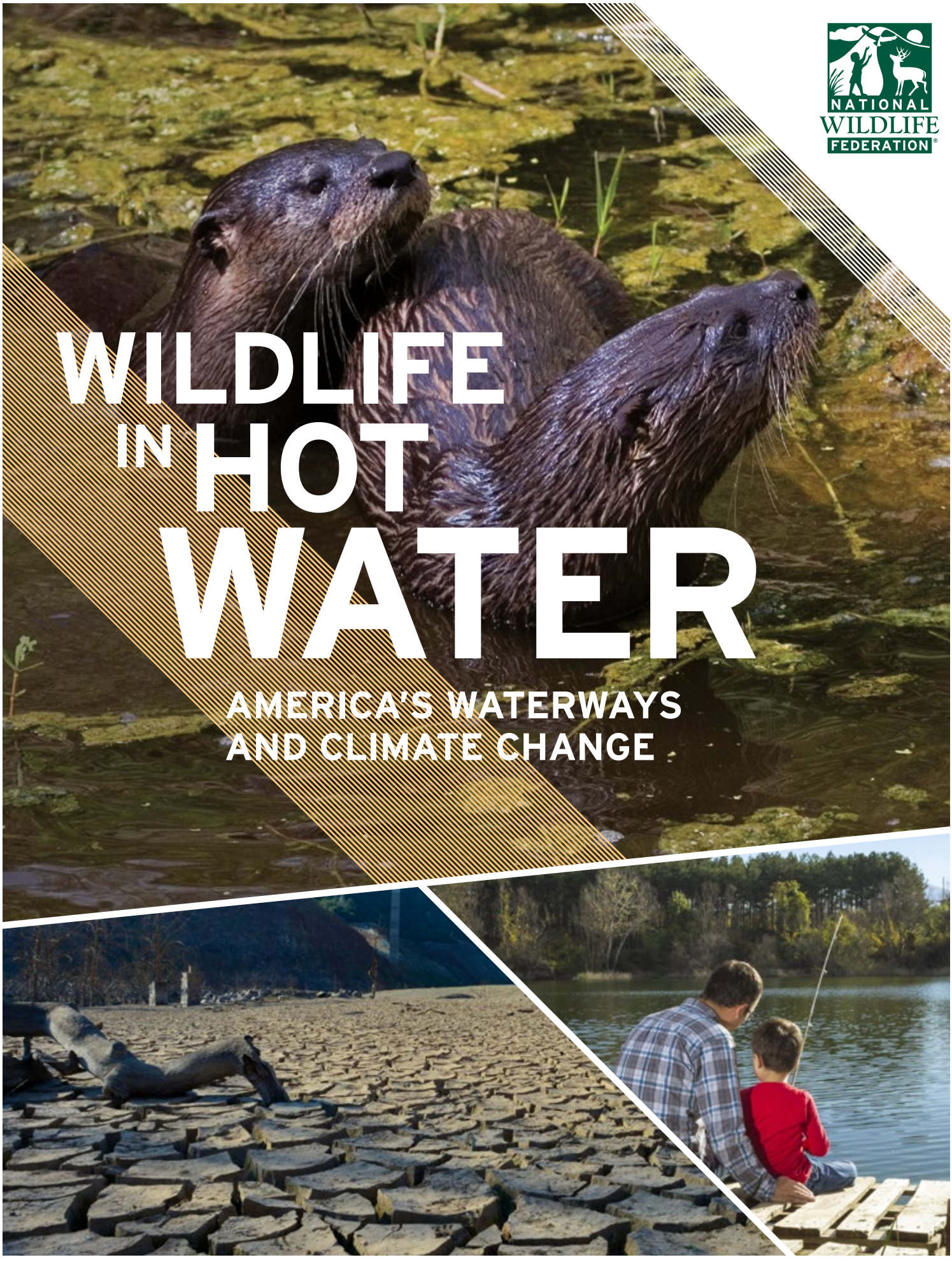


WILDLIFE IN HOT WATER

AMERICA'S WATERWAYS AND CLIMATE CHANGE

NATIONAL WILDLIFE FEDERATION®

PHOTO: USFWS - NORTHEAST REGION

Front Cover: River otters struggling in an algal bloom. River Otters - Flickr - Richard Crook.
Full photo credits online at www.nwf.org/wildlifeinhotwater.

PHOTO: FLICKR / EWAN TRAVELER

When my three-year old daughter Riley and I play outdoors, we often end up exploring waterways and generating memories that will last a lifetime (at least for me!).

From rescuing stranded horseshoe crabs on the beach and running ankle deep into the foaming white surf of Delaware Bay, to canoeing or fishing on the tranquil Brandywine Creek or just dipping her hand into a local pond, there are few things that make me more proud as a parent than watching Riley develop a lifelong love of our waters.

These precious moments serve as a constant reminder of the vital importance of water. Our country is blessed with an abundance of water, from mountaintop snowpack, to our streams and rivers, to the Great Lakes and other ponds and lakes, to our coastal waters. Our fish, our wildlife, and our very existence are all dependent upon an abundance of clean, healthy water.

Everywhere I travel I see the effects of climate change on our nation's water and waterways. Less winter snowpack on mountains reduces stream flows in the spring. Streams run too warm to support healthy trout populations. Many reservoir levels are perilously low. Some communities face intense, prolonged droughts, while others experience record flooding.

Meanwhile, coastal communities prepare for extreme weather events, like hurricanes, while also planning for accelerating sea level rise due to the melting ice caps.

Throughout our nation's history, America's waterways have played a central role in our growth and our way of life. They are essential to our public health, our outdoor heritage, and our regional economies. We must invest in their restoration and resilience—and reduce ongoing threats from carbon pollution through the Clean Air Act to safeguard wildlife and ourselves from climate change.

Together, we can ensure that future generations can enjoy the amazing bounty from our waterways that my daughter and I—and all Americans—enjoy today.

Collin O'Mara
President & CEO
National Wildlife Federation

INTRODUCTION

"Water is the driving force in nature."

LEONARDO DA VINCI
1452-1519

PHOTO: FLICKR - TIM DONNELLY

DRIVEN BY CARBON POLLUTION, climate change is causing a rapid transformation of Earth's water cycle (Figure 1). Changes include "earlier and more rapid snowmelt, fewer and more intense rainfall events, and more frequent and extreme droughts and floods."[1] These and other changes in the water cycle are expected to have multiple and widespread ecosystem impacts (Figure 2).

The evolution of the rich diversity of our nation's wildlife has been driven primarily by various geological and climatic conditions. Given that all life is dependent on water, the water quantity, timing, quality, form, and seasonality are among the major factors determining where and how various species live. In fact, the type of water available to species has had a huge effect on their evolution and characteristics—their size, appearance, behavior, feeding habits, reproduction and more.

Due to the close wildlife/water relationship, it is not surprising that climate change's impact to wildlife is a major concern. A duck without water and a sea turtle without a nesting beach are not the legacies we want to leave our children.

This report examines how climate change is affecting and is expected to affect our nation's waterways and, in turn, our nation's wildlife. It covers the impacts that climate change is having on waters and aquatic habitats "from the mountains, to the prairies, to the oceans"[3] and everywhere in between. In addition, this report describes actions that we can and must take to protect our waterways for the benefit of people, wildlife, and wildlife habitats. These include implementation of the Clean Power Plan to reduce carbon pollution (CO_2) from our largest sources—power plants; reducing America's use of the carbon-intense fuels—coal, oil, and gas;

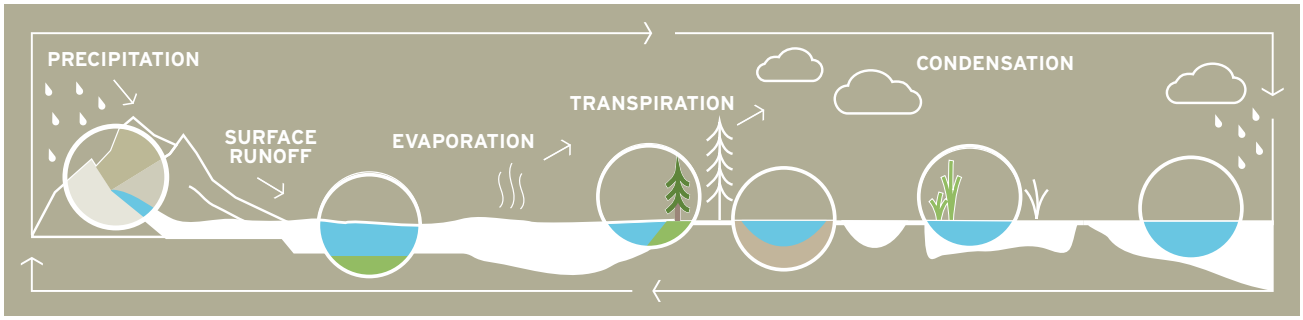


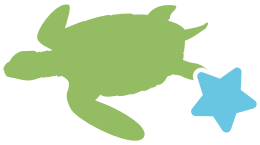
Figure 1. The Water Cycle, from the mountains to the oceans[2]

Loss of habitat for cold and cool water fish species

Loss of wetlands and reduced riparian/floodplain connectivity

Reduced dissolved oxygen levels in streams and lakes

Loss of stream connectivity due to drying of stream and river reaches



Reduced extent, diversity, and quality of instream habitat for aquatic biota

Increased pollutant concentrations from urban and agricultural runoff

Figure 2.[4] Changes in the water cycle due to climate change are expected to cause many environmental shifts.

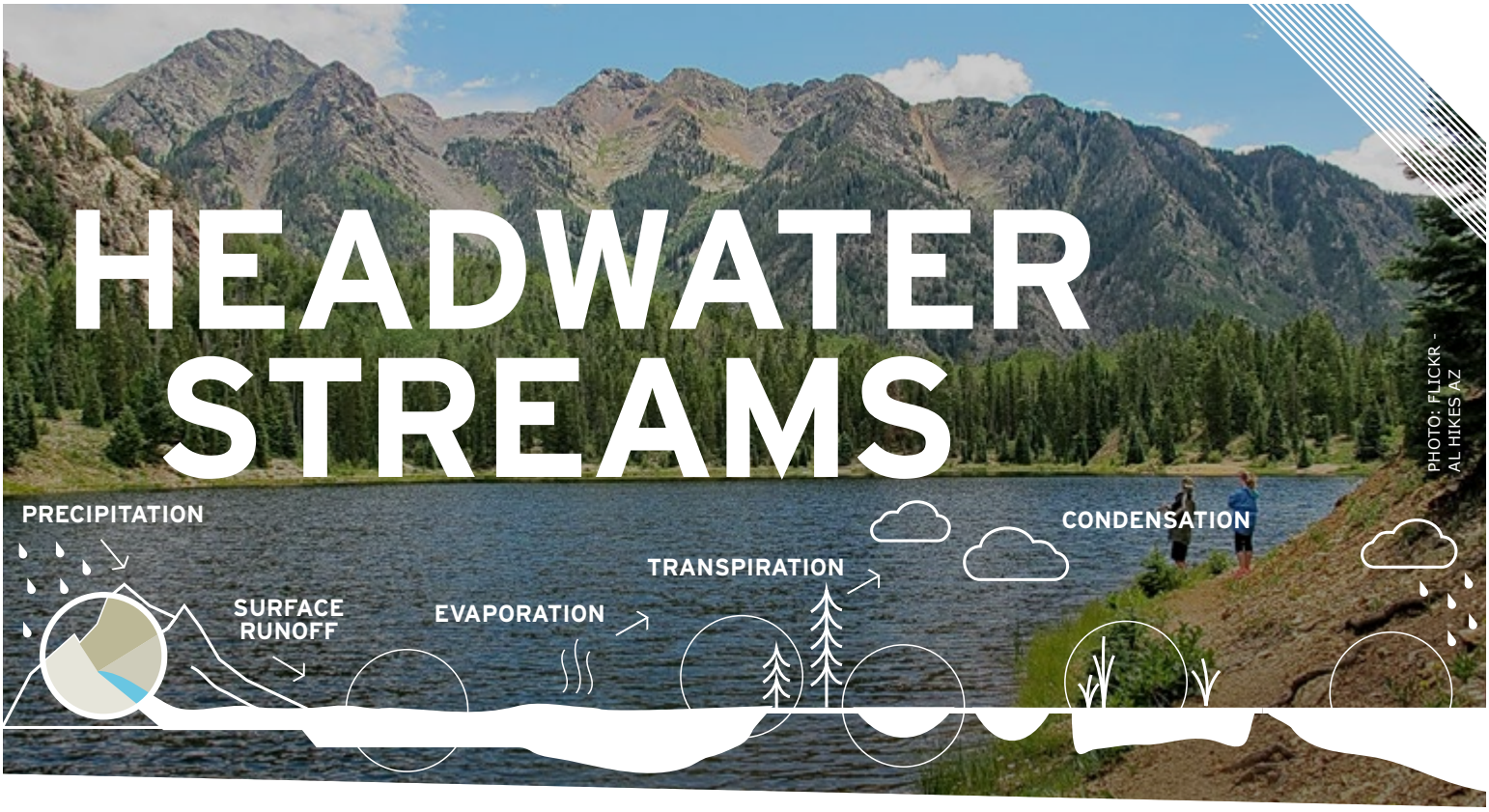
THE CLEAN POWER PLAN

THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) has taken an historic step forward by putting in place Clean Power Plan standards which will establish first-ever limits on carbon pollution from our country's largest source—power plants. These new standards are a core component of President Obama's Climate Action Plan and a critical next step in reducing our country's carbon pollution.

The Clean Air Act gives the EPA the authority to regulate pollutants, such as carbon dioxide, from power plants in order to protect public health and welfare. Before this rule, we regulated smog-forming chemicals, particles, sulfur dioxide (that causes acid rain), mercury, arsenic, and other pollutants from power plants but not carbon pollution—the key driver of climate change. These carbon pollution limits will help sustain our outdoor heritage, conserve wildlife habitat, protect our clean air and water, and create thousands of clean energy jobs. We should support the EPA by defending these rules and working with states to ensure the rules are effectively implemented.

PHOTO: FLICKR - ROBERT DONOVAN

increasing energy efficiency and developing alternative energy sources such as wind, solar, and biofuels; safeguarding wildlife and wildlife habitat from climate change; facilitating adaptation of species and habitats to the changing climate; and supporting recent efforts to restore Clean Water Act protections to many of our nation's waters.



HEADWATER STREAMS

PHOTO: FLICKR - AL HIKES AZ

> "Cascading, life blood of frost coated hilltop. Streams like veins meander past quivering heather, pine tree and moss coated boulder."
>
> PETER NASH[5]

HEADWATER STREAMS ARE THE LIFEBLOOD of our rivers, lakes, and oceans. Comprising about 60 percent of the nation's stream miles[6] and often starting at high elevations as mountain streams, they are like capillaries that link together as they flow downward to form larger streams, rivers, lakes, and estuaries. As the origins of our waterways, these streams provide vital and unique functions for wildlife.

Headwater streams and the wildlife they support are especially vulnerable to changes in the climate. They can be dramatically impacted by changes in rainfall, snowmelt, temperature, and timing of precipitation, among other conditions affected by climate change. Similarly, the many species that depend on these streams often have nowhere to go when these streams dry up, become too warm, or are affected by floods, fires, and droughts.

Changes in Flow

Many mountain and headwater streams depend largely on snowmelt or rainfall for their flow. Already, in western North America, snowpack is melting one to four weeks earlier than it did just over half a century ago.[7] As a result, peak spring flows in mountain and headwater streams are earlier and the streams more frequently reach very low levels in the hot summer months. Lower flows mean hotter water temperatures both upstream and in the downstream rivers, which stresses fish species that are dependent on cold waters.

Changes in flow and temperature of headwater streams can be devastating to wildlife, such as the brook trout.

PHOTO: USFWS

Effects of changes in water flow to wildlife, such as trout, can be severe. For instance, flow changes can disrupt fish migration by impeding their ability to orient themselves for effective navigation.[8] Changes in flow can also impede reproduction since changes in peak flow can scour streams and destroy the shallow gravel beds that many trout, steelhead, and salmon use for nesting sites.[9]

Flow changes can also affect the lifecycles and abundance of insects and other invertebrates that are the primary food source for trout and other fish in mountain streams. For example, mayflies may emerge as adults at earlier times and smaller sizes than would otherwise occur.[10]

Changes in snowpack and precipitation feeding headwater streams affect drinking water supplies. Snowmelt and associated headwater tributary systems provide 60 percent of the water supply in drought stricken California.[11] Snowpack provides up to 75 percent of the water supply in some western states.[12]

Changes in Temperature

Headwater and mountain streams are extremely valuable to wildlife because they provide habitat with cold, oxygen-rich waters. Some species, like native brook trout, require these habitats to survive and reproduce. In addition to direct temperature effects, warm water cannot hold as much life-giving oxygen. The net result is that these upstream sanctuaries are disappearing.

> By the end of this century, habitat that meets the climate requirements of cold-water species is projected to decline by 50 percent across the United States.[13]

Brook trout, known for their speckled bodies and need of cool streams, are severely threatened by climate change in places like the Southeast. If air temperatures warm by just 2.7° Fahrenheit from current conditions, which is expected if carbon emissions are not dramatically and quickly reduced, there will be a projected 20 percent loss in brook trout habitat in Virginia, North Carolina, South Carolina, Tennessee, and Georgia. If no action is taken to reduce carbon pollution, we could see warming of 6.3° Fahrenheit, which would likely result in a nearly 80 percent loss of habitat.[14] Likewise, cutthroat trout in the West may lose almost 60 percent of their currently-

THE CLEAN WATER RULE

THE U.S. ENVIRONMENTAL PROTECTION AGENCY and the Army Corps of Engineers recently put in place a rule, the "Clean Water Rule," which restores critical Clean Water Act protections to more than half of the nation's streams and millions of acres of wetlands. For more than a decade, many of our nation's waters were stuck in a legal limbo that compromised federal enforcement in more than 500 pollution cases and increased the rate of wetlands loss by 140 percent.

With climate change threatening headwater streams and wetlands, the Clean Water Rule is critical to the protection of these habitats from pollution pressures or outright destruction. Keeping smaller streams healthy and functioning is necessary to preserve downstream water quality, including the drinking water supply of 1/3 of all Americans. Unfortunately, this historic new rulemaking is already under attack in Congress and the Courts and must be defended to protect our water resources, as they are critically important to wildlife and people.

PHOTO: BETH PRATT

Streams like this one in the Great Smoky Mountains are vulnerable to warming or drying out.

PHOTO: FLICKR - KEN STIGLER

occupied habitat by 2080 due to increased water temperatures.[15] Unless warming is quickly slowed and ultimately halted, brook trout and similar cold water fish will simply have no place left to go in many regions.

Headwater and mountain streams are important because they provide downstream rivers with an infusion of cold, steady flow. This flow is particularly important in the warmer summer and fall months. Changes in snowpack and stream flow are already leading to mid-season fishing closures in the West because low flow and warmer temperatures are stressing trout and other fish populations. To reduce other stressors, fishing restrictions during periods of high water temperatures are more frequently being put in place for trout fisheries like the Bitterroot, Blackfoot, and Clark Fork Rivers, due to warm water conditions.[16] The average number of days each year that are thermally stressful for trout has approximately tripled in Montana's Madison River since the 1980s.[17] Closures of these popular fishing locations during summer vacations can have major economic implications. The fishing opportunities in Yellowstone National Park, where there have been closures, are valued at between $67.5 and $385 million annually.[18]

Extreme Events

Climate change is causing more frequent and more extreme weather-related events like floods, droughts, and forest fires. These events have major impacts on mountain and headwater streams.

In the West, forest fires are growing in number, intensity and size due in large part to hotter, drier conditions.[19] Since the mid-1980s there has been a 60 percent increase in the frequency of large wildfires in the northern Rockies.[20] In 2014, 400,000 acres of state and federal land burned in California. Just a year earlier the area burned in the Sierra Nevada forest shattered previous records.

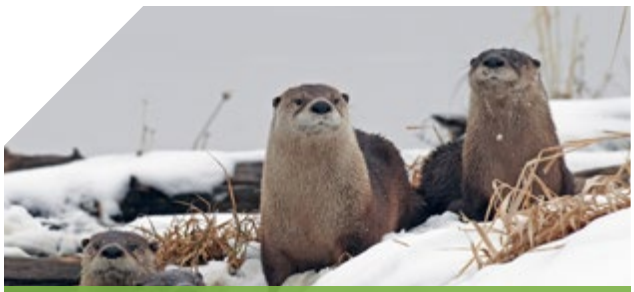
The destruction caused by large, severe fires removes shading and ground cover[21] and can even burn away organic material in the soil. When rains do come, burned forests are not able to hold back waters as effectively, making flooding worse. Furthermore, the subsequent severe erosion causes excessive siltation in the waterways, degrading water quality and nesting habitat for fish. The increased likelihood of more extreme fires is putting conservation efforts and species like cutthroat trout at risk.

For years, conservation efforts in the Southwest have successfully kept cutthroat trout from having to compete with non-native trout by putting in place barriers to keep non-native trout out of the higher mountain streams that cutthroat trout prefer. This also prevents interbreeding which would create hybrids and drive out genetically pure cutthroats. However, when excessive drought and wildfires strike, degrading cutthroat habitat, the barriers preclude them from moving downstream to survive.[22] Trout populations declined 70 percent in the South Platte River following the 2002 Hayman Fire in Colorado.[23] With the already increasing severity of precipitation events, flooding scours streams, washes away habitat, and smothers eggs with sediment.[24]

Increased severe drought—as has been experienced in California for several years—means that many streams, and the habitat they provide, have simply dried up. Drought also means that the landscape around these streams become "hardened" and less able to soak up rains, making flooding worse when rains do come and the precipitation quickly runs off the land.

OUR NATION IS BLESSED with some mighty river systems, such as the Connecticut, Colorado, Columbia, Hudson, Mississippi, Missouri, Ohio, and Rio Grande rivers and their tributaries. Ohio's Cuyahoga River catching fire provided Congress with the impetus to pass the Clean Water Act in 1972, which aimed to control pollution and once again make our waters fishable and swimmable.

Climate change compounds the existing human-caused stressors of pollution, dammed rivers, invasive species, disease, and destruction of forests and wetlands. Some 147 freshwater fish species and populations are federally listed as threatened or endangered.[25] An estimated 37 percent of all freshwater animals—from fish to crayfish to mussels—are considered at risk. The rate of aquatic species extinctions is five times higher than in terrestrial habitats.[26, 27] Climate change is only going to further stress the already highly-stressed freshwater aquatic life.



Both habitat and food sources for river otters are threatened by climate change.

PHOTO: USFWS - KENNY BAHR

Water Supply

Snowpack on western mountains is melting one to four weeks earlier than it did just 50 years ago, shifting the timing of flow regimes that are connected to fish life cycles.[28] More-severe wildfires followed by heavier rainfall events are allowing massive amounts of ash and silt to be washed into rivers, degrading fish habitat such as spawning areas. Heavier rainfall events propel pulses of sediment, phosphorus, and nitrogen pollution downstream, which further degrades habitat quality.

A principal example of the complex changes being driven by climate change is seen in the Colorado River Basin of the western U.S. The Colorado River provides critical water supplies for 40 million people in the seven states of Wyoming, Colorado, New Mexico, Utah, Nevada, Arizona, and California. It also provides water for about 15 percent of the nation's food production, and supplies two of the largest U.S. water reserves: Lake Powell and Lake Mead.

Heavy rain events can cause river flooding and allow sediment and nutrients to wash into waterways.

PHOTO: FLICKR - CHRIS NORTHWOOD

In recent years, California's water supply has been at critically low levels due to "extreme to exceptional drought."[29] Lake Mead—the largest reservoir in the U.S.—hit its lowest point in history (37 percent full)[30] in June 2015, which will trigger cutbacks in water supply to Las Vegas, Southern California, and Arizona if the situation doesn't improve over the next couple of years. Lake Powell is not much better off at only 47 percent of capacity.[31] Though there are a multitude of causes behind the California drought and these water shortages in the Colorado River, there is no doubt that climate change is playing a role. These effects are exerted through several pathways: rising air temperature increases evapotranspiration losses (evaporation plus moisture loss from plants), and reduced rainfall and snowpack mean less water to begin with. The deck is already stacked for even more severe impacts in the future.

Wildlife along the Colorado are struggling and will continue to face greater challenges with a warming climate. According to the U.S. Geological Survey, "the Lower Colorado River Basin has one of the most imperiled fish faunas in the nation with about half of the native fish species listed as Threatened or Endangered under the Federal Endangered Species Act."

Water Temperature

Prolonged and more severe droughts causes the little water that there is to heat more rapidly and to higher temperatures. As we earlier noted, by the end of this century, habitat that meets the climate requirements of cold-water species is projected to decline by 50 percent across the United States.[32] For example, native cutthroat trout are expected to lose an additional 58 percent of their current habitat.[33]

PRIMARY SOURCE REPORTS:
RIVERS

WARMING YELLOWSTONE RIVER IN MONTANA

I grew up in Montana hunting and fishing with my family. Today, I make my living running a fly fishing company with my two brothers. In my spare time, I chair Montana's Fish and Wildlife Commission. As a sportsman, I have watched as smallmouth bass have marched up the Yellowstone's warming waters all the way to Livingston. As a Commissioner, I have been forced to close Montana's finest cold water fisheries to protect trout from excessive water temperatures and catastrophically low water flows. Climate change affects our family's business and threatens one of the most sustainable, unique parts of Montana's economy. Equally importantly, it threatens one of the most important gifts we can give our children — cold, bountiful waters traversing valleys of healthy forests and grasslands. We must address the changing climate before it is too late. Future generations deserve nothing less.

Dan Vermillion, Livingston, Montana

PHOTO: MCDOWELL

PHOTO: CHESAPEAKE BAY PROGRAM

WARMING WATER IN NEW HAMPSHIRE

"When the water got hot the trout left," said Trout Unlimited fisheries biologist Joe Norton. Joe has worked on various stream improvement projects in northern New Hampshire for a decade now. But it was his work the summer of 2012 that shed some dramatic light on just how climate change is already impacting the Granite State's native brook trout. That summer, he was working on a project on Indian Stream, a popular remote trout fishing stream in the far northern corner of the state very near the border with Canada.

Trout Unlimited was working with the New Hampshire Fish and Game Department on tagging brook trout with radio tags to monitor their movements in Indian Stream. It was an unusual year in that an April deluge wiped out several culverts leading to the remote sections of the stream, making it inaccessible for much of the spring. The road was repaired only to have another deluge wash out the road again in late May. Despite this, Joe and his fellow Fish and Game biologist did manage to get up and place radio transmitters in a number of brook trout.

The funny thing about the heat wave that swept in after the deluges is that by the time the anxious anglers finally had access to the stream in July, all of the tagged trout had vanished! Yes, the stream temperature by mid-July was in the 80's and the trout had migrated downstream to the much deeper and colder Connecticut River. So by the time the fishermen got access to the river, the trout were gone!

Joe reminded me recently about this, telling me, "Our native trout need cold, clean, complex, and connected waters." Cold and clean water is obvious, but I had to think about the other needs too, such as "complex", meaning lots of cover, like logs and riffles, and connected so that trout can successfully move to cooler waters when needed.

I still find it hard to believe that a pristine trout stream on the Canadian border in northern New Hampshire simply got too hot for trout.

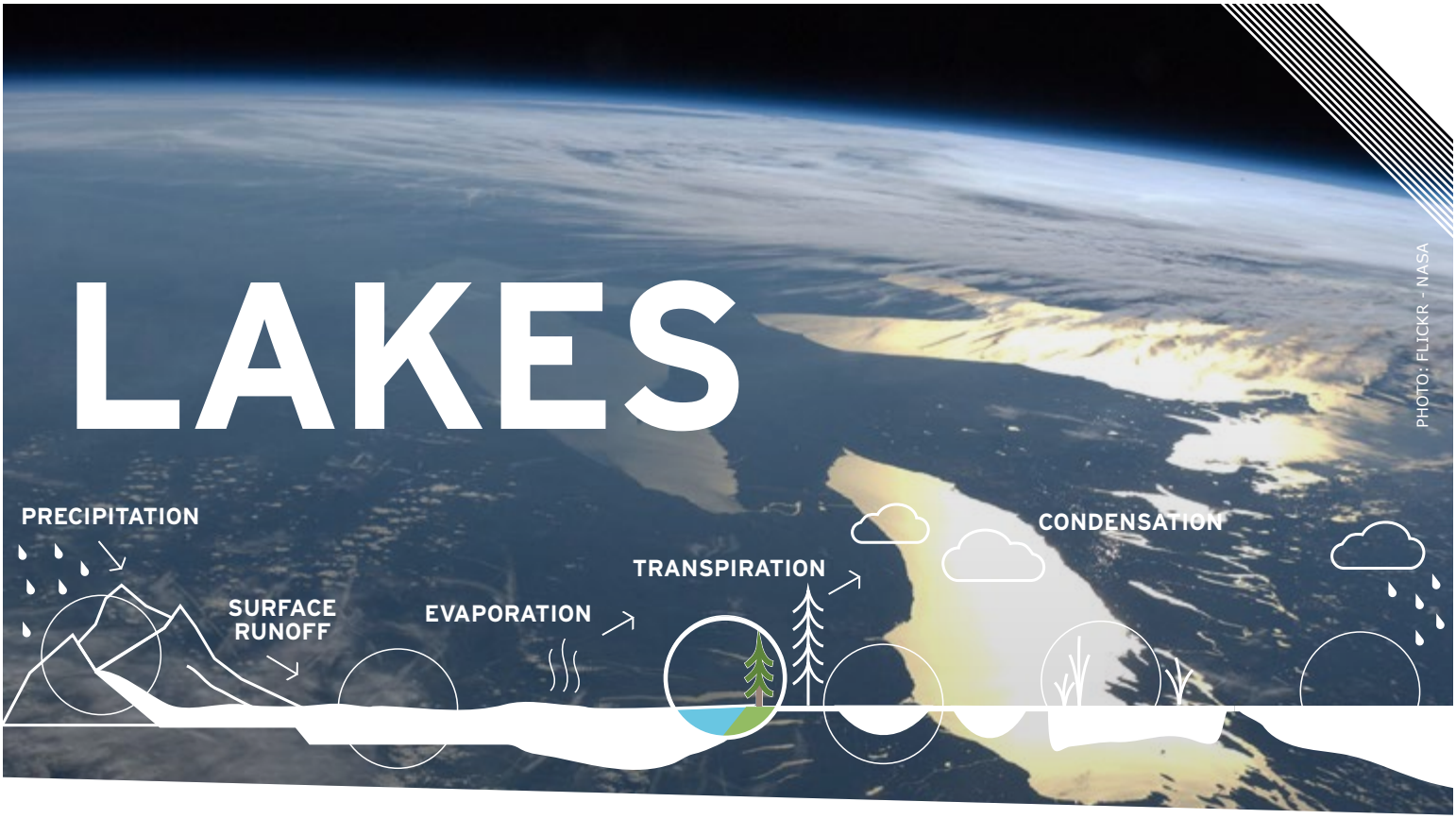
Eric Orff, Wildlife Biologist, New Hampshire

FISHING IN PENNSYLVANIA

Up until 2005, then the hottest year on record, my family had been floating the middle Susquehanna for more than 25 years, camping on the islands, and wade fishing for smallmouth bass. But climate change has altered temperature and rainfall patterns, causing repeat kills of smallmouth bass in 100 miles of the middle Susquehanna River. The fishery has been devastated to the point that many guides have quit taking anglers there and my family no longer takes these fishing trips that were such an important part of our outdoor experience.

Ed Perry, Pennsylvania

PHOTO: ALAN GREGORY



"The lakes are something which you are unprepared for; they lie up so high, exposed to the light, and the forest is diminished to a fine fringe on their edges, with here and there a blue mountain, like amethyst jewels set around some jewel of the first water,–so anterior, so superior, to all the changes that are to take place on their shores, even now civil and refined, and fair as they can ever be."

HENRY DAVID THOREAU, 1854

LAKES ARE AFFECTED BY CLIMATE CHANGE in many ways, including through impacts to both the amount and quality of water. Some variability in lake water levels is normal and important for maintaining healthy lakeshore habitat, including wetlands, used by many fish and wildlife species.[34] However, climate change exacerbates changes in lake levels, causing structural impacts to shoreline features such as beaches, barriers, dunes, and wetland extent, and in turn, to the fish and wildlife dependent on these areas.

Climate change also affects the usually seasonal mixing (spring and fall) of different layers of water that are stratified by different temperatures and other characteristics. When water stratification and mixing are affected, the entire chemistry of lakes is altered with subsequent impacts on aquatic life.[35] And as water temperature rises, lake wildlife changes as it becomes less favorable for cold water fish like trout, and more favorable for other species that live in warmer waters.[36]

Climate change also affects water quality. As extremes in both quantity and frequency of precipitation events increase, the high volume and rapid runoff carry with it large quantities of sediments and pollutants, such as fertilizers. Excessive sediment runoff decreases water clarity and buries fish spawning areas in sediment, affecting both the diversity and quantity of aquatic life.[37] The large runoff of nutrients from fertilizers and other sources cause huge algal blooms, leading to "dead zones" where there is so little oxygen the lake becomes devoid of fish. Some of these algal blooms may even be toxic (see section "Harmful Algal Blooms").[38]

Great Lakes

The Great Lakes have one-fifth of the world's surface fresh water[39] and are an important resource for more than 40 million citizens in both the U.S. and Canada. The Great Lakes provide drinking water and many recreational opportunities. They also support about 1.5

million jobs in the region paying about $62 billion in wages.[40] They provide important habitat for hundreds of fish and wildlife species. Fishing in the Great Lakes annually engages 1.6 million adult anglers who spend more than $1.9 billion.[41]

The Great Lakes have suffered many insults during the past 200 years. Water flows have been purposefully altered. There has been extensive pollution from industrial wastes dumped into the lakes and into rivers supplying the Great Lakes. Heavy loads of nutrients have come from agricultural runoff and sewage treatment plants.[42] With the help of the Clean Water Act and a better understanding of the importance and value of the Great Lakes, their water quality has generally been improving in recent decades.

Climate change from carbon pollution is now another stressor to the Great Lakes. During the past five decades, there has been increasing precipitation from heavier rainfalls and higher surface water temperatures, such as the 4.5° Fahrenheit increase in summer temperature in Lake Superior. Because of warm temperatures, the ice cover has declined, causing more open water and evaporation in the winter, contributing to lower water levels.[43]

Fish, wildlife, and people face challenges from the climate-driven changes to the Great Lakes. Lake whitefish eggs are provided shelter by winter ice cover, which is declining. Waters may become too warm in some areas for walleye to reproduce. Spawning smallmouth bass face the challenge of increased storm events disturbing their nests.[44] Warming water and spring storm events washing nutrients off the landscape are predicted to increase with climate change, causing larger algal blooms, especially in the shallower waters of the western portion of Lake Erie.[45]

Human health in the region has been threatened by runoff from heavier rain events increasing surface water contamination by bacteria and other microorganisms.[46] These heavier rain events could also contaminate private wells where flooding occurs.[47] With longer summers, there is more exposure to diseases transmitted by insects, such as West Nile Virus.[48] As with other lakes, the Great Lakes are expected to be affected by increased stream-flow causing heavier nutrient runoff and decreased mixing of the different water levels.[49]

ICE FISHING

THE STORY OF SEBAGO LAKE'S DECLINE IN ICE fishing is emblematic of how ice fishing is changing across the northern states. A favorite ice fishing place for many, Sebago Lake in Maine is facing rising winter temperatures which have meant fewer days for safe ice fishing, with alarming projections for the next generation of anglers. According to the Maine's Climate Future report, "the state's warm season increased by two weeks from the early 1900s to the 2000s. Global climate models predict that the warm season will increase by an additional two weeks over the next 50 years. On top of that, winter is warming at a faster rate than summer."[57] In Wisconsin, the ice season on lakes is almost 18 days shorter than it was 150 years ago. The reduction in opportunities for ice fishing for land-locked salmon, varieties of trout, bass and other sport fish on Sebago Lake is not without impact. It affects the long-time tradition of ice fishing and has economic impacts on residents and businesses.

Anglers are some of the first to experience the changes that a warming climate is having on fish.
PHOTO: WISCONSIN DEPT OF NATURAL RESOURCES

Harmful Algal Blooms

A growing public health and ecological concern in water bodies across the country is harmful algal blooms. In contrast to the more common green algae, which in the process of growing and dying cause oxygen depletion leading to dead zones, the term "harmful algal bloom" typically refers to distinct types of algae that produce toxic chemicals. Harmful algal blooms can also cause the oxygen depletion and dead zones typical of other algal blooms, in addition to their production of toxins.

The toxins of harmful algal blooms damage organs such as the liver, and have killed wildlife, such as ducks and grebes.[50] The incidences of harmful algal blooms in the U.S. and around the world are increasing.[51] In 2013, some 21 states reported harmful algal blooms in 147 different locations.[52] At risk are fish, wildlife, pets, livestock, and people.[53]

Examples of recent harmful algal bloom in the U.S. include:

- The August 2014 harmful algal blooms in western Lake Erie led to advisories telling people not to drink, bathe, or use water in any way in the Toledo, Ohio area for nearly three days.
- In the spring of 2015, harmful algal blooms killed fish and turtles off Long Island, New York.[54]
- Blooms of the misleadingly named "golden algae" were responsible for numerous fish kills in Texas waters over the past 15 years.[55]
- Toxins produced by a particular harmful algae in freshwater were transported downstream to Monterey Bay, California in the fall of 2007. This caused sea otter deaths, and more deaths were documented in subsequent years as well.[56]

Collin O'Mara, President & CEO of the National Wildlife Federation, with a glass of algae-tainted water during the 2014 harmful algal bloom in Lake Erie.

PHOTO: NWF BLOGS

PRIMARY SOURCE REPORTS:
LAKES

ALGAL BLOOMS IN LAKE ERIE

There are at least a half million different stories from last summer's water crisis in Toledo, Ohio. Harmful algal blooms fed by heavy spring rains and nutrient runoff led to toxic microcystin overwhelming the City of Toledo's drinking water treatment system. 500,000 people and their pets were told they couldn't drink the water, nor shower or bathe, operate restaurants or conduct scheduled medical procedures for nearly three days.

"Panic, literally, widespread panic," is how Lucas County Commissioner Pete Gerken described reaction within the community. "Water is a basic element of life. This thing hit in the middle of the night, people woke up startled, and we didn't know when it was going to be resolved. The panic was handled as well as it could be, but the memory is fresh in people's minds. You can still find stores rationing water."

Gerken served on Toledo City Council in the mid-1990s where he led the Council's Public Utilities committee in resolving a lawsuit with the EPA to reduce the use of combined sewer overflows wherein sewers used to transport human sewage also serve as drainage during heavy rain events. This leads to contaminated waters and high nutrient discharges that fuel algal blooms, and all increasing with more frequent heavy rainfall resulting from climate change.

"We didn't fight the science, but took responsibility for our part of the problem, a series of rate increases and other funds total a half a billion dollars of public investment in new infrastructure." As Councilman and later as County Commissioner, Gerken created city and county stormwater utilities focused on infrastructure to control flooding and control runoff from buildings, streets, and parking

CONTINUED...

lots—again reacting to new extreme weather patterns and an eye to the future.

"In 2002 we started noticing 50 and 100 year storms happening more frequently. Increased rainfall, increased runoff. Our community has been proactive and creative and we've asked ratepayers to invest to make the necessary changes."

Gerken and his two colleagues on the Board of Lucas County Commissioners, Tina Skeldon Wozniak and Carol Contrada, are partnering with National Wildlife Federation on public policy and public engagement to stem the drivers of harmful algal blooms in the western basin of Lake Erie as part of the @ClearWaterTLC campaign. He lives on Toledo's urban waterfront, and enjoys watching wildlife as a frequent kayaker. "We see deer, bald eagles, great white herons, giant white egrets, Canada geese, maybe 30 other species of birds, when we paddle," he said. "It just adds enjoyment and value to Toledo and Lucas County—it's priceless. I can catch fish every night, and that's what's in danger and what we're working to protect."

Frank Szolllosi, Toledo, Ohio

PHOTO: FLICKR - NASA

PHOTO: NATIONAL PARK SERVICE

LAKE MEAD

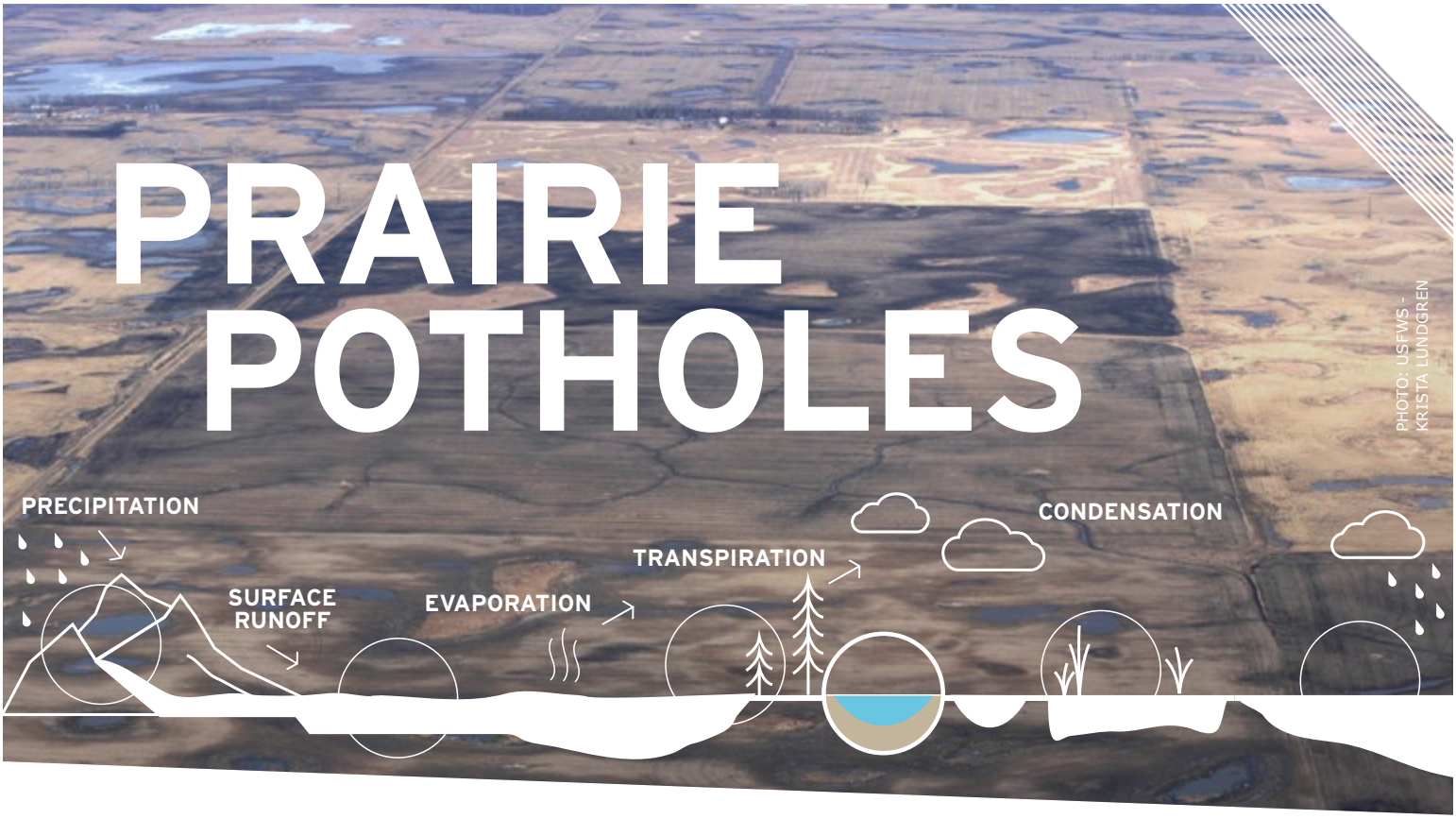
I've been visiting the Las Vegas Valley since 1977 and have lived here for over a decade. Seeing Lake Mead dry up has been terrifying. Along with millions of other people in Nevada and Arizona, I rely on the lake for my drinking water, for hydro-electric power, and for birding and boating. The water levels are so low now that the marinas keep moving their docks and boat ramps, chasing a receding shoreline.

Janelle Losoff, Henderson, NV

Lake Mead dropped to

37%

of it's capacity in 2015



PRAIRIE POTHOLES

PHOTO: USFWS - KRISTA LUNDGREN

"The one place that was always first in my father's thoughts was Iowa. His favorite description of Iowa was how the first settlers found it - beautiful rolling prairies, the... streams and rivers full of fish, and the woods filled with game."

BERENICE LACEY SAWYER
JOHN F. LACEY'S DAUGHTER, 1916

ONE OF NORTH AMERICA'S ICONIC LANDSCAPES is the Prairie Pothole Region, characterized by expansive grasslands dotted with millions of shallow wetlands, often called "potholes." Thousands of years ago, glaciers created these depressions, leaving them behind when the glaciers melted. These depressions fill with water from rainfall and snowmelt in the spring, creating valuable wetlands supporting abundant plant and animal life. In the United States, the Prairie Pothole Region includes parts of Montana, North Dakota, South Dakota, Minnesota, and Iowa. This encompasses an estimated 118 million acres of land with 21 million acres of grass cover and millions of wetland basins.[58]

The Prairie Pothole Region is termed America's "duck factory," and is the most productive area for nesting waterfowl in North America, and perhaps even globally.[59] Some 50 percent or more of the annual production of ducks is in the Prairie Pothole Region. Of the 800 migratory bird species in North America, more than 300 use the Prairie Pothole Region for breeding and nesting, as well as for feeding and resting during spring and fall migrations.[60]

Agricultural Development

The Great Plains of America once boasted the most extensive grassland in the world, with 100,000 acres of prairie pothole wetlands. Due primarily to conversion to agricultural land, the current wetland acreage is a 61 percent reduction from the nearly 17 million acres of wetlands that were estimated in the region in the middle of the 19th century.[61] Although the losses have slowed, they haven't stopped. Wetlands in the Prairie Pothole Region declined an estimated 74,340 acres between 1997 and 2009, which is an average annual net loss of 6,200 acres, or about 10 square miles.[62]

In addition to providing vital wildlife habitat, the region's rich prairie soils sequester vast amounts of carbon.[63] When the region's undisturbed soil is put into cultivation,

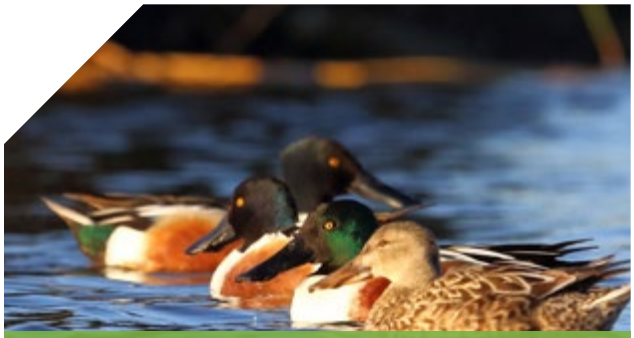
it releases up to half of its carbon over 50 years at an estimated 59.8 tons of CO_2 per acre,[64] exacerbating climate change.

Drought

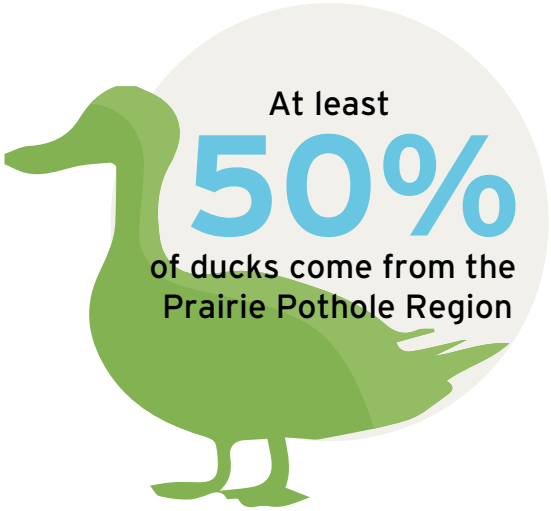
As if the huge loss of Prairie Potholes to agricultural development has not been bad enough for wildlife, now climate change is expected to cause further decline in the number of prairie potholes. While there are many impacts of climate change in the Prairie Pothole Region, one of the largest threats is severe drought. These concerns are important to waterfowlers across the country who may find themselves asking "Where have all the ducks gone?", as they sit in their duck blinds at dawn awaiting the soft whistling of duck wings overhead.[65]

The annual abundance of waterfowl breeding ponds in the Prairie Pothole Region is extremely variable and determined by fall soil moisture, winter snowfall, and spring rains.[66] Waterfowl productivity is closely tied to the number of ponds in the region in spring. In fact, spring surveys of the number of ponds in the Prairie Potholes are an important factor for projecting fall populations of ducks and in setting hunting season regulations.[67]

> "Extreme weather patterns, rising agricultural commodity prices and oil and gas development are threatening millions of acres of prairie wetlands, putting further pressure on the most valuable breeding area for ducks in the Americas."[68]
>
> Dan Ashe, Director, U.S. Fish and Wildlife Service



Ducks like Northern shovelers are at risk from extensive drought, as a result of climate change.
PHOTO: FLICKR - DON MCCULLOUGH



In dry years, there can be as few as two million ponds, in contrast to as many as six million in wet years.[69] Prairie pothole wetlands are expected to dry more rapidly and have lower water volumes as temperatures increase.[70] Although waterfowl populations normally vary dependent upon climate conditions in the area, with climate change it is likely that dry years will be more frequent and more intense. This could reduce waterfowl populations below historical levels, and make it much less likely for populations to recover during the fewer years that have wetter conditions. During dry years, mallard ducklings have much lower survival rates.[71] Areas with the most favorable moisture conditions for waterfowl in the Prairie Potholes are expected to shift farther to the north and east as the climate changes. However, these areas have already been extensively drained and cleared, and offer little available habitat even with good moisture,[72] forcing ducks to breed in less productive areas.

Flooding

Prairie potholes not only provide wildlife habitat, but also provide important flood storage capacity, groundwater recharge, and runoff absorption, thereby reducing the high water mark during floods.[73, 74] Climate change is a driving force behind more extreme weather events, like high intensity rainfall that often times results in hazardous flooding. Wetlands and prairie potholes are known for their ability to "function like natural tubs, storing flood waters that overflow riverbanks and surface water that collects in depressions."[75] Flood storage capacity may provide downstream communities relief from unforeseen future flood damage linked to climate change.

COASTAL WETLANDS & ESTUARIES

PHOTO: FLICKR - PETER MASSAS

"A natural reciprocal nurturing of ocean and earth creates abundant wildlife in coastal wetlands."

JOSEPH SIRY

THE NATION HAS MORE THAN 88,000 MILES of tidally-influenced ocean coastline[76] harboring vast areas of coastal wetlands and more than 100 estuaries[77] – the places where major rivers meet the sea. These areas are transition zones between freshwater and saltwater, and they are among the most productive habitats on earth.

Although coastal ecosystems comprise less than 10 percent of America's land area, they contain 25 percent of the nation's wetlands. These areas support a diverse array of wildlife, including 40 percent of all federally-listed endangered species and at least 30 percent of North American waterfowl on their wintering grounds.[78]

U.S. coasts and estuaries contribute hundreds of billions of dollars to the nation's economy. Coastal tourism and recreation activities such as beach-going, recreational fishing, and wildlife viewing alone have been valued at up to $50 billion annually (Figure 3).[79]

The fish catch in estuaries contributes
$4.3 Billion
to the U.S. economy.

Estuaries provide habitat for more than 75% of the U.S. commercial fish catch, and an even greater percentage of the recreational fish catch.

Coastal recreation and tourism generate
$8-12 Billion
to the U.S. economy.

180 million Americans visit estuary and coastal waters each year for recreation and tourism.

Commercial and recreational fishing contribute
$111 Billion
to the U.S. economy.

Commercial and recreational fishing employ 1.5 million people.

Figure 3. The annual economic value of coasts and ecosystems.[80]

Unfortunately, coastal habitats are under pressure from human activities such as development and pollution. Now, sea-level rise and other impacts of climate change create even greater challenges for our coastal ecosystems and the people and wildlife that depend on them.

Rising Sea Levels

During the 20th century, average global sea level rise was approximately 7 inches.[81] The current rate of sea level rise is 50 percent higher than over the past 20 years.[82] This rate is expected to accelerate even further in the decades to come. By the end of this century, sea levels are projected to rise by another one to four feet from today's levels.[83]

The primary driving force of sea-level rise is rising atmospheric temperatures caused by CO_2 pollution from the use of fossil fuels. About 2/3 of current sea-level rise is caused by the melting of glaciers and ice fields in places like Greenland and Antarctica. The other third is caused by the thermal expansion of water as it heats up. The actual sea-level rise in any area is also dependent upon local factors. In coastal Louisiana, for example, local land subsidence due to a combination of human and natural factors has more than tripled the rate of sea-level rise.[84] This is a major factor in coastal Louisiana losing more than 1,800 square miles of land between 1932 and 2010.[85, 86] If the trend of land loss that occurred between 1985 and 2010 (16.6 square miles per year) continues, as is currently expected, the region will continue to lose wetlands equivalent to the size of one football field every hour of every day.[87]

The Chesapeake Bay is experiencing very rapid sea-level rise due to a variety of local factors, such as land subsidence, on top of melting ice caps and thermal expansion of water. At least 13 islands in the bay have disappeared entirely, and many more are at risk of being lost this century.[88] Favorite places to fish, hunt, bird watch, and play on the beach are being affected.

Maryland's Blackwater National Wildlife Refuge in the Chesapeake Bay is predicted to lose more than 90 percent of its tidal marsh, tidal swamp, and brackish marsh by 2100 (compared to about the mid-1980s). These areas will convert to saltmarsh and, ultimately, open water.[89] These projections are based on only a mid-range of sea-level rise, although sea level rise could be higher. The loss of brackish marsh to saltwater marsh or open water would be particularly harmful to species that are adapted to these habitats, including rockfish and white perch, as well as anadromous species such as herring and shad, which use brackish marsh as habitat as they transition from their freshwater to saltwater life cycles.[90]

Due to a variety of interacting factors, including sea level rise and the invasive species nutria which destroys marsh vegetation, the Blackwater National Wildlife Refuge has already lost more than 5,000 acres of natural wetlands since the 1930s. Now, the refuge continues to lose wetlands at the accelerated rate of 300 acres annually.[91]

While coastal habitats such as marshes and beaches may be able to accommodate moderate changes in sea level by moving inland, that opportunity is reduced in many areas due to coastal development and associated armoring of shorelines with seawalls, dikes, and other structures. Shoreline armoring poses both an immediate and long-term threat to species such as Florida's sea turtles, which are forced to nest in sub-optimal areas closer to the shoreline where nests are vulnerable to inundation by sea water.[92,93]

More-Intense Coastal Storms

The nation's coastal and estuarine habitats are also at risk from more-intense storms and associated erosion, storm surges, and flooding.[94] Higher ocean temperatures have already contributed to an increase in the intensity of tropical storms and hurricanes in the Atlantic Ocean, a trend that is projected to continue in the coming decades.[95] To make things worse, the massive storm surge from tropical storm Sandy in 2012 would not have been nearly as high if sea level in the region had been what it was in the 1950s.[96]

Blue crabs and their sensitive estuary ecosystem are projected to be harmed by climate change

PHOTO: USFWS - KEENAN ADAMS

Healthy coastal habitats protect human communities from the effects of hurricanes and flooding. Coastal wetlands have been estimated to provide as much as $23.2 billion worth of storm protection services in the United States each year.[97] The dynamic nature of coastal ecosystems makes them especially resilient to natural disturbances. Healthy ecosystems, in particular, have considerable capacity to recover and regenerate over time following floods and hurricanes.[98]

The economic and social consequences notwithstanding, an increase in the intensity of hurricanes could have a significant impact on coastal wildlife and habitats. Although many coastal species and ecosystems are, to a certain extent, adapted to storms and other disturbances, they may not be as resilient to extreme storms – particularly those outside of the range of historical frequency and/or intensity. Following Hurricane Hugo in 1989, population densities of white ibis on South Carolina's Pumpkinseed Island declined precipitously as storm surge reduced availability of its primary food source of crayfish.[99] More recently, Hurricanes Katrina, Rita, and Wilma in 2005 caused extensive loss of emergent intertidal wetlands, seagrass beds, and other critical coastal fishery habitats from Florida to Texas.[100] The Florida leafwing butterfly has essentially disappeared from the lower Florida Keys after Hurricane Wilma in 2005 damaged some of the species' last remaining habitat.[101]

Especially at risk are those species already vulnerable because of low population or reliance on isolated or limited habitats. A large storm that devastates broad expanses of an ecosystem could push such species over the brink – even more so if major storms occur more consecutively, leaving species and their habitats with little time to recover in between storms.[102]

Altered Runoff into Estuaries

Climate change's impacts on America's coastal habitats is not just a matter of what happens at sea. Both major flooding and severe droughts on land are creating what scientists call an "extreme future" for estuaries across much of the country.[103] Perhaps no place has experienced the two extremes more intensely than Texas. After years of severe drought, low freshwater inflows from the Trinity and San Jacinto Rivers into Galveston Bay led to estuary waters too salty for many species, from alligators and shrimp to oysters and finfish. In the fall of 2011, salinity levels at the mouth of the Trinity River reached 32 parts per thousand, some six times higher than the 5 parts per thousand that would normally occur during that time of year.[104] It hasn't helped matters that, during drought conditions, water in the rivers is further stressed by water withdrawals upstream. At the other extreme, record rainfall in the spring of 2015 sent tremendous amounts of pollutant-laden floodwaters into the bay, leading to closures of some of the region's most popular fisheries.[105]

The Gulf of Mexico is heavily impacted by algal blooms.
PHOTO: USGS

The radical ebb and flow of water into estuary systems has also been a hallmark of California's San Francisco Bay and Sacramento-San Joaquin Delta, where climate change is exacerbating the effects of numerous other stressors to these systems. Not only is the watershed one of the primary sources of freshwater for the state's people, but the Sacramento-San Joaquin Delta also supports more than 500 plant and animal species.[106] Both major floods and extended droughts have historically plagued central California, and efforts to corral water for both consumption and flood control have already led to a tremendous loss of fish and wildlife habitat.[107] Climate change is projected to increase the extent and severity of extreme droughts and floods throughout the region.[108,109] At increased risk is loss of drinking water supply, as well as flooding of communities. In addition, important species such as Delta smelt and Chinook salmon would be further challenged.[110]

PRIMARY SOURCE REPORTS:

COASTS & WETLANDS

COASTAL DEGRADATION IN LOUISIANA

The Mississippi River Delta could represent the most viable option for the nature-lover seeking to 'live off the land.' But according to Foster Creppel, and many residents of Southern Louisiana, the Delta's bounty may lead to its ultimate ruin. "It's a rich place, easy to survive down here," remarked the 18-year proprietor of Plaquemines Parish's *Woodland Plantation Fishing Lodge*. "American Indian and Cajun communities have been here for over a thousand years." The relatively sudden shift in resource consumption beginning in the early 1800s left in its wake a very different maze of bayous and wetlands than those of the pre-industrial days.

"First, they clear-cut nearly all the cypress swamps along the Gulf Coast." Foster can remember swimming through 19th-century lumber canals as a child near his grandmother's house, avenues that cleared the way for cypress-transport, while exposing the inner bayous to the harsh, salty waters of the Gulf and increasing the vulnerability of communities to storm surge. Shortly after came the levees, which to this day "facilitate shipping interests while inhibiting the land creation" that naturally results when the sediment-rich Mississippi River is connected with the surrounding wetlands. Meanwhile, nearby oyster beds, "the skeleton of our delta," as referred to by Foster, were being harvested at an alarming clip. Most affected were the barrier islands, which often rely on these reefs as "part of their foundation."

The encroachment of salty oceans and lost land occurs on both coasts as a result of rising sea levels. All along the Mississippi River Delta, we further accelerate the process by slicing through wetlands and bottling up the river that feeds them. Still, Foster is optimistic that Louisiana's governance can curb the coastal decay. "The delta is resilient enough to recover. We just need to start thinking long term – and that means 100-200 years, not just the span of our lives."

Isaac Mudge
Washington, DC

PHOTO: NPR - NELSON HSU

PHOTO: LISA POHLMANN

COASTAL DUCK HUNTING IN MAINE

Duck hunting has a rhythm in Maine. When the season starts in October, local dabbling ducks are plentiful. These birds flee south quickly due to cooler weather and hunting pressure. As the weather cools, new birds arrive from the North and make for more interesting hunting (birds that are new to an area are less educated about where hunters might be). Then the smaller waterbodies freeze up in November, and birds move to larger waterbodies. By December, the large lakes and rivers start to freeze and then coastal hunting becomes excellent. Diving ducks—whistlers and Buffleheads—come down from the boreal forest in large numbers and appear in Casco Bay.

But in too many recent winters, this great, rhythmic movement of ducks just never quite materialized during the season because of the warmth. When it's too warm, new ducks don't come in from the North. If the rivers and lakes don't freeze, hunting on Casco Bay never gets good.

I look forward to duck season all year. I know a crummy duck season isn't the worst consequence of global warming, but it sure puts a damper on my fall.

Nick Bennett,
Augusta, Maine

FLOODS IN VIRGINIA

Since moving to the Hampton Roads area in 2010, I have enjoyed everything from great schooling to having the beach just a short drive away. However, I quickly became aware that when it rains, it floods. When it starts to rain or storm, the water begins to flow into the streets. Not only is this dangerous to drive in, but it also causes traffic, blocks road ways, and damages property to the point where insurance agencies refuse to insure them. For somebody who is always on the go like me, it becomes difficult to travel and get necessary things done. In addition, the flooding puts a damper on industries such as fishing and duck hunting due to the disappearing natural habitats these animals call home. Therefore, regardless of whether it's a human being, or an innocent animal, we are all negatively affected by climate change.

Brandon Hare
Norfolk, Virginia

PHOTO: FLICKR - MICHAEL PEREKAS

"With every drop of water you drink, every breath you take, you're connected to the sea. No matter where on Earth you live."

SYLVIA EARLE

"THE BLUE PLANET"[111] IS AN APPROPRIATE NAME for Earth. Our vast blue oceans hold about 96.5 percent of all Earth's water, and about 70 percent of the Earth's surface is covered by water (saltwater and freshwater).[112] From sea to shining sea"[113] our immense oceans have an enormous effect on global climate. In turn, climate change is rapidly altering the fundamental character of our oceans, threatening the countless species that depend upon them for survival. Rising ocean temperatures, changing ocean chemistry, and additional human-induced stressors such as marine pollution are having a profound effect on marine ecosystems.

Rising Water Temperature

On a global scale, the average temperature of the upper 250 feet of the world's oceans rose by about 0.8° Fahrenheit from 1971 to 2010, a trend that scientists have determined is a direct result of human activities.[114,115] If global warming pollution continues unabated, average surface ocean temperatures are projected to rise by an additional 2.7 to 5.4° degrees Fahrenheit before the end of the century.[117]

COMPLEX RELATIONSHIPS – THE LOBSTER FISHERY

A spring 2012 heat wave had unexpected consequences for Maine's famous lobster fishery. As temperatures warmed earlier, lobsters migrated to their shallow inshore summer habitat weeks ahead of schedule, extending the typical fishery season. Molting rates also increased in the abnormally warm water, enhancing the number of legal-sized lobsters. The result? Record numbers of lobsters were caught that exceeded the processing capacity and market demand for the product, resulting in a price collapse and an economic crisis for the U.S. and Canadian lobstermen.[116]

These changes in ocean temperature may sound minimal, but can have devastating consequences for ocean organisms. Ocean warming is one of the greatest threats to coral reefs, some of the most biodiverse ecosystems on earth.[118] When ocean temperatures exceed a certain threshold, coral bleaching events occur, which frequently result in coral death. Coral reefs provide essential food and habitat for countless other marine species, and loss of these corals impacts entire food webs.

CORAL BLEACHING

WHEN OCEAN TEMPERATURES EXCEED the thresholds that they have evolved to tolerate, coral polyps expel their zooxanthellae, the algae that live symbiotically inside the corals and provide them with food and oxygen. Because the zooxanthellae also give the corals their colorful pigment, this traumatic event is called "bleaching," and results in coral weakening or even death.[119]

Some ocean species respond to rising ocean temperatures by shifting their ranges, typically northward to cooler waters.[120] This is more evident than ever in the North Atlantic, where some of the most rapid ocean warming in the world is occurring.[121] In the Gulf of Maine, iconic species of the region like cod and herring are retreating northward, being replaced by black sea bass, blue crabs, and squid that have traditionally been fished farther to the south.[122]

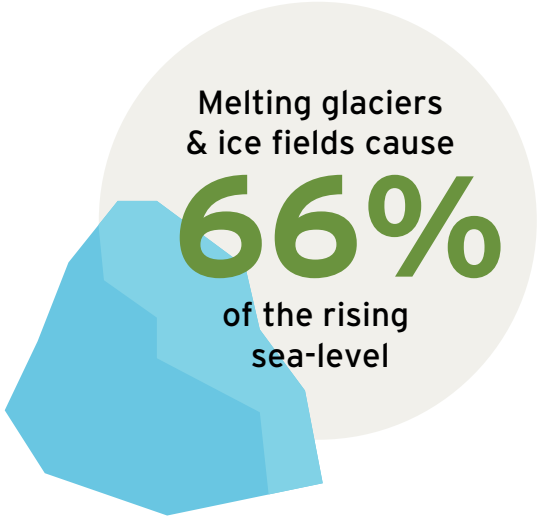
Warmer water temperatures can also affect the life cycle of sea turtles. Delays in loggerhead nesting season have been associated with the increase in average sea surface temperatures.[123] Ocean warming is also known to contribute to episodic die-offs of sponges and seagrasses, which are important foods for hawksbill and green sea turtles, respectively.[124,125]

There is also considerable concern that warmer waters would facilitate the spread of disease and invasive species, such as the invasive Indo-Pacific lionfish that thrives in warmer water conditions and has now been found as far north as New York and Rhode Island.[126, 127] Given the important roles that all native species play in their respective ecosystems, it is likely that shifts in range and abundance will significantly alter the very nature of our coastal marine ecosystems, with significant repercussions for commercial and recreational fisheries and coastal communities.

Acidifying Oceans

Ocean acidification, also caused by carbon pollution, is often thought of as the evil twin of global warming. The ocean has a significant capability to absorb CO_2, including about a third of the CO_2 emitted by burning fossil fuels.[128] While this capacity has been a buffer to the amount of CO_2 in the atmosphere, it comes at a steep price. When CO_2 dissolves in seawater, it changes the water chemistry by increasing its acidity. This process, called ocean acidification, hinders the ability of shellfish, corals, and even some types of plankton, to build their calcium carbonate shells.[129] Combined with warming water, ocean acidification is likely to have a major effect on the structure, function, and productivity of marine ecosystems.

Ocean acidification has already resulted in significant losses for the $270 million shellfish industry in Washington State. Coastal economies all around the country are vulnerable to the impacts of ocean acidification, including many East Coast communities that rely heavily on the harvest of sea scallops and other shelled mollusks.[130] The ocean is acidifying so rapidly that it could reduce U.S. shellfish harvests by as much as 25 percent over the next 50 years.[131]



Sea turtle nesting sites around the world are threatened by sea level rise.
PHOTO: NOAA

Additional Stressors

The effects of other stressors, like overexploitation of living resources, habitat destruction, high nutrient levels from agricultural run-off, oil spills such as the Deepwater Horizon oil rig explosion in 2010 in the Gulf of Mexico, and other pollution can make ocean environments more susceptible to large-scale changes like rising water temperature and acidity.[132]

For example, local factors including polluted river discharges and associated algal blooms can increase acidic conditions in the near-shore environment.[133] Accumulation of pollution from farms and cities in the Chesapeake Bay watershed has resulted in Bay waters acidifying three times more quickly than the open ocean.[134] Combined with ocean acidification from increases in dissolved CO_2, these local drivers only exacerbate harmful impacts on marine ecosystems.

NWF ECOLEADERS: CUTTING CO_2 ON CAMPUS

NATIONAL WILDLIFE FEDERATION'S *EcoLeaders* are working in 250 cities in nearly every state to protect wildlife, restore habitat, and curb carbon pollution. Certified Ecoleaders receive support through workshops, an online community, project planning tools, and through special events. One easy way for students and young professionals to earn their EcoLeaders certification is through leadership in the annual energy and water reduction competition: Campus Conservation Nationals (CCN). Organized by the National Wildlife Federation and Lucid, with partners U.S. Green Building Council and Alliance to Save Energy, CCN is the largest competition for colleges and universities in the world aimed at mitigating the impacts of climate change. To-date, more than 1 million students have participated, saving 6 million kilowatt hours of electricity, which is equivalent to averting more than 9 million pounds of CO_2 from entering the atmosphere! Learn more at www.nwf.org/ecoleaders.

Campus Conservation Nationals 2013, San Diego State University.
PHOTO: SAN DIEGO STATE UNIVERISTY

TAKE ACTION

FOR CLEAN SKIES & HEALTHY WATERWAYS

PHOTO: LONDON ARRAY LIMITED

AS THE THREATS AND TROUBLING CHANGES to our waters tell us, we mustn't delay action to combat climate change. The science is clear: the longer we do delay taking meaningful steps to reduce harmful carbon pollution, the more serious the impacts to our aquatic ecosystems will be, including the fish and wildlife they support. If atmospheric CO_2 continues to rise at the current rate, the earth will experience catastrophic global temperature increases that world leaders have agreed we must not exceed. Action is necessary now for the benefit of people, wildlife, and wildlife habitats.

To preserve our ability to enjoy the outdoors and protect wildlife and the waters they depend on we must:

1

Utilize the Clean Air Act to require reductions in carbon pollution from our largest source– power plants.

The U.S. Environmental Protection Agency has taken an historic step forward with new standards that establish first-ever limits on carbon pollution from our country's largest source – power plants. These new standards, known as the Clean Power Plan, are a critical next step in reducing our country's carbon pollution. We should support the EPA to implement and protect from weakening, as well as work with states to ensure the rules are effectively implemented.

2

Reduce fossil fuel use and reject expansion of dirty fuels.

Oil, gas, and coal development destroy, degrade, pollute, and fragment habitat. Carbon pollution from these sources exacerbates climate stressors for wildlife. Science is telling us that we must slow and stop the expansion of new dirty energy reserves—such as the massive coal fields in North America and the tar sands in Canada—which threaten important habitat and would lock in more carbon pollution for decades to come.

3

Invest in clean, wildlife-friendly energy and improving energy efficiency.

A serious effort to reduce carbon pollution must include investing in clean, wildlife-friendly energy sources such as on- and offshore-wind, solar, sustainable bioenergy, and geothermal. We can also make significant improvements in the efficiency with which we use energy. In fact, energy efficiency is the cheapest, fastest way to use less energy, lower consumers' electricity bills, and reduce pollution. As we make this transition to clean energy, it is essential that clean energy sources be developed in an environmentally responsible way to minimize and compensate for potential effects on wildlife and the habitats, like our waters, that they depend upon.

4

Safeguard wildlife and wildlife habitat from climate change.

Healthy ecosystems are more resilient to the potential effects of climate change. Management to reduce other stressors such as water pollution, extreme flooding caused by rapid high-volume runoff from impervious surfaces and agricultural areas, and habitat fragmentations such as dams or invasive species will likely reduce the effects of a changing climate.

5

Facilitate adaptation of habitats to the changing climate.

Climate-smart conservation of our waterways means taking climate change into account when identifying risks and developing adaptation strategies to ensure that our waterways will continue to support wildlife and their habitats. Pro-active approaches include provision of adequate stream flow, management of stream corridors for shade, and assuring adequate freshwater inflows to our estuaries.

6

Use the Clean Water Act to fully protect streams and wetlands.

The recent Clean Water Rule is crucial for the wildlife who make their home in our waterways, as well as for flood protection and safe drinking water. If Congress blocks the Clean Water Rule, at least 60 percent of America's streams and 20 million acres of wetlands nationwide will continue to be at risk from pollution and destruction from development, oil and gas production, and other industrial activities.

ENDNOTES

PHOTO: USFWS - GREGORY BREESE

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