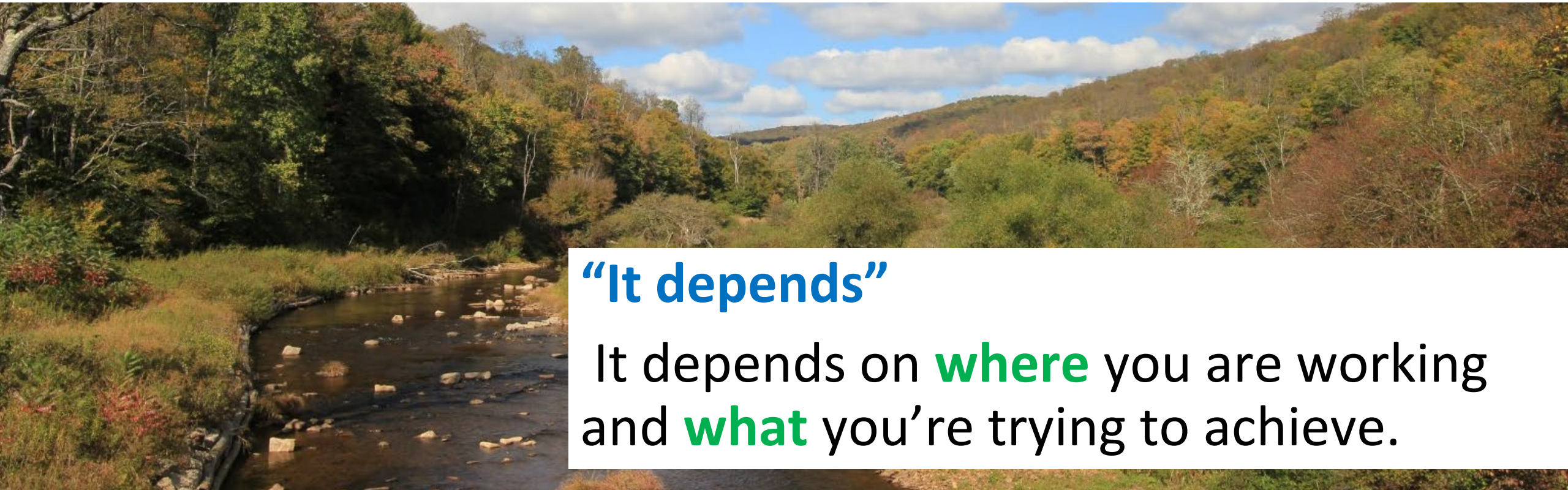
However, there are things that may need re-examination due to climate change.

Identifying Adaptation options



Watersheds + forests + climate change

Can we enhance the ability of a natural ecosystem to **cope** with climate change and **meet our goals and objectives**?

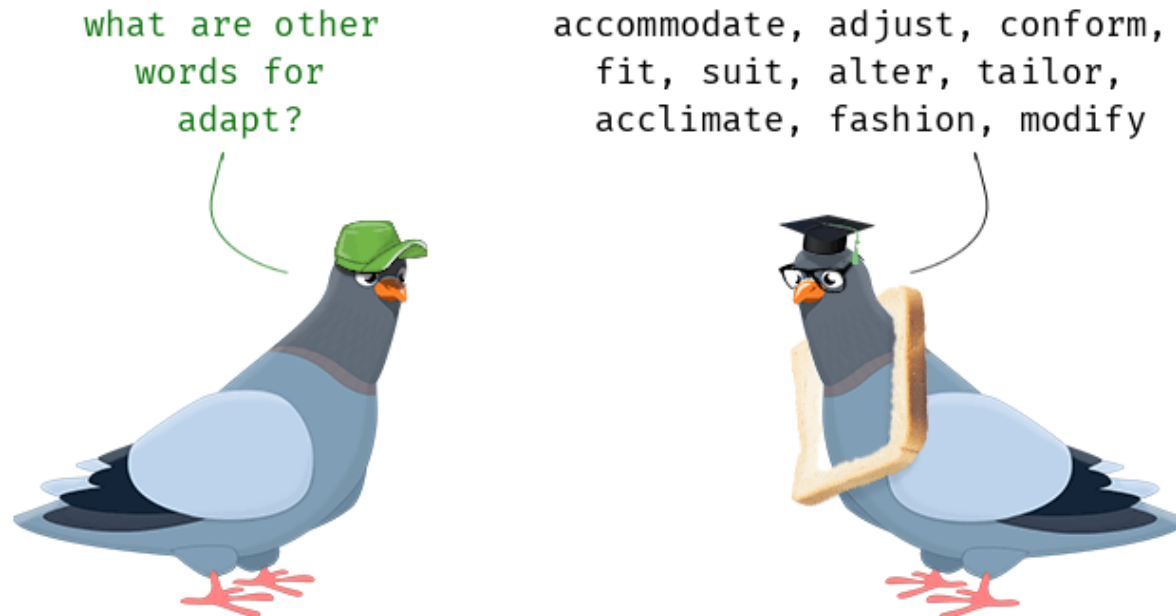


“It depends”

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

Adaptation Strategies

- How do we organize our ideas around Climate Adaptation?
- How do we communicate what we're trying to do?



Adaptation can help to retain ecosystem services

Challenge:

Existing climate adaptation literature and reports tend to:

- Only covers broad adaptation **concepts**
- Focus on hyper specific management practices relevant to a **system or location**

Solution

Develop a **list** of plausible strategies and approaches that can help natural resources practitioners move from **general concepts to tangible, targeted** adaptation tactics designed for their system.

Menus of Adaptation Strategies and Approaches

- A diverse set of **options** for responding to climate change within forests and ecosystems.
- **Derived from** contemporary reports, expert input, and peer-reviewed publications
- **Flexible**, can be used in various ecosystems, land ownerships and locations throughout the Midwest and Northeast Regions.

Intended users: those planning and implementing on-the-ground conservation & management actions.



Image source: US Fish and Wildlife Service

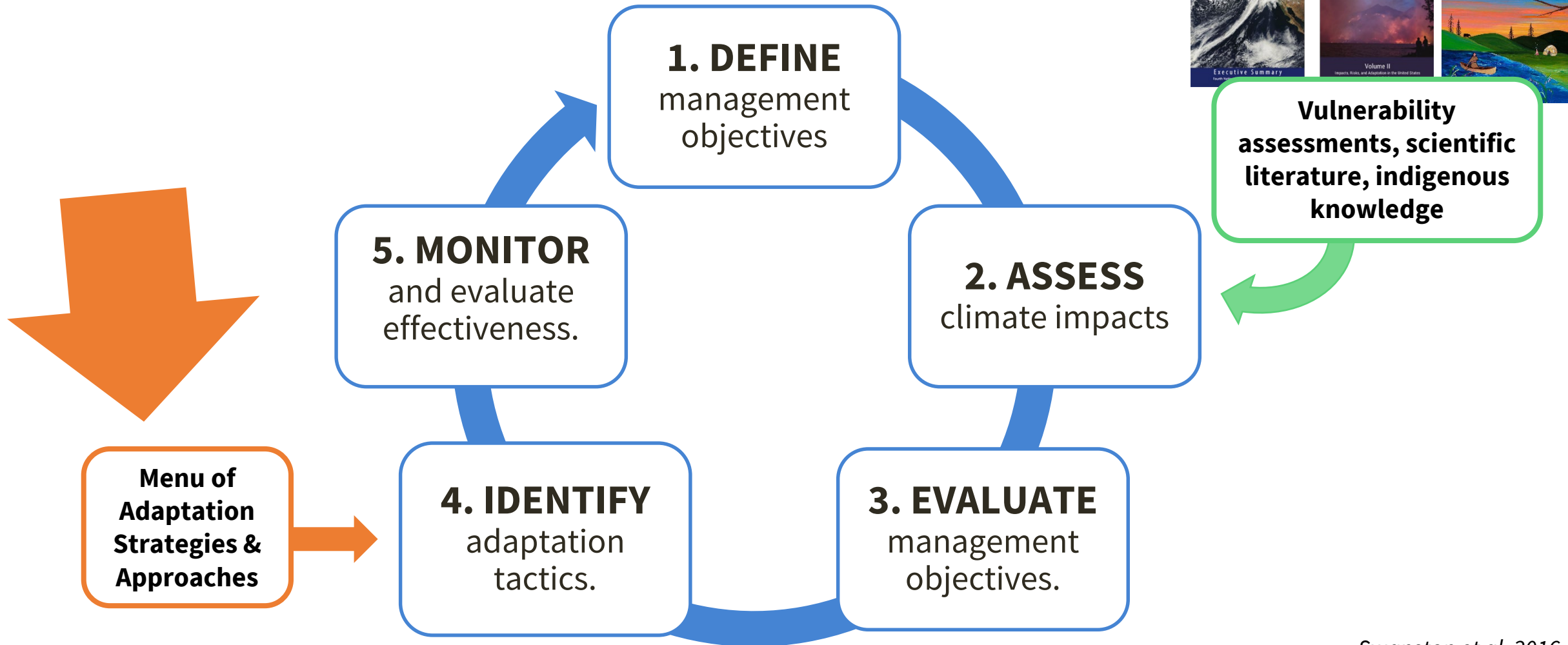
What is a menu of adaptation strategies?

A menu is NOT ...

- **Not intended to replicate existing resources** nor to provide an overview of ecosystem dynamics or climate vulnerabilities, which are covered in other sources.
- **Not an assessment** of climate impacts and vulnerabilities.
- **Not a spatial tool** that will tell you WHERE to act. That's up to you!
- **Not setting guidelines, or recommendations.**

Designed to be used with the Adaptation Workbook

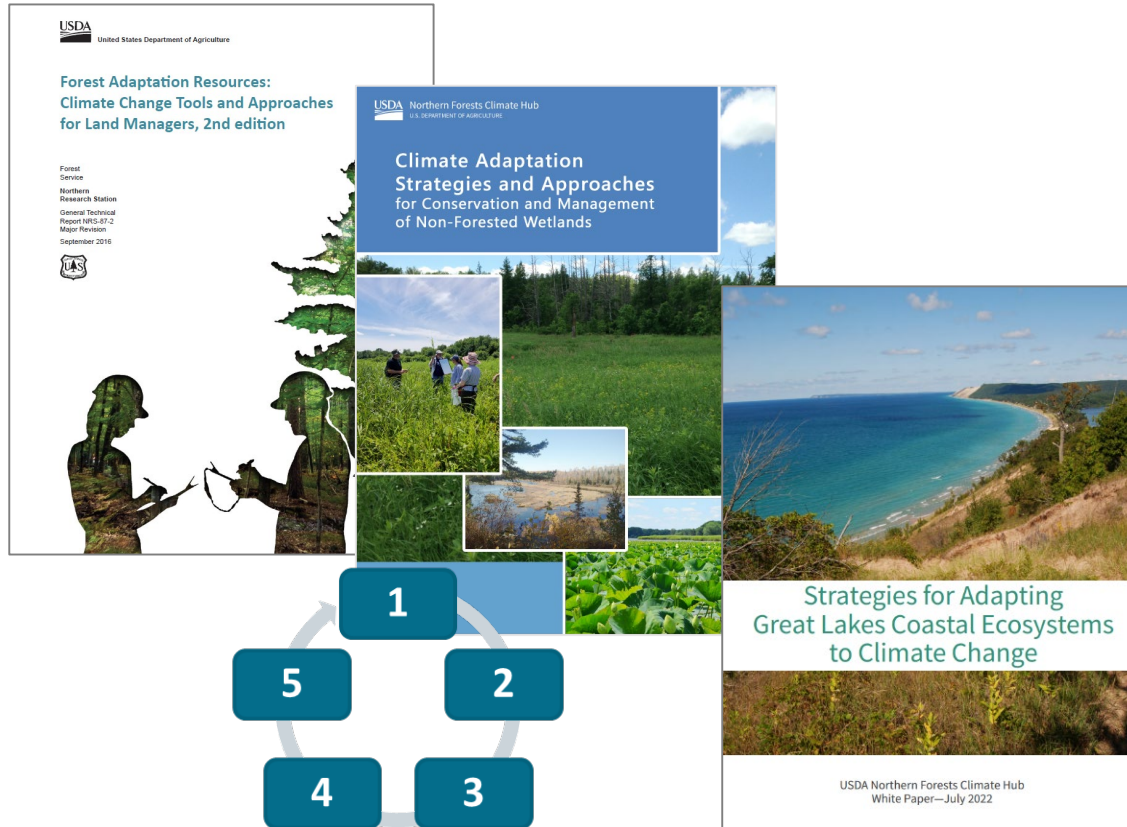
Decision-support framework



Swanston et al. 2016

Adaptation Strategies for Natural Resource Management

*Adaptation topics for a **variety** of perspectives*



Published Adaptation Strategies:

- [Agriculture](#)
- [Fire-Adapted Ecosystems](#)
- [Forests](#)
- [Forest Carbon Management](#)
- [Forested Watersheds](#)
- [Great Lakes Coastal Ecosystems](#)
- [Inland Glacial Lake Fisheries](#)
- [Non-Forested Wetlands](#)
- [Recreation](#)
- [Tribal Perspectives](#)
- [Urban Forests](#)
- [Wildlife Management](#)

Browse all menus at: ForestAdaptation.org/strategies

Adaptation Menus of Strategies and Approaches

CONCEPT

Option: Foundational adaptation concepts: resistance, resilience, and transition

Strategy: A strategy is a broad adaptation response that is applicable across a variety of resources and sites

Approach: An approach is an adaptation response that is more specific to a resource issue or geography

Tactic: The most specific adaptation response, providing prescriptive direction about actions that can be applied on the ground

ACTION

Adaptation Strategies for Forested Watersheds

Strategy 1: Sustain fundamental hydrologic processes

Strategy 2: Maintain and enhance water quality.

Strategy 3: Maintain or restore forests and vegetative cover.

Strategy 4: Facilitate forest ecosystem adjustments through species transitions.

Strategy 5: Accommodate altered hydrologic processes.

Strategy 6: Design and modify infrastructure to accommodate future conditions.

Resistance

Resilience

Transition
(Response)

Shannon, P.D., et al 2019. <https://doi.org/10.1016/j.cliser.2019.01.005>

forestadaptation.org/water

Adaptation Strategies for Forested Watersheds

Strategy 1: Sustain fundamental hydrologic processes

Strategy 2: Maintain and enhance water quality.

Strategy 3: Maintain or restore forests and vegetative cover.

Strategy 4: Facilitate forest ecosystem adjustments through species transitions.

Strategy 5: Accommodate altered hydrologic processes.

Strategy 6: Design and modify infrastructure to accommodate future conditions.

Resistance

Resilience

**Transition
(Response)**

Shannon, P.D., et al 2019. <https://doi.org/10.1016/j.cliser.2019.01.005>

forestadaptation.org/water

Strategy 5: Accommodate altered hydrologic processes.

- **Approach 5.1: Manage systems to cope with decreased water levels and limited water availability.**
- Approach 5.2: Enhance the ability of systems to retain water.
- Approach 5.3: Adjust systems to cope with increased water abundance, and high water levels.
- Approach 5.4: Respond to or prepare for excessive overland flows (surface runoff).

Tactics (examples)

- Reduce leaf area, favor native species that consume less water (like xeric drought tolerant species)
- Control invasive species on newly exposed soils due to lower water levels
- Reduce aquatic habitat fragmentation during periods of low water levels by removing modifications may exacerbate low water levels (dams, drain tiles, undersized culverts).



Strategy 5: Accommodate altered hydrologic processes.

- Approach 5.1: Manage systems to cope with decreased water levels and limited water availability.
- Approach 5.2: Enhance the ability of systems to retain water.
- **Approach 5.3: Adjust systems to cope with increased water abundance, and high water levels.**
- Approach 5.4: Respond to or prepare for excessive overland flows (surface runoff).

Tactics (examples)

- Protect, and expand setbacks in riparian areas to slow the flow
- Diversify and favor riparian species tolerant of wet/moist conditions
- Target invasive species management in new flood prone areas
- Protect soils from erosion



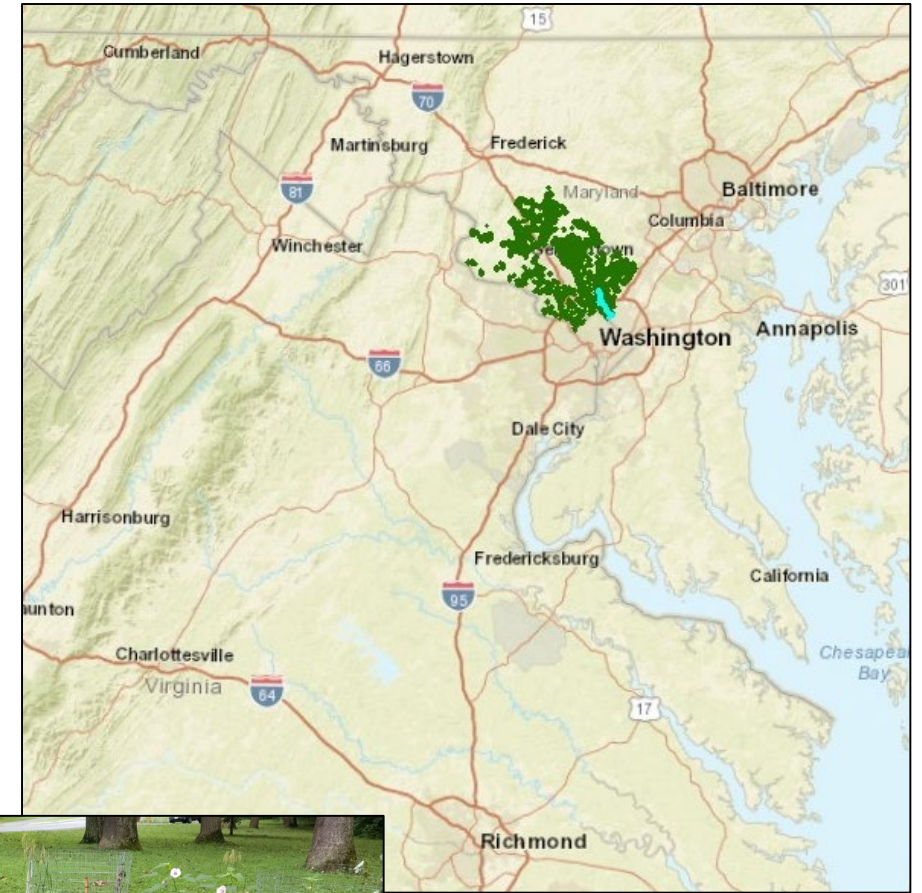
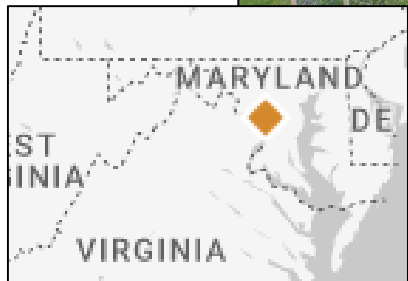
Volunteers planting trees at Crosby Farm Regional Park; Photo Credit: Mary Hammes, Mississippi Park Connection - www.adaptivesilviculture.org

Adaptation example



Adaptation in the wild

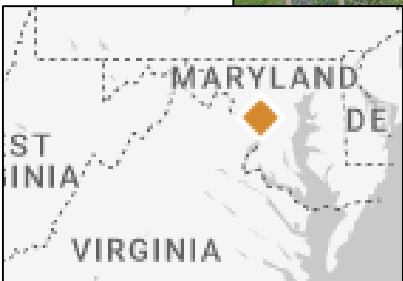
- Climate-informed reforestation in urban riparian forests and floodplain areas.
- Threats: Rising temperatures + urban-heat-island effect can lead to heat related stress on urban trees.



More info at: forestadaptation.org/sligo-creek-reforestation

Adaptation in the wild

- Climate-informed reforestation in urban riparian forests and floodplain areas.
- Threats: Rising temperatures + urban-heat-island effect can lead to heat related stress on urban trees.



Adaptation Approaches:

- Reduce soil erosion and sediment deposition.
- Promptly revegetate after disturbance
- Promote diverse age classes
- Maintain and restore diversity of native species

On-the-ground tactics:

- Replace failing stream structures
- Plant # trees per year with a diversity of tree species to enhance biodiversity
- Remove non-native invasive shrub layer and replace with native shrub layer, diverse age class of trees
- Maintain meadow/open space

More info at: forestadaptation.org/sligo-creek-reforestation

Learn from the community.



CLIMATE CHANGE
RESPONSE FRAMEWORK

Who we are ▾

Assess ▾

Adapt ▾

Learn ▾

Focus ▾

Contact



Demonstrations

[Home](#) » [Adapt](#) » Demonstrations



Forestadaptation.org/demos

Closing Thoughts...

Forest and Watershed management: Same job, new challenges

- *Similar stressors, but new patterns and agents.*

Adaptation actions will reflect values and risk tolerance

- There is no one-sized fits all solution to climate change.
- Think about place and objectives within the context of risk and values.
- Document your rationale and intent.

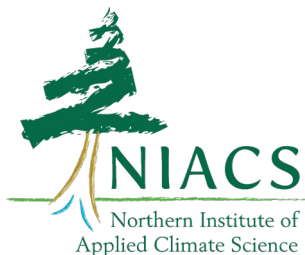


Attend this free course:

Adaptation Planning Course

Online, 8 weeks – 1 session/week

ForestAdaptation.org/training



Danielle Shannon
dshannon@mtu.edu

Thank you!

A scenic view of rolling green mountains under a blue sky with white clouds. The mountains are covered in dense green forest, and the sky is a clear blue with scattered white clouds.

Thank you!

Contact me with any questions!
Danielle Shannon (dshannon@mtu.edu)

