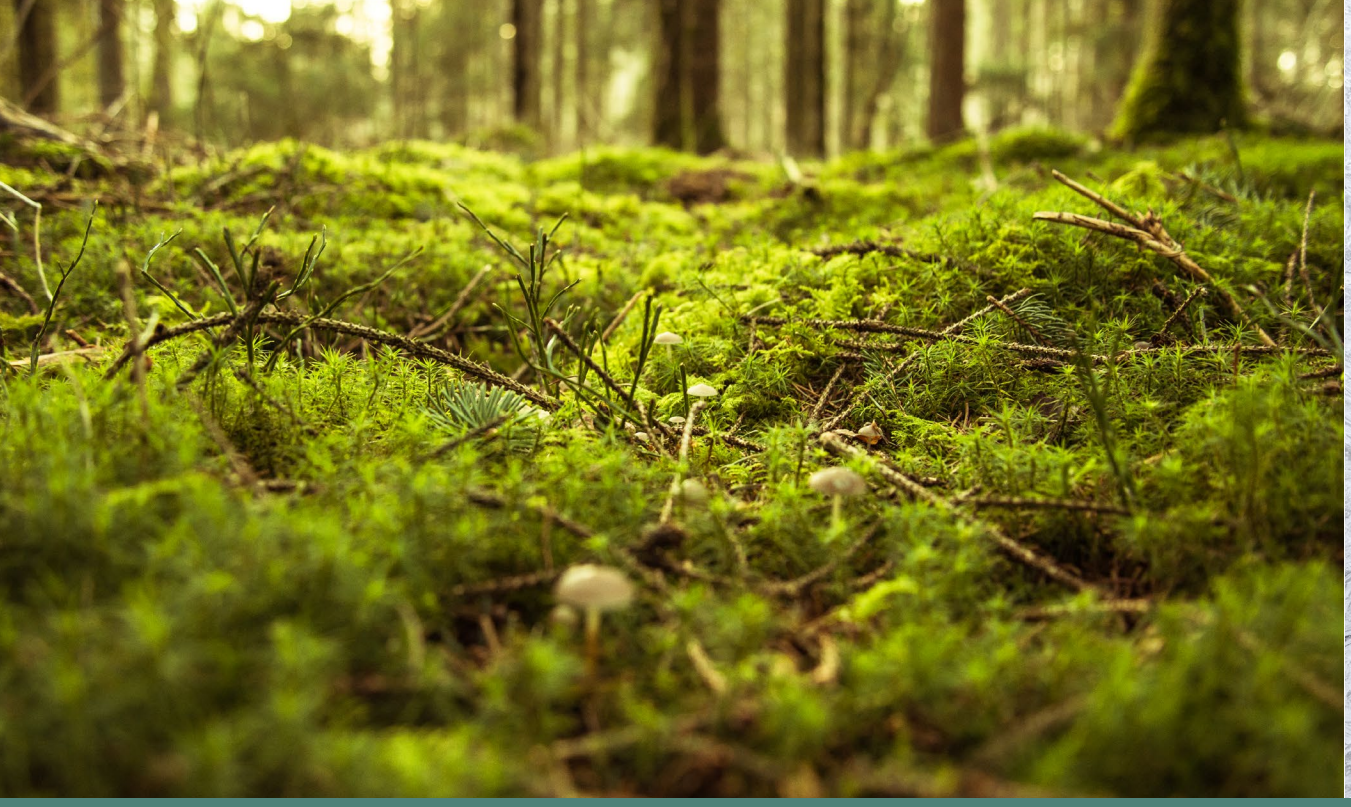
Embracing Change

Adapting Conservation Approaches to Address a Changing Climate

Wildlife Conservation Society

DORIS DUKE CHARITABLE FOUNDATION



Integrating climate change into conservation planning can reveal the need for strategic and forward-looking adjustments in the **WHAT, WHERE, WHEN** and **WHY** of our conservation efforts.

Summary

Climate change may undermine the effectiveness of current efforts to conserve wildlife and ecosystems. Given that time and money for conservation are limited, there is a need for responsible investments that embrace the realities of a changing climate. A thorough consideration of anticipated climate change impacts can reveal the necessity of intentional, strategic, and forward-looking adjustments to what kinds of actions are being implemented, where actions are located, when actions are needed, and what goals those actions are designed to achieve. In this report, we offer real-world examples of how conservation practitioners are already beginning to modify the **WHAT, WHERE, WHEN,** and **WHY** of their conservation endeavors. These stories are intended to inspire others to take a closer look at their conservation strategies and determine whether different approaches will be needed to make the most of limited conservation dollars in the context of climate change and uncertainty.

Introduction

Human-induced climate change poses serious concerns for the conservation of biodiversity. Impacts are already evident through longer and hotter droughts, bigger and more frequent floods and wildfires, habitat changes, the displacement and loss of species, altered human behaviors and land use, and other effects (USGCRP 2014, USGCRP 2017).

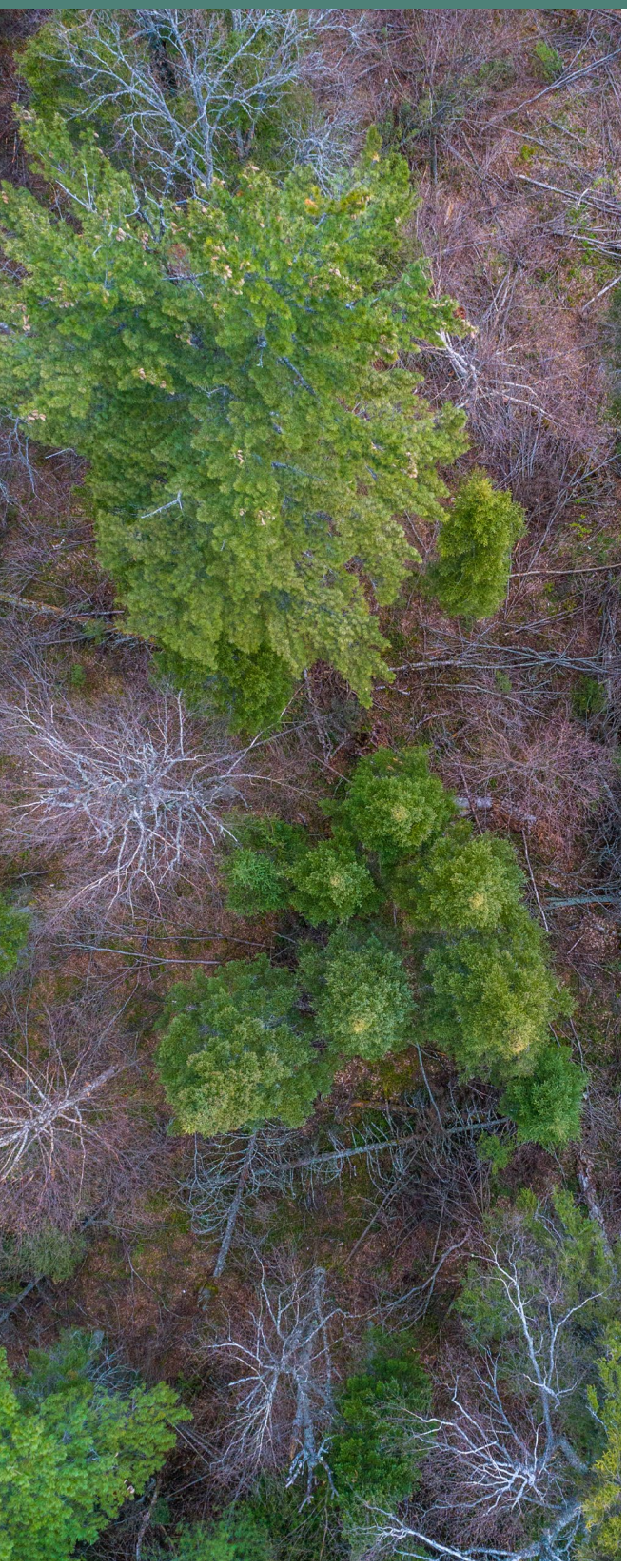
To incentivize new and innovative efforts to help wildlife and ecosystems respond to climate change, the Wildlife Conservation Society (WCS) created the Climate Adaptation Fund in 2011. Made possible by a grant from the Doris Duke Charitable Foundation, the WCS Climate Adaptation Fund has awarded more than $14 million to 78 adaptation projects across the United States. This portfolio includes a diversity of conservation practices applied in strategic ways to help wildlife and ecosystems adapt to a changing climate.

In our first report, *14 Solutions to Problems Climate Change Poses for Conservation*[1], we shared examples of the solutions conservation practitioners are already implementing to address particular climate change impacts. **In this report, we highlight how conservationists are doing their work differently, to maximize the effectiveness of their investments as the climate changes.**

Photos: pexels.com

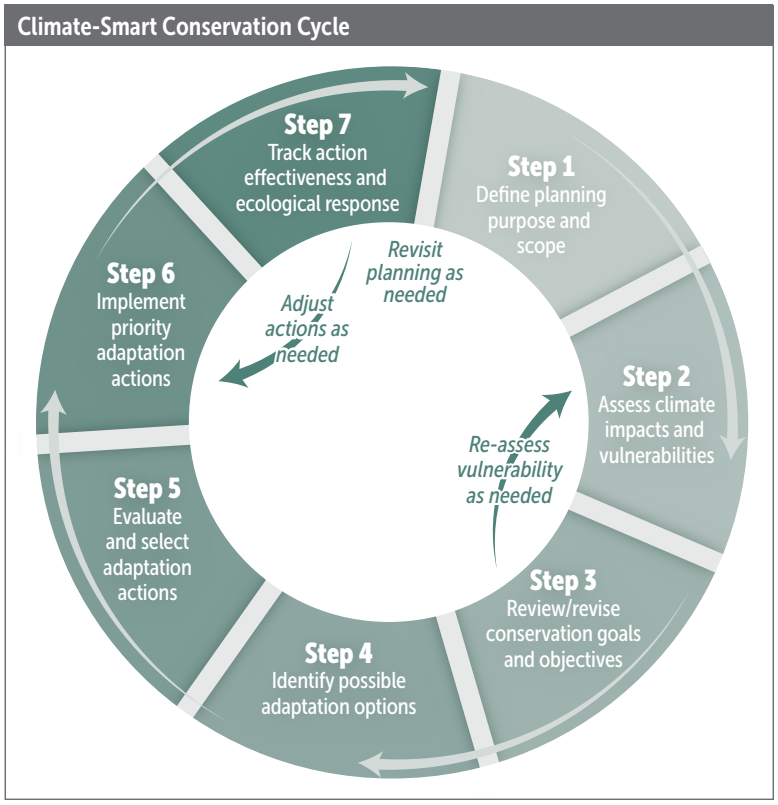
1 https://www.wcsclimateadaptationfund.org/s/14-Solutions-Report.pdf

EMBRACING CHANGE IN CONSERVATION PLANNING



The most important way that climate-informed conservation is different from business-as-usual is the process by which the latest climate science is considered when setting goals and choosing actions.

Climate-informed conservation planning approaches help users to design goals and actions based on the best available science, and to re-assess decisions as the understanding of climate change and its impacts evolves. For example, see the Climate Smart Conservation Cycle below and other adaptation planning resources listed at the end of this report.



A series of generalized steps for incorporating climate change science into conservation planning (Stein et al. 2014).

Northwoods forest in northern Minnesota (Credit: C. Dalbec).

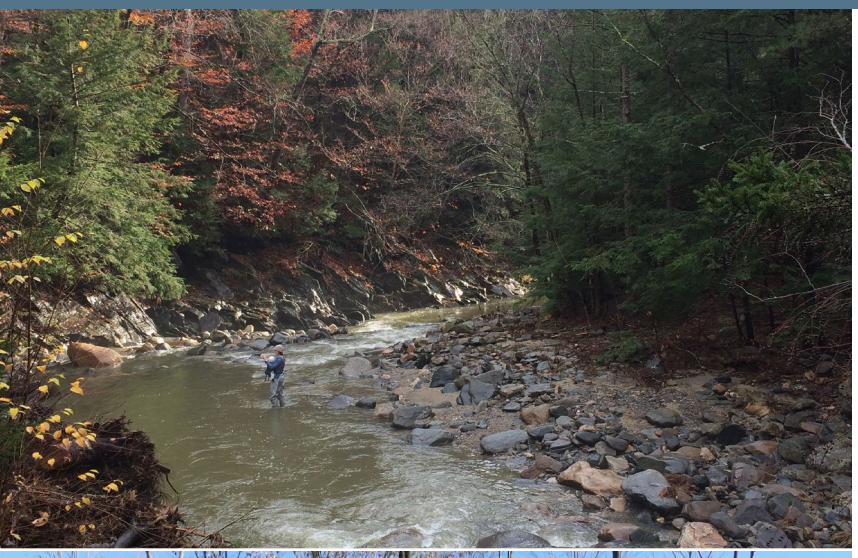
For some practitioners, taking climate change impacts into account may reinforce the appropriateness of current goals and actions, at least for the time being.

But in many situations, they may decide that conservation approaches need to shift in targeted ways to reach desired conservation outcomes as the climate changes:

WHAT	WHERE	WHEN	WHY
Taking Climate-Informed Actions	**Working in Strategic Locations**	**Shifting the Urgency and Timing of Actions**	**Embracing Forward-Looking Goals**
Practitioners are introducing new or modifying current actions in ways that make them more effective in light of climate variability and projected changes.	**Conservationists are working in new or strategic locations to target places where longer-term maintenance of species, populations, ecosystem services, or other values is more likely.**	**To stay ahead of or keep pace with a changing climate, the need for action may become more urgent, or actions may be needed at different times of year.**	**The goal of conservation projects may evolve as climate change affects a place or ecosystem, leading practitioners to focus on new threats or targets.**
EXAMPLES INCLUDED IN THIS REPORT:			
• Supersizing stream restoration actions to increase their effectiveness during bigger floods • Altering restoration planting mixes to foster species expected to thrive under future conditions • Taking new actions to address changing wildlife behavior	• Working upslope from current protected areas to connect to climate refugia • Locating restoration projects in areas projected to be suitable in the future • Prioritizing stream restoration in basins that are more likely to sustain late season flows	• Preventing rapid ecosystem loss as sea level rises • Bolstering drought tolerance before an extreme drought • Providing pollinator habitat at different times of year	• Expanding restoration goals to include offsetting snowpack declines • Broadening goals to reduce impacts of bigger floods on both fish and people • Managing for future conditions, not just past conditions

In this report, we offer 12 real-world examples of how conservation practitioners around the United States are modifying the **WHAT, WHERE, WHEN,** and **WHY** of their approaches, to support the capacity of wildlife and ecosystems to adapt to a changing climate.

CHANGING THE "WHAT"
Taking climate-informed actions



Adjusting our actions to attain conservation objectives is often the first line of defense against climate change.

Adjusting actions (or **WHAT** we are doing) to continue to attain current conservation objectives is often the first line of defense against climate change. After intentional consideration of climate change effects, minor or significant adjustments to on-the-ground activities may be needed to address the near- and longer-term impacts of climate change.

HOW IT'S BEING DONE:

Climate-informed actions may include using a different combination of tools from a well-recognized toolbox of management practices, or it may be necessary to modify specific tools to make them more effective. Relatively novel actions could be brought to an impacted site from another region that currently has climate conditions similar to what is projected for that site in the future. In some cases, actions that are very different from familiar practices may be deemed necessary.

Top: By "supersizing" stream restoration techniques - e.g., replacing culverts with larger structures - stream functions and fish populations are better protected during increasingly large floods (Credit: Trout Unlimited).

Middle: Planting tree species with greater tolerance for future climate and flood conditions can help bottomland hardwood forests weather a changing climate (Credit: Ducks Unlimited).

Bottom: With declines in accessible summer sea ice, Pacific walruses are hauling out in unusually large numbers on Arctic coasts, where they need new actions to protect them from disturbances (Credit: K. Lemeshev).

EXAMPLES OF CHANGING THE "WHAT"

Super-sizing stream restoration actions to increase their effectiveness during bigger floods

Location: North River of Vermont and New Hampshire

Business-As-Usual Approach: Standard stream restoration activities designed to conserve coldwater fish and ecosystems include adding woody debris to create deep and cold pools, installing culverts that facilitate fish passage upstream and downstream, and protecting healthy riparian areas.

Climate-Adapted Approach: Trout Unlimited and their partners are modifying these traditional practices to improve their success as climate change leads to bigger and more frequent floods on the North River. Changes include replacing culverts with larger structures that can accommodate projected heavier flows, larger debris, and higher sediment loads.

Altering restoration planting mixes to foster species expected to thrive under future conditions

Location: Bottomland forests in Illinois and Indiana

Business-As-Usual Approach: Standard forestry practices in bottomland forests near the confluence of the Mississippi and Missouri Rivers have favored a mix of hardwood tree species that have historically dominated these forests. However, these historically-dominant tree species may be negatively affected by the increasingly extreme swings between wet and dry conditions as climate changes.

Climate-Adapted Approach: Ducks Unlimited and their partners are altering forest management practices along the Mississippi and Cache Rivers in southern Illinois and the Patoka River in southwestern Indiana to facilitate a shift in the composition of floodplain forests in the hopes that it will help these ecosystems persist. To do this, they are modifying their restoration planting mix to include trees with greater tolerance for future climate conditions and flood dynamics, such as tupelo, cypress, and pin and willow oak. They are also using seed stocks from areas further to the south in Kentucky and Missouri, that are adapted to warmer conditions.

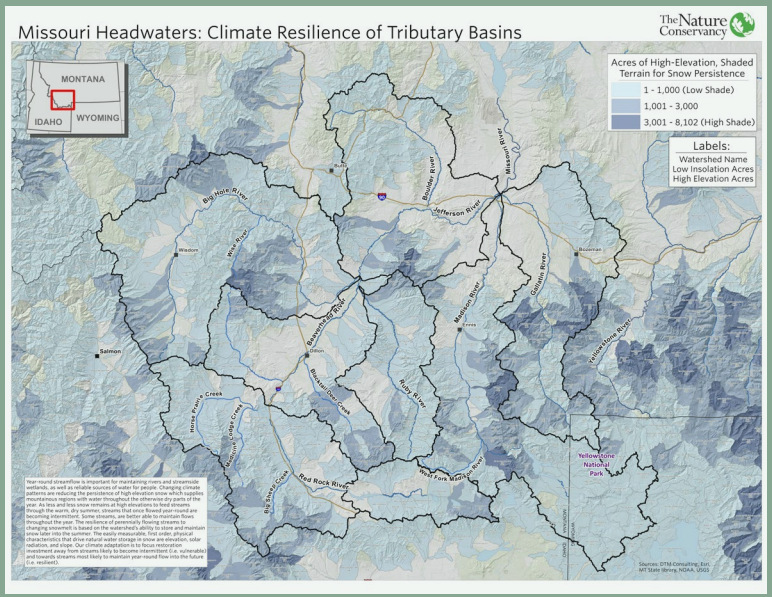
Taking new actions to address changing wildlife behavior

Location: Pacific walrus haul outs in coastal Alaska

Business-As-Usual Approach: During the mid to late 1900s, sea ice conditions in the Arctic supported what were thought to be healthy populations of Pacific walruses. Management largely focused on ensuring that indigenous hunting was conducted without waste and for traditional purposes authorized by the Marine Mammal Protection Act.

Climate-Adapted Approach: With dramatic declines in accessible summer sea ice in the Arctic, female walruses and their calves are now hauling out in unprecedented numbers in the tens of thousands along the Alaskan and Russian coasts. These haul outs are sometimes close to villages and attract tourists into otherwise remote areas. When on land, the animals are vulnerable to being startled, and the resulting stampedes to the water can result in hundreds of dead animals. These changes have necessitated new actions to monitor and protect walruses, such as efforts by the Wildlife Conservation Society on the Russian Coast and by Native communities in Alaska to implement local stewardship programs that minimize impacts from planes, visitors, and other disturbances.

CHANGING THE "WHERE"
Working in strategic locations



It can be strategic to invest preferentially in climate adaptation actions in some parts of the landscape over others.

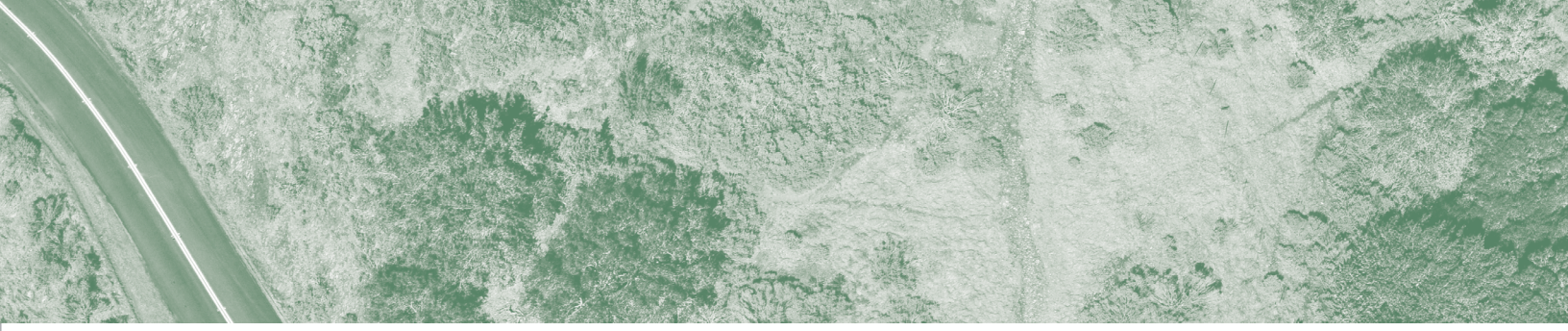
While thinking about what actions are needed to achieve conservation goals in the face of a changing climate, we also need to look closely at **WHERE** we target those actions. As climate change affects some areas more than others, there may be places within a landscape that are more likely to remain or become suitable in the future, and other areas that are more likely to experience declines in suitability. Therefore, it can be strategic to invest preferentially in climate adaptation actions in some parts of the landscape over others, depending on how climate change and its impacts are expected to play out.

HOW IT'S BEING DONE:

Some conservation practitioners are relying on climate change impact models to identify locations where longer-term persistence of species and habitats is more likely. Others are examining physical characteristics of the landscape to select sites that are naturally more likely to retain desired future conditions.

Top and Middle: Hawaiian honeycreepers and other native birds are threatened by increasing avian malaria, pushing conservation efforts further upslope to relatively cooler, malaria-free areas. Planting trees in degraded pastures provides a corridor to these higher elevation climate refugia (Credits: J. Jeffery-top, Mauna Kea Watershed Alliance-middle).

Bottom: Map of climate-resilient watersheds in southwest Montana. Darker colors indicates watersheds that are more likely to retain late spring snowpack (Credit: R. Levine, N. Korb, The Nature Conservancy)



EXAMPLES OF CHANGING THE "WHERE":

Working upslope from current protected areas to connect to climate refugia

Location: Forest habitat for native birds in Hawaii

Business-As-Usual Approach:
The Hakalau Forest National Wildlife Refuge on the island of Hawai'i has long provided a safe haven for native hawaiian birds. As warming enables the expansion of avian malaria into the Refuge, new areas will be needed to continue providing cooler, disease-free habitat.

Climate-Adapted Approach:
To provide native birds with access to higher elevation and cooler areas that can provide refugia from malaria-infected mosquitoes, the Hawaiian Silversword Foundation, Mauna Kea Watershed Alliance, Department of Hawaiian Home Lands, and other partners are now working beyond the Refuge's boundaries to reforest degraded pasture in an area called the Kanakaleonui Bird Corridor. This linkage connects the mid-elevation forests of the Hakalau Forest National Wildlife Refuge with the higher-elevation woodlands of the Mauna Kea State Forest Reserve, and provides an opportunity for native birds to seek refuge upslope from increasing malaria threats within the Refuge's boundaries.

Locating restoration projects in areas projected to be suitable in the future

Location: Sagebrush steppe ecosystems in Colorado

Business-As-Usual Approach:
Restoration of wet meadows and riparian areas within sagebrush steppe ecosystems in Colorado has long been a conservation priority to provide brood-rearing habitat for the Gunnison sage grouse. To date, these efforts have focused on sites that are currently considered important for grouse and other wildlife dependent on sagebrush ecosystems.

Climate-Adapted Approach:
Given how climate change may shift the location where suitable wet meadow conditions will be found in the future, The Nature Conservancy and Gunnison Climate Working Group partners are rethinking where they target their restoration efforts. They are prioritizing sites that are most likely to support wet meadows under severe drought and extreme rainfall conditions, using an analysis of satellite imagery of plant growth during extreme wet and dry years. At these sites, they are installing simple rock and log structures designed to reduce erosion during heavy rain events and boost underground water storage to support plant growth during dry periods.

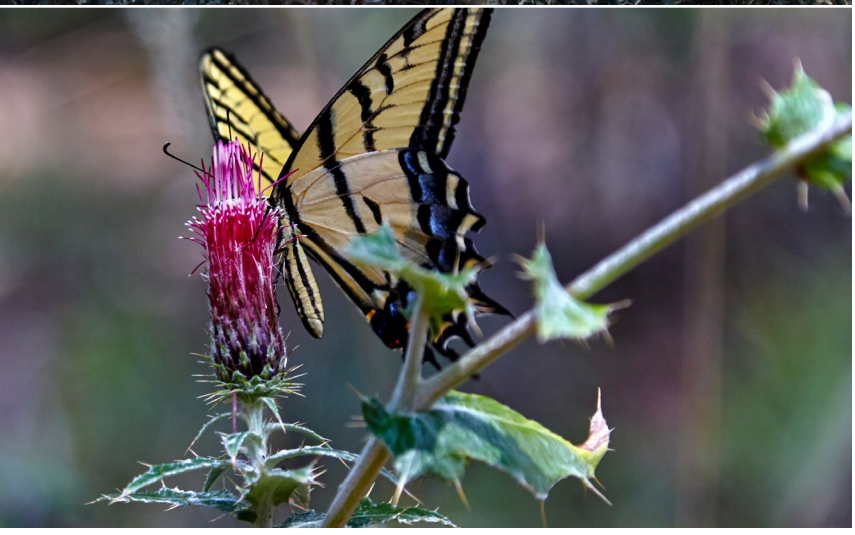
Prioritizing stream restoration in basins that are more likely to sustain late season flows

Location: Mountain streams in Montana

Business-As-Usual Approach:
Traditionally, restoration work in southwest Montana has largely focused on streams where native fish persist in spite of threats from hybridization with non-natives, dewatering for irrigation, fragmentation by dams, and other human activities.

Climate-Adapted Approach:
Because mountain snowpacks are melting earlier, which reduces natural water storage for the dry period in late summer, The Nature Conservancy and their partners are taking a different approach to locating their stream conservation efforts. They are prioritizing restoration work in stream basins whose physical characteristics—e.g., elevation, slope, and aspect—make them naturally more likely to retain snowpack into the late spring and early summer. Even as the climate warms, these basins should experience later snowmelt relative to their neighbors, providing more reliable flows in the summer when water is needed most by fish, wildlife, and people.

CHANGING THE "WHEN"
Shifting urgency and timing of actions



As climate change and its impacts accelerate, quick actions may be necessary to keep up with or stay ahead of those changes.

Climate change can influence **WHEN** actions are needed in order to be most effective. As the rate and magnitude of climate change and its impacts accelerate, quick actions may be necessary to keep up with or stay ahead of those changes. Alternatively, actions may need to occur at different times of year, in response to shifts in the seasonal timing of weather events (such as the arrival of cooler temperatures at the end of the wildfire season) or biological events (such as the onset of spring leaf-out and flowering).

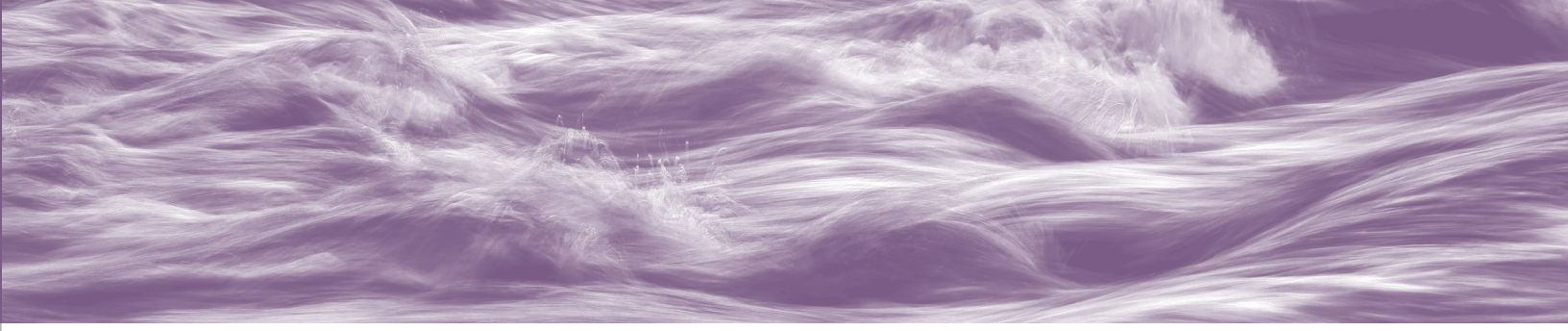
HOW IT'S BEING DONE:

For some practitioners, the accelerating impacts of climate change are encouraging a shift in the sense of urgency for taking actions. Some current actions may be deemed less urgent if they will no longer be effective; whereas other current or new actions may become more urgently needed, such as those that might slow or prevent undesirable ecological transformations when taken in advance of climate-related disturbances. The timing of certain actions may also need to shift in response to climate-driven changes in the timing of seasonal events.

Top: Waterlogged marshes need urgent attention to reduce the risk of erosion and conversion to open water (Credit: Aududon).

Middle: Prescribed fire and forest thinning help to restore drought-tolerant trees to Central Hardwood forests in Indiana in advance of an extremely hot drought (Credit: C. Bladow).

Bottom: Climate-driven changes in blooming times can have negative consequences for pollinators, requiring conservation actions that provide flowering resources at different times of year (Credit: wingedwolf, istockphoto.com).



EXAMPLES OF CHANGING THE "WHEN":

Preventing rapid ecosystem loss as sea level rises

Location: Coastal marshes in Maryland

Business-As-Usual Approach:
The protection and restoration of low-lying coastal marshes has long provided critical habitat for thousands of waterfowl and marsh birds along the coast of Maryland. However, many of these conservation investments could become permanently inundated by rising seas. Of particular concern is the sudden loss of coastal marsh during more severe storm surges that create trapped floodwaters, and rapid transitions to open water.

Climate-Adapted Approach:
In response, the Audubon Society and its partners are focusing less on coastal marshes at high risk of inundation, and more on efforts to facilitate the inland migration of marshes by reducing the damaging effects of trapped floodwaters. This approach has become an urgent priority because these waterlogging events are already becoming more frequent, and once these marshes convert to open water it is difficult-to-impossible to re-establish healthy marsh habitat and foster upslope marsh migration. Their innovative strategy for reducing waterlogging includes excavating a channel that connects the marsh to a nearby tidal creek, providing improved drainage during flood events.

Bolstering drought tolerance before an extreme drought

Location: Central hardwood forests in Indiana

Business-As-Usual Approach:
Historic fire suppression in the Central Hardwood forests in southern Indiana has favored trees and understory plants that prefer cooler and more moist conditions; as climate change leads to increased summer drought stress in the region, these forests are poised for widespread declines.

Climate-Adapted Approach:
To retain Central Hardwood forest habitat, The Nature Conservancy is physically removing and intentionally burning trees that require moist conditions, so as to reduce their dominance and increase the presence of native, drought-tolerant trees, such as oaks and hickory. These drought-tolerant species are projected to fare well under future climate conditions. Although such actions are valuable even under current drought regimes, climate change adds increased urgency for this work to take advantage of the fact these forests still have some drought-tolerant species, whose growth can be encouraged. Waiting longer could increase the chances of a major collapse of forests in the region during an extreme drought.

Providing pollinator habitat at different times of year

Location: Sky Island region of Arizona

Business-As-Usual Approach:
The Sky Island region provides critical habitat for migratory pollinators such as bats, hummingbirds, and butterflies, which rely on having access to flowers at the time of year when they traditionally arrive. As winter precipitation and spring temperatures are changing, so too are the bloom times for many plants, with potential negative consequences for pollinator species. Pollinator-friendly planting efforts that typically take place in the spring have been hindered by the loss of late winter rain and increasingly warm spring temperatures.

Climate-Informed Approach:
The Sky Island Alliance and partners are adapting their pollinator habitat restoration efforts to provide flowering resources across all seasons. Among other changes, they are increasing the diversity of key nectar and food plants, to include species that grow and flower at different times of year. As late winter precipitation becomes less reliable and to take advantage of the more dependable summer rains, they are shifting their planting activities from the spring to summer and fall.

CHANGING THE "WHY"
Embracing forward-looking goals

It may be necessary to revise goals to be more forward-looking and accommodating of change and uncertainty.

Climate change may create conditions under which current conservation goals (the **WHY** for a project) are increasingly difficult and costly to achieve, or futile, even with modified actions. In these situations, it may be necessary to revise goals to be more forward-looking and accommodating of change and uncertainty. Rethinking goals can be a difficult aspect of looking at conservation work through the climate-change lens, because some goals are mandated by regulations or legislation. It can also be emotionally challenging to consider letting go of species and ecosystems that people care about. Despite these challenges, thoughtful consideration of our goals in the face of climate change is a critical aspect of preparing for the future. This re-consideration of goals may result in the need for new actions to be taken in new places.

HOW IT'S BEING DONE:

In some cases, goals may shift or broaden in response to new threats brought about by climate change. In others, species and habitats may no longer find suitable climate conditions within a conservation area, making it impossible to fulfill objectives aimed at protecting those species and habitats in that location under any course of action. Such a shift may require new, forward-looking goals for that place, focused on different species, or on ecosystem functions and services instead of individual species.

Top: Restoration of meadows and streams in California's Sierra Nevada mountains not only provides wildlife habitat, but also helps offset the loss of snowmelt inputs to streams as snowpacks decline (Credit: American Rivers).

Middle and Bottom: Managing for climate change in northwoods forests of Minnesota means carefully selecting plant species for restoration that are expected to thrive even as the climate changes (Credit: C. Dalbec).

EXAMPLES OF CHANGING THE "WHY":

Expanding restoration goals to include offsetting snowpack declines driven by warming

Location: Montane meadows in California and Nevada

Business-As-Usual Approach: Restoration of high-elevation meadows, degraded by overgrazing and other land-use practices, in the Sierra Nevada Mountains has long been a focus of efforts to rehabilitate wildlife habitat.

Climate-Adapted Approach: Climate change has introduced a new threat to Sierra Nevada meadows by causing a transition from snow to rain, reducing snowpacks, and lowering streamflows during the summer when many fish and wildlife need it most. In response, American Rivers has expanded its goals for meadow restoration beyond the provision of wildlife habitat, to place a greater emphasis on the value of improving the meadows' hydrological functioning. By reconnecting incised channels to the floodplain and re-vegetating riverbanks, these meadows are able to act as better "sponges" by storing more water in shallow aquifers, increasing groundwater inputs to streams, and extending the timing of peak flows later into the summer.

Broadening goals to reduce impacts of bigger floods on both fish and people

Location: Norton Creek watershed in Michigan

Business-As-Usual Approach: Restoration of the Norton Creek watershed was initiated in response to concerns about poor water quality due to historic channelization of streams and runoff from housing and commercial developments. Climate change is expected not only to exacerbate these runoff concerns during larger storms, but also to result in bigger flooding problems than what the watershed has experienced in the past.

Climate-Adapted Approach: With large, intense storms and floods becoming more common, the Huron River Watershed Council and their partners have added new goals for their restoration work related to reducing the negative effects of flooding on aquatic ecosystems and vulnerable human communities. These new goals include watershed-wide planning and implementation of "green infrastructure" projects to soak up excess floodwaters and filter out pollutants, as well as restoring the historic shape of the river channel and improving floodplain function to better accommodate water during heavy rain events.

Managing for future conditions, not just past conditions

Location: Northwoods forests in Minnesota

Business-As-Usual Approach: Conservation in the Northwoods has typically focused on maintaining or restoring forests dominated by boreal conifers. However, warming, drying, and a higher incidence of droughts and floods are negatively affecting boreal trees and increasing the risk that some boreal forests will convert to open, brushy conditions, generating consequences for wildlife and ecosystem services.

Climate-Adapted Approach: In response, The Nature Conservancy and their partners are using an analysis of physical landscape characteristics (e.g., slope, aspect, soils) and regional climate trends to design appropriate, forward-looking goals in different parts of the landscape. In places where boreal conditions are likely to persist for several decades even as the climate warms, they are striving to maintain boreal forests. In areas that are expected to experience decreased suitability for boreal species, they are embracing new goals focused on assisting the transition from boreal to northern hardwood forests, by planting tree species expected to thrive under future climate conditions.

Move beyond business-as-usual conservation and embrace new, climate-informed approaches to make the adaptive investments needed to keep up with a changing climate

CONCLUSION

To make the most of limited conservation resources, there is a need for responsible and adaptive investments of both time and money that consider climate variability and projected changes. In some situations, that requires embracing new, climate-informed approaches to conservation. In describing some of the ways that conservation practitioners are already altering the **WHAT, WHERE, WHEN,** and **WHY,** we aim to inspire others to address climate change effects in their conservation work. We hope these examples show others how to take climate-informed actions, in strategic locations, with a shift in urgency and timing, and in the service of forward-looking goals.

How do you get started? By consulting the latest science on observed climate trends and projections of potential future climate impacts, and considering how those changes may affect your ability to achieve your current goals with your current actions. This does not need to be an overwhelming process, and it is one that has already been done by many practitioners using some of the adaptation planning resources cited below. Following these steps will help determine whether you need to conduct your work differently to help wildlife and ecosystems—and the people who rely upon them—respond to and cope with the effects of a changing climate.

In this era of uncertainty, it is more important than ever that we look critically at the durability of our conservation approaches and assumptions. The WCS Climate Adaptation Fund seeks to support adaptation practitioners that are testing new and modified approaches to conservation that take climate change into account. More information about projects supported by the WCS Climate Adaptation Fund and our annual competitive grant program can be found at: www.wcsclimateadaptationfund.org.

SELECTED ADAPTATION PLANNING RESOURCES

The **Adaptation for Conservation Targets (ACT) Framework** is a simple yet structured planning approach that builds familiar elements of conservation planning (e.g., local knowledge, conceptual modeling, scenario-based planning, and adaptive management) into a process tailored for addressing climate change. https://northamerica.wcs.org/Conservation-Initiatives/Climate-Change/Climate-Adaptation-Planning.aspx

The **Adaptation Workbook** from the U.S. Forest Service's Northern Institute for Applied Climate Science (NIACS) offers an easy to use, interactive and self-guided tool that creates a custom adaptation plan for forest management and conservation. NIACS also hosts the **Climate Change Response Framework,** that provides an integrated set of tools, partnerships, and actions to support climate-informed conservation and forest management.
http://adaptationworkbook.org; https://forestadaptation.org

The **Climate Adaptation Knowledge Exchange (CAKE)** is a clearinghouse for climate change adaptation tools and case studies. Managed by EcoAdapt, CAKE includes a large database of adaptation plans focused on natural and human systems. http://www.cakex.org/

The **Climate-Smart Conservation Cycle** (see Figure on Page 4 of this report) is a generalized framework for climate adaptation planning and implementation that draws upon many existing conservation planning and adaptive management approaches. It can be used to guide an adaptation planning effort, or inform the incorporation of climate change into other decision-making processes.
https://www.nwf.org/Our-Work/Environmental-Threats/Climate-Change/Climate-Smart-Conservation/Guide-to-Climate-Smart-Conservation

The **US Fish and Wildlife Service's National Conservation Training Center** offers a number of courses and workshops on climate change vulnerability assessment, climate-smart conservation planning, and scenario planning.
https://nctc.fws.gov/courses/programs/climate-change/

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Above Left: Credit: S. Wallace
Above Right: Credit: pexels.com
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Conservation practitioners are strategically modifying the WHAT, WHERE, WHEN, and WHY of their approaches, to help wildlife and ecosystems adapt to a changing climate.

Volunteers restore stream functions in a climate-resilient watershed in Montana that is more likely to retain late spring snowpack as the climate warms (see map and project description on pages 8-9) (Credit: N. Korb, The Nature Conservancy).

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