GAME CHANGERS

Air Pollution, a Warming Climate, and the Troubled Future for America's Hunting and Fishing Heritage

NATIONAL WILDLIFE FEDERATION 2011

NATIONAL WILDLIFE FEDERATION

PROTECTING AND RESTORING HABITAT

Report

Introduction


R. Will Roach, USFWS

For American hunters and anglers, healthy populations of fish and game are considered a birthright. But woods and waters teeming with bass, trout, elk, ducks, and deer didn't happen by accident. For more than 150 years, countless individuals have spoken up on behalf of the conservation of our fish and wildlife. Hunters and anglers have contributed more than $10 billion to fish and wildlife conservation, and in a typical year pump $75 billion into the economy.[1] And in a future increasingly characterized by urban sprawl and the demands of modern life, retreating to wild places with a rod or gun in hand is a cherished means of reconnecting with those sportsmen conservationists who came before us and re-invigorating ourselves to step up to the conservation challenges of our time.

America's remarkable storehouse of wildlife is threatened by assaults unknown until modern times. Toxic air pollution and a warming climate are a double whammy for wildlife, and some of our most popular and beloved game species are paying a heavy price. Fish are disappearing from lakes and streams. Birds are taking to wing with heavy metals and other contaminants in their bodies. Big game populations are being pushed out of their historic ranges by a warming climate.

In a single generation, the future for game and fish is changing. It's time for this generation of American hunters and anglers to continue the legacy of speaking up for wildlife.

Invisible Villains

There are four specific airborne threats that are endangering the habitats of wildlife species. Each affects wildlife in places as diverse as urban parks and remote wilderness regions, but they come from the same sources: the smokestacks of power plants and refineries as well as America's fleet of automobiles.

MERCURY

Mercury contamination, primarily resulting from coal-burning power plants, has long been identified as a major issue for many fish species. Small prey fish all across the country are contaminated from mercury in the air, and as predator fish eat these smaller prey, mercury accumulates in their tissue. Top-level predator fish such as brown trout, walleye, and largemouth bass are favorite fish for the frying pan, but more and more regions are under strict warnings about the human consumption of mercury-laced fish. Long-term mercury exposure can cause neurological symptoms such as difficulty walking, blindness, memory problems, and even death. For pregnant mothers, mercury exposure can lead to a risk of permanent damage to a fetus' developing brain.[2] The dangers of mercury aren't limited to aquatic ecosystems, however. Emerging research is showing how mercury harms terrestrial mammals and even migrating songbirds, prompting scientists to reconsider how mercury negatively impacts larger ecosystems.[3]

ACID RAIN

Even in remote, wild regions, *acid rain* has long been identified as a killer of forests, lakes, and streams. The "acid" in acid rain is from sulfur dioxide, most of which comes from coal-burning power plants. Scientists are now learning that acidification of aquatic habitats may even alter the ability for some fish species to recognize threats such as predators[4]—ushering in new questions about how chemical pollutants might affect not only the health of wildlife, but the intricacies of wildlife behavior.

GROUND-LEVEL OZONE

Automobile and industrial emissions emit the compounds that help form *ground-level ozone*, or smog, which is only now beginning to be identified as a game-changer for game and fish species. Long known to exacerbate respiratory and cardiopulmonary difficulties in humans, ozone is emerging as a threat that damages the leaves of sensitive plants, making them susceptible to disease and less able to produce and store food. Wildlife habitat and entire forest ecosystems are at risk.[5]

CLIMATE CHANGE

Carbon pollution from coal-burning power plants, refineries, and vehicles is causing worldwide *climate change*. Already, a warming climate is changing our world. From sea level to the highest mountain peaks, entire ecosystems are in retreat. Wetlands are vanishing. A warming ocean is spawning more and more powerful storms. Many wildlife species are struggling to adapt. Some never will.

These changes are leading to direct habitat loss as well as more insidious changes, such as decreases in snowpack that result in a massive loss of fish spawning sites and increased summertime temperatures that will change the wildlife communities of forests and streams forever. From game species as varied as ruffed grouse and mountain goats, to venerated fish such as salmon and smallmouth bass, America's rich community of fish and game is at risk from a warming world.[6]

This report puts a spotlight on 10 species of American wildlife that hold a special place in the hearts of conservationists, and that are battling some of most difficult challenges in the natural world. These fish, birds, and mammals are not alone, however. Behind each of these icons are many more that face a troubling future due to toxic air pollution and rising temperatures. Those modern threats will change the game for American hunters and anglers—unless conservationists and the sporting public stand up to fight for clean air and an end to the pollution that leads to a warming climate.


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Wildlife Icons at Risk

Northern Bobwhite


Seabamirum on flickr

RANGE: Central and Eastern U.S.

A pointing dog's trembling stance, wind in the pines, the explosive roar of a covey of quail taking flight—these are beloved aspects of hunting heritage across much of the South and Midwest. But a changing climate spells trouble for bobwhites. Even though warming temperatures could support an increase in bobwhite populations at the northern limits of their range,[7] hotter, drier summers can also lead to embryo mortality and nest abandonment by parent birds. Also, quail chicks rely on a diet rich in insect protein,[8] and harsher summers could reduce the availability of such high-quality prey items.[9] Hot times for quail will also bring unwelcome neighbors to fields and hedgerows in the form of invasive fire ants, which have been shown to negatively impact bobwhite chicks.[10] In more western states, the expansion of steppe habitats could push bobwhite quail out of their grassland homes.[11] Quail also feed on the seeds of plant species known to be sensitive to ground-level ozone, such as white ash, fox grape, sycamore, and yellow poplar.[12]

THREATS: Ground-level ozone. Climate change.

Lesser Scaup


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RANGE: Breeds in Alaska, western and eastern Canada, northern U.S. prairies and south-central U.S.; winters along all U.S. seaboards and neighboring inland waters.

From their boreal forest and prairie pothole breeding grounds, lesser scaup wing southward across all four North American flyways. Migrating in large flocks, these swift fliers are a favorite quarry for big-water duck hunters. Fewer of these ducks are making it to hunters' decoys, however. According to the U.S. Fish and Wildlife Service, the continental population for lesser scaup has fallen to a record low, and the future presents enormous challenges.[13] In the prairie pothole region, a warming climate could impact 90 percent of the small wetlands vital for breeding ducks.[14] Breeding range for lesser scaup on National Wildlife Refuges alone has been predicted to contract by nearly 37 percent due to climate change.[15] Acid rain in Midwest wetlands used by scaup on their spring migrations southward could be one factor in reducing the quality of invertebrate foods in the critical weeks prior to breeding.[16] In the boreal forests of northern Alberta, acid rain caused by pollution from the massive tar sands development projects in northern Alberta could affect birds in a highly productive portion of their breeding grounds.[17] And lesser scaup from areas as geographically diverse as the Great Lakes, Florida, and San Francisco Bay have shown relatively high levels of mercury, prompting further scientific study.[18]

THREATS: Mercury. Acid rain. Climate change.

Black Duck


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RANGE: Breeds across eastern and central Canada and north-central and eastern U.S. south to North Carolina; winters in eastern and central U.S.

American black ducks hold a special place in the hearts of duck hunters. Big, brawny, and revered as one of the craftiest of all ducks, black ducks are considered a true trophy on the wing. But even its legendary wariness won't protect the black duck from a one-two punch of climate change and acid rain. One-third of the 165 species of wetlands breeding birds show medium or high vulnerability to climate change, and black ducks have been identified as particularly susceptible to sea-level rise associated with a warming climate.[19] And acid rain affects black ducks in insidious ways. Young broods of black ducks have shown a tendency to avoid wetlands with high acidity,[20] and no wonder: Acidification of wetlands used by black ducks decreases the quality of forage foods, and has been shown to stunt the growth and development of black duck chicks,[21] even potentially reducing bone mass and strength.[22]

THREATS: Acid rain. Climate change.

Walleye

RANGE: Native to Midwest, now found across most of U.S.

Few fish have such a rabid fan base as the cool-water-loving walleye. The state fish of Minnesota and South Dakota, walleye are targeted by anglers who chase these toothy predators year-round—in rivers and lakes, from boats and shore and even through the ice. But the walleye, unfortunately, is the "poster child" for mercury problems in fish,[23] with fish consumption advisories posted across its range. Most Great Lakes states have posted a statewide advisory for all inland waters due to mercury contamination—women of child-bearing years, nursing mothers, and anyone under the age of 15 are advised not to eat more than one walleye meal per month.[24] And a warming climate is literally changing the world around the walleye. In Minnesota, warming lakes are decimating populations of ciscos, a major prey item for walleye.[25] At present, 650 of the state's lakes have adequate water quality for ciscoes, but scientists estimate that number will plummet to less than 100 within 50 years.[26] Acid rain could also be winnowing away walleye populations. Studies at Ontario's George Lake suggest that acidification of lake waters has led to the complete extirpation of walleye in the lake.[27] Researchers also have concerns that a warming climate is allowing fish not native to walleye waters to expand their range and compete with walleye for food sources.[28]


woody1778a on flickr

THREATS: Mercury. Acid rain. Climate change.

Salmon

RANGE: Pacific watersheds and northeastern Atlantic seaboard including Canadian maritimes.

From their storied migrations to their wild, remote habitats, few other fish can compare to the salmon for a majestic expression of the marvels of natural history. Due to their extraordinary ability to move from freshwater to saltwater environments, however, few other fish are as imperiled by a world quickly changing. In addition to the well-known challenges salmon face from human-caused factors such as dams, the fish must confront a warming climate. Healthy stocks of salmon in the Pacific Northwest are dependent on sufficient water supplies in their headwater spawning streams. But the region has warmed over the last century, with snowpack volumes dropping more than 10 percent. The timing of peak stream flows from melted snow water are coming earlier and earlier, and with warming waters and lower flows, available spawning habitat will plummet.[29] Some scientists predict that Oregon and Idaho could lose more than 40 percent of salmon habitat by 2090.[30]

Feeding might also be hampered by ocean acidification. Emerging research


scazon on flickr

raises concerns that acidifying Pacific waters might not support healthy populations of the swimming sea snail, a tiny crustacean that makes up nearly half the diet of pink salmon.[31] Across the continent, acid rain threatens Atlantic salmon populations from southeastern Canada and into Maine. Acidic waters impair the ability of a salmon's gills to absorb oxygen, leading to circulatory failure.[32] Research on Atlantic salmon has also shown that acidification may disrupt the efficiency of its biophysical alarm system—salmon that can't process threats might be at risk from increased predation.[33] According to the Atlantic Salmon Foundation, acid rain has decimated salmon in Nova Scotia's southern upland region, with populations in 50 rivers threatened.[34]

THREATS: Acid rain. Climate change.


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Northern Shoveler

RANGE: Breeds in widespread regions across northern U.S. and Canada; winters along all U.S. seaboards and neighboring inland waters.

Hunters call the northern shoveler a "smiling mallard" due to the exposed bill serrations that give it a garish grin. The flattened bill functions as a sieve to allow the shoveler to filter out tasty morsels from lake-bottom muck and decaying vegetation. That creates a problem: tests on northern shovelers in the Great Salt Lake Basin of Utah have shown some of the highest mercury concentrations ever reported for the species.[35,36] Those concentrations frequently exceeded or approached the 1 part per million limit considered unsafe for human consumption of fish and game,[37] and well above the thresholds that many states now use in developing their fish consumption advisories. Nor are northern shovelers immune to the challenges posed by a warming climate. Shovelers are very common breeders in the prairie pothole region, where rising temperatures could impact 90 percent of the small wetlands vital for breeding ducks.[38]

THREATS: Mercury. Climate change.

Largemouth Bass

RANGE: Southern Canada and throughout U.S.

The vicious surface strikes and head-shaking leaps of the largemouth bass make it America's favorite gamefish—but those predatory behaviors also make the largemouth highly susceptible to America's serious water quality issues. Bioaccumulation of mercury in largemouth bass is an issue in states from California[39] to New York[40] to Massachusetts.[41] In many Arkansas waters, even in wildlife refuges, consumption of largemouth bass is strictly curtailed due to mercury concentrations.[42] In some areas, acid rain can also harm bass populations. In a Wisconsin study, bass in highly acidified lakes spawned, but their eggs failed to hatch. While bass grew larger for a few years, they ultimately disappeared from the lake.[43]

Climate change is also an issue for largemouth bass. Some anglers are heartened with news that a warming climate might bring faster growth rates for bass.[44] But scientists warn


F. Eugene Hester, USFWS

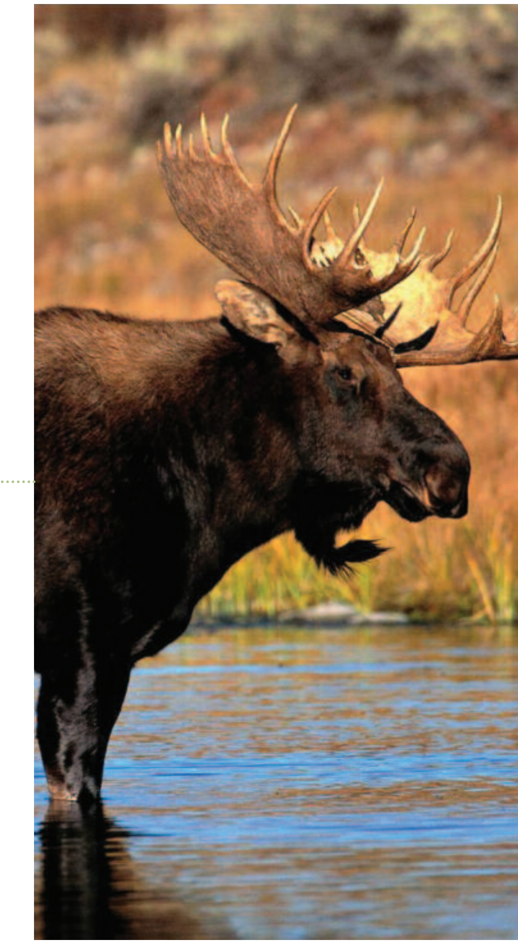
that warming waters threatens to alter entire aquatic food webs, and could destabilize entire ecosystems. A warming climate could lead to a greater number and greater intensity of hurricanes, and as rising seas inundate freshwater marshes along the coast, more largemouth habitat could be lost.[45]

THREATS: Mercury. Acid rain. Climate change.

Moose

RANGE: Canada south of the Arctic, Alaska, New England, New York, upper Rockies, Minnesota, and Michigan.

Massive and majestic, moose are a symbol of the North Woods and a cherished icon of North American hunting for both Native Americans and modern hunters alike. These big mammals are tied to wetlands and require cool climates, and those aspects of moose biology place the animals in difficult straits. When it comes to rising temperatures, heat affects moose directly, leading to a fall in pregnancy rates.[46] Moose may have evolved to bear young when climate conditions are most favorable, and some scientists are concerned that they could have a difficult time adapting to climatic variability.[47] A warming climate will also devastate moose habitat as the preferred habitat of aspen and birch retreats northward.[48] In northwestern Minnesota, moose numbers fell from more than 4,000 animals to fewer than 100 over the last two decades. Higher temperatures also may promote higher winter tick infestations, which have decimated the moose herds in Isle Royale National Park[49] and impacted moose in New Hampshire[50]; a single moose can host as many as 120,000 ticks.[51]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Ground-level ozone might add to these ills. Birch, beech, and aspen have been shown to be sensitive to high levels of ozone,[52] and these trees are important moose habitat. There also is the possibility that acid rain might be helping whittle moose populations to a fraction of their historic numbers. The potential for acid rain to leach cadmium from watersheds[53] could be a problem for moose. In Norway, moose with high cadmium levels in their kidneys and livers were shown to have lower body weights and diminished reproductive success.[54] In Maine, high cadmium levels have led to advisories for human consumption of moose liver and kidneys.[55]

THREATS: Acid rain. Ground-level ozone. Climate change.

HuntFishGuide on flickr

Striped Bass

RANGE: Native to the U.S. Atlantic and Gulf seaboards, now found along Pacific seaboard and reservoirs across U.S.

The comeback of the striped bass has been heralded as one of the great conservation success stories of the last 100 years. Stripers, also known as "rockfish," live as adults in the open ocean, and migrate up coastal rivers to spawn in the spring. Few gamefish require such vastly different habitats. But there could be rocky times ahead for rockfish populations. A warming climate could lead to sea-level rise that would decimate the coastal marshes that serve as nurseries for juvenile striped bass. In the Chesapeake Bay, warming waters could lead to increased incidence of toxic algal blooms, which could have profound impacts on fish resources, and an increased incidence of hypoxia, which could reduce the amount of deep, cool waters favored by striped bass.[56] And warmer waters can have a cascade of ill effects on fish. Fish can bioaccumulate toxic chemicals more quickly at higher temperatures, and research has shown that striped bass with higher loads of organochlorines produced fewer viable offspring.[57]

As top predators, striped bass are known to have high levels of mercury. Mercury bioaccumulation has been found in striped bass populations in a wide range of waters, from the open marine environments of Rhode Island's Narragansett Bay[58] to Georgia's Savannah River.[59]

THREATS: Mercury. Climate change.

Brook Trout

RANGE: Native to northeastern U.S., southeastern Canada, and the Southern Appalachians, now found across eastern and western U.S. and Canada.

Dappled with color and quick to take a fly, brook trout are a cherished part of our national fishing heritage. The only other trout species (along with lake trout) native to eastern America, they are sought in tiny headwater creeks, remote wilderness ponds, and fast-flowing rivers. The very fact that they require clear, cold, healthy waters is proof that the brook trout lives up to its scientific name, *Salvelinus fontinalis*, which means "dweller near springs." Unfortunately, that requirement also puts brookies in peril from a host of air pollution problems. In the Northeast, many high-elevation brook trout streams have suffered from high rates of acidification, which studies have shown causes decreased growth rates, lower survival rates of smaller trout and a drop in egg-to-larva survival rates.[60] Farther south, in the Great Smoky Mountain National Park along the Tennessee-North Carolina state line, a study of caged brook trout in three mountain streams showed measurable signs of physiological stress during periods of artificially induced acidification.[61]

And it's not just acid rain that's stressing native brook trout. In a recent survey of data from the northeastern United States and southeastern Canada, 75 percent of brook trout samples showed mercury concentrations higher than accepted levels of concern.[62] And a warming climate is expected to decimate populations. Parts of Michigan's Muskegon River watershed could see a 90 percent reduction in brook trout populations due to expected changes in air and water temperatures from climate change.[63] Across the Appalachian mountain range, some scientists estimate that up to 90 percent of brook trout habitat could be lost due to climate change, and what suitable habitat remains could be fragmented and scattered, making natural recolonization improbable.[64]

THREATS: Mercury. Acid rain. Climate change.

Eric Engbretson, USFWS

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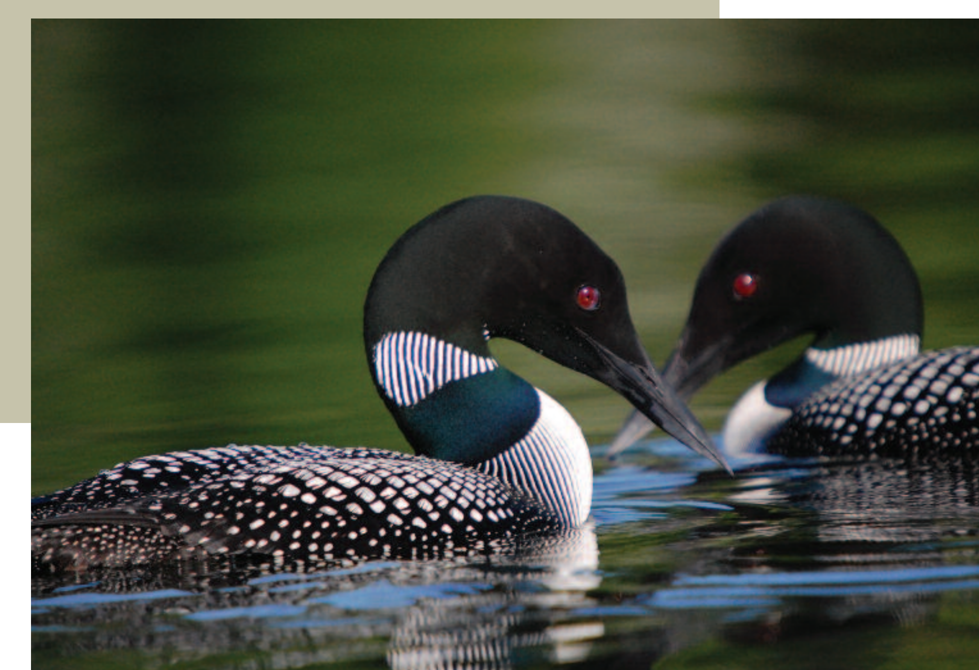
OTHER AFFECTED SPECIES

- **River otters and mink are the frequent companions of anglers on streams and creeks. Feeding heavily on fish, otters and mink accumulate mercury from their prey. At high levels, mercury has been associated with toxicity to the nervous system and death in adult mink and otters[65]; mercury levels in the tissue of one Ontario river otter suspected of dying of mercury poisoning were among the highest ever recorded for a free-living terrestrial mammal.[66]**

black-throated green warbler on flickr

- **The upward flute-like trill of the wood thrush signals the end of the day for hunters and anglers in Eastern forests. But wood thrush numbers are falling, in part because of acid rain that depletes the soil of much-needed calcium. Without the needed nutrient, the birds lay thin, brittle eggs.[67] Mercury also has been found in the wood thrush, and studies have shown that a related species, Bicknell's thrush, bioaccumulates mercury not from aquatic sources but from eating mercury-laden insects in their forest habitat.[68]**

- **Few bird songs are as recognizable as the tremulous call of the common loon. Northern lakes are getting quieter, however. High levels of mercury in loons has been shown to cut loon egg production.[69]**



Gary J. Wege, USFWS Midwest

Taking Action for Wildlife

Throughout American history, conservationists have fought to protect and preserve wildlife and wild places. Once upon a time, those threats were as visible as a cleared forest—unchecked logging, unregulated water pollution, unrelenting development. Now, some of the most challenging threats to the future of our iconic game species are invisible, silent, and progress over long periods of time. They are no less real, however, and they require no less action on the part of America's hunters and anglers.

The wildlife and wild places that Americans hold dear are under assault from 21st century pollution challenges. Thankfully, solutions exist to turn back the tide of these toxic, invisible villains. Fully utilizing our environmental laws such as the Clean Air Act can help rid the air of harmful pollutants, restoring health to the waters and woodlands that support America's legacy of fish and wildlife.

But moose, brook trout, black ducks, salmon, and other species have no voices of their own and each of us has a responsibility to help reduce the pollution that threatens them.

For over forty years, Americans and wildlife have benefitted tremendously from Clean Air Act programs that:

- **Protect** our streams and rivers from acid rain, our lakes from toxic mercury pollution, and our forests from tree-killing smog.
- **Prevent** 160,000 adult human deaths in 2010 through improved air quality—a number projected to grow to more than 230,000 pollution-related deaths prevented in 2020.[70]
- **Produce** benefits to our economy that will exceed $2 trillion by 2020, while only requiring an investment of $65 billion in implementation costs—that's a return on our investment of 30 to 1.[71]

Passed by Congress with overwhelming bi-partisan support, the Clean Air Act has been one of the starting points for our country's proud legacy of environmental protection. Now, more than ever, that legacy needs to be protected. The Clean Air Act is a critical tool that we need available to finish the job of significantly reducing the air pollution that is wreaking havoc on wildlife.

Hunters, anglers, and conservationists need to speak up in support of the Clean Air Act and encourage the Environmental Protection Agency (EPA) to update the nation's pollution standards to address the wildlife impacts caused by mercury, ozone, sulfur dioxide (acid rain), and carbon dioxide (climate change). Right now, the EPA is taking action to make our country's biggest polluters responsible for their pollution and we must demand that Congress does not interfere with these important steps to safeguard our wildlife and wild places.

America has a choice: Clean air, clean water, and healthy wildlife populations, or a polluted future where the only winners are special interests. This nation's core of conservationists, hunters, and fishermen has a proud legacy of working to protect wildlife and that effort is still underway.

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National Wildlife Federation
11100 Wildlife Center Drive
Reston, VA 20190
703-438-6000
www.nwf.org