

14 Solutions to Problems Climate Change Poses for Conservation

Examples from the WCS Climate Adaptation Fund



Wildlife
Conservation
Society



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Summary

While climate change is still a relatively new concern for conservation practitioners, a growing number of organizations and agencies are tackling the challenge. These groups are identifying and implementing on-the-ground projects to address the effects of climate change on wildlife and ecosystems. In this report, we describe several climate-driven problems that are projected to affect, or are already affecting, particular wildlife species and ecosystems, and solutions that conservation groups are implementing to help plants and animals respond and adapt. These projects are tangible examples of climate-informed conservation, and can serve as inspiration for others grappling with similar issues.

Introduction

In the coming decades, human-caused climate change may become the most severe and widespread threat to wildlife and ecosystems worldwide. Adverse impacts of climate change are already in evidence, even in places that are relatively untouched by human activities. It is essential that we consider the effects of climate change on our conservation work to ensure the long-term success of the investments that we are making today.

To incentivize new and innovative efforts to help wildlife and ecosystems respond to climate change, the Wildlife Conservation Society (WCS) and the Doris Duke Charitable Foundation have created the WCS Climate Adaptation Fund. Between 2011 and 2016, the WCS Climate Adaptation Fund awarded more than \$12 million to 66 adaptation projects across the United States. This portfolio includes both traditional and new conservation tools applied in strategic ways to help wildlife and ecosystems adapt to particular climate impacts, including decreasing water availability, increasing risks from floods and wildfire, rising sea levels, direct effects on species and their habitats, and changing human behaviors and land use as people also respond and adapt to a changing climate.*

Cover photos: Beaver mimicry structure (Credit: WCS), Appalachian forest (Credit: T. Faull), snow geese and tundra swans at Pocosin Lakes National Wildlife Refuge (Credit: A. Clark). This page: Madison River, Montana (Credit: M. Turner).

*Throughout this report, information about the challenges posed by climate change was taken from: Melillo, Richmond and Yohe, Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program. doi:10.7930/J0Z31WJ2.

14 Solutions to Problems Climate Change Poses for Nature Conservation

In this report, we describe 14 solutions for addressing particular climate change concerns, using examples of real-world projects supported by the WCS Climate Adaptation Fund. These projects span the United States and cover a diversity of ecosystems. Additional projects supported by the WCS Climate Adaptation Fund grant program can be found at: www.wcsclimateadaptationfund.org.

Problem: **Less Water, Worse Droughts**

Solution 1: Restore the natural water storage capacity of ecosystems

Solution 2: Reconnect rivers and floodplains to recharge groundwater aquifers

Problem: **Bigger Floods**

Solution 3: Adjust water management to reduce flooding risks of the future

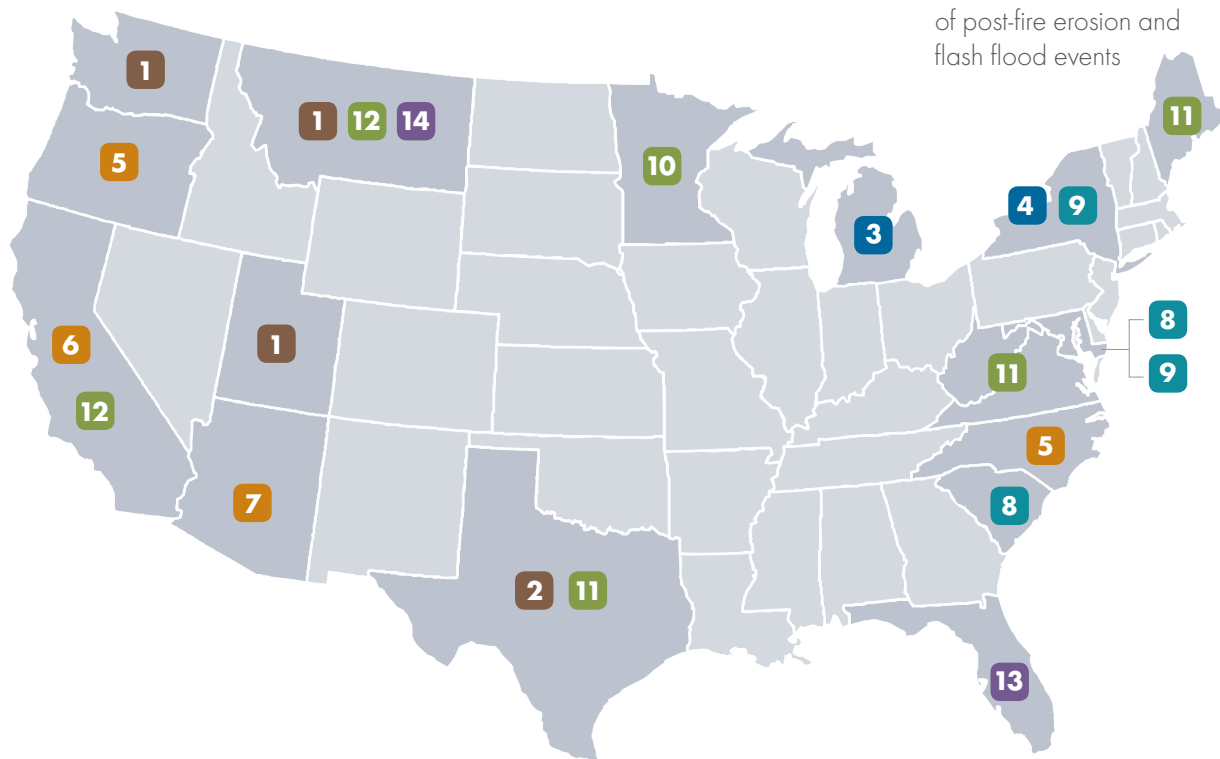
Solution 4: Design road crossings so that stream functions are unimpeded during flood events

Problem: **Bigger and Hotter Fires**

Solution 5: Reduce the likelihood of unnaturally large and severe fires

Solution 6: Reduce the risk of undesirable ecosystem transformations after intense fires

Solution 7: Reduce the risk of post-fire erosion and flash flood events



Problem: **Rising Seas**

Solution 8: Install 'living shorelines' to slow inundation and raise the elevation of coastal ecosystems

Solution 9: Enable the in-land migration of coastal ecosystems

Problem: **Direct Effects on Species**

Solution 10: Position ecosystems to thrive under future climate conditions

Solution 11: Protect or restore areas likely to remain or become suitable as climate changes

Solution 12: Help species track suitable climate and habitat conditions

Problem: **Human Responses**

Solution 13: Protect lands that will be important to wildlife as land uses shift in response to climate change

Solution 14: Proactively address water conflicts among diverse users as water resources decline

Problem: Less Water, Worse Droughts

Changing water availability in streams and riparian ecosystems

Warming temperatures combined with changes in rain and snowfall are likely to have a significant effect on the quantity and timing of water available to support streams, wetlands and riparian forests. Warming is also likely to result in hotter droughts, with more severe effects on water resources. In some places, these changes could result in negative consequences for both aquatic and terrestrial wildlife. For example, in streams fed by melting snow and glaciers, spring and summer runoff may decline if warmer winter temperatures result in more precipitation falling as rain rather than snow. Even in places where the amount of precipitation is expected to remain the same or increase, shifts in the timing of water inputs – for instance, earlier peak spring runoff – could have consequences for fish, wildlife and habitats that depend on adequate water being available during particular times of year.

Solution 1: Restore the natural water storage capacity of ecosystems

Example: Reintroduce beaver (Washington, Utah)

The Methow Beaver Project, Grand Canyon Trust, and the US Forest Service are returning beavers to landscapes in eastern Washington and southern Utah, where they once were abundant. As beavers build dams, create stream meanders and activate side channels, they slow runoff, increase riparian habitat and store water above and below ground. These changes help to offset declines in water storage in high elevation snowpack, and extend runoff to the warmest months when it is needed the most.

Example: Mimic in-stream beaver activity (Montana)

In areas where riparian systems are too degraded to support a beaver population, or where landowners are unwilling to accept beavers, the Wildlife Conservation Society is working with private landowners and State and Federal agency partners to install structures designed to mimic some of the beneficial functions of beaver activity (e.g., see front cover photo). Using a low-cost and relatively simple technique that weaves together willow stems and branches, these semi-permeable “speed bumps” help to slow the flow of streams, rebuild sediments, recreate meanders, and boost the storage of water in soils beneath riparian areas. Similar to beaver reintroductions, these changes help to compensate for the loss of snowpacks and boost streamflows during low-flow periods.

Solution 2: Reconnect rivers and floodplains to recharge groundwater aquifers

Example: Reduce sediment build-up and widen river channels (Texas)

The World Wildlife Fund, National Parks Service and other partners are improving water retention in the Big Bend region of West Texas by reconnecting the Rio Grande/Bravo River with its floodplain, and revegetating local tributaries. Over time, dense stands of invasive giant cane along the Rio Grande have caused the build-up of sediment and narrowed the river channel. Removing giant cane plants helps to create a wider, more shallow river system that is better connected to its floodplain. Along local tributaries, native riparian trees are being restored to augment the widening of the river channel by reducing flow velocities. In addition to creating better habitat for wildlife, these changes will increase the amount of active floodplain areas along the river where streams can connect with and recharge aquifers that may decline as the climate become more arid and droughts worsen.

Problem: Bigger Floods

Increasing frequency and intensity of flood events

Large floods are already beginning to occur more frequently, primarily driven by an uptick in heavy rain events and warming in mountainous regions that causes snow to fall as rain. Rain flows quickly into streams, whereas snow melts at a more gradual rate. Shifts in wintertime precipitation from snow to rain and heavy precipitation events are projected to happen more often in many parts of the United States as climate changes. Many of the effects of flooding are physical, such as the erosion of stream banks, shifts in stream channels, and removal of riparian vegetation. But flooding also leads to changes in water quality by washing more nutrients and sediments into rivers and streams. All of these effects can alter habitats for aquatic organisms, and pose concerns for birds and mammals that live in riparian forests. Floods can also put people at risk and damage infrastructure in floodplains.

Solution 3: Adjust water management to reduce flooding risks of the future

Example: Manage dams to moderate high flow events (Michigan)

The Huron River Watershed Council is working with individual dam operators and the Huron River Dams Network in Michigan to regulate river flows during increasingly frequent and large floods. Traditionally, dams on the Huron River have been operated in a “run of the river” mode, where inputs into reservoirs are automatically released downstream once reservoirs are full. Releases occur even when the river is at or nearing flood stage. By encouraging dam operators to spread out releases, the project will reduce the negative effect of large floods on the spring spawning success of many native fish living downstream of the dams.

Solution 4: Design road crossings so that stream functions are unimpeded during flood events

Example: Re-design culverts to accommodate future floods (New York)

The Nature Conservancy is replacing and retrofitting culverts to ensure that fish populations in the Lake Champlain Basin in upstate New York can move into upstream cold water refuges as temperatures increase and extreme flooding events become more frequent. The sizes of the new structures are informed by estimates of future stream flows, and a bottomless design allows for sediment and debris to safely pass during a flood. The new culverts provide fish passage and reduce flood impacts to aquatic ecosystems, while also providing benefits to human communities by reducing long-term maintenance costs, and better protecting transportation infrastructure and human safety during floods.

Larger, bottomless culverts reduce the effects of bigger and more damaging floods, and allow fish to seek refuge in colder tributary streams
(Credit: E. Bailey, The Nature Conservancy).



Problem: Bigger and Hotter Fires

Increased risk of frequent and severe wildfires

Climate-driven changes in fire regimes could significantly impact wildlife. Fires in the western U.S. are projected to become more frequent and more severe as the climate gets warmer and more arid. In the eastern U.S., wildfire is less likely to increase as a direct result of climate change since many areas are likely to get wetter. Still, eastern ecosystems could see increased fire risks during years when they are simultaneously affected by hotter droughts and insect outbreaks. Some plants and animals are well adapted to high intensity wildfires. But those that are not could have trouble responding. In some cases, wildfire might force undesirable shifts from one ecosystem type to another – from forest to grassland, for instance. In addition, soil erosion and flash flooding are major concerns following fires, especially since climate change is also expected to increase the frequency of heavy rain events.

Solution 5: Reduce the likelihood of unnaturally large and severe fires

Example: Thin forests and conduct prescribed burns to reduce dense fuel loads (Oregon)

The Lomakatsi Restoration Project is selectively thinning and applying prescribed fire to oak woodland forests in southwestern Oregon that have grown unnaturally dense thanks to years of fire suppression and other land use practices. As these dense forests face warmer temperatures and drier summers, they become more likely to burn in large, intense wildfires. Current fuel reduction practices tend to uniformly remove all vegetation from an area. Lomakatsi is taking a different approach by thinning at different intensities across a stand. This technique is designed to reduce the occurrence and intensity of wildfires under a changing climate by creating a mosaic of large oaks and pines, interspersed with open areas and patches of chaparral. This diversity improves habitat and adaptation opportunities for the ecosystem and wildlife.

Example: Eliminate land use practices that exacerbate drying (North Carolina)

As temperatures climb and precipitation patterns change, pocosin bogs in North Carolina that have been historically ditched and drained for agriculture and forestry are more likely to dry out. Drier conditions can then set the stage for more frequent and intense wildfire. The Nature Conservancy is using berms and water control structures to reduce the risk of fire by restoring the ability of these bogs to absorb water during seasonal precipitation events. They are specifically targeting pocosin bogs that are further inland and less at risk of near-term inundation from sea level rise. These inland bogs will be able to provide habitat for wildlife longer into the future.

Berms and water control structures reduce wildfire risk under a warmer climate by keeping pocosin bogs wet, which will benefit a diversity of wildlife species (Credit: A. Clark).



Solution 6: Reduce the risk of undesirable ecosystem transformations after intense fires

Example: Remove exotic invasive species that thrive with frequent fire (California)

The Institute for Conservation Research at the San Diego Zoo is working to prevent the conversion of California coastal sage scrub to landscapes dominated by exotic plants. In degraded sage scrub habitat, more frequent fire can favor exotic plants over natives. The increased abundance of exotics increases fuel loads, which further increases fire frequency, which further favors exotic species, and so on. To reduce the chances of coastal sage scrub being replaced by exotic grasslands, the Institute is restoring native plants that can naturally suppress the spread of exotics, and promote healthy coastal sage ecosystems in southern California. The area where they are working is strategic because it is located in a key wildlife corridor that will enable animals to move to cooler, higher elevations as the climate warms.

Solution 7: Reduce the risk of post-fire erosion and flash flood events

Example: Install erosion control structures (Arizona)

The Sky Island Alliance and US Forest Service are installing low-tech erosion control structures (e.g., one-rock dams and rock-based structures called 'Zuni bowls') in watersheds of the Sky Island region of Arizona that have recently burned or have a high risk of experiencing unusually large wildfires as the climate changes. These structures are designed to slow surface runoff and the movement of soils downhill and downstream. They also trap rainfall and retain soil moisture, creating pockets on the landscape that are less likely to burn.



Erosion control structures reduce erosion damage during rain events after intense fires that may become more common as climate changes (Credit: Sky Island Alliance).

Problem: Rising Seas

Sea level rise and increasing coastal storm surges

Over the past century, global sea level has risen by roughly 8 inches, a faster rate than at any time in the past 2000 years. Models project that ocean warming combined with melting glaciers and ice sheets could cause global sea levels to rise another 1 to 4 feet by 2100, although the degree of change expected at individual coastal locations will vary. Higher sea levels can lead to inundation of low lying areas; erosion of coastal lands; changes in the movement of sand and other sediments; more frequent flooding during storm surges; the movement of saltwater further upstream into estuaries and aquifers; and the migration and fragmentation of barrier shorelines and islands. These changes can have significant effects on coastal and estuarine ecosystems and the wildlife that depend on them, especially when compounded with human development that prevents the inland and upslope migration of plants and animals.

Solution 8: Install ‘living shorelines’ to slow inundation and raise the elevation of coastal ecosystems

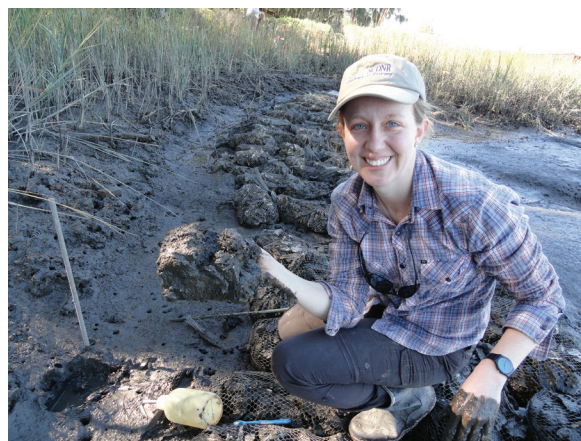
Example: Construct oyster reefs to reduce wave action (South Carolina)

In South Carolina, The Nature Conservancy is building oyster reefs adjacent to important coastal marshes to reduce the energy of boat wakes and tidal flows, which erode the marshes. In addition to buffering the marshes from erosion, the oyster reefs promote sediment accumulation, helping to raise the elevation of marshes to protect them from rising sea levels. The project’s high visibility just outside of Charleston encourages greater public support for natural approaches to stabilizing shorelines that provide benefits to both people and nature.

Example: Design living shorelines that can keep pace with rising sea levels (Maryland)

The National Wildlife Federation and the State of Maryland are using innovative techniques to reduce erosion and restore coastal habitats impacted by current and projected sea-level rise and coastal flooding. The creation of healthy, vegetated slopes along eroding shorelines increases sediment accumulation and encourages the expansion of marsh habitat while reducing erosion and nutrient runoff into Chesapeake Bay. While traditional living shoreline projects use permanent, immovable structures, this climate-smart design uses cobble and sand that can shift further inland as sea levels rise. It is strategically located in an area that has been identified as a wetland migration corridor because it is devoid of any barriers to upland migration. This project is not only demonstrating that living shorelines provide ecological benefits, but they are also more cost-effective than traditional shoreline protection approaches such as bulkheads and sea walls.

Oyster reefs promote sediment accumulation, helping to raise the elevation of marshes and buffer them from sea level rise.
(Credit: The Nature Conservancy)



Solution 9: Enable the in-land migration of coastal ecosystems

Example: Protect upland migration zones and maintain connectivity to existing coastal wetlands (New York)

In the Hudson River estuary in New York, Scenic Hudson has acquired land immediately upslope from floodplain wetlands that are expected to be inundated in coming decades. These areas are expected to transition into tidal wetlands as water levels rise and the river's flows change. By protecting higher elevation areas from development, and managing them to facilitate wetland changes and inland migration of coastal habitats, the project is helping to ensure the long-term persistence of brackish and freshwater wetlands in the Hudson estuary.

Example: Actively facilitate the inland migration of salt marsh habitat into upland forests and former agricultural lands (Maryland)

Models project that many tidal marshes important to birds in the Blackwater National Wildlife Refuge on the eastern shore of the Chesapeake Bay will be drowned in the coming century. Fortunately, the refuge is bordered by upland forests and abandoned agricultural fields that offer an opportunity for the coastal salt marshes to migrate inland. The Conservation Fund, US Fish and Wildlife Service and other partners are actively facilitating this migration by removing and preventing the establishment of the common reed (*Phragmites australis*), an invasive plant that crowds out native marsh grasses, and by cutting down dead or dying trees that border marsh lands. These actions will support the establishment of native tidal marsh plants in upland areas as lower elevation marshes are inundated by rising waters, and help ensure the future existence of high-quality bird habitat.

Strategic protection of lands immediately upslope from floodplain wetlands that are expected to be inundated by sea level rise, and managing those lands to facilitate the inland migration of coastal habitats, helps to ensure the long-term persistence of coastal ecosystems (Credit: Scenic Hudson).



Problem: Direct effects on species

Climate-driven changes in habitat suitability for particular plants and animals

As climate change alters temperatures, water availability, and the frequency and severity of disturbances like fires, floods, droughts and pest outbreaks, some plants and animals may find the places they currently inhabit unsuitable. This is likely to lead to changes in the mix of species found in a given location as some plants and animals die off or move. It can also lead to shifts in the distribution of species across the landscape. A number of plants and animals have already begun moving to higher elevations and latitudes in response to recent warming. As the rate and magnitude of warming and other climate changes accelerate, some species may not be able to adapt to the new conditions, or shift to areas with more suitable climate and habitat.

Solution 10: Position ecosystems to thrive under future climate conditions

Example: Use future climate projections to adjust planting mixes in restoration projects (Minnesota)

The Nature Conservancy, US Forest Service, the State of Minnesota and two local counties are consulting future vegetation models and range maps for trees and songbirds to design climate-informed tree plantings in Minnesota's Northwoods. Traditionally, conservation efforts in the region have focused on re-foresting logged areas with boreal conifers. However, research suggests that these species are less likely to persist as the region warms and dries. The project is taking proactive action to help maintain a healthy forest ecosystem by revising their planting mix to include more native species that are projected to thrive under warmer and drier conditions, and using seeds sourced from warmer areas at lower elevations and latitudes.

Adjusting post-harvest planting mixes to include more of those native tree species that are projected to thrive under future climate conditions may help maintain healthy forests into the future (Credit: WCS).



Solution 11: Protect or restore areas likely to remain or become suitable as climate changes**Example: Reduce the effects of climate-related disturbances in relatively cool and moist areas within otherwise arid landscapes (Texas)**

Within arid west Texas, high-elevation sky islands provide relatively cool and wet refuges for wildlife. Canyons within those sky islands are relatively buffered from climate change because of their sheltered topography and intermittent streams. Historic grazing practices, which excluded fires, have resulted in high-density forests that are susceptible to droughts, insect outbreaks, and wildfires. Because these stressors are likely to intensify, The Nature Conservancy is proactively managing these areas by thinning trees, which reduces forest sensitivity to drought and the probability of high severity fires. Reducing those threats increases the chance that these forested canyons will shelter plants and animals that lose suitable habitat in the surrounding uplands as the climate gets warmer and drier.

Example: Target land protection in areas that are more likely to house climate and habitat refugia (Maine)

The Trust for Public Land is helping establish an “ecological reserve” through conservation easements and land purchases in the White Mountains to Moosehead Lake region of New Hampshire and Maine, an area that is projected to be a vital climate refuge. This high-elevation, mountainous region is projected to retain sufficiently cold water for eastern brook trout, as well as snowpack and spruce-fir forests as the climate changes. Its unique geology, rugged topography, and role as a primary east-west corridor across the Northern Forest region also highlights its importance in offering species a range of micro-climates and habitats to meet future needs.

Example: Protect and restore patches of cold-water habitat most likely to persist as climate changes (Virginia, West Virginia)

Trout Unlimited is using a climate change analysis for eastern brook trout—a sentinel cold-water species—to target their habitat protection and restoration efforts in Virginia and West Virginia. The climate model uses fish population data, landscape metrics and direct measurements of the relationship between air and water temperatures, to map the vulnerability of streams across the brook trout’s range. Trout Unlimited is then choosing to focus their protection and restoration activities on cold-water stream reaches that have relatively low vulnerability to climate change, or places where climate change vulnerabilities can be reduced through conservation actions. For example, they are restoring riparian vegetation to shade streams, which can help counter the effects of warming temperatures.

Solution 12: Help species track suitable climate and habitat conditions

Example: Restore riparian corridors to re-connect climatically-diverse mountain ranges (California)

The central coast of California is likely to encounter future climate conditions that are well outside of what the region has experienced in the past, which will pressure many plants and animals to find new homes. To support species' ability to adapt, The Nature Conservancy is working to reconnect Mount Hamilton with other nearby mountain ranges. Doing so will help ensure that a diversity of climate conditions—from relatively wet coastal areas to drier interior lands—are available over relatively short distances. Animals will be able to migrate to relatively cooler and wetter places through corridors such as one along the Pajaro River at a pinch-point between the mountain ranges. The team is ensuring the restoration work is adapted to future climate conditions by planting a broad range of plants that can tolerate different climate conditions and will provide diverse habitat and food resources year-round for wildlife.

Example: Re-connect lower elevation streams with high elevation, cold water habitat (Montana)

Some low elevation streams in the Madison River Valley of southwest Montana are expected to warm beyond optimal thresholds for native trout and other aquatic organisms adapted to cold-water streams. Meanwhile, conditions in higher elevation tributaries that are currently too cold to support native trout, are likely to improve as the climate warms. The Greater Yellowstone Coalition, State of Montana, and the US Forest Service are helping native trout and other species access these higher elevation streams by removing fish passage barriers, improving riparian vegetation, and securing in-stream flow rights.

One strategy for conserving cold-adapted native fish is to re-connect low elevation streams that may warm beyond optimal temperatures with much colder, high elevation tributaries that may see improved conditions as the climate warms (Credit: M. Haring).



Problem: Human responses

Human responses to climate change that pose a threat to wildlife and ecosystem conservation

Most research on the consequences of climate change for wildlife focuses on the relatively direct effects on species, populations and ecosystems. But some scientists argue that even greater threats stem from the influence of climate change on human behavior and land use. Changes in where people live or grow crops, what plants and animals they harvest for subsistence and profit, and how they store and manage water, could have a significant impact on wildlife and their habitats.

Solution 13: Protect lands that will be important to wildlife as land uses shift in response to climate change

Example: Place conservation easements on higher elevation lands before human populations relocate into those areas from coastal cities threatened by sea level rise (Florida)

Sea level rise projections for Florida indicate that many heavily populated coastal cities will become inundated, or impacted by high tides and more frequent and severe storm surges. As sea-level rise affects these areas, residential development is expected to creep toward the interior of the Florida peninsula. Many of these inland areas are critical habitat for wildlife such as the Florida panther, Florida black bear, and other iconic bird species of the Everglades. To get ahead of this wave of human migration and guide future development, the National Wildlife Refuge Association led the establishment a new federal unit known as the Everglades Headwaters National Wildlife Refuge and Conservation Area. This designation provides a catalyst for securing conservation easements on large ranches that provide wildlife habitat and corridors that will be increasingly important in the face of climate change.

Solution 14: Proactively address water conflicts among diverse users as water resources decline

Example: Implement a drought response plan and improve water-use efficiency on agricultural lands (Montana)

Competition for available water in western Montana is likely to increase as spring runoff comes earlier and summers become hotter. Low summer flows and higher water temperatures, exacerbated by the need for irrigation water to sustain agriculture, could have significant effects on native fish and other aquatic species. The Blackfoot Challenge, The Wilderness Society and the Center for Large Landscape Conservation are addressing this challenge by working with private landowners in the Blackfoot and Upper Clark Fork Rivers to conserve streamflow during drought. Using an innovative “shared sacrifice” approach, the community-developed drought plan works with water users to voluntarily limit or cease their removal of water from the river when flows fall below a pre-determined threshold. These limits—combined with the installation of more efficient irrigation infrastructure, improvements to soil health and water retention, leasing water for in-stream flows, and stream restoration—help to leave more water in the streams to support species and ecosystems during current and future droughts.



Spurring further actions to address climate change effects

The climate adaptation practices described in this report offer inspiration for conservationists working to address similar challenges. While not every strategy presented will be appropriate in every location or situation, there are a number of options for helping species and ecosystems prepare for changes to come.

These real-world projects illustrate how a combination of traditional and innovative conservation tools can be applied in targeted ways to address common climate change problems. We encourage readers to consider these ideas, but also to carve out time to examine the best available research and to think creatively about strategies that will help plants and animals in your landscape adapt to climate change. In some cases, those strategies may involve doing things differently—taking new actions, working in new places, or striving for new goals—than we have in the past.

Proactively considering climate change makes it more likely that the investments we make today will produce successful results in the decades ahead. We are already seeing significant uptake of these ideas, and the leveraging of millions of dollars in both public and private funding to replicate and expand adaptation projects across these landscapes.

The WCS Climate Adaptation Fund will continue to catalyze implementation of projects to improve outcomes for wildlife and ecosystems as the climate changes through an annual competitive grant program. Details about the grant program and funded projects can be found at: www.wcsclimateadaptationfund.org

People are taking action now to improve conservation outcomes as climate changes



Partners from World Wildlife Fund, Big Bend National Park, Coca-Cola North America, Rio Grande Scientific Support Services, Profauna and the National Commission of Natural Protected Areas (CONANP) are reconnecting the Rio Grande/Bravo River with its floodplain to recharge aquifers that may decline as the climate become more arid and droughts worsen (Credit: A. Melton).



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