

Responses to Climate Change: What You Need to Know

Title Slide

Responses to Climate Change: What You Need to Know



This is a screenshot of the title slide. The title is centered on the screen, and the Forest Service shield is in the bottom left corner.

Introduction

Forests are shaped by climate. Climate is a major factor in not only where we find forests, but what types of forests we find there. The average temperature has increased in the United States and worldwide over the past century, accompanied by altered precipitation and other effects. As the climate changes, our forests will respond.

Forests provide valuable resources and benefits, such as water, plant and animal life, recreation, and wood products. We manage our forests for the things we need and value. As the climate changes and forests change, it may become harder to maintain these values. This is why it is important that we begin preparing now.



This is a screenshot of the introduction slide. This image shows a map of the United States with different tree icons in different regions representing forests and climate change icons in bubbles representing the climate of the region.



This is a screenshot of the introduction slide. This image shows a forest silhouette in front of a clipboard with management goal icons like water, wildlife, recreation icons.

Adaptation

Climate change effects are already being observed, and these effects are expected to continue—and intensify—in the future. *Adaptation* means taking action to prepare for anticipated changes and respond to effects. Preparing human and natural systems for climate change involves assessing information about the vulnerabilities and risks associated with climate change and then choosing a course of action that best fits the management goals and the needs of the system.



This is a screenshot of the adaptation slide. This image shows a person icon thinking through the vulnerability and risk of climate change depicted in icons.

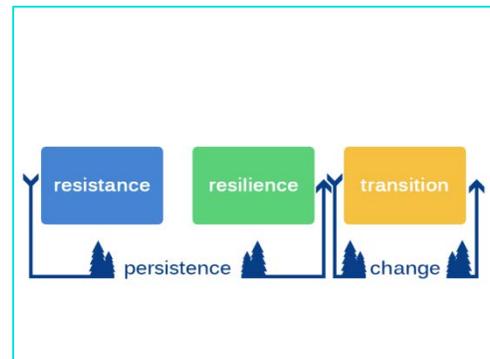
There is no single “right” way to respond to climate change, just as there is no single right way to manage resources. Natural resource management is diverse and will continue to be diverse with climate change.

Some of the actions we are already taking to manage natural resources will likely help ecological systems adapt to changing conditions, even though climate change may not have been a specific consideration in developing those actions. However, it is risky to automatically assume that our current management plans and actions will work in a changing climate with warmer temperatures, altered precipitation patterns, and other expected effects. Given the potential challenges of climate change, it is important to act with *intentionality*, which means explicitly considering and addressing the climate change effects that could impact our management goals and actions. Deliberately including climate change in our work makes plans and actions more robust. How well do current actions already address the expected effects of a changing climate? Are there other actions that we may want to consider?

There are three different options that are helpful for thinking about climate change adaptation: *resistance*, *resilience*, and *transition*. Resistance and resilience emphasize management for the persistence of existing systems, and transition promotes system change.



This is a screenshot of the adaptation slide. This image shows a silhouette of tree images with red risk arrows indicating the risk of managing forests without considering climate change, which is depicted by location bubbles.



This is a screenshot of the adaptation slide. This image shows three boxes with the three adaptation options, resistance, resilience, and transition. A forest image points out that resistance and resilience emphasize persistence and transition emphasizes change.

Resistance

The first adaptation option is *resistance*. Resistance actions improve the defenses of a system against anticipated changes, or directly defend the system against disturbance so that the system remains relatively unchanged.

We may choose resistance as the adaptation option for a system when we want the system to essentially stay the same in the future regardless of climate change pressures, like being inside a protected bubble. This option could be most useful in high-value systems that may not be able to cope with disturbances and pressures from a changing climate. These systems may be economically, socially, or culturally valuable, or protected for specific values or characteristics. However, resistance actions do come with risks. The investment and resources to maintain the bubble around the system are likely to increase as conditions change. If we continue to resist climate pressures and changes over the long term, we could be setting the system up to fail if some critical threshold is reached. A large disturbance could cause the bubble to collapse and significantly alter the system. The disturbed system may grow back differently, be less productive, or may not provide the same values as the original system.



This is a screenshot of the resistance slide. This image shows a current forest of tree icons and a future forest of trees under a bubble with climate change location icons.



This is a screenshot of the resistance slide. This image shows a current forest of tree icons and a future forest of different trees after the bubble with larger and more climate change location icons.

This slide features an interaction as indicated by the box on the left-hand side of the screen that pops in after the slide animations and narration have finished. The box says, “Interested in on-the-ground resistance actions? Click here to see an example.” Clicking on the box shows a pop-up screen with an example.

Turner Endangered Species Fund and U.S. Fish and Wildlife Service Chiricahua Leopard Frog Habitat Project

The Chiricahua leopard frog habitat project is a joint effort between the Turner Endangered Species Fund, the U.S. Fish and Wildlife Service, and other partners, located in New Mexico. The Chiricahua leopard frog is a threatened species in the southwest. Populations have declined due to predation, non-native competition, habitat loss, disease, and climate stressors.

The main goal of the project is to provide and maintain consistent habitat for frog populations.

Projected climate change effects for the area include increased temperature, altered precipitation patterns, and an increase in drought conditions.

Current adaptation approaches and tactics focus on providing habitat for frogs by using windmill and solar-powered pumps to retain water levels in ponds. This creates refugia from drought conditions and helps sustain the Chiricahua leopard frog population.

The overall adaptation option for the Chiricahua leopard frog habitat is essentially a resistance option, because these actions allow the system to remain the same despite climate change effects like drought. This option may not always be sustainable, but it is an important management objective for a high-value threatened species like the Chiricahua leopard frog.

For current project status and more information, visit the Ted Turner Endangered Species Fund [project website](#).

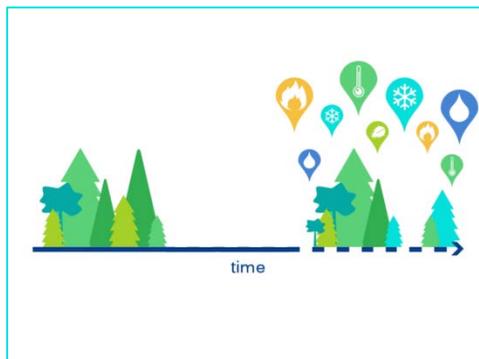
Resilience

The second adaptation option is *resilience*. Resilience actions enhance the ability of a system to return to prior conditions after a disturbance. Although some degree of change may occur, the intent is for the system to return to a state similar to what it was before the disturbance.

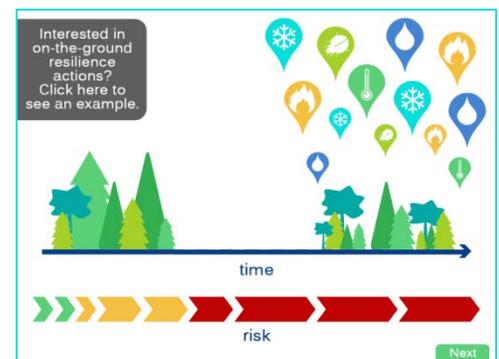
We may choose resilience as the adaptation option for a system when we want to increase the capacity of the system to absorb changes and recover from any disturbances. The system may undergo relatively minor changes as climate pressures increase, but a resilient system will maintain its character into the future. Even though the future system may not look exactly like the original, it will be similar in composition and function. Resilience carries less risk than resistance because we manage the system to cope with some amount of climate disturbance. Risk still increases over time because the system may not be able to maintain the same character in a different climate.



This is a screenshot of the resilience slide. This image shows a current forest of tree icons and a future forest of trees under climate change location icons.



This is a screenshot of the resilience slide. This image shows a current forest of tree icons and a future forest under more climate change location icons with trees that are different but similar to the current forest



This is a screenshot of the resilience slide. This image shows a current forest of tree icons and a future forest under more climate change location icons with trees that are different but similar to the current forest and a risk arrow going from green to red.

This slide also features an interaction as indicated by the box on the left-hand side of the screen that pops in after the slide animations and narration have finished. The box says, “Interested in on-the-ground resilience actions? Click here to see an example.” Clicking on the box shows a pop-up screen with an example.

Pioneer Forest and Ozark National Scenic Riverways Jerktail Mountain Project

The Jerktail Mountain Project is joint effort between the L-A-D Foundation and the National Park Service, located in south-central Missouri. The project area features rugged terrain with mostly shortleaf pine and oak scattered with igneous and dolomite glades. The main goal of Jerktail Mountain is to enhance the adaptive capacity of Ozark woodland and glade ecosystems.

Projected climate change effects for the area include increased temperature, increased precipitation in winter and spring and decreases in summer, and increased frequency and severity of wildfire.

Rather than trying to resist fires, the current adaptation approach is to improve the capacity of ecosystems to “bounce back” more quickly after a disturbance by favoring fire-tolerant species. Tactics include restoring fire-adapted systems and native species through prescribed burns and selective timber harvesting.

The overall adaptation option for the Jerktail Mountain Project can be considered a resilience option, because these actions will help to enhance the ability of current woodlands and glades to cope with expected climate changes such as increases in temperature and wildfire.

For current project status and more information, visit the [Jerktail Mountain Project](#) adaptation demonstration summary.

Transition

The third adaptation option is *transition*. Transition actions intentionally accommodate change, enabling a system to adaptively respond in a deliberate way. By encouraging a gradual and intentional transition, it may be easier to maintain important functions and values over time, even as the character of a system changes.

We may choose transition as the adaptation option for a system when we want to facilitate changes that we believe will make the system better suited to future conditions. As time goes on, climate pressures on the system increase and the system may change. By anticipating likely effects on the system, we can shape our response to maintain desired functions and values even as the system is altered. Transition actions can take place in advance of climate change effects or in response to them. In the long term, transition may carry less risk because we are actively considering how a system may change and taking action to promote those changes.



This is a screenshot of the transition slide. This image shows a current forest of tree icons and a future forest of trees with new small planted trees under climate change location icons.



This is a screenshot of the transition slide. This image shows a current forest of tree icons and a future forest under more climate change location icons with trees that are different from the current forest and growing planted trees.



This is a screenshot of the transition slide. This image shows a current forest of tree icons and a future forest under more climate change location icons with trees that are different from the current forest and growing planted trees and a risk arrow going from green to yellow.

This slide also features an interaction as indicated by the box on the left-hand side of the screen that pops in after the slide animations and narration have finished. The box says, “Interested in on-the-ground transition actions? Click here to see an example.” Clicking on the box shows a pop-up screen with an example.

The Nature Conservancy Adaptation Forestry in Minnesota's Northwoods

The Minnesota Northwoods Project is located on a mix of federal, state, and county land in northeast Minnesota and is a collaboration of several different organizations. The project area features mostly boreal species such as aspen and white spruce. The main goal of this project is to try alternative silviculture strategies to promote diverse forest stand structures and incorporate new tree species and genotypes through planting.

Projected climate change effects for the area include increased temperature and more drought stress during the growing season, along with shorter winters and less snowfall.

The current adaptation approach includes establishing a new mix of native species through plantings of tree seedlings projected to be better suited for future climate. All species being planted (such as burr oak) are native to the region and are anticipated to thrive under future climate.

The overall adaptation option for the Northwoods Project can be considered a transition option, because planting promotes a change in forest composition that will likely be better suited for expected climate effects.

For current project status and more information, visit the [Adaptation Forestry in Minnesota's Northwoods](#) demonstration summary.

Plans

Now that we understand different adaptation options, how do we make them into on-the-ground actions? What are our management goals? How can we meet these goals in the context of a changing climate? It is important to understand the system and its vulnerability to climate change so that we can identify feasible adaptation actions that fit into management plans and activities.



This is a screenshot of the plan slide. This image shows three boxes with the adaptation options above a large tree icon forest. The forest has climate change location icons and small vulnerability and action arrows

This slide features two interactions as indicated by the boxes on the bottom and right-hand side of the screen that pop in after the slide animations and narration have finished. The bottom box says, "Want to learn more about federal strategies? Click here to check out the National Fish, Wildlife, and Plants Climate Adaptation Strategy." Clicking on this box opens a new website to [NFWP Climate Adaptation Strategy](#). The right-hand interaction box says, "Wondering how to begin a vulnerability assessment? Click here." Clicking on the box opens a new webpage to the [Climate Change Resource Center topic page](#) on assessments.

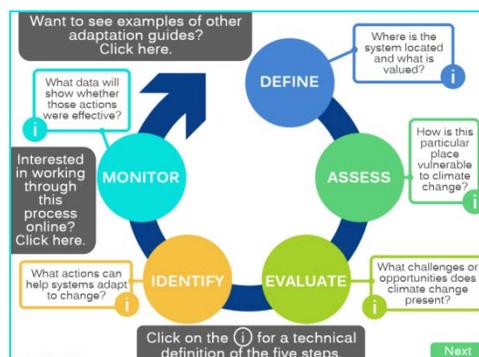
FAR

Resources are available to help managers integrate climate change into planning and decision making. These tools can be adapted to different management goals and geographic locations.

One adaptation process is from a guide called Forest Adaptation Resources, and despite the name, this process can be used for most any type of natural resource management. We begin by defining management goals for a specific project or area. Next, we assess how the system is vulnerable to climate change. Based on these, we can evaluate potential challenges and opportunities from climate change. This helps identify adaptation actions that also meet management goals. The last step is to monitor the effectiveness of our actions. These steps walk managers through the process of integrating climate change into their work and help them create tailored on-the-ground actions.



This is a screenshot of the FAR slide. This image shows resources like computers and books with climate change icons and icons depicting decision making.



This is a screenshot of the FAR slide. This image shows the FAR process in a cycle arrow: define, assess, evaluate, identify, and monitor. Each step has a short definition that is read in narration.

This slide features three interactions as indicated by the boxes on the top, bottom and left-hand side of the screen that pop in after the slide animations and narration have finished. The left-hand box says, “Interested in working through this process online? Click here.” Clicking on this box opens a new website the [online Forest Adaptation Resources Workbook App](#).

The top box says, “Want to see examples of adaptation guides? Click here.” Clicking on this box opens a pop-up screen with two examples:

Check out these adaptation guides:

Forest adaptation resources: climate change tools and approaches for land managers, 2nd edition ([Swanston et al. 2016](#))

Responding to climate change in national forests: a guidebook for developing adaptation options ([Peterson et al. 2011](#))

Climate-smart conservation, putting adaptation principles into practice ([Stein et al. 2014](#))

The bottom box says, “Click on the i for a technical definition of the five steps.” Clicking on the small box labeled with an i on the process graphic will open a pop-up screen with the technical definition for each step.

DEFINE area of interest, management objectives, and time frames.

ASSESS climate change impacts and vulnerabilities for the area of interest.

EVALUATE management objectives given projected impacts and vulnerabilities.

IDENTIFY and implement adaptation approaches and tactics.

MONITOR and evaluate effectiveness of implemented actions.

Mitigation

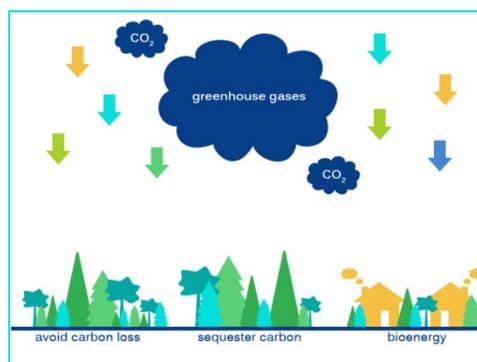
The concepts of adaptation and mitigation are sometimes confused. Adaptation focuses on coping with the effects of climate change on systems. Mitigation focuses on reducing atmospheric greenhouse gases, such as carbon dioxide, that cause climate change. Systems may need help adapting to climate change, but they already play a crucial role in mitigation efforts.

When managing ecosystems, greenhouse gas mitigation can be incorporated as a management goal, similar to goals for improving water quality or providing recreation opportunities. Mitigation options for land management include reducing the amount of carbon emissions by storing or sequestering additional carbon in forests, providing renewable energy from biomass, or avoiding carbon losses from fire, mortality, or conversion.

Forests in the United States absorb the equivalent of about 16 percent of the country’s carbon emissions each year. Ensuring that forests are able to adapt to changing conditions will allow them to continue sequestering carbon dioxide and may even allow them to store more carbon in the future.



This is a screenshot of the mitigation slide. This image shows a large greenhouse gas cloud with smaller CO2 clouds and down arrows representing mitigation. There is a small silhouette of a forest underneath with climate change location icons.



This is a screenshot of the mitigation slide. This image shows a smaller greenhouse gas cloud with fewer CO2 clouds and more down arrows. There are three icon depictions of a forest for sequestering carbon, houses using bioenergy, and a forest that avoids carbon loss.



This is a screenshot of the mitigation slide. This image shows a bar with CO2 clouds at the top that is filled to 16 per cent. There are tree icons making a current forest under climate change location bubbles on one side of the bar and different trees under larger climate change icons creating a future forest on the other side.

Restoration

Restoration is another management strategy. Sometimes defined in terms of restoring ecosystem function, restoration is most often defined as returning an altered system to its previous state with the intention of reestablishing the structure, productivity, and diversity that we think was originally present in the system.

Restoration can be complementary to adaptation. This would occur for instance when we expect that restoring a degraded or altered system to its previous state will better enable the system to cope with the pressures of climate change. In fact, restoration without considering climate change could put a system at a higher risk if the restored state has greater vulnerability to climate change. Although the main focus here is on adaptation, it is important to understand the differences among adaptation, mitigation, and restoration, and how they can complement each other.



This is a screenshot of the restoration slide. This image shows a “returning” cycle arrow with a small tree icon forest with a “reestablishing” cycle arrow with a diverse forest of different types and sizes of tree icons.



This is a screenshot of the restoration slide. This image shows text with “mitigation”, “adaptation”, and “restoration”. Mitigation has a cloud icon, adaptation has callout response icons, and restoration has a cycle arrow icon.

This slide features an interaction as indicated by the box on the top of the screen that pops in after the slide animations and narration have finished. The box says, “Interested in viewing a short video example of a climate-informed restoration and mitigation project? Click here.” Clicking on the box shows a pop-up screen with a video example.

Climate Informed Restoration in the Appalachians

To learn more about climate informed restoration in the Appalachians, visit the Climate Change Resource Center Adaptation Examples and the Climate Change Response Framework Adaptation Demonstration summary.

Please be patient while the video loads

Press Next to continue

Conclusion

Managing our natural resources will become more challenging as the climate continues to change, but change, complexity, and uncertainty have always been part of managing natural resources. Climate change creates new challenges, but also new opportunities. It will require both skill and creativity to address the challenges and take advantage of the opportunities.

There is no single “right” way to respond to climate change, and many different actions will be needed to address the challenges. Incorporating information about expected changes is an important first step. From there, emphasizing actions that maintain flexibility and address the greatest risks may preserve the most choices for future managers even as they help ensure meeting current management goals.

What actions can we take to improve the ability of ecosystems to adapt to a changing climate? More and more people are helping systems adapt to climate change. Adaptation actions are tailored to each particular place and the values of the people working in that place, but they can provide useful examples on how to integrate new information and ideas into our work. Click on the map to see examples of adaptation in action.



This is a screenshot of the conclusion slide. This image shows a silhouette of tree images with large action arrows indicating adaptation actions and considering climate change, which is depicted by location bubbles.

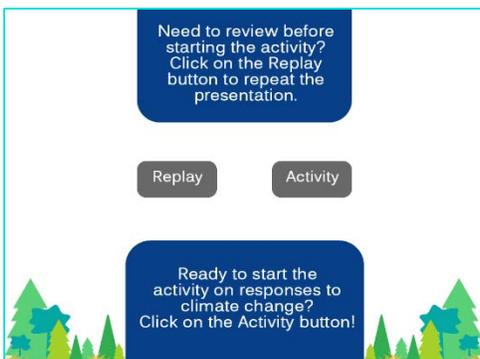


This is a screenshot of the conclusion slide. This image shows a map of the United States with callouts featuring on-the-ground adaptation around the country.

This slide features two interactions as indicated by the boxes on the bottom and left-hand side of the screen that pop in after the slide animations and narration have finished. The first bottom interaction box (left) says, "Interested in seeing more adaptation examples? Click here." The box opens a pop-up with four websites listed: Climate Change Response Framework (CCRF) [adaptation demonstrations](#), Climate Adaptation Knowledge Exchange ([CAKE](#)), Climate Resource Center ([CCRC](#)), and the Wildlife Conservation Society [Climate Adaptation Fund](#). The other bottom box (right) says, "Click on the call-out to see some examples of adaptation around the country." Clicking on any of the call-outs on the map will lead to a landing page for the specific adaptation project.

Activity

The last slide in the module is a landing slide that allows users to either replay the module by hitting the Replay button or move on to the activity with the Activity button.



This is a screenshot of the transitional slide between the information portion of the module and the activity. The box at the top of the screen asks, "Need to review before starting the activity? Click on the Replay button to repeat the presentation." The box on the bottom of the screen asks, "Ready to start the activity on climate change effects on forests and grasslands? Click on the Activity button!" There are two buttons in the center of the screen. The left-hand button is the Replay button, and the right-hand button is the Activity button. There are two reflecting images of a forest at the bottom created from tree icons used within the module.

If you would like additional accessibility resources not available on the site, please contact us at ccrc@fs.fed.us.