HUNTERS AND ANGLERS were some of America’s first supporters of conservation and wildlife management. Today, they still play a huge role in conservation and in supporting local economies. Through various excise taxes and the purchase of hunting and fishing licenses and stamps, sportsmen and women provide key funding to state fish and wildlife agencies for conservation. They also contribute some $90 billion to the national economy each year.1

Unfortunately, the pastimes of hunting and angling and the enjoyment they provide are being threatened by climate change. Many of the cherished species important to these sportsmen and women, including big and small game, birds, and fish, are facing increasingly dangerous situations brought on by warmer waters, shorter winters, and longer droughts. Trekking into the outdoors is popular, whether to hunt, fish, or wildlife-watch, but as climate change progresses and wildlife populations migrate or disappear, these activities are being harmed. These changes may even pose an increased risk to outdoor adventurers, such as in the case of increased pests, like Lyme disease-carrying deer ticks.

Fortunately, with the help of hunters and anglers, the causes of climate change can be addressed. By supporting and implementing the Environmental Protection Agency’s Clean Power Plan to reduce carbon pollution from power plants, developing clean energy sources, and reducing fossil fuel use, we can help reduce the carbon and other climate pollutants going into the atmosphere and protect wildlife habitat from climate change impacts.

This report explores the importance of sportsmen and women for conservation and the recreation economy. It also examines the challenges faced by outdoor recreationalists and the wildlife important to hunters and anglers in the face of a changing climate.
FOR AMERICAN HUNTERS AND ANGLERS, healthy populations of fish and game are considered a birthright. Due to loss of habitat, unregulated take, and other factors, populations of many species of wildlife were dangerously low by the beginning of the 20th century. The woods and waters with bass, trout, elk, ducks, and deer which we enjoy today didn’t happen by accident. For more than 150 years, countless individuals, including sportsmen and women, have spoken up on behalf of the conservation of our fish and wildlife.

Today, hunters and anglers are on the front lines of climate change. Climate change poses an immediate and specific threat to hunting and fishing in America, challenging the traditions and values of outdoor recreationalists, their respect for the land, and the legacy they leave to future generations. Many sportsmen and women are already seeing its effects on their hunting and fishing opportunities, and are very concerned about what climate change means to the future of these traditional outdoor activities. Fish are disappearing from some lakes and streams. Big game populations are being pushed out of their historic ranges. Ducks and other game birds are losing habitat right in front of our eyes. How we address the challenges of global climate change now will dictate outdoor opportunities for future generations.

Hunters and anglers, as well as wildlife watchers, photographers, outdoor recreational businesses and wildlife managers, all have a vested interest and a role to play in cutting climate pollution and safeguarding fish and game species and their habitats in the face of climate change.

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 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 air pollutants in order to protect public health and welfare. With the Clean Power Plan, sensible limits will be put on carbon pollution (the key driver of climate change) from power plants, just like limits exist on soot, sulfur dioxide, mercury, nitrogen oxides, and other harmful pollutants. 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 must support the EPA by defending these rules and working with states to ensure the rules are effectively implemented.
HUNTERS AND ANGLERS are a core constituency to preserving our conservation legacy. While conservation investments come from many sources, sportsmen and women play a big role in preserving the wildlife and habitats important to their traditional outdoor recreation.

One of these sources is a tax paid by hunters through the Federal Aid in Wildlife Restoration Act, also known as the Pittman-Robertson Act for the two Congressmen who championed its passage. Through Pittman-Robertson, a law strongly supported by hunters, wildlife conservation is funded through an 11% manufacturers’ excise tax on guns, ammunition, and archery equipment. The funds generated from this tax are disbursed to state wildlife agencies for wildlife conservation, purchase of public lands open to hunters, and hunter education. Further, the distribution of these funds is dependent on states dedicating 100% of their revenue from hunting and fishing license, tag, and stamp sales to wildlife conservation.1 Since its passage 75 years ago, nearly $10 billion dollars (inflation adjusted) have been distributed for conservation.2 Since its passage 75 years ago, nearly $10 billion dollars (inflation adjusted) have been distributed for conservation.3

In 2014 alone, $1.1 billion was distributed to the state wildlife agencies from sportmen and women excise tax revenues.4 In today’s challenging fiscal climate, continuing the dedicated funding from these acts is absolutely critical for facilitating conservation actions by the states. With the success of these laws and many other efforts by citizens, state wildlife agencies, and federal agencies, hunting, fishing, and viewing opportunities have grown remarkably.

Even further, President Franklin Roosevelt’s Migratory Bird Hunting Stamp Act required anyone older than 16 to have a federal duck stamp affixed to a state hunting license in order to hunt waterfowl. Today, these stamps cost $25 and raise more than $25 million annually for habitat purchase and restoration. While created with waterfowl in mind, stamp sale funds benefit all types of species and outdoor enthusiasts.6

Similarly, the Federal Aid in Sport Fish Restoration Act, commonly referred to as the Dingell-Johnson Act (later known as the Wallop-Breaux Act) after its Congressional supporters, created a manufacturers’ excise tax on fishing equipment to provide revenue to states for management and restoration of fish populations.7

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Of the nearly $90 billion spent by hunters and anglers in 2011, $42 billion was on fishing, $34 billion was on hunting, and $14 billion was on items used for both hunting and fishing. For big game specifically, there were nearly 12 million adult big game hunters, and they spent more than $16 billion for big game hunting purposes. More than 22 million people watched big game around their homes, and 10 million traveled to view big game. Comparatively, there were 4.5 million small game hunters and 2.6 million migratory bird hunters spending $2.6 billion and $1.8 billion respectively. For anglers, more than 27 million adults sought out their favorite fishing holes. On average, each angler went fishing some 17 days and spent an average of $934.9 These activities provide a significant and much needed boost to the economy and jobs.

Unfortunately, with rivers warming or drying up, big game populations shifting, bird migration patterns changing, and invasive species becoming more abundant, these revenues are threatened. The loss of recreational hunting and fishing opportunities due to climate change could have real economic impacts across the nation, particularly in rural areas that depend on these expenditures. This is all on top of the fact that many past wildlife restoration efforts are expected to be set back by climate change.
Climate change poses an increasingly dire threat to wildlife, communities, and public health. Changes to our climate are projected to destroy essential wildlife habitat, cause habitat and species ranges to shift, increase incidence of pests and invasive species, decrease available food and water, change the chemistry of the ocean, and increase the rate of species’ extinction. Many of these impacts are already occurring.13

Many wildlife species are struggling to adapt and some never will. From game species as varied as ruffed grouse and walleye, America’s rich community of fish and game is at risk from a warming world.14

Climate change is already causing many species to shift to new locations, often at faster rates than scientists previously expected.15 As temperatures have increased, land-based plants and animals have been moving further north and to higher elevations. For example, 177 of 305 species of birds tracked in North America have expanded their range northward by 35 miles on average during the past four decades.16 Some plant species’ ranges have been shifting in response to changes in water availability, rather than temperature.17 And marine species appear to be shifting ranges even faster.18

Unfortunately, some species have nowhere to go. For example, species found at high elevations or near the poles are already living at the edge of their climate tolerance, and thus are particularly vulnerable to increasing temperature.

Not only are individual species relocating, but in some instances major ecological communities are shifting. Forests are moving northward into the Alaskan tundra19 and upward into the alpine tundra of the Sierra Nevada in California.20 Broadleaf forests are edging out conifers in Vermont’s Green Mountains.21 Continued climate change this century is projected to cause shifts in major ecosystems over 5 to 20 percent of North America.22

As climate change alters the playing field, plants, fish, and wildlife face new situations. Individual species respond differently to changes in the timing of seasons or the frequency of extremes, which can create mismatches between wildlife and their food sources. At the same time, the ranges of some species are shifting at different rates, creating interactions among species that previously did not exist. All these shifts will create winners and losers, but ecologists expect that climate change will bring an overall decline in biodiversity.23 A majority of studies find that climate change will have alarming consequences to biodiversity, with worst-case scenarios projecting mass extinction rates.24

The impacts of climate change can disrupt a wide range of natural processes, especially if they occur more quickly than plant and wildlife species can adapt.

Species and habitats shifting locations

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Extreme weather and drought

Extreme conditions are likely to have some of the biggest impacts on wildlife in the coming decades simply because floods, droughts, freezes, and winter thaws are the sorts of events that exceed normal tolerance levels, directly killing organisms or altering their competitive balance. Ecosystems are adapted to historical patterns of disturbances, but changing the climate conditions will drive longer, more frequent, and more severe disturbance with major ripple effects on ecosystems.

Extreme conditions concerning precipitation can be especially dangerous for wildlife. Since about 1950, the number of heavy precipitation events have increased in both frequency and intensity.25 In recent years, a higher percentage of precipitation in the United States has come in the form of intense single-day events.26 These cause excessive runoff of nutrients, exacerbating harmful algal blooms and dead zones in lakes and rivers. These events can also cause changes in streamflow and transport large amounts of sediment downstream, significantly modifying riverbeds and coastal wetlands.27

Warming is also expected to cause an increase in the intensity of tropical cyclones by the end of the century. This change means there will be an increased destructive potential for hurricanes and other tropical storms.28 These storms cause massive beach erosion and unprecedented inland flooding, as was recently seen with hurricanes Irene, Patricia, Katrina, and Sandy, which results in the destruction of coastal and inland wildlife habitat.29, 30

At the other extreme, many areas of the United States are experiencing less precipitation and more drought than usual.31 Along with becoming warmer and shorter32, winter is also becoming less white. The extent of snow cover across the Northern Hemisphere has decreased by approximately 3 to 9 percent since 1978, with especially rapid declines in the western United States.33 Dwindling snowpack accumulation in mountain areas is depriving downstream areas of valuable snowmelt runoff during the summer and fall. These shifts in the seasonal cycle of streamflow present significant challenges for managing water supply for human consumption and agriculture, in addition to the stresses they put on fish and wildlife. Extreme droughts also contribute to increased wildfires, both harming local economies and putting wildlife at risk.34

One of the most scientifically certain factors of our changing climate is that temperatures are getting warmer. In fact, the International Panel on Climate Change (IPCC) states that it is “certain” global mean surface temperature has increased since the late 19th century.35 As average temperatures warm, heat waves have become progressively more intense. Over the past 30-40 years, record-setting daily high temperatures and the occurrence of unusually hot summer nights have increased at a progressively faster rate.36 The top 10 warmest years on record worldwide have all occurred since 1998. The most recent year, 2014, ranks as the warmest on record and 2015 is already looking to be another record breaker.37

Warming air temperatures have created warmer waters as well. This allows some invasive species to move higher up in rivers and streams, threatening highly susceptible cold water fish species.38 It can also increase the frequency and intensity of harmful algal blooms.39 In the oceans, warmer sea surface temperature can alter marine ecosystems in several ways, such as migration and breeding patterns, and the presence or absence of different plant, wildlife, and microbe species. Coral bleaching occurs when water temperatures are too warm. Damage to and die-off of coral could dramatically alter ocean ecosystems and lead to declines in fish populations, which in turn could impact marine anglers, whether for recreation, food, or livelihood.39

Increases in temperature can have several devastating impacts for wildlife and people alike. Moose are distressed by high temperatures, vegetation types may shift northward as temperatures increase, and higher temperatures dry up ponds needed by waterfowl to raise ducklings. Annual and seasonal temperature patterns determine the types of wildlife and plants that can survive in particular locations. These changes can disrupt a wide range of natural processes, especially if they occur more quickly than plant and wildlife species can adapt.
INCREASED PESTS AND DISEASES

Climate change also poses a new challenge to people, wildlife, and the outdoor experience in the form of increased contact with pests and diseases. Shifting ranges for pests and disease-causing pathogens may have some of the most devastating impacts for wildlife and habitats. Most notably, pests and the pathogens that cause diseases are increasingly able to survive and thrive during the winter, which allows their populations to explode. These pests not only pose a threat to wildlife, but also to traditional outdoor recreationalists themselves.

Ticks may be the most obvious and pervasive target. The blacklegged tick, or “deer tick,” widely distributed throughout the eastern United States, is known for its transmission of Lyme disease, a disease that can be debilitating for those who contract it. Other examples of increased pests and diseases brought on by climate change include: warming ocean waters which have enabled the outbreak of microbial disease in reef-building corals and pathogens of the eastern oyster. Longer growing seasons and warmer winters are enhancing pine bark beetle outbreaks, increasing tree mortality and the likelihood of intense and extensive fires. Tiger mosquitoes, poison ivy, jellyfish, and fire ants are all also becoming more common with climate change and can severely impact the experience of hunters, anglers, and anyone who enjoys the outdoors.

MAMMALS

MOOSE

Massive and unforgettable, moose are a favorite for hunters and wildlife watchers. Moose are superbly adapted for deep snow and cold climates, enduring extremely cold winter weather in their northern habitats. But their adaptation to cold weather is also a liability. Moose are in jeopardy across the lower 48 states—from New Hampshire, Vermont, and Maine; to Michigan, Minnesota, Wyoming, and Montana. Not surprisingly, as the climate has warmed, moose are already feeling the heat in southern portions of their range, reducing their populations and loss of viewing and hunting opportunities.

When it comes to rising temperatures, heat affects moose directly. Heat stress leads to dropping weights, a fall in pregnancy rates, and increased vulnerability to predators and disease. A warming climate also affects prime moose habitat, as aspen and birch retreat northward. Increased winter tick infestations, due to higher temperatures and shorter winters that enhance winter tick survival, are the other major threat to moose from climate change. Severe infestations can cause high moose mortality, particularly in calves. Heavily infected moose may starve to death because they eat less when irritated by ticks, lose body heat due to hair loss, become vulnerable to infection, and suffer extensive blood loss to the ticks.

The New Hampshire moose population has plummeted by more than 40% in the last decade from over 7,500 moose to about 4,000 today. In the winter of 2014-15, 74% of radio-collared moose calves died from tick overloads in New Hampshire. As the moose population has dropped, the recreational activities and associated revenue surrounding the species has followed. In New Hampshire, the moose hunting season has been cut back, and permits have been reduced nearly 85% since 2007. In 2014, moose hunting permits in Maine were slashed by 25% because of the explosion in the winter tick population. Permits were cut another 10% in 2015. Similarly, in Montana, moose hunting licenses have been cut by more than 50% since 1995. In Minnesota, moose populations are down 60% from 2006 levels, and moose hunting was discontinued in the state in 2013 due to the rapid population decline. As populations drop in the warmer southern portions of the moose’s range and the climate continues to warm, the future of moose hunting in the lower-48 states areas appears bleak.
GAME CHANGERS
THE NATIONAL WILDLIFE FEDERATION

PRONGHORN
Native only to central and western North America, pronghorn inhabit open grasslands, shrublands, and deserts as long as there is sufficient water and forage. Their most common shrub habitat is sagebrush, which may comprise nearly 80% of their diet in some areas. Pronghorn populations exist in much of the West, including Wyoming, Montana, Colorado, New Mexico, Texas, and Arizona. Though pronghorn can reach speeds up to 50mph, they may not be able to outrun climate change. Climate change is projected to cause warmer and drier conditions, fundamentally altering grasslands and shrublands across the western United States in the coming decades. In some regions, vast areas of sagebrush habitat could be reduced to a fraction of their current size. For example, in the Great Basin, climate change is a major factor in a projected 80% decline of sagebrush ecosystems as they are replaced by trees and invasive species such as cheatgrass. This reduces and fragments habitat for pronghorn and other sagebrush-dependent species.

Drought is one of the climatic factors which can have catastrophic effects on important pronghorn food sources. Without adequate forage, pronghorn fawns are born underweight and have lower survival rates. In 2012, many areas in Wyoming (home to about a third of pronghorn) were stricken by severe drought, necessitating a drop in pronghorn hunting permits issued.

For the pronghorn herds which migrate long distances, enhancing connectivity and establishing wildlife corridors in areas of climatically-suitable habitat is important. Minimizing other factors such as habitat destruction from oil and gas development as well as urban sprawl are likely to also be important strategies to help them cope with changing climate conditions.

WHITE-TAILED DEER
White-tailed deer inhabit the entire lower 48 states, with the exception of California and some areas in the Southwest. One might be skeptical that deer could be in peril from anything, given their widespread distributions, established populations, and diversity of habitats. However, these traits don’t provide immunity from climate change. Even many common species are expected to lose significant suitable habitat.

Extreme weather, disease, and changes in habitat are all potential climate-driven stressors on white-tailed deer. In northern areas of their range such as Maine, New Hampshire, Minnesota, and Wisconsin, deer often seek out winter shelter from wind, extreme cold, and deep snows in areas known as “deer yards.” But if climate-driven changes alter the suitability and location of deer yard habitats, deer may have difficulty finding new safe areas to over-winter or be forced into areas difficult to protect.

White-tailed deer are also vulnerable to hemorrhagic disease (HD). Infected deer can rapidly become ill, losing their appetite and natural fear of humans, and develop a fever and extensive internal bleeding, often followed by death. HD is expected to thrive with climate change bringing warmer summers, longer droughts, and more intense rain events—the perfect environment for the midges that transmit HD. During drought years mids are also more exposed to midges as the deer and midges both concentrate in the few areas with available water. Because HD-carrying midges are killed by freezing temperatures, warming winters may also allow the disease to spread to more northern areas and expose white-tailed deer to HD for longer periods of time. In northern states where deer are usually not as frequently exposed to HD, losses can be 25% of a local deer population, although it has exceeded 50% in some cases.

In Michigan, there were nearly 15,000 deer reported dead in 2012, resulting in an emergency order to reduce the number of allowed licenses to hunt antlerless deer. Also in 2012, thousands of deer were killed by the disease in Montana, resulting in a hunting tag decrease of more than 20%. In 2014, nearly 10% of deer in Virginia were infected with the disease. Mule deer range from the western Great Plains to the Pacific Coast and from Canada to Mexico. Unfortunately, major droughts, projected to be more severe in the future, have contributed to declines of this species. Moreover, oil and gas development leading to habitat loss and fragmentation is now a major concern in some areas. This combination of factors has devastated Colorado’s Logan Mountain mule deer population, reducing it from about 15,000 mule deer in the 1980s, to 6,000 in the mid-1990s. The population has not recovered since. On the Colorado Plateau, two decades of severe drought transformed the composition and structure of the plant community, which in-turn was detrimental to mule deer.

In Colorado’s Logan Mountain management area, the antlered harvest dropped by more than two-thirds, from an average of about 1,400 in the mid-1980s to about 400 by 2000, and has yet to recover. No antlerless harvest has been allowed from 1999 through at least 2010. In Wyoming, mule deer harvest has declined in recent years by about 25%. The Wyoming Game and Fish Department has kept harvest levels down to account for severe drought and other factors. Failure to address these stressors will increasingly affect mule deer hunting and viewing opportunities.

BIGHORN SHEEP
These rock-climbing wildlife once nearly disappeared from our western landscapes due to disease transmitted from domestic sheep, competition for forage, and other factors. In 1998 the desert peninsular bighorn sheep was listed as endangered, followed just a year later by the Sierra Nevada bighorn sheep. Today, though still far below historic levels, bighorn sheep exist in 15 western states, as well as parts of Canada and Mexico. Unfortunately, while some bighorn sheep populations have recovered, climate change is a new and growing threat.

Winter snowpack in the Rocky Mountains and Sierra Nevada is critical for maintaining important food and water sources for bighorn sheep throughout the year. Bighorn sheep are projected to be challenged by this reduced and rapidly melting snowpack along with warming temperatures and less rainfall. Plant growth, reproductive cycles, and survival of young could be affected.

Climate change has already been a factor in the decline of desert bighorn sheep in the Southwest in the 20th century. An average temperature increase of nearly 2 degrees Fahrenheit in the region and a 20% decrease in precipitation has reduced available forage, particularly in the lower, drier
Mountain goats live in high elevations, roaming the rocky high country of the Rockies, Cascades, and Coast ranges of North America. However, high altitudes are now warming at a faster rate than lower altitudes, making the future of this alpine species less than certain.

Mountain goats tend to migrate to lower ranges during the wintertime when sub-zero temperatures and large amounts of snow are common, but they spend most of the year in the subalpine and alpine zones. This means that as these areas warm with climate change, mountain goats can’t go any higher to get to the cold-weather areas for which they are adapted.

Disease and a change in vegetation may also pose threats to mountain goats. With shorter winters, alpine areas may see changes in the timing of spring vegetation growth. This change has been found to impact the growth of mountain goat kids, which may affect their ultimate survival. High-altitude mountain goats also have a low diversity of pathogen resistant genes, in part because there are fewer parasites in these areas. Unfortunately, with climate change, mountain goats may be exposed to new diseases as pathogens are able to survive in more northerly areas and at higher altitudes.

Despite having one of the healthiest mountain goat populations of the lower 48 states, Montana has closed nearly 20% of mountain goat hunting districts since 1994 due to low numbers. Because the state has fewer mountain goats, it can provide only a few hundred permits each year, generating little revenue for goat management and population surveys. This has led to uncertainty in population trends, forcing the department to close hunting seasons to be on the safe side.

Mountain ranges. During this time period, 30 of the 80 known populations of desert bighorn sheep in the region died out. More populations could disappear given the projections of rising temperatures and lower precipitation.

**MOUNTAIN GOATS**

**BIRDS**

**RUFFED GROUSE**

The ruffed grouse is widely distributed from coast to coast across Canada and the northern United States. Living in forest habitats, its range also extends southward in the Rocky and Appalachian Mountains. Ruffed grouse are adapted to living in climates where the ground is often covered by snow during the winter months. Males are known for their noisy ritual of using their wings to “drum,” and can be heard from up to a quarter mile to attract mates.

Unfortunately, ruffed grouse are projected to lose nearly 35% of their breeding range over the next 65 years. Their suitable climate area is expected to shift northward and it is not clear yet if the forests the grouse depends on will expand northward as well. Ruffed grouse will likely withdraw from both the Great Lakes region and much of the Northeast due to the movement of paper birch, a major component of their diet in the northern part of its range. Changes in rainfall amounts and patterns may also negatively affect the survival of grouse chicks. Because of climate change, Pennsylvania may no longer be suitable to host its state bird!

**Ducks**

The Prairie Pothole Region is where tens of millions of waterfowl breed annually, hatching 50% of North America’s ducklings. But this incredible duck factory—which in the United States ranges from portions of eastern Montana to Minnesota and southward into northern Iowa—is threatened by climate change. The region provides important breeding habitat for ducks like mallard, pintail, gadwall, blue-winged teal, shovelers, canvasback, and redhead. What happens in the Prairie Potholes affects the entire continent because ducks produced there have been found in all of the lower 48 states and Alaska. Should climate change affect wetlands and ducks as projected, waterfowlers across the country will find themselves asking “Where did all the ducks go?” as they sit in their duck blinds at dawn.

Waterfowl nesting success is closely tied to the number of ponds in the Prairie Potholes in spring. Prairie Pothole wetlands are expected to dry more rapidly and have lower water volumes as temperatures increase. Areas with most favorable moisture conditions for waterfowl in the Prairie Potholes are expected to shift further to the north and east as the climate changes. However, these areas have already been extensively drained and cleared, and offer little available habitat with good moisture, forcing ducks to breed in less productive areas.
North of the Prairie Potholes is the boreal forest, a vast expanse of wetlands and evergreen forests in Canada, harboring up to 40% of North America’s ducks including scaup, mallard, American wigeon, green-winged teal, buffleheads, goldeneyes, scoters, and ring-necked ducks.\(^{15, 18}\) Climate change is altering this landscape through increased fire and pine bark beetle epidemics as well as increasing annual climate variability. In addition, outright habitat loss is a threat because up to 60,000 square miles of boreal forest could become more suitable for agriculture if atmospheric carbon doubles.\(^{14}\) All of this will combine for potentially significant declines in waterfowl of the boreal forest.

Some of the most commonly hunted ducks are already showing signs of decline. Lesser scaup populations, which habituate all four North American migratory flyways, have already fallen to a record low, and the future presents enormous challenges. Breeding range for lesser scaup on National Wildlife Refuges alone has been predicted to contract by nearly 37% due to climate change. The common loon populations, most common in the Northeast, are projected to decline significantly under all climate change scenarios.\(^{119}\)

BOBWHITE

The joys of hunting for northern bobwhite quail—a pointing dog’s trembling stance, wind in the pines, the explosive roar of a covey of quail taking flight— are threatened by a changing climate, as are bobwhite populations throughout its vast range. Northern bobwhite quail populations have declined 80% since 1967 and populations are no longer healthy enough to support hunting in many places in the East.\(^{76, 121}\) Even though warming temperatures may support an increase in bobwhite populations at the northern limits of their range,\(^{74}\) hotter, drier summers can also lead to embryo mortality and nest abandonment by parent birds.\(^{120}\)

Quail chicks rely on a diet rich in insect protein,\(^{120}\) and harsher summers could reduce the availability of such high quality prey items.\(^{112}\) Hot times for quail will also bring unwelcome neighbors to fields and hedgerows in the form of swarming fire ants, which can kill bobwhite chicks.\(^{110, 111}\) In the westernmost portion of its range in the central United States, the expansion of steppe habitats could push bobwhite quail out of their grassland homes.\(^{124}\)

FISH

BROOK TROUT

Brook trout inhabit only the coolest, clearest, and cleanest flowing streams and rivers in most of the eastern United States and throughout the mountains of Appalachia. Unfortunately, as air temperature increases due to climate change, brook trout are expected to lose habitat as the cool water they depend upon warms and oxygen levels decline.\(^{123}\) More frequent droughts can further harm brook trout by reducing stream flow and killing vegetation, which provides shade that helps keep streams cool. The brook trout’s historic habitat in Virginia has already been cut in half due to a number of pollution pressures, including climate change.\(^{125}\)

Brook trout, known for their speckled bodies and need of cool streams, are also severely threatened by climate change in places like the Southeast. If air temperatures warm by just 2.7 degrees Fahrenheit from current conditions, which is expected if carbon emissions are not dramatically and quickly reduced, there will be a projected 20% loss in brook trout habitat in Virginia, North Carolina, South Carolina, Tennessee, and Georgia. If no action is taken to reduce climate pollution, we could see warming of 6.3 degrees Fahrenheit, which would likely result in a nearly 80% loss of habitat.\(^{127}\)

CUTTHROAT TROUT

Native cutthroat trout are the crown jewel of Yellowstone National Park’s fisheries as well as those of many western states. Biologists estimate that up to 42 species—including otters, osprey, and grizzly bears—rely on these native beauties, making them a critical link in the food chain. Drought, fires, and hot summer temperatures are putting these fish and fisheries at increasing risk.\(^{126}\) In Yellowstone, several tributaries critical for spawning native trout are now running dry in late summer, interrupting migration and making trout more vulnerable to predation.

By the end of this century, native cutthroat trout across the western United States are expected to lose an additional 58% of their current habitat.\(^{129}\) With coldwater fish species around the country experiencing similar declines, the number of days anglers participate in cold-water fishing is projected to decline by more than 1 million days by 2030 and by more than 6 million days by the end of the century. Associated with the decline in fishing days for cold-water fish is a projected national economic loss of as much as $6.4 billion annually by the end of the century, if climate pollution is not curbed.\(^{130}\)
CLIMATE CHANGE IMPACTS
THE OYSTER BUSINESS

My company, Mook Sea Farm in Walpole, Maine produces both seed oysters, which we sell to other farms from Virginia to Maine, as well as oysters for the half shell market. Our hatchery, where we grow our oysters through the early life stages, is the engine that drives our business and is what is most vulnerable to ocean acidification caused by climate change.

Oysters, like clams, mussels, and many other mollusks, go through a free-swimming larval phase during which they make thin, fragile shells from the most soluble form of calcium carbonate. When seawater is too acidic, the larvae are in big trouble. In Lake Superior, summer surface temperatures have increased 4.5 degrees Fahrenheit since 1980, and the sea lamprey is clearly benefiting from this warming; it has increased in size by 12%, which increases reproduction. These threats to walleye threaten not only treasured wildlife-associated pastimes in Ohio, like fishing, it also threatens the economy of the Great Lakes region.

SALMON

Salmon spawn and rear their young in the cold, clean waters of the Pacific Northwest, but populations have already declined significantly from historic levels, owing to a number of obstacles including dams and pollution. Now, climate change poses yet another threat to the future of salmon from extreme heat, warming waters, decreased snowpack, more drought, and disease. Increasing water temperatures in the summer and fall can lead to higher prevalence and severity of both proliferative kidney disease and Ichthyophonus in salmon. Both of these diseases are caused by parasites and are associated with an increase in mortality.

Many fish species, including salmon in the Pacific Northwest, are especially dependent on melting mountain snowpack for stream and river flow. Water storage systems in the West are threatened by reduced snowpack, as 75% of the water resources in many western states are tied to snowmelt. Water shortages in many regions will present potential harm for fish species, like salmon, as tradeoffs arise between maintaining fish populations and continuing intensive irrigation, hydropower, and water supply. Such changes in stream flow will affect salmon’s reproductive success as earlier or increased peak flow can scour streams and destroy the gravel beds that are used for nesting sites.

OYSTERS

Oysters are an important delicacy, cultural staple, and big business in both New England and the Chesapeake Bay region. Unfortunately, oysters are facing threats caused by climate change on several fronts—from ocean acidification to warming waters, and the spread of disease.

Ocean acidification is a phenomenon resulting from oceans absorbing growing amounts of carbon dioxide in the air produced by burning fossil fuels. Acidifying waters make it more difficult for creatures with calcium carbonate shells or skeletons to build and maintain their shells and survive. Mollusks, such as oysters, are generally known to be particularly sensitive to ocean acidification and are also among the most lucrative and sustainable fisheries in the United States.

Warming waters from climate change are closely linked to increased disease, which is also a problem for oysters. MSX and Dermo are the most devastating parasitic oyster diseases on the East Coast and result in infections that can impact reproductive capacities, growth rate, and cause mortality. These diseases thrive in warming waters, and oysters become susceptible to these diseases over a mild winter.

BLUE CRAB

There are few species more important to Virginia and Maryland than the blue crab. However, recent reports have shown that blue crabs are projected to be detrimentally impacted by climate change in a way that can also wreak havoc on the sensitive Chesapeake Bay ecosystem. Warming water temperatures have already been recorded in more than 92% of the Bay’s waters. This also reduces the amount of dissolved oxygen present in the water, making dead zones more prevalent. Warming temperatures in the Chesapeake Bay are predicted to greatly impact eelgrass, a cool-water high-salinity seagrass that provides essential habitat for juvenile blue crabs. Warm water over an extended period kills eelgrass, especially in combination with turbidity and low-light conditions.

Increased carbon pollution is also expected to cause blue crabs to grow abnormally large shells. While this might sound good, it actually corresponds to less meat under those shells. As higher carbon causes crabs to put more energy into building larger shells, less energy goes into other critical life processes like tissue growth and reproduction. This can have severe consequences for crab populations and the economy of the Chesapeake Bay where the dockside value of the harvest is approximately $53 million annually for the State of Maryland alone, making the blue crab the most economically important shellfish in the region.

The National Wildlife Federation
THE WILDLIFE AND WILD PLACES that Americans hold dear are under assault from climate change and America’s hunters and anglers are needed to speak up and take action! This nation’s core of hunters, and anglers and other conservationists has a proud legacy of working to protect wildlife, which continues today.

The science is clear: the longer we delay taking meaningful steps to reduce climate pollution, the more serious the harmful impacts to our outdoor traditions, including fishing and hunting will be. Action is necessary now for the benefit of people, wildlife, and wildlife habitats.
Use the Clean Power Plan to reduce 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 standards, known as the Clean Power Plan, are a critical next step in reducing our country’s carbon pollution and spurring the transition to wildlife-friendly clean energy sources. Supporting the standards, protecting them from being weakened, and ensuring they are effectively implemented in the states will have great benefits for wildlife. The EPA and implementing state governments need the support of hunters, anglers, and conservationists to speak up in defense of the Clean Power Plan and the implementation of state-based clean energy solutions to address the wildlife impacts caused by carbon pollution.

Significantly expand large-scale conservation funding investments for wildlife at the national level.

There are thousands of species of conservation need as identified by state wildlife agencies in their wildlife action plans. It is estimated the cost to take actions to prevent these wildlife species from becoming threatened or endangered is over $1 billion annually. The federal State Wildlife Grants program is the nation’s core program to prevent wildlife from becoming endangered, but it is woefully inadequate in providing only about $50 million a year across the nation. Greater funding will enable agencies to better manage species and the habitats they depend upon in the face of the stresses caused by climate change, saving both wildlife and taxpayer dollars from costly recovery efforts.

Support strong action on methane pollution by the Environmental Protection Agency.

Methane is a potent greenhouse gas that traps more than 80 times as much heat as carbon does over a 20 year time period, meaning a small amount of pollution can have big impacts on climate. Methane pollution also causes ground level ozone pollution which can harm wildlife and interfere with outdoor recreation. The EPA has proposed a rule calling for the reduction of methane emissions by 40 to 45% from 2012 levels by 2025 from the oil and gas sector, and needs support from sportsmen and women who are seeing the impacts to wildlife firsthand.

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

A serious effort to reduce climate pollution must include investing in clean, wildlife-friendly energy sources such as on and offshore wind, solar, sustainable bioenergy, and geothermal. 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 their habitats. 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.

Reduce fossil fuel use and reject expansion of dirty fuels.

Oil, gas, and coal development destroy, degrade, pollute, and fragment habitat. Carbon and methane 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 climate pollution for decades to come.

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, invasive species, and habitat fragmentations will likely reduce the effects of a changing climate.

To preserve our ability to enjoy the outdoors and protect wildlife we must call on our leaders and our communities to:

1. Use the Clean Power Plan to reduce carbon pollution from our largest source—power plants.
2. Significantly expand large-scale conservation funding investments for wildlife at the national level.
3. Support strong action on methane pollution by the Environmental Protection Agency.
4. Reduce fossil fuel use and reject expansion of dirty fuels.
5. Invest in clean, wildlife-friendly energy and improve energy efficiency.
6. Safeguard wildlife and wildlife habitat from climate change.
LITERATURE CITED

INTRODUCTION


THE ROLE OF HUNTING AND ANGLING IN CONSERVATION


CLIMATE IMPACTS TO OUR HUNTING AND FISHING HERITAGE


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38. IPCC. 2013.


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GAME WILDLIFE AND FIRE RISK


