Module 4

Climate Change, Biodiversity, and Public Lands

Main Takeaways

Human activities over the past ~150 years are driving the rise of global temperatures, which in turn, negatively impact the planet's ecosystems and biodiversity.

We know from a variety of sources — Indigenous knowledge, scientific and agricultural data, as well as our current lived experiences — both climate change and biodiversity loss are happening.

Public lands offer a variety of solutions to the climate change and biodiversity crises, because with proper land management, public lands can simultaneously address the inequitable impacts, biodiversity loss, and climate change mitigation.

What are climate change and biodiversity loss, and how do we know this is happening?

Alex Sánchez, co-founder of the organization Voces Unidas de las Montañas, shared his story about how climate change is impacting his family and community as a part of the "Communities at the Heart of Climate Action" collection which highlights community members who are committed to protecting the people and places they call home.

Alex Sánchez grew up in a small town on the Mexican Pacific Coast called "El Colorado," named after its bright red soil. Farming and ranching were at the heart of the community. Many families, including his own, produced corn, beans, and watermelon and raised livestock.

By the time Alex was nine, climate change combined with unfavorable agricultural trade policies made it almost impossible for the family business to remain productive. It became too hard to make ends meet. In search of better opportunities, the Sánchez family migrated north. By a twist of fate, they settled in another place called Colorado — this time in the United States. They made El Jebel, a small town in the Roaring Fork Valley, their new home.

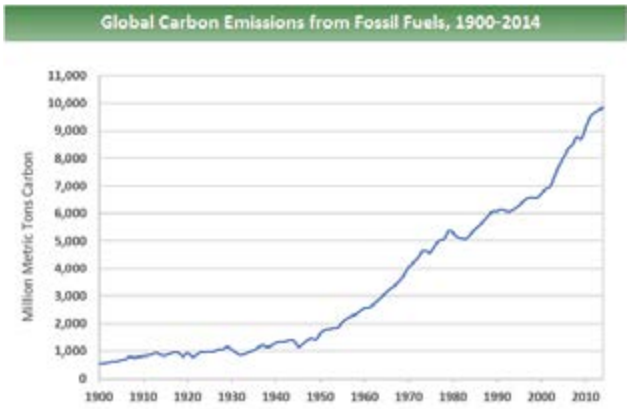
"Migration worldwide is tied to climate," says Sánchez. "It's tied to policies that are made by governments and institutions that create unintended consequences, and emigration is one of them."

The experience had a lasting impact on Sánchez's life. In Colorado, he became keenly aware of climate change and pollution around him. He noticed that communities of color were disproportionately burdened by the fossil fuel industry's unchecked pollution and the resulting climate change impacts — including hotter days and smoke from nearby forest fires.

"On the Western slope in Colorado, it's no secret where the pollution, bad water, and negative effects of industry ends up," he says. "It's next to communities that happen to be low income, that happen to be working families, that happen to be People of Color."

Climate Change

Our planet's climate has changed many times throughout its history. Over geologic time our planet has been both warmer and cooler than it is now. However, in the past 100 years, our planet's average temperature has more rapidly risen compared to all other times in history, dating back several millennia. These changes have caused major landscape and species fluctuations (ice ages, mass extinctions, etc), but typically these changes happened over thousands of years, not hundreds



Source: Boden, T.A. Marland, G., and Andres, R.J. (2017). Global, Regional, and National Fossil-Fuel CO2Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2017.

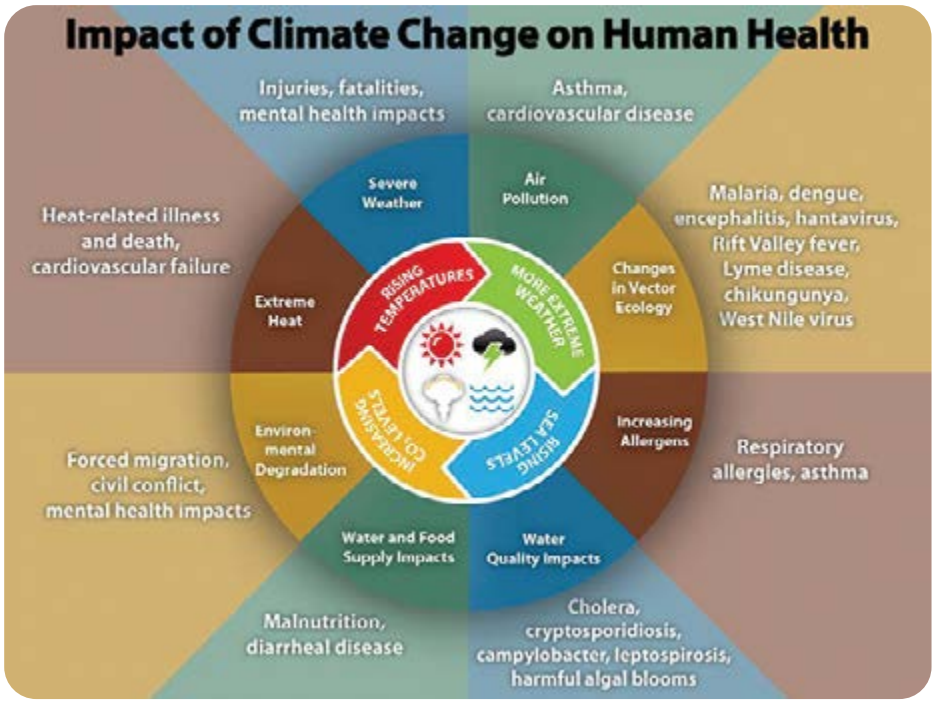
of years as is happening now. We know this from many sources, but some of the strongest evidence is ice-core data that shows atmospheric gas composition including greenhouse gases, past air temperature variations, and glacial accumulation and melt rates. During the past 100 years, carbon emissions have rapidly increased and so have global temperatures. In this same 100 year period, history shows significant increase in extraction and burning of fossil fuels, major deforestation, and extraction of hard rock minerals, along with changes in global commerce. This has resulted in a recognition that these changes in human activities from 1900 to the present are driving climate change.

Carbon dioxide, methane, and nitrous oxide are called greenhouse gases because they trap heat from the sun in Earth's atmosphere, similar to how a greenhouse used for growing plants traps heat from the sun, or how a car gets hot on a sunny day. Although the greenhouse effect is a natural process, human activities including agriculture, carbon emissions, industrial processes, and deforestation are increasing greenhouse gas concentrations resulting in a rise of average temperatures at unnatural and unprecedented rates. This increase in global average temperature is called global warming, and it is the root cause of the climate change many communities are currently experiencing.

In addition to ice-core data and other Western measurements of climate change, there are other ways we know that climate change is happening. Indigenous peoples have been aware of and tracking climate change for many years. Many tribes and Indigenous groups have traditions related to ecosystems and specific plants and animals and as temperatures have warmed over the past 100 years, Native cultures are observing the shifting dates of traditional ceremonies. For example, a 2016 USDA report describes how a spring Bread Dance ceremony is traditionally held by the Shawnee people when a particular tree's leaves become the size of squirrel ears. In recent years, Shawnee elders have noted this benchmark is happening earlier in the spring. Understanding of the world that is based on connectedness to land, ecology, and tradition is known as traditional ecological knowledge (TEK), and there are countless examples of tribal members using TEK to identify a changing climate. Other observations of the natural world also indicate a major shift in our climate. Farmers around the globe have reported hotter growing seasons, harsher winters, wetter monsoon seasons, and generally more challenging growing conditions for crops. In the past 10 years, firefighters have battled wildfires that are bigger, hotter, and spread faster than many can remember. While most of the narratives about climate change in the mainstream media focus on "Western" scientific data, it's important to acknowledge the many ways of experiencing and knowing our climate is changing.

The Intergovernmental Panel on Climate Change (IPCC), a large group of scientists convened by the United Nations, found atmospheric concentrations of CO_2, methane, and nitrous oxide are higher than any time in the last 800,000 years. Since the turn of the 20th century, the planet has warmed 1.8°F (1°C) and is on track to continue warming. Scientists point to human industrial activities as a cause for this change in atmospheric conditions and the related warming. In a special report released in 2018, the IPCC found global warming will soon exceed 2.7°F (1.5°C), "leading to irreversible loss of the most fragile ecosystems, and crisis after crisis." The effects of climate change are different in scope and severity for every community and can include:

- more frequent and severe weather events
- increased flooding and erosion, particularly along coastlines
- extreme heat, droughts, and wildfires



Source: cdc.gov

- reduced agricultural yields and food insecurity
- loss of outdoor tourism and recreation economies
- migration of peoples displaced by these effects

Climate change is an existential threat to all of us, but its effects are felt disproportionately among low-income communities and communities of color. A 2017 United Nations report identified three ways communities who experience social inequity, including low-income communities and Black, Indigenous, and People of Color, are bearing the brunt of the effects of climate change :

- Increased exposure to climate change's effects, i.e.; living outdoors, in flood-prone areas, or without air conditioning.
- Increased likelihood of being harmed by climate change's effects, i.e.; food insecurity, loss of livelihood, and health problems such as respiratory and cardiovascular diseases, injuries from severe weather events, heat related illnesses, mental health problems, as well as water and insect-borne diseases.
- Decreased ability to cope and recover from the damage suffered, i.e.; inequitable access to legal or medical assistance, inequitable distribution of relief funds after natural disaster, or loss of culturally significant subsistence practices.

It is important to recognize these disparate impacts are not by accident - they are the result of past and current unjust social and economic systems rooted in systemic racism. These inequities are often referred to as environmental racism, and strategies to rectify it are called environmental justice.

Biodiversity Loss

Biodiversity refers to the variety of life in an ecosystem, from simple cells and microbes to complex plants and animals. It also includes the ecological processes and services that sustain life in an ecosystem, such as nutrient recycling and pollination. Scientists have found the Earth has entered a sixth era of mass-extinction. Since 1900, a total of 198 species have gone extinct, and another 279 are possibly extinct. In 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) estimated another one million animal and plant species could go extinct within the next few decades. In addition to species extinction, population sizes among monitored animal species are shrinking. Scientists have noted a 68% average reduction in population size among 4,392 monitored animal species between 1970 and 2016.

Similar to climate change, many Native communities have identified biodiversity loss through cultural, agricultural, and oral traditions. The Quileute Tribe in Washington state is unable to find smelt eggs to make "stinky-eggs" in time for Honoring Elders Day, and the Iñupiaq of Alaska connect sea

Brock's Story: "My Climate Story" Project

The Fraser Basin Council Youth Program created the "My Climate Story" platform in 2018 for youth from a diversity of backgrounds across British Columbia, Canada to share how climate change is affecting their communities, and what inspires them to take action on climate change and environmental issues.

This story from Brock, a member of the Métis people, highlights the impacts of climate change on the Fraser River run of sockeye salmon.

Born and raised along the shores of the Little Shuswap Lake, near the mouth of the Adams River, I have always had a great appreciation for the journey of the sockeye salmon who also share this home at the beginning and end of their lives. As a child I spent many crisp autumn afternoons walking along the banks of the frigid river as bright red swarms twisted and reshaped the flowing water. The smells so pungent, yet oddly magnetic and comforting, as the salmon melted back into the earth to be recycled and resuscitated into the web of re-creation, spun out again to continue on the cycle that started since time immemorial. I recall the words of local Secwepemc elders weaving images into our minds and hearts of the importance of sqleltenuẁ i (the sockeye), summoning stories of when the river ran so red you could walk across it without ever touching the water.

In August 2018, I joined a canoe full of young leaders and we journeyed down the Fraser River from the headwaters near Mount Robson, through ten biogeoclimatic zones, to the Salish Sea. Along the way we were welcomed by Indigenous fishers, whose eyes gleamed of hope for a year of abundant and healthy salmon, mirroring their own perseverance of traditions and culture. With each stroke we took, we knew that the strength and rhythm of our paddles were a mere fraction of the power and stamina the sockeye expelled swimming against us. As water beads dripped down to our fingers, we reflected on how this precious resource, which carves its way through the heart of the province, is what the sockeye rely on to navigate home and bring life to a new generation. Every year, their route along the Fraser becomes more challenging, the water is more shallow, the temperature is warmer, and the banks are eroding.

That autumn, I returned home to Tsútswecw Provincial Park along the Adams River. To witness once again the splendor of this incredible phenomenon. Sadly, as I stared into the river, I only spotted speckles of red, a trend that is now all too common. These mighty warriors are becoming less and less. As they channel back to this place, something has begun. The vessel that carries their spirit can no longer cope with increasing pressures of such a task. Their decomposing bodies cast a glow that leaks into the pebbles that make the beds for the eggs, and for a moment they look like stars. Sparkling in the vast dark waters that once ran red.

ice loss and altered whale migration to less successful whale hunts. In southeast Alaska, Native people have seen shellfish unable to produce calcium carbonate shells due to ocean acidification. Toxic algae outbreaks have also become more common, threatening traditionally local species. The Amskapi Piikani/Blackfeet people identified that "sage, berries, sweetgrass, and willows are seen as declining in population… the trees are moving further up the mountain…there is an increase in the number of grizzly bears, mountain lions, and wolves within the Blackfeet Nation, and along with this increase 'there's a lot of predation.'"

In the ancestral homelands of the Ojibwe or Chippewa, now known as the states of Minnesota, Wisconsin, and Michigan, 11 Ojibwe tribes have formed an intertribal natural resource agency called the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). In 2018, GLIFWC interviewed tribal elders, harvesters, and knowledge-holders to complete a Climate Change Vulnerability Assessment on 60 beings, or species of interest, across the Ceded Territories. The Ojibwe have reserved treaty rights to hunt, fish, and gather in the Ceded Territories as they have since time immemorial, so the biodiversity and ecological health of the region is critically important to their food security, livelihoods, and culture. Two species highlighted in the report as extremely vulnerable to increased warming were Waabooz (Snowshoe Hare) and Manoomin (Northern Wild Rice). Climate change not only threatens species vital to the biodiversity of ecosystems, but also to the traditional ways of people who have inhabited these and neighboring lands for thousands of years.

Maintaining biodiversity is beneficial for many reasons. When an ecosystem has diversity in its plant and animal populations, it is inherently more resilient to short term events like wildfires and flooding. Diversity in plant life increases soil fertilization, controls erosion which improves water quality, and helps with pollination. Biodiversity also refers to genetic diversity within species which is beneficial in preventing disease outbreaks. Biodiversity also provides numerous benefits to humans, including but not limited to:

- Food security — Agricultural production, hunting, fishing, and gathering are all dependent on biodiversity. Pollination, nutrient recycling, and pest regulation are all ecosystem services that enhance food production on both wild and working landscapes.
- Pollination — For many plants to fruit and reproduce, a pollinator is needed to transfer pollen between plants. Insects like bees and beetles, birds, and bats that feed on nectar are all pollinators. Many essential human food resources require pollination to produce.
- Nutrient recycling — Nutrient recycling is best visualized as a food web, with different species of plants and animals both consuming and contributing nutrients into the ecosystem.
- Pest regulation — Diverse ecosystems are more resistant to pests and have a healthier balance of predator and prey populations. This resilience to pests can reduce the impact of natural disasters like wildfires, floods, and hurricanes by preventing damage that would be exacerbated during these events.
- Medicines — Biodiversity is essential for both natural medicines and the development of pharmaceuticals. Plants, fungi, and even wildlife anatomy contribute to medicines and pharmaceuticals.

While there are many important cultural, ecological, and biological reasons that biodiversity is important, it is also important to recognize the financial value to biodiversity as well: IPBES estimated the value of biodiversity at around $24 trillion per year, based on the economic value of each of the benefits biodiversity provides to humans.

How can public lands address the climate and biodiversity crises?

Public lands offer solutions to sustainably develop renewable energy, mitigate the effects of a warming globe and increased greenhouse gases, and protect critical habitat for preserving biodiversity. Additionally, public lands policy can rapidly start to address environmental justice issues, especially for communities most affected by climate change and biodiversity loss.

The Convention on Biological Diversity, which was originally established in 1992 and now has 196 member-countries, established an international goal of conserving 17% of each country's terrestrial area and 10% of each country's ocean waters, which scientists say is not enough to preserve Earth's biosphere from irreparable harm. Several scientific and environmental organizations began calling for a new goal: placing 30% of Earth's lands and waters into conservation status by 2030 (also known as 'thirty by thirty'). The Convention included the 30x30 initiative as a target in the official Global Biodiversity Framework draft published in 2021. Independently, President Biden issued Executive Order 14008 in January 2021, establishing a national goal of conserving 30% of U.S. lands and waters by 2030. Federal agencies collaborated to release the Conserving and Restoring America the Beautiful report in 2021, which was the first step in developing a conservation plan reflecting the 30x30 vision in the United States. Ultimately, the goal of this movement is centered around preserving land, protecting ecosystems, and placing land in non-extractive statuses. Designations such as Wilderness, Wildlife Refuges, National Recreation Areas, Wilderness Study Areas, and National Parks/Monuments help reach this goal.

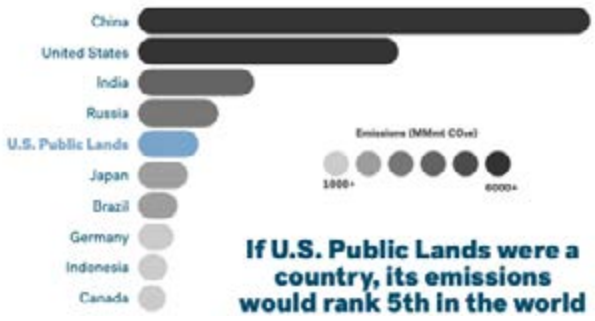
The 30x30 initiative is an important step forward in recognizing the self-determination of Indigenous peoples and the value of TEK. One of the core principles of the 30x30 initiative is "regular, meaningful, robust consultation with

Tribal Nations." This represents a significant departure from the way tribes and Indigenous groups have been "consulted" on land management decisions in the past and ensures TEK will receive an important role in shaping future land management strategies. Findings from the 2019 IPBES report documents that tribes and Indigenous groups are effectively preserving biodiversity. Although Indigenous groups only own, occupy, or manage 25% of the world's land, 80% of the world's biodiversity is found on those lands.

The 30x30 goal is an ambitious and important goal, relying on the many benefits of public lands to address the effects of climate change and biodiversity loss. The following are specific ways that public lands can be a solution to these crises.

Renewable Energy on Public Lands

The federal government controls access to 2.4 billion acres of minerals (e.g., coal, oil, and natural gas) located under the surface of the United States. Scientists have reached consensus: in order to reduce average temperatures on Earth, we must cut down on greenhouse gas emissions caused by burning fossil fuels. Currently, the lifecycle emissions of fossil fuels produced on public lands account for nearly a quarter of greenhouse gas emissions in the United States. If federal public lands were a country, these lands would be the world's fifth largest emitter of greenhouse gases. Although resource extraction on public lands is a big part of carbon emissions, most of these emissions can be eliminated with a shift in federal energy policy.



In 2019, there were 96 large-scale renewable energy projects on public lands generating more than 5,000 megawatts (5 gigawatts) and powering more than 2 million homes. Although these projects are substantial, they represent less than 5% of the total available capacity for renewable energy production in the United States. In 2020, Congress adopted a national goal of producing 25 gigawatts of solar, wind, and geothermal electricity by 2025, but that would still be less than 25% of the capacity for renewable energy.

In May of 2021, Congressman Mike Levin reintroduced the Public Lands Renewable Energy Development Act (PLREDA) in an attempt to ensure these projects are sited responsibly with minimal impacts to wildlife, and to create a Renewable Energy Resource Conservation Fund that supports expanding recreational access, conservation and restoration work, and other important stewardship activities.

The Bureau of Land Management (BLM) has already identified over 700,000 acres as Designated Leasing Areas (DLAs) for renewable energy development that meet three criteria:

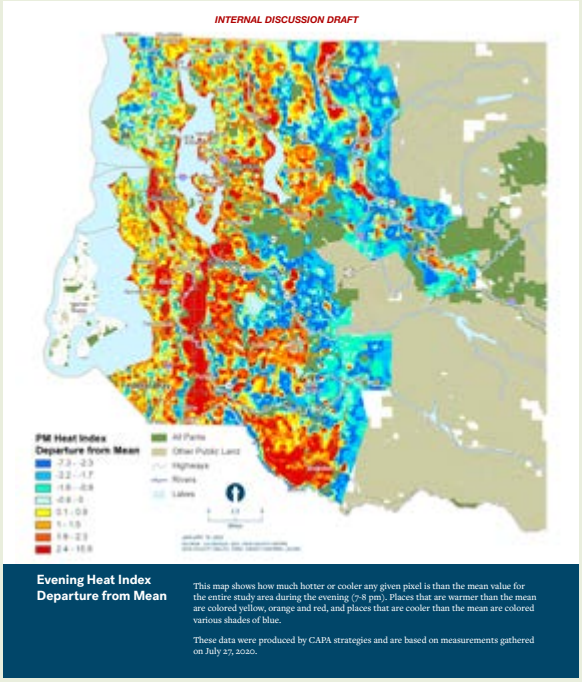
- excellent solar or wind resources
- proximity to existing or planned transmission and highway corridors
- lower environmental, social, cultural, and recreational impacts

By utilizing appropriate federal public lands for renewable energy development and decreasing fossil fuel extraction, the United States would significantly reduce emissions, construct sustainable energy infrastructure, and create lasting economic benefits for workers and communities. In terms of climate change and biodiversity, this policy change would represent a major shift towards a sustainable future, resulting in lower global average temperatures and more resilient ecological communities.

Heat Equity — Urban Parks and Green Space

The 1995 Chicago heat wave killed over 700 people in the course of five days of record temperatures. Most of the victims were Black, elderly, and low-income Chicagoans. The disaster sparked increased public scrutiny of what the EPA now calls "heat islands" and "heat equity." Intra-urban heat islands are areas of a city dominated by concrete and steel hardscaping which exacerbate the effects of sun and heat. The Trust for Public Land's (TPL) 2020 report revealed additional data supporting green space as a solution to the heat island and climate crisis. According to the report, areas within a 10-minute walk of a park are up to 6 degrees cooler than areas farther away. Increasing access to local parks has great potential to reduce heat-related illness as well as promote physical activity and social cohesion. Parks and green space mitigate the effects of hot weather, but racially discriminatory urban planning practices such as redlining and interstate highway development have forced low-income communities and People of Color into higher density and industrial neighborhoods. Those same discriminatory urban planning practices have ensured wealthier neighborhoods have parks and green space that mitigate heat.

As climate change exacerbates the effects of heat islands, communities are looking for ways to protect both environmental and human health. The city of Albuquerque, New Mexico is seeking to reduce the effects of heat islands and promote climate resiliency by planting 100,000 trees in 10 years. A report by The Nature Conservancy found the city's tree canopy is being degraded by extreme heat and drought caused by climate change, limited capacity for proper tree care, and poor species and site selection. In response, experts evaluated and scored 136 tree species on a total of 15 criteria, including but not limited to: temperature and drought tolerance, urban compaction tolerance, pest and disease resistance, and whether the species supports wildlife. Without the thoughtful and concerted effort of the "Let's Plant ABQ" campaign, Albuquerque's urban forests would be vulnerable to dramatic dieback, and residents would suffer dramatic health impacts in turn.



King County and City of Seattle Heat Island Mitigation Strategy

King County and City of Seattle applied for a FEMA hazard mitigation grant in 2021 that would help fund the development of a countywide urban heat island mitigation strategy. This grant would provide funding for urban and street tree planting, increased public access to greenspace, incentives for energy efficiency retrofits and green roofs, increased access to cooling centers, and increased outreach and education about managing heat impacts on health. Reducing heat impacts is one of many priority actions in King County's updated Strategic Climate Action Plan, which provides strategies to cut countywide greenhouse gas emissions in half by the end of this decade, prepare for the impacts of climate change, and build more sustainable and resilient frontline communities.

Public lands can be a potential solution to heat islands. Local city planning efforts can ensure parks and green space are included in development and all communities have equitable access to these important places. These planning processes are often open to public comment and grassroots campaigns led by citizens and community groups can impact planning decision-making. The City of Seattle and King County in western Washington state undertook a heat-mapping project in the summer of 2021. King County's Strategic Climate Action Plan includes reducing heat impacts as a priority action to prepare for climate change and build resilient communities.

Carbon Sequestration

An important way land conservation can mitigate climate change is by capturing and storing carbon dioxide, a greenhouse gas that causes an increase in global temperature. Through photosynthesis and the carbon cycle, plants capture carbon and store it in vegetation and the soil. Because of these natural processes, many public lands are carbon sinks - places that absorb more carbon than they release. Maintaining carbon sinks is essential to slowing and mitigating climate change.

Forests are critically important carbon sinks, storing carbon in woody vegetation and the soil. The United States Forest Service (USFS) manages over 190 million acres in 154 National Forests. The 16.8 million acre Tongass National Forest is a rainforest in southeast Alaska - the largest temperate rainforest on the planet. According to a 2021 study, the Tongass accounts for 44% of the carbon capture in the whole United States National Forest system.

Wetlands, like those in Everglades National Park, the National Wildlife Refuge System, and Waterfowl Production Areas (WPAs), trap organic matter and slow decomposition, storing carbon in the soil. Wetland soils are capable of holding 40% soil carbon, compared to the .5%- 2% soil carbon in most agricultural soils. A 2016 study published in Nature found that despite accounting for only 5%-8% of the planet's surface, wetlands hold 20%-30% of global soil carbon. When wetlands are drained, dredged, or filled, that stored carbon enters the atmosphere, speeding up the greenhouse effect.

Preserving and Protecting Intact Ecosystems

In addition to slowing climate change and mitigating its effects, conserving public lands will be instrumental in slowing the rate of biodiversity loss and protecting intact ecosystems. Preserving habitat, migration corridors, and breeding/calving grounds are three ways to preserve biodiversity through land protection.

Habitat

In 2019, the IPBES found that 75% of Earth's land surface and 66% of marine environments have been altered by humans. Forests have been cleared for agriculture and timber, wetlands have been polluted, and grasslands over-grazed. These changes have reduced habitat spaces for many species; wildlife and native flora need habitat for food and population security. Some species can adapt to vastly different conditions, while others can only survive in very specific habitats. By protecting the most ecologically sensitive areas, which often have the richest biodiversity, we can sustain healthy populations of wildlife whether they are endangered, threatened, or common.

Migration corridors

Animals migrate to find food, better habitat, breed and rear their young, and to expand their range. Migrations can be seasonal or spontaneous and include individual animals or millions at a time. Roads and human activity present significant barriers to animal movement. Even fences around pastures and rangelands can present a significant barrier to some species like the pronghorn antelope, which rarely jumps fences because they are a plains animal that did not evolve to jump over obstacles. Pronghorn have been observed walking for miles down a fence line until they can go under the fence on their bellies.

In the Northern Rocky Mountains, ensuring natural connectivity between distinct grizzly bear populations is crucial for viability of the species. Bears in the Greater Yellowstone Ecosystem (GYE) are isolated from other populations of bears, namely the Northern Continental Divide Ecosystem (NCDE) population in and around Glacier National Park. This isolation has been identified as a long-term threat to the genetic viability of the GYE bears. Human development in the Missoula and Bitterroot Valleys of Montana is preventing grizzly migration between the two recovery zones. In 2018, an NCDE bear made its way south into the Bitterroot Valley, but was relocated after digging holes on a golf course. The bear was released in the Seeley Lake area to the northeast, but had to be euthanized a year later due to conflicts with humans.

Wildlife crossings connecting public lands dissected by roads are becoming a valuable tool for land managers in the United States. Several states, such as Washington and Montana, have already built wildlife crossings over major roads like I-90 and Highway 200 that were once a major barrier and source of mortality for migrating wildlife. In the Pigeon River Gorge between Great Smoky Mountains National Park and Cherokee National Forest, Interstate 40 divides Tennessee and North Carolina. The 28-mile stretch of highway has been identified as a "death trap" due to increased high-speed traffic and a lack of wildlife-friendly infrastructure. The Safe Passage project is studying wildlife movements and seeking to build wildlife crossings over and under I-40 to mitigate the increased mortality resulting from traffic through the gorge. Plans to build a wildlife crossing in Los Angeles are expected to break ground in 2022. This crossing over the 101 freeway at Liberty Canyon in Agoura Hills will provide a vital link in the chain connecting the Santa Monica Mountains, Simi Hills, and the Santa Susana Mountains allowing all animals to move freely between these open spaces.

Breeding/Calving/Spawning Grounds

Many animals require a particular habitat to breed and raise their young. Spotted owls require old growth forest for nesting, waterfowl need the prairie potholes of the North Central United States and Central Canada, and salmon need clean, cool water in their natal streams.

The coastal plain east of Prudhoe Bay, Alaska, known as the "1002 Area" of Arctic National Wildlife Refuge, is the calving grounds for the Porcupine Caribou Herd. The Refuge, which is home to 42 fish species, 37 land mammals, 8 marine mammals, and more than 200 migratory and resident bird species, also includes the country's largest Wilderness area. The 1.5 million acre coastal plain, the calving grounds of the Porcupine herd and biological heart of the Refuge, was not included in the Wilderness designation. Oil and gas companies have lobbied to open the 1002 area to drilling for decades. For the Gwich'in people, who have hunted, fished, and trapped in the region since time immemorial, the Porcupine herd provides a central part of their diet and culture. Gwich'in leaders, scientists, and conservation groups agree that allowing drilling, road building, and other extractive industrial activity in the 1002 area would have a devastating effect on the area's biodiversity and the Gwich'in way of life. Permanent protection of the coastal plain is imperative to preserving the caribou calving grounds and this important ecosystem on which the Gwich'in depend.

Appalachian Landscape Conservation Cooperative (Appalachian LCC)

The Appalachian LCC is a science and management partnership between various public and private organizations working to protect the biodiversity of the Appalachian region and create a coordinated landscape-level conservation effort. The LCC contains the most significant biodiversity "hot spot" east of the Rocky Mountains and is the largest contiguous biodiversity hot spot area in the nation. The Central and Southern Appalachians are unrivaled in the United States for aquatic species diversity and comparable only to China for forest diversity. Approximately 198 species are federally listed as threatened or endangered. Of these, 108 or 54% are aquatic species (primarily mussels and fish). Additionally, the LLC supports the 30x30 initiative of supporting landscape conservation.

What actions can you take to help?

As an individual, the challenges brought up in this module can feel overwhelming; it's easy to get discouraged and feel helpless. While these are natural and normal feelings, it is important to remember the collective actions of many individuals can have major impacts when it comes to climate change and biodiversity loss. There is plenty of information online about steps you can take to reduce your own impact on climate change — simple things like changing incandescent light bulbs to LEDs, turning off lights at home when you're not using them, reducing heating and cooling system loads in the home by 1-2 degrees, and reducing food waste. These strategies make a difference when undertaken by millions of people over many years, although they also sometimes feel very small in comparison to the scale of the biodiversity/climate crises today. Below are some additionally impactful ways you can influence the climate change and biodiversity conversations in today's world.

- Plant habitat gardens. Urban pollinator gardens can be as small as a few feet square, and in more suburban/rural areas, planting wildflower meadows encourages native species of pollinators. Additionally, you can help native species like mason bees by building bee houses, put out hummingbird feeders during migration season, and plant food sources like milkweed that are vital to various insects and animals.
- Engage in a restoration project as a volunteer. This might be a half-day event identifying and removing invasive species of plants, a day of cleaning up a dump-site and removing garbage from public lands, or a bigger project like stabilizing and rerouting a stream to help with habitat.
- Support climate friendly legislation. This can be in the voting booth, at campaign rallies, or in public local government forums/meetings. The more people who are advocating for climate-responsible governance, the more likely our elected officials will support it.
- Learn about and educate others on the benefits of biodiverse, natural ecosystems and landscapes. After wolves were reintroduced in Yellowstone National Park, many species including elk and deer populations benefited; yet, there exists a strong anti-wolf movement in the Greater Yellowstone Ecosystem. Similarly, beavers provide vital habitat to many species of native fish, migratory birds, and plant species; yet, in many parts of the country beavers are seen as nuisance animals. By learning about the ecological benefits of these species and sharing knowledge with others, you can encourage environmentally responsible land management practices.
- Encourage traditional land management strategies when possible. For example, in much of the western states, Indigenous peoples set small-scale burns in the forestlands to maintain a healthy forest ecosystem with little disease, few invasive insects, and low large-scale wildfire risk. As traditional land management practices decreased or were outlawed, forests became overgrown and larger, destructive fires have become common. Today many land managers are working to thin forests and to manage with "prescribed burns," returning to practices closer to traditional management strategies of these areas. Publicly supporting this type of work is vital to its long-term success and to the ecological restoration that is important in these areas.
- Support community-based organizations fighting for climate equity issues. This could be directly donating time, money, or other resources to these efforts; it might be canvassing a neighborhood and advocating for a policy, protesting, donating money to support a specific campaign, or offering to speak publicly about a climate-related inequity you've seen or experienced.
- Spend time on public lands. Go for a hike, explore a nearby nature center, or stop for a few minutes at a public park. By engaging with public lands, you are validating their existence. Document your visit on social media-share it as widely as you're comfortable to make others aware of these resources.
- Make climate change/biodiversity loss visible. If you're an artist, content creator, or have a social media profile, create, share, and encourage climate/biodiversity focused art projects. There are many artist-activists today focusing on climate change and biodiversity with the goal of making these issues visible and important to a broader audience. By joining this movement or sharing this work, you can amplify these efforts.

Community Members organizing an Earth Day planting event.

- Write opinion pieces or letters to the editor about public lands in your community.

These strategies will not change the world on their own, however they will make a direct appeal to land managers, policy makers, and elected officials who create local and global policies that impact these issues on a broader scale. These strategies can also elevate the pressing need for change in the eyes of elected officials and voters. Since many potential large-scale solutions to these challenges can be addressed through public land management and policy, there is a real opportunity to influence elected officials through public support and visibility. On a larger scale, public support of these issues can influence leaders globally, through trans-national agreements and summits. The climate and biodiversity crises did not emerge overnight, and will not disappear rapidly either. With many people taking small steps toward non-extractive, ecologically-responsible practices, we can begin to address them.

Module 4 Lesson 1

Climate Change Mixer

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Lesson at a Glance

Participant Read/Digest *(10 min)*: Participants will read perspective card(s) (human, species, or location) and prepare to represent the perspective(s) to others during the mixer activity.

Mixer Activity *(30 minutes)*: Participants will read/represent and listen to other perspectives and complete a worksheet with prompts.

Conclusion and Reflection Questions *(Whole group, think/pair/share, or written; 10+ minutes)*: Participants will reflect on climate change, interpret the perspectives represented in the activity, and consider their own personal perspective/story of climate change.

Learner Outcomes

Participants will:

- Be able to voice perspectives on climate change.
- Understand how climate change impacts humans, species, and places.
- Express their own story/understanding of climate change and how it impacts their lives.

Getting Ready

Time: 45-60 minutes

Materials: Mixer perspective cards, printed reflection questions, materials for written reflection (optional)

Preparation: Spread mixer perspective cards out on a table/ground for participants to select

Location: Indoor or outdoor, with enough space for participants to move around; for a large group reflection, having a space for all participants to sit or stand in a circle.

Number of participants: 5-30

Objective: To promote understanding of the impacts of climate change on people, species, and places.

Participant Read/Digest *(10 min)*

Participants will choose or receive at least one identity card, representing either human perspectives on climate change, impacts on species, or changes to landscapes/places. After distributing roles, distribute name tags for participants to fill out, using the name of the person/species/location they are assigned. For those less familiar with expressing others' views, having a leader model what level of expression is expected can be very helpful in engaging the group. Participants will read the perspective they will be voicing and plan on how they will express the views represented; remind learners that they should be internalizing the perspective assigned to them, and memorizing as much of the information as possible.

Mixer Activity *(30 minutes)*

During the mixer, participants will engage with others and express the viewpoints on their cards, and/or their own experiences with climate change. There are several ways to facilitate this activity, depending on the level of comfort/experience/engagement of the group:

Facilitation Considerations

An important part of this lesson is preparing participants to respectfully voice perspectives — not only their own perspective but also that of another being (person, plant, animal, or place). Respectful dialogue is essential as participants are taking on the persona of someone with whom they may or may not share a background. It's important to acknowledge that many groups are stereotyped based on their identities and to set the expectation that stereotypes and disrespectful role play have no place in the learning environment. For recommendations on facilitating role play activities, visit this resource created by the Zinn Education Project (https://www.zinnedproject.org/materials/climate-crisis-mixer). Some key guidance to share with learners include:

- Speak using your own accent, language, and mannerisms
- Speak as if you are your assigned person/species/location
- Use I/we statements, and encourage participants to "become" their perspective

1. For less engaged groups, consider setting up a rotating structure (similar to "speed dating") so participants have facilitated short bursts of engagement throughout the time.

2. For a moderately engaged group, consider setting a target of interacting with x number of "people," y number of "places," and z number of "species" to allow for greater autonomy but still have structure to encourage continuous engagement.

3. For a highly engaged group, consider a more self-directed approach, allowing participants to fully mix with each other for the duration of the activity. Encourage participants to talk 1:1 instead of in small groups- this encourages more interaction for all participants, and doesn't allow for disengagement during the time.

For all groups, having a timekeeper who is rotating participants every 2-3 minutes can be very helpful. Ask participants to complete the "Questions to Answer During the Mixer" worksheet and make notes on the questions while they interact with others. Participants can also make notes on their emotional reactions, any larger themes that they identify, and what perspectives surprise them through these conversations.

Conclusion and Reflection Questions

(Whole group, think/pair/share, or written; 10+ minutes)

Facilitate some or all of the following questions:

1. If you had to write down a similar profile for yourself, your family, your school, or your community, what would that focus on? What is your climate change story?

2. What perspective did you hear that was new to you or that surprised you the most/least? How does this perspective compare to perspectives you've heard in the past?

3. Think about the news media and what you have heard about climate change in the popular media streams that you consume. How do those perspectives and voices align with the voices you've heard in this mixer?

4. How are people, places, and species connected in the conversation about climate change and biodiversity?

5. Public lands offer an opportunity to develop unique and large-scale solutions to some of the issues voiced by various perspectives in this mixer. What are some of the public land-based solutions that you heard or that you can think of after doing this activity?

6. Consider the human perspectives shared in this activity; is there someone that you could take joint action with? Who is this? What action might you take together? How would it support both their perspectives on climate change as well as your own personal one?

These questions can be facilitated in different ways. A common practice is "think/pair/share", where learners first have a set amount of time to independently think about a question, then pair up with another person to talk about it, and then share out to the whole group. If you have a more engaged/confident group, jumping into a whole group reflection can also be an effective strategy. Written reflection can also be a valuable tool.

Lesson adapted from *A People's Curriculum for the Earth*, ed. Bill Bigelow and Tim Swinehart; Rethinking Schools, 2014. Used by permission. See the Zinn Education Project for an updated version: https://www.zinnedproject.org/materials/climate-crisis-mixer

Adapt the lesson

- Find local species that have been affected by climate change and integrating those into the cards
- Have participants write their own perspectives on climate change and how it has affected them and use these in future lessons
- Have participants do a research project about one of the perspectives or ideas that surprised them in the perspectives represented

Climate Change Mixer Questions
(Suggested During Activity)

1. Find a voice who is hurt by climate change. Who is this? How have they been hurt or how might this individual be hurt in the future?

2. Find a voice who might benefit from climate change, or who contributes substantially to climate change. Who is this? How might the voice benefit or in what way does this voice contribute?

3. Find a voice who has been forced to move because of climate change, or may have to move. Who is this? Why might they have to leave and where will they go?

4. If a person or family is forced to make a change (career wise, if an oil rig or coal mine closes, or location wise, if a home or employer is destroyed by flooding or wildfire), what resources should be provided to this person, and by whom?

5. Find a voice who is affected by climate change in a way that is similar to how you're affected. Who is this? How are your situations similar?

6. Find a voice whose story involves a connection between.....

A) water and climate change. Who is this? What's the connection?

B) fire and climate change. Who is this? What's the connection?

C) biodiversity and climate change. Who is this? What's the connection?

7. Find a voice who has an idea about what should be done to deal with climate change — or a voice who is taking action in some way. Who is this? What is the idea or action they are taking?

Larry Gibson

Mountaintop removal activist, Kayford Mountain, West Virginia

They say that to move away from oil we need to rely more on "clean coal," mined here in the USA.

Clean coal. That's a lie. That so-called clean coal comes from mountains in Appalachia that have been destroyed by coal companies, like Massey Energy. They blast mountains apart to get at the coal and dump every-thing they don't want in the valleys and streams, poisoning everything around.

When they talk about clean coal, they sure don't mean how they got it. They want you to focus on the fact that burning coal today produces less sulfur dioxide than it used to. That's the stuff that causes smog and acid rain. But burning coal still releases about twice as much carbon dioxide as natural gas, and a third more than oil — for the same amount of energy. And carbon dioxide is a greenhouse gas, the gasses that cause global warming.

So mining coal is bad for the people of Kentucky and West Virginia, but it's also bad for the planet.

I've been fighting mountaintop removal of coal for more than 25 years. I'm not going to sit around and watch my home and the planet be destroyed. The coal companies care about the money. For me, it's not about the money. It's about the land. My mother gave me birth. The land gives me life.

Chris Loken

Apple grower, Hudson Valley, New York

Everybody is saying awful things about global warming, and I know that it's bad for a lot of people. But recently Fox News did a report on climate change "winners" and they came to talk to me. As they said in their report, "There are some upsides to global warming."

Frankly, I saw this coming. I knew that things were going to get warmer and you know what they say about a crisis: It's also an opportunity.

I live in a beautiful place. Rolling hills. Good for apple trees. But I decided to diversify. Right next to the apples, I planted peach, apricot, and plum trees. Years ago. As I say, I saw this coming. These trees wouldn't have survived the winters of the old pre-global warming days. But our winters are getting milder, and I'm betting my trees will do just fine. As I told the Fox News people: "This farm here has been set up for the future." It's not easy running a farm these days, and if the weather decides to cooperate a little bit, who am I to argue? I'm sorry for those folks who are hurt by all this, but I've got to think of my family.

Stephanie Tunmore

Greenpeace climate campaigner

I joined the environmental organization Greenpeace because I felt like I had to do something to make the world a better place. To me, it seems that climate change is the most dangerous problem facing humanity and the environment. The consequences of global warming will be catastrophic, and we have to do something.

I've been working to save the Arctic. People think of the Arctic as just one big empty block of ice and snow. Either that, or where Santa Claus and the elves live. But it's an unbelievable place. There are species of birds and fish that are found only there and a few other places. Polar bears, musk oxen, and caribou reside there; and in the summer, snowy owls, ducks, and swans migrate there to nest. But already Alaska's North Slope has been taken over by 28 oil production plants, almost 5,000 wells, and 1,800 miles of pipes.

But the oil companies see global warming and the melting ice as an opportunity to drill for even more oil and gas. Haven't we learned anything? Why are we looking for more fossil fuels? The good thing is that more and more people are determined to stop oil development. We've taken direct action and have confronted the oil drillers in places like the Beaufort Sea, where we towed a fiberglass dome with two Greenpeace activists inside into a BP Northstar oil-drilling construction area. Two other activists unfurled a banner: "Stop BP's Northstar, Save the Climate." Direct action. That's what it will take to stop these oil-drilling criminals.

Rafael Hernandez

Immigrant rights activist, The Desert Angels, U.S.-Mexico border

In 1986, I crossed the border from Mexico to the United States, looking for a better life for my family. Now I am committed to helping migrants in need. My group, Los Angeles del Desierto — The Desert Angels — patrols both sides of the Mexican-California border near San Diego. We look for lost migrants and leave water, clothing, and food at key spots in desert locations to help people on their journey.

Recently, we rescued María Guadalupe Beltrán, a 29-year-old mother of four who had been burned severely in the huge Harris Fire on the border. Her father had died in Mexico and she had returned home to attend his funeral. She was caught in the fire coming back into the United States. But after suffering terribly, Beltrán died of her injuries. Afterward, I spoke to her husband, Rafael, who sat by her hospital bed for two weeks. He told me: "I asked the Virgin: 'Tell me whatever you want, please just don't take her.' But she did. At 11 in the morning my wife went away. She died at 11." Six migrants died in the fire and eight were injured.

The border patrol has pushed migrants to cross in unsafe desert areas. And global warming is making these areas even more unsafe, more deadly. Climate experts say that these wildfires, just like the awful ones in Greece, Australia, and Colorado, are going to happen more and more as the climate shifts. So María and other wildfire victims are also victims of global warming.

Richard H. Anderson

CEO, Delta Airlines, Atlanta

I am CEO of Delta Airlines, and live in Atlanta. I'm a businessman and a lawyer, and have been in the airline business for more than 20 years. My job is to oversee Delta's long-term goals. Ultimately, I need to keep the company profitable for our investors and a secure and fulfilling place to work for our 80,000 employees.

I've been reading that air travel is bad for global warming. People say our jets produce a huge amount of carbon dioxide and other greenhouse gasses that increase global warming. An article I read recently said, "Flying is one of the most destructive things we can do." This researcher concluded that "the only ethical option . . . is greatly to reduce the number of flights we take."

But ethics are complicated: Don't I have an ethical responsibility to my employees and stockholders — and to the 160 million customers who fly Delta every year, on more than 15,000 flights each day? And that means expanding air travel, advertising low fares, and trying to get people to take vacations to faraway places like Japan and China, to keep Delta profitable. Sure, we will try to pollute less, but we'll leave global warming to the politicians and scientists to figure out. I'm a businessman.

Steve Tritch

President and CEO, Westinghouse Electric

Before I became the head of Westinghouse I was senior vice president for Nuclear Fuel, providing nuclear fuel products and services to nuclear power plants throughout the world. Before that, I led the merging of the former ABB nuclear businesses into Westinghouse Electric, and was senior vice president of nuclear services. And before that, in 1991, I became manager of the Nuclear Safety Department, and later was appointed general manager of Westinghouse's Engineering Technology. Today, I belong to the American Nuclear Society and serve on the Nuclear Energy Institute's board of directors. I guess you could call me Mr. Nuke.

You might say that I'm a man on the hot seat these days. Not only are we running out of easy-to-find oil, but oil is also blamed for global warming. Coal is an abundant source of power, but it produces even larger amounts of greenhouse gasses than oil — or natural gas. People are looking to my company, Westinghouse, for solutions. The solution is obvious: nuclear power. As I tell my employees, "What's good for the planet is good for Westinghouse."

Sure, the accident at the Fukushima nuclear plants in Japan was serious, and people were hurt. But the whole industry has learned from this accident, and even Japan still knows that nuclear power is the best way to go. The real threat is global warming. Global warming could destroy much of life on Earth. But nuclear power produces no greenhouse gasses. They say nuclear power has dangers. Well, last year 5,200 Chinese coal miners died in accidents — and that's a lot more than have ever been hurt in a nuclear power accident. I see hope for the planet and Westinghouse is here to play our part.

Nancy Tanaka

Orchard Owner, Hood River Valley, Oregon

Our family has owned and operated fruit orchards in Oregon's Hood River Valley since my husband Ken's grandparents bought land here in 1917. The only time our family left this land was when the U.S. government locked our family in internment camps during World War II. But that's another story.

Every generation of our family has farmed this land. And then we woke up to the front-page article in our local newspaper. It was a shocker. In fact, it scared us half to death. A study by Oregon State University found that 75 percent of the water during the summer months in the Upper Middle Fork of the Hood River comes from melting glaciers on Mt. Hood. And because of global warming, the glaciers are disappearing. That's our river. Well, we don't own it, but it's the river that irrigates our pears and cherries. Our family has grown fruit on this land since before we were born, and now they tell us that our irrigation water may be disappearing?

To tell you the truth, I never knew so much of the river's water in the summer came from glaciers. You see, glaciers on Mt. Hood are kind of small compared with glaciers on other mountains. Scientists say the problem is that glaciers have been shrinking because of global warming. I always thought global warming might affect the Arctic and the polar bears, but not the Upper Middle Fork of the Hood River.

Trisha Kehaulani Watson

Environmental lawyer, Hawaii

I was born and raised in the valley of Manoa, in the district of Kona (known today as Honolulu), on the island of Oahu. I am Native Hawaiian. I am a lawyer specializing in environmental law — but much of my knowledge comes from talking with my family and kupuna, our elders.

Over the years, I have seen the beaches I played on my entire life steadily erode. In many places, the sand is disappearing.

My valley has always been very waiwai (wealthy, rainy, with much fresh running water), yet the waters have changed. We have far more unstable weather. When I was a little girl my grandfather used to take me down to the streams to watch the water rise when the heavy rains came. But things are much different today. The heavy rains are devastating. A few years ago we had a terrible flood wash through the valley. Since then, my street has been shut down numerous times due to dangerous flooding.

The seasons have also changed. It gets much colder than it used to, and also much hotter. The plants have changed because of it. Fruits come at unusual times of the year. Flowers bloom at different times of the year. Health problems also result from these weather changes.

The Earth is not well.

James Hansen

Former director, Goddard Institute for Space Studies, National Aeronautics and Space Administration (NASA), New York, City

I am a scientist, but I am also a grandfather. So that makes me especially interested in the future.

Recently, I was arrested at the White House in Washington, D.C., protesting the construction of the 1,700-mile Keystone XL Pipeline to send oil from the Tar Sands of Alberta, Canada, to Texas. Why would a scientist and a grandfather commit civil disobedience and get arrested? That's simple. If this pipeline is built and they continue to take this especially dirty and polluting oil from the Canadian Tar Sands, it makes it very unlikely that we will be able to stabilize the climate and avoid the disastrous effects that we are already beginning to see. As I've said, this pipeline is the fuse to the biggest carbon bomb on the planet.

Many years ago, I was one of the first scientists to warn that as we burn more fossil fuels — coal, oil, natural gas — the carbon dioxide created will heat the Earth to dangerous levels, with terrible, terrible consequences. I thought people would respond to scientists' rational arguments that we needed to end our addiction to fossil fuels. Now I know we need to take more drastic action.

So I volunteered to be arrested with 1,200 other people to draw attention to the importance of stopping this deadly pipeline from being built. I am more than 70 years old, but if need be, I will keep getting arrested.

Robert Lovelace

Ardoch Algonquin First Nation leader, Ontario, Canada

A few years ago, I was sentenced to six months in jail and ordered to pay a $15,000 fine. What was my "crime"? Trespassing on my own land — trying to block a uranium company, Frontenac Ventures, from prospecting on and polluting Algonquin Indian land. It began when we noticed people cutting down trees on land we had never ceded to the Canadian government. Someone had given Frontenac a prospecting license and they had gotten a court to issue an injunction against "trespassing." But this is our land, and Algonquin Indians and our non-Indian supporters organized a 101-day blockade to physically stop Frontenac from destroying the land. I was arrested and became a political prisoner.

Because of global warming, the nuclear power industry is claiming it is the "clean" alternative, because nuclear power does not generate greenhouse gasses like coal or oil. The price of uranium shot from $43 a pound in 2006 to $75 a pound a couple of years after. It came down as a result of the 2011 nuclear disaster in Japan, but it will go back up. Canada is already the world's leading exporter of uranium, and many in our government want to increase exports and turn Canada into an "energy superpower."

There is nothing good about uranium mining. Uranium mining has no record other than environmental destruction and negative health issues. Mining companies clearcut the land and destroy the Earth to get at the uranium. Uranium can't be stored safely and other uranium mines around Canada have left land polluted with heavy metals like arsenic. And nuclear power itself is not clean. Nuclear waste stays radioactive for thousands of years and no one has found a safe way to store nuclear poisons that long.

Paulette Richards

Miami, Florida

I live in Liberty City, a mostly low-income and African American neighborhood in Miami, Florida. I love this neighborhood. Just walk down the street and you can smell that wonderful Haitian fried pork and plantains coming out of people's houses. I bought my home back in 2001 for $90,000. Recently, I've struggled to make mortgage payments because without health insurance my cancer treatments left me with a lot of debt. Somehow, the real estate people must have heard that I was short of money, because I have been getting phone calls everyday from people wanting to buy my home.

It's the rising seas, caused by climate change. That's why the rich white folks want my house. For years, those people wanted to live down near the water. They still do, but now they are starting to see that with climate change, it's risky to live near the ocean. The city of Miami says that by 2060, the sea level will rise anywhere from 14 to 34 inches. For years and years, because of segregation and racism, banks wouldn't lend to People of Color, and we were only allowed to live in the less desirable high ground — the coral ridge, stretching from north Miami-Dade County to the upper Florida Keys. That's why suddenly, all the real estate people and developers are trying to buy our places and sell them for lots more money. Community activists in my neighborhood call it "climate gentrification." And as housing prices go up, so do the taxes. People who rent homes or businesses are seeing their rents skyrocket. What are they supposed to do? But I didn't buy a house for investment. I bought this to live in, to die in. It's my legacy, my home, my worth. Without that what else do I have? The good news is that this community is organizing and fighting back — people are talking about rent control and freezing taxes, and forcing developers to build affordable housing, if they want to do business here. This is my community; I'm not going anywhere.

Matthew Gilbert

Member of Gwich'in Tribe, Northern Alaska/Northwestern Canada

I am a member of the Gwich'in, the northernmost Indigneous nation on the American continent. There are about 8,000 Gwich'in. Because of global warming, we are threatened as a people.

We survive mostly from hunting caribou. Less snowfall is making sled and snowmobile transportation more difficult. Creeks are freezing later, and the ice is too thin to carry heavy loads. Lakes are drying up.

The worst threat is to the caribou. In 10 years, their number dropped from 178,000 to 129,000. Calves drown when they try to cross rivers that are usually frozen. My grandfather remembers vast numbers of caribou moving in waves near their village during spring and summer. No more. Our environment is in chaos. The hunters find it harder and harder to find the caribou that feed our people.

We must reduce greenhouse gasses. My people are dying.

Tom Conway

Miami, Florida

I know that climate change is going to hurt people. But here's the thing: With any change comes opportunity, and if you're smart, you'll take advantage of opportunities that come your way. I am a developer in Miami. Basically, I buy places as inexpensively as I can and then I fix them up either to rent or to re-sell.

As I say on my website, I have a "sharp financial foundation" and "an analytical aptitude." I began to notice that property values in certain inland neighborhoods were going up faster than property values on the beach. Sure, beachfront property is still expensive and desirable, but the scientists say that by 2060 the sea level here will rise by 14 to 34 inches, so people are becoming more interested in the parts of Miami on higher ground. For years, areas like Liberty City, Little Haiti, and Overtown were where the poor people lived. In these higher ground neighborhoods, property values are increasing three times the average in the rest of Miami-Dade County. So I'm going into these neighborhoods and buying up businesses and homes as cheaply as I can. For example, I just bought up a couple of shopping centers in the Little Haiti neighborhood. The tenants — a travel agency, a tuxedo shop, a clothing store, some restaurants, a tax preparation place, and other businesses — had been there for years, some as long as 30 years, and weren't paying much rent. As wealthier people move into the neighborhood, they want other kinds of businesses — businesses that can pay a lot more rent. So I evicted all the tenants in order to remodel my new shopping centers. I followed the law and gave people 15 days to move out.

People in the community protested — they are still protesting. "Climate gentrification!" they called it. They said I am a racist, because the tenants I removed were Black and I'm white. Look, I have nothing against the former tenants of my buildings. This is just business. I can make more profit renting to people who have more money, people who feel that with climate change, the neighborhoods on higher ground are a safer risk.

Elizabeth Easton

Beaumont, Texas/Oakland, California

I guess you could say that I am a climate change refugee. I now live in a big old lot behind an Office Depot with about a hundred other people in Oakland, California. We live in cars, in tents, in old campers, in tiny houses people have put together. But I used to live in Beaumont, Texas, about 90 miles from Houston. Here's the story.

In August of 2017, Hurricane Harvey made landfall on the coast of Texas. Harvey had winds of 150 miles per hour when it hit. In Beaumont, where I lived, we got more than 50 inches of rain! I had never seen anything like it. The worst thing is that the little house where I was renting lost water service — the whole city water system shut down. No drinking water, no way to flush the toilet. It was terrible. Beaumont opened a shelter, but conditions were so unsanitary in the shelters that the city had to get us out of there. I know that there have always been hurricanes, but I heard a scientist on the news who said that climate change made storms like Hurricane Harvey three times as likely, and Hurricane Harvey had 38 percent more rain than if there wasn't any global warming.

I didn't have much, but I lost everything in that storm. I liked Beaumont, but I had to get out of there, so I took a bus to Oakland, California, where I have family. But it is way too expensive to live here. There is no place I can afford. I lost almost everything in the hurricane. Now, my home is here, behind this big Office Depot. I paid someone to let me stay here, but it's not safe — especially at night. Here, I feel forgotten, tossed aside. People talk about the "homeless crisis." For me, it all started with a hurricane, fueled by climate change.

Glacier National Park

Montana, USA

There's no question, the summers are getting hotter and the winters are changing - I can feel it. These changes are threatening the very landscapes I'm famous for. Whole acres of my glacial ice are melting and I've already watched over half of my remaining glaciers slowly melt away in the past 50 years. The scientists that come to measure and take photos of my melting glaciers say that what I have left of this impressive ice could be gone in just ten more years. But they warn that's just an estimate because glacial melting is a vicious cycle; the more glaciers recede the faster they will continue to melt. Will people still come to see me if there are no glaciers to see?

My whole landscape is already feeling the changes. When the glaciers are gone, my summer streams will barely flow without the seasonal meltwater, endangering the whole habitat that these cold clean streams provided. From insects to plants to animals- everyone will notice. Even the animals that walk my rocky cliff faces will notice the change - mountain goats use the glacial ice as air conditioning in the hot summer sun, and with less ice and hotter days coming I worry about my mountain goat residents.

I'm starting to feel naked without my glaciers and I fear for all the beings that I'm watching struggle to adapt to my changing landscape.

Fair Bluff, North Carolina

Columbus County, USA

I was never a big town, but now there's only a few residents left to even call me a town. Our main street was a pretty riverside downtown, right along the Lumber River. Until the flooding started. We'd always had flooding now and then (downtown is built on the floodplain) but now scientists say severe storms and the flooding they bring are the new normal, all thanks to climate change.

I've been told warmer temperatures and warmer ocean waters means more evaporation happens out over the ocean, so more water is sucked up into these big storms and then dumped right onto our flood prone town during each storm. I remember in 2016 Hurricane Matthew caused the Lumber River to flood - and I mean really flood - putting all our houses, roads, and stores underwater for weeks. But that wasn't it; we'd barely rebuilt when the next one hit. 2018 brought Hurricane Florence, and it happened all over again. My residents who could, started leaving. It's just too hard to rebuild and repair your house over and over, knowing another big hurricane, and another big flood will come.

And that's just the problem. We're already living with climate change but it will only get worse from here since severe weather, like hurricanes, are only expected to become more intense in the coming years. We can't take more intense rains and flooding, we are still repairing from the damage we already have. I'm shrinking and soon I'll be a climate change ghost town.

Gila National Forest

Arizona/New Mexico Border, USA

I'm a pretty diverse forest and an important habitat for many critters of the southwest like the Mexican spotted owl, so just like many of my neighboring states, wildfires and drought are a growing concern for me.

Sweltering temperatures, even for this area, have been melting any snow we got before spring has barely started. Everything is hot and dry, so forest fires are starting easily, just a strike of lighting can start a blaze. I know this because that's exactly what happened with the Whitewater-Baldy Fire that burned 297,845 acres of forest. That's a lot of my forest, but a lot of it actually did okay.

We're used to fires here; the U.S Forest Service who manages the forest has a policy of letting small fires burn naturally when it's safe. And there's good news because their tactic seems to be working. The Whitewater-Baldy Fire was expansive but burned at lower temperatures in the areas that had been burned recently by these smaller fires. More frequent low severity fire is better for the trees and the animals in the forest because it burns built up vegetation so there's less fuel for bigger fires and new vegetation grows back quickly. This new growth after a fire is important because it helps keep the debris and ash in place that could otherwise harm fish like the Gila Trout and cause flooding when summer rain storms come.

Although this management approach of the Forest Service doesn't mean I'm immune to high severity burns in the future, I might be a more resilient forest and have a better chance against climate change.

North Cascades National Park

Pacific Northwest, Washington State, USA

Maybe you've seen photos of my majestic snow capped mountains and green forests spreading up to the huge slopes? Those glaciers feed rivers and streams, keeping the forest green with ferns and huckleberry bushes. That's the mountains of the Pacific Northwest, or at least what it has been.

But lately when there's any talk of glaciers the photos getting passed around aren't to show off my beauty, but instead to see how much the glaciers are receding. Planes have been flying overhead here for years taking photos documenting how those glaciers are shrinking. What used to be glaciers that covered whole valleys are now just patches clinging to the shadiest side of the ridges. And while the glaciers shrink each year, the rivers run lower in the summers and the forests dry out a little bit more, leaving space for wildfire to creep in and burn longer and hotter each and every summer. Not only are the old trees that were home to so many animals burned, but trails and campgrounds close, and smoke obscures those beautiful views I brag about. Things just aren't the same as they were in the past.

Monongahela National Forest

West Virginia, USA

The early 20ths century stripped me of too much of my red spruce habitat already but it's endangered once again. The logging and mining in the forest weren't exactly good for the health of trees. And now even though people are replanting trees and restoring habitat these red spruce trees aren't out of the woods yet. Now the dry summers and heat waves are reaching up into the mountains where these trees once found refuge. But there's nowhere else for them to go, living on top of mountains means no where to migrate too, just risk replacement as the drought tolerant life moves up the mountains.

But why do I care about the red spruce? Well for one, I wouldn't be the same forest without them, but they're not just trees. Salamanders that are already endangered themselves, keep cool in the shade this treed habitat provides. And the brook trout of West Virginia's cold water streams risk living in stream temperatures that are too warm if the spruce cover is lost. I'm used to change but I hate to lose all this to climate change.

Valles Caldera National Preserve

Jemez Mountains, New Mexico, USA

Did you know that land can get scars just like humans can? My grasslands and forests have vast wildfire burn scars of dead trees and ash, especially from the big fire that blazed here in 2011. Some people even described that 2011 fire as a mega-fire. The drought fueled the fire with the dried out grassland and forest letting it burn hotter than other fires. The heat was so intense that it left some places completely burned and dead, with no living trees or even a seed for miles. No seeds means no new trees to hold everything in place and prevent erosion, which means burn scars last even longer and my very land could be washed away with each rain.

But a historic fire like this gets people's attention. Scientists have been studying the soil since the 2011 burn, because it's not just the trees that are impacted by fire. The research is showing that some soils can return to the same or even better condition after the fire passes through. The heat increased some nutrients in the soil and created better conditions for plants to uptake the nutrients they need to grow, though there are some negative effects too. These findings could be so important because the soil and all that goes on within it can change how a forest regrows. All this goes to show that fires and how they impact all parts of the forest are not all good or all bad and there's still so much to learn.

The one thing I do know is that even after the trees that are replanted by helping hands have grown and soils have regenerated, there will be more fire in my future.

Okefenokee National Wildlife Refuge

Florida/Georgia Border, USA

Everyone seems to be talking about the big wildfires in the western U.S. these days and the droughts and rising temperatures that are causing them. But I'll tell you it's not just happening in the West. You might only hear about the hurricanes that hit here in the southeast on the news, but the drought is here too. Even a swamp wetland like me has been dried out just like droughts have done to forests in the West. A swamp might sound like a wet place that wouldn't burn very well, but when the water dries out after too many hot dry days, the decomposing plants that accumulate making my swamp a rich ecosystem are exposed and become fuel for any spark of fire.

Over the past 15 years there's been too many fires to count that burn in a cycle as drought conditions dry the swamp and then fires burn across the refuge. Like many places, fire is natural here, but these big fires that burn for months and come back with the drought each year are dangerous and becoming more common.

Boundary Waters Canoe Area

Minnesota, USA/Canada Border

For now I'm still the Boundary Waters the people know, but you should probably come to see my boreal forest and extensive lakes before things change. It's the trees that will start to move on first; I can tell the black spruce, balsam fir, paper birch and others are already feeling parched in the summers. And I hear that the summers will keep getting hotter, and if that heat starts evaporating more moisture than we get, things will start to shift. I know my rocky soils won't be able to support a whole boreal forest when they're dried out so the forest will have to give way to something different.

The oak and maple trees from further south have already started to move up with the warming conditions and when it really heats up the grasses won't be far behind. I'll have shed my boreal forest with it's spruce and fir trees, so you might not recognize me in my new coat of grasslands but I'll still be here in this future of climate change.

West Maui Reef System

Hawaii, USA

When you picture coral reefs in the tropical water of Hawaii you probably think of colorful coral and fish of all kinds swimming through the vibrant structures. That's what you'll see in my reef system too, we even have organisms that don't live anywhere else on earth. But some areas are looking a little more dull recently.

It's not just the air temperatures that are rising around the world, but us underwater ecosystems are feeling rising water temperatures too. Warmer waters might sound nice for swimming, but when a marine heatwave comes, the corals are more likely to bleach. It's called coral bleaching because coral literally gets bleached of their color — the symbiotic algae that give coral their color and food leave due to the stress of the high water temperatures. If the heatwave continues for too long and the algae don't return this can even kill the coral. That's just what happened in 2015 when I saw living corals die due to a heatwave. Dead coral doesn't just look bad to tourists who want to come to Maui to scuba dive, but it also means the fish that live in these reefs face trouble too. Without habitat these reef fisheries could decline, changing the whole food web.

But it won't just be the animals of the reef that feel these heat waves, everythings connected in the reef, and the food web includes humans who fish these waters too.

Red Rock Lakes National Wildlife Refuge

Greater Yellowstone Ecosystem, USA

I'm home to over 200 species of birds, including many migratory species that use my wetlands and lakes to breed and overwinter. Originally I was designated as a wildlife refuge to give protection to trumpeter swans who were struggling due to lost nesting grounds. I'm proof that protecting important habits can really save animals because I now host a rebounded and healthy population of these swans.

Although the refuge has been a great success, many of the birds I host might start facing challenges as the climate here changes. Warmer temperatures in both the summer and winter seasons and less water availability means that other non-native species, of plants and animals, will likely start colonizing the refuge to take advantage of new conditions that suit their needs. While new species move in, species like wetland rushes that traditionally made up most of the wetlands might not be able to compete in the drier conditions. With all this change of new species coming and others getting pushed out, my whole habitat could start looking very different. I might not be the right place for many of the birds that have long called me home, and they might even have to move on to new locations. But I'll still be here as things change into the future, providing habitat to whoever can successfully make their home here.

Gila Trout

Gila River, USA

I'm one of the rarest trout species in the U.S, but it's certainly not easy being rare. I've been fighting to survive for a long time already. I was even listed as an official endangered species back in 1973. Although I'm doing better, they only call me a threatened species now, I'm facing new challenges.

Before I took cold mountain water for granted, but now I have to worry about the temperature of the water I'm swimming in, or if there's even any water to swim in. With less water in the streams from less winter precipitation the streams aren't full anymore and the rising air temperatures heat these especially shallow waters quickly. I can't survive long in waters that are too warm; it makes life difficult at all stages of life. Fires are also burning away the vegetation on the banks of the creeks, exposing those of us living in the water to even more heat. The ash from these fires is also dangerous. When too much ash gets washed into the creek when it rains it can be toxic and even deadly to us already stressed Gila trout.

But we're not totally on our own. Recently, when fires are looking particularly dangerous forest managers will move us to a safer section of stream. With people looking out for us and good forest fire management we'll have a shot at continuing to survive in the Gila River.

American Bullfrog

Columbus County, USA

Everyone's talking about how life is getting harder, but I've got to say us bullfrogs are doing okay - I'd even say we're doing good!

It's not so hard to survive when I can find more habitat as places are warming up. Some people might call it "invading" but I'm just living where I can find a good home and food to eat. I'm originally from the eastern U.S, but I've found good spots across the country and even down in South America and on other continents. I can travel pretty far on my own, even miles in a night time rain, but sometimes humans are even helping me get to new places and they don't even know it. Even the warming temperatures are helpful because now I'm living in places that used to be too cold.

I'm well adapted to living with changes. I'll eat just about anything so it's easy to stay well fed even in a new place. I eat invertebrates, snakes, frogs, rodents, and even my own young if I need to. Plus, away from my original home I have less predators who are adapted to hunting and eating me which makes life easier too. For now I'm going to keep enjoying what climate change is giving me so you won't hear me complaining.

Southern Pine Beetle

Eastern Texas to Maryland, USA

I might be small, almost too small for you to see with your eyes, but I'm making big moves in this warming world. I burrow into pine trees to lay eggs and live inside the wood. I'll admit that when I make my home in a tree it can cut the tree off from water and nutrients and the tree eventually dies. But I'm just doing what I can to survive and even thrive.

These days it's even easier to find trees to burrow into since so many trees are already weak from drought and overcrowding. Weak trees are good for us beetles because they can't fend us off. Whole forests of these weak trees are helping us Southern Pine Beetles move in and reproduce quickly, which is great for our growing population.

All this warmer weather is great in other ways too. We're from the South where it's warm all year, so our biggest danger is when temperatures drop below 14 degrees F. But we've noticed even up in the northeastern U.S. the winters aren't as cold these days and less freezing temperatures means we can survive all winter instead of dying off with the winter freezes. As long as temperatures keep warming we'll keep going where we can find trees and mild winters. Maybe we'll even head up into Canada in a few years when the winters warm up a bit.

Western Larch

Crown of the Continent, USA

I'm a unique kind of conifer tree that takes part in the annual fall foliage show in the northwestern U.S. and Canada. My needles turn a bright yellow and orange in the fall with the other deciduous trees and then fall off for the winter. But in the future the fans of my colorful needles may have to search further and further north to find me.

Dry and warm conditions could start shrinking my already limited habitat zone in the northern U.S., pushing me further into Canada. My seedlings prefer cooler and wetter areas to start our long lives, so these young larches may suffer in the heat. All of this change could weaken us, making larches more susceptible to diseases and insect outbreaks that threaten to further shrink our population. And like other western trees, the danger of fire looms on the horizon. But I might have some advantages here. I'm fire resistant to natural low severity fires thanks to my thick bark and deciduous needles. Fire even helps distribute my seeds. All this is helping me in the short term, but as drought encourages fires to burn hotter and longer, my natural adaptations might not be enough to spare me from fire damage and the impacts of climate change.

Peach Trees

California to Georgia, USA

As a peach tree, success comes when we bloom plenty of blossoms that turn into juicy fruit in the summer. But it's not only sun and blue skies that makes a peach tree bloom. It's cold winters that we need to bring the country a booming peach harvest.

Peach trees need between 650 to 850 hours in the winter that are below 45 degrees F to have successful spring blooms when the temperatures start to rise. These cold winter hours that we call 'chilling hours' allow the tree to go dormant for the winter until the spring temperatures signal the time to bloom. But if we can't get enough chilling hours we stay dormant, unable to bloom.

Winters aren't as cold as they used to be. Recently some places aren't even getting enough cold winter days to fulfill the needed chilling hours, and my lack of spring peach blossoms prove it. The warm winter of 2017 caused so many of us Georgia fruit trees to stay dormant we hardly had fruit that year. It's just a shame to see us peach trees bare with hardly any fruit to share around. Some scientists are looking to wild peach trees to get clues about how to create climate change resilient fruit trees, but until then I'll be hoping for cold winters.

Corn

Iowa, USA

Iowa and the Midwest are known as the Corn Belt of the U.S. for a reason - we've been growing successfully for many years. But we might not be bragging much longer. We've all heard about the drought and warmer temperatures climate change is bringing. So far us corn plants have been getting by knowing that after an extra hot day a cool night will follow. But now even the cover of night is not going to provide a reprieve from the summer sun. We usually use nighttime as a chance to breathe out, literally releasing oxygen without losing too much water to the sun. But now warmer nighttime temperatures mean we get no break from the heat and we'll lose more water to evaporation. These frequent hot days and nights mean we won't grow as tall and will look dried out and brown. We might even lose some of the development of our corn kernels we're known for.

As a plant I know the soil is the other half of the equation. The soil helps me get the nutrients and water I need to grow strong. But these drying conditions mean that soil can be washed or swept away in the strong storms we do get. It's hard to grow from unhealthy and eroding soil so we can't risk losing too much of it. Some farmers are finding ways to protect the soil by using cover crops when corn plants are out for the season. We're going to need these techniques to help us keep growing like we have been through these changes.

Monarch Butterfly

United States

I've become an icon because of my extensive migration patterns from the U.S. down to Mexico and back again every year. Although this migration path has never been easy, life at every step of the way is becoming more challenging and our numbers are shrinking because of it.

Before migration can even start, we begin our lifecycle as eggs laid on our favorite plant - milkweed. Once we transition to life as caterpillars, milkweed becomes our food too. Milkweed used to be abundant amidst crops in the midwest, making for great Monarch habitat. But the use of pesticides and pesticide resistant crops means we're losing our habitat on milkweed.

Habitat loss isn't our only struggle though, warming temperatures are confusing our internal calendars that tell us when to head south for the winter. We usually depend on the first cool fall days to tell us when to leave the northern U.S., but lately warm fall temperatures mean we are staying up north longer, up to six weeks sometimes. This later migration cue means we're traveling south later and risk getting caught in cold winter weather and storms. These storms are terrifying for such a small being and are oftentimes deadly. Fewer and fewer of us are surviving the harrowing journey to Mexico where the Monarch Butterfly Biosphere Reserve offers some protection. But even within this reserve our habitat on oyamel fir trees is not guaranteed. The oyamel fir is another species threatened by climate change, making it difficult to know if our winter safehaven will be around in the future.

American Lobster

New Jersey to Maine, USA

I used to be found all along the Northeast coast of the U.S., but recently water temperature changes are hurting lobsters in the southern waters.

As sea surface temperatures rise in my southern range, off the coast of New Jersey, New York and Connecticut, the lobster populations there have been falling. These warming waters make it harder for our young in the larval stages to survive to become adults. Temperatures above 20 degrees C increase our stress levels and weaken our immune systems making us susceptible to mass die offs and deadly parasites. This all sounds like us lobsters are in hot water, and we are, but thankfully our populations in northern areas of the Atlantic coast seem to be doing just fine for now.

Lobsters in Maine aren't yet experiencing sea surface temperatures warming above the 20 degree C/68 degree F stress threshold that is causing death further south. The Maine population is actually booming, as lobstermen will tell you. Although these cooler waters up north are keeping our population numbers up, we might have to keep shifting north as sea surface temperatures continue to rise. Even the Maine waters could soon be too warm. Researchers here in Maine tell us that these waters are warming 99% faster than sea surface temperatures in the rest of the world's oceans. All this warming makes it hard to tell where we'll be in the future, but it's likely we'll be further north where temperatures might stay cooler.

Steelhead Salmon

California, Oregon, Washington, USA

I'm one of the Pacific salmon species that migrates from freshwater to the ocean to grow into an adult and then back to my home freshwater stream to spawn and reproduce. These travels mean my habitat stretches great distances, but it seems that there's similar problems appearing across the waters I swim through.

Both in the freshwater streams us steelhead salmon are born in and then return to, and in the salty Pacific Ocean, water temperatures are increasing. Our inland waters are warming due to high temperatures and less tree cover over streams due to deforestation and development. Low stream flows due to shrinking glaciers and water diversion for other uses will only further this warming. Cold water not only keeps us salmon cool enough to survive at our early life stages, but it also holds more oxygen than warmer waters. We need plenty of dissolved oxygen in the water to breathe, just like humans need oxygen to breathe. And once we've migrated out to the ocean, cold waters aren't always a guarantee there either. Marine heat waves are becoming more frequent, and warm ocean waters make survival in our adult stages difficult too.

If only we could return to the furthest reaches of our traditional habitat in the mountains where waters may still be cold and clean. But the construction of dams from California up to Washington have shrunk our available spawning habitat and contributed to smaller population sizes. Fish ladders and other technologies at some dams are helping a few of us move up stream, but the loss of so much spawning habitat is hard to overcome.

Eastern Beech Tree

Appalachian Mountains, USA

As a common part of many forests in the eastern U.S., I'm concerned about where I'll be with this changing climate. The rising temperatures and more frequent droughts are concerning to many of us trees of the Appalachian Mountains and I'm worried about how I'll grow in these conditions. A warmer climate is likely to benefit my biggest nemesis, beech bark disease. This disease occurs when a scale insect and the fungal infection that follows infects our thin bark. It can kill young and old beech trees alike. Many of us are already infected, likely making us more susceptible to the stressors and pests that a warming climate will bring.

With more frequent drought and wildfires I'm again at risk because of my thin bark that does little to protect against fire. In stands where beech bark disease has taken hold the downed trees and limbs will only provide more fuel, creating more dangerous fires. On the other hand, winter will still bring challenges too. Like other hardwood trees, we can suffer damage after strong winter storms and we're slow to heal and regrow. With more extreme storms likely there's no doubt we'll keep facing losses to these storms. These weaknesses make me susceptible to the threats of climate change that could begin to push me out of my home forests.

Module
4
Lesson
2

Art and Climate Change

Lesson at a Glance

Silent Gallery Walk *(15 minutes):*
Participants will look at and reflect on artwork related to climate change and biodiversity.

Questions, Reflections *(10 minutes):* Participants will discuss the work they've seen in small groups.

Data driven artwork discussion *(10 minutes):*
Participants will dive deeper into Jill Pelto's artwork, looking at examples of data-driven visual storytelling.

Data driven artwork *(20+ minutes):* Using the artistic style of Jill Pelto, participants will be able to create their own visualization of climate change.

Conclusion *(5 minutes):*
Final questions, comments, continuations.

Learner Outcomes

Participants will:

- Work with real data relevant to climate change or biodiversity loss and create an artistic piece
- Be introduced to three artist's work that is relevant to climate change, biodiversity loss, and public lands in the United States
- Reflect on how visual media can inspire awareness and action of climate change and biodiversity loss

Getting Ready

Time: 1 hour +

Materials: High quality printouts of climate change and/or biodiversity-related artwork, colored pencils, watercolors, pencils, blank white paper, tracing paper (optional), rulers, scissors, enough relevant data charts for each student, markers, chart paper if groups will be observing one art piece in a small group.

Preparation: Spread gallery walk images out on tables, with significant distance between them so that 3-5 people can look at each piece comfortably. Have art supplies and data charts easily accessible.

Location: A location with tables or other writing surfaces; preferably an outdoor pavilion or other space closely connected to nature.

Number of participants: 1-30 participants

Objective: To experience and create climate change advocacy through art.

Silent Gallery Walk *(15 min)*

A Silent Gallery Walk is a method for participants to engage with new material independently. Preface that you will be leading a discussion about questions, reflections, and observations participants have about the piece after the gallery walk. It can be helpful to set an expectation of how many "talking points" you want each person to have for this. Each piece of work has a short caption underneath it in the curriculum. You may choose to leave these visible during the initial gallery walk or to "reveal" them at a later time.

Introduce participants to the concept of a Gallery Walk by encouraging these guidelines:

1. Please be silent and keep your observations to yourself as you view the work. Each learner is experiencing this work in their own way — by remaining silent and observing the work, you are allowing your peers the opportunity to discover their own observations just as you are discovering the work yourself.
2. You may record your observations or curiosities on a piece of paper or in a notebook.
3. Try to spend at least two minutes with each piece; if you're highly engaged or excited by a piece, you may want to spend longer- this is natural. By spreading your time more evenly throughout all of the work, you may find connections to a piece you aren't initially drawn to.
4. As you visit each piece, try to maintain a few feet of physical distancing between yourself and others; this distancing can enhance your experience as well as theirs. If you notice the piece of work you were going to visit next has a crowd around it, change your strategy to visit another one.they are representing. Have each group assign a note taker and a presenter.

Questions, Reflections *(10 mins)*

Guide participants in a reflective conversation about the artwork displayed. Begin with questions that allow for sharing of initial thoughts and reactions:

- *What did this make you think about?*
- *What do you think ties these pieces together?*
- *Why do you think we're looking at this body of work?*
- *How do you feel after viewing this work? What emotions came up for you during this exercise?*
- *What assumptions does this work challenge/reinforce?*

After initial reactions, offer the following questions to guide the group to a discussion about biodiversity, environmental justice, and climate change.

- *Where do you see climate change or biodiversity loss represented?*
- *Why did the artist say this piece was related to climate change? What do you see that links this work to climate change or biodiversity loss?*
- *What power structures does this work reinforce/break down?*
- *How did the artist create this work? What tools or techniques do you think the artist used?*

Data Driven Artwork Discussion *(10 minutes)*

Review Jill Pelto's artwork with the students. She creates pieces by taking climate data charts and using them to tell stories about the effects of climate change on the environment.

"Landscape of Change" uses four line graphs: sea level rise, glacier volume decline, increasing global temperatures, and the increasing use of fossil fuels. While the piece is from 2015, it tells a story that is relevant more today than ever. Ask participants if they can identify specific data lines.

"Gulf of Maine Temperature Variability" highlights the temperature fluctuation and temperature increase that sea water in the Gulf of Maine has experienced over the past 15 years; it also highlights the native species (codfish, lobsters, shrimp, and burrowing clams) that have been impacted by ocean acidification and depleted fish stocks. Ask students to consider what will happen to the people who rely on these species to provide for their families if this trend continues.

Creating data drive artwork *(15+ minutes)*

Ask participants to choose a dataset to create their own art in the style of Jill Pelto. Ideally, provide data charts related to local issues. There are several sources for global data available online:

- wxshift
- climate.gov
- skepticalscience.com
- www.eia.gov/beta/states/states/mt/data/dashboard/renewables

Participants can create art directly onto a graph they have printed or hand-drawn. They can also trace a graph onto a different piece of paper, especially if using paints. Participants can also use multiple datasets to make more complicated pieces. As participants create their own artwork, encourage them to consider including aspects of the environment, plant and animal species, and human interaction.

Conclusion *(5 minutes)*

Final questions, comments, continuations.

What story did you choose to tell with data, and why?

How did this activity increase your understanding of data, storytelling, and climate? Suggest if students are interested in contributing to data collection, they participate in a community science project!

What are ways of knowing that the climate is changing? What stories have you heard that the data supports or contradicts? Aside from numbers, how do communities know that change is happening?

Many Indigenous and Native communities have commented on climate change and how their traditional ways are at risk; yet these stories and commentary are not typically told in western scientific circles. How does this activity highlight other ways of knowing?

How does public land link to this activity? (Some links are: Data collection happening on public lands, imagery of public lands, science about biodiversity on public lands)

All artwork for this lesson used with permission from the artists.

Adapt the lesson

- For a highly engaged group, consider having participants self-select into small groups around the artwork displayed that they are especially interested in or drawn to. Ask participants to write down what they notice or wonder about the artwork, asking them to avoid statements that start with "I like" or "I don't like." Groups can present to the larger group.
- For an extended project, consider asking participants to collect their own data for several weeks or months prior to this activity and use it to create their artwork.
- Consider splitting into two lessons- the Silent Gallery Walk as part 1 and the Art Creation as part 2. Additionally, after participants create their own work, they could repeat the silent gallery walk process with their original pieces.

Jade Leyva

I Have a Soul: Is a piece that encompasses the duality of the Earth as well as the individual one represented as the day and the night. The tree as a central piece represents life itself and many things that come with it. Each branch ends with a hand doing something meaningful and fun. Many cultural subjects are depicted here for inspiration about diversity. Characters in the painting include: John Lennon, Gandhi, Isaac Newton, Virgin of Guadalupe and her son, Buddha, the feathered serpent, Catrina (Mexican iconic day of the dead figure), Krishna among others.

Jade Leyva

Let Your Creative Heart Flow: This piece was created as the basic design for a seed mural Jade Leyva did with 19 detained young women at a youth detention center in Albuquerque, NM. The theme was created by her to inspire young people to let their creativity flow and they can then see how it evolves into beautiful things. The landscape is inspired in the central New Mexico area, the Rio Grande, local indigenous people, plants and fauna.

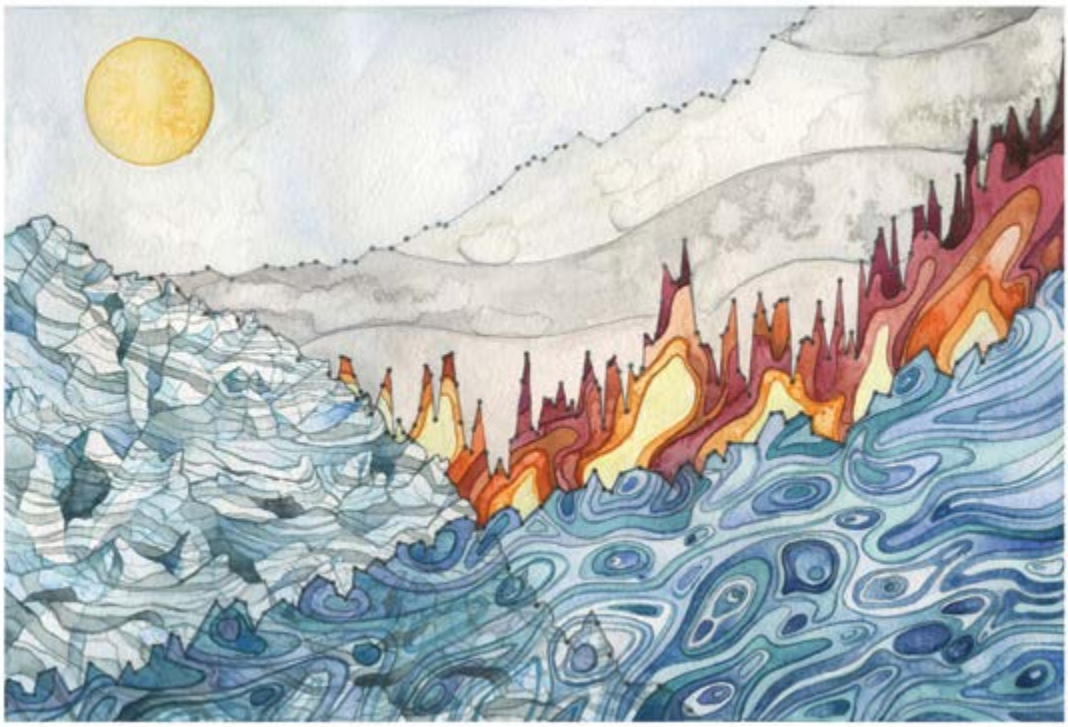
Jade Leyva

Bee the Change: This segmented mural was part of Jade Leyva's environmental awareness project which included several large scale murals made with seeds brought by Jade Leyva into 105 different locations in New Mexico. This one mural has 9 sections and they were designed by many New Mexico Artists that Jade Leyva asked to volunteer their work for it, including Endion Schichtel, Priscilla Garcia, Noel Dora Chilton, Ashley Cummings, Cate Clark, Christian Michael Gallegos, Dona Dowell, Dennie York, Emily Schuyler & Jade Leyva.

Each hexagon measures 3′ wide and it was created by different communities gluing on seeds following the painted colors and patterns previously painted by local artists. All this work on this piece was meant to raise awareness about the importance of bees and their deep connection to everything else. This mural was donated to Valle del Oro Wildlife Refuge in Albuquerque and to be and it will be used to educate the community about bees.

We handed out free educational material and organic, local & drought tolerant wildflower seeds encouraging people to help our little buzzing friends by planting them in their gardens.

Jill Pelto



Landscape of Change uses data about sea level rise, glacier volume decline, increasing global temperatures, and the increasing use of fossil fuels. These data lines compose a landscape shaped by the changing climate, a world in which we are now living.

Jill Pelto

Gulf of Maine Temperature Variability tells the story of increasing temperature fluctuations in Maine's coastal marine environment. The watercolor uses ocean temperature data from the past 15 years to highlight how greater variability affects various species including ourselves. The piece also highlights the inattention to the coupled relationship between human action and environmental responses that has contributed to depleted fish stocks and increased ocean acidification. This Gulf of Maine story spans the water column: from the burrowing clams and bottom-dwelling lobster and shrimp, to the overfished cod which disappear across the painting as they struggle to return to a changing habitat, and finally up to the surface where fishers and managers may adopt sustainable practices or continue the practices that have resulted in overfishing and by-catch. Each species has a complex interaction with the environment, and if the imbalance of our give-and-take relationship with the ocean persists, we will continue to see new stresses that irreversibly change ocean conditions within the intertidal mudflats and into the yet unexplored ocean depths.

Xavier Cortada

Pinecrest Mangrove Forest 2, 2019: In 2019, Xavier Cortada created Pinecrest Mangrove Forest, the county's first urban mangrove forest alongside his 200-ft long mural which was unveiled with representatives from local schools coming to plant the mangroves. The path between the mural and mangrove forest serves as a public space that connects Pinecrest Gardens and the Pinecrest Community Center. The area is also a beautiful backdrop to the popular Farmers Market held every Sunday year-round. Fifteen years after Miami Mangrove Forest, Cortada led the creation of Pinecrest Mangrove Forest, a mural that depicts the fully-grown mangrove forest the seedlings from the original mural would eventually become. However, Pinecrest Mangrove Forest functions more than just a metaphoric reforestation of the local area, but as a prompt for literal reforestation, a conceptual and practical evolution from its predecessor.

Mangroves are salt-tolerant plants that eventually grow into large trees most often found along coastlines. The environmental impact of mangrove trees existence in coastal areas should not be understated, as mangroves actively stabilize coastlines by reducing erosion and combat sea level rise by allowing for a buildup of sediment in the water. They also serve as an integral part of coastal ecosystems, the trees themselves providing shelter for a variety of marine and avian life. After witnessing the removal of mangrove forests within his community, Cortada set out to reclaim urban environments for nature through the planting and exhibition of mangroves throughout Miami. The focus of mangroves in Cortada's work can be initially seen in projects like Miami Mangrove Forest, a large-scale public art project from 2004 that saw the artist and volunteers paint mangrove propagules along the underbelly of Miami's I-95 interstate in an effort to create a conceptual reforestation of the urban area. This eventually led way to a literal reforestation of the urban Miami area in the Reclamation Project, initiated in 2006. The Reclamation Project was an attempt at reintroducing nature into the built environment, specifically to strengthen coastlines from storm surges, but also an acknowledgment of the precarious nature of such a meeting. Plan(T) builds upon this by looking towards the future, the importance of utilizing salt-tolerant mangroves to address issues of climate change facing Miami being paramount.

Xavier Cortada

Underwater HOA Elevation Drive, 2018: Mapping the topography of a conceptual coastline is the basis of Cortada's *Underwater HOA* project, necessary "to make the invisible visible." Working in conjunction with Cortada's Antarctic Ice Paintings from 2006, Underwater HOA is a participatory art project that depicts South Florida's vulnerability to sea-level rise, specifically this vulnerability towards homeowners within South Florida. At Pinecrest Village's main thoroughfare, Killian Drive, featured Underwater Markers along a 2.5-mile stretch, between US1 and Red Road, to show drivers the gradual increase in elevation from one end of the street to the next. Art students from four local high schools helped Cortada map the elevation of four major intersections along Pinecrest's Killian Drive by painting his markers on the roadway.

Xavier Cortada

Endangered World (2009): Eastern Hemisphere drawings, 180 graphite drawings on paper, each 9" x 12" 2009. The work depicts endangered animals originally featured in the artist's 2008 North Pole installation. Each animal represents an endangered or threatened species located at one of the globes 360 longitudinal degrees; this image shows the 180 species of the Eastern Hemisphere. In addition to this installation, Cortada has leveraged this project to include participatory online and social media efforts, installation pieces at the Biscayne National Park, the North and South poles, Holland, and in the Netherlands. Cortada encourages participants to "adopt" a species and engage in eco-actions to help rebuild the ecosystems that these endangered animals need to survive.