



Ticked Off

America's Outdoor
Experience and
Climate Change



NATIONAL
WILDLIFE
FEDERATION.



Preface



Experiencing nature with my family and doing the outdoor activities in *Ranger Rick*® magazine were the foundation of my commitment to wildlife conservation—and today I strive to instill the same passion for wildlife in my two-year old daughter, Riley.

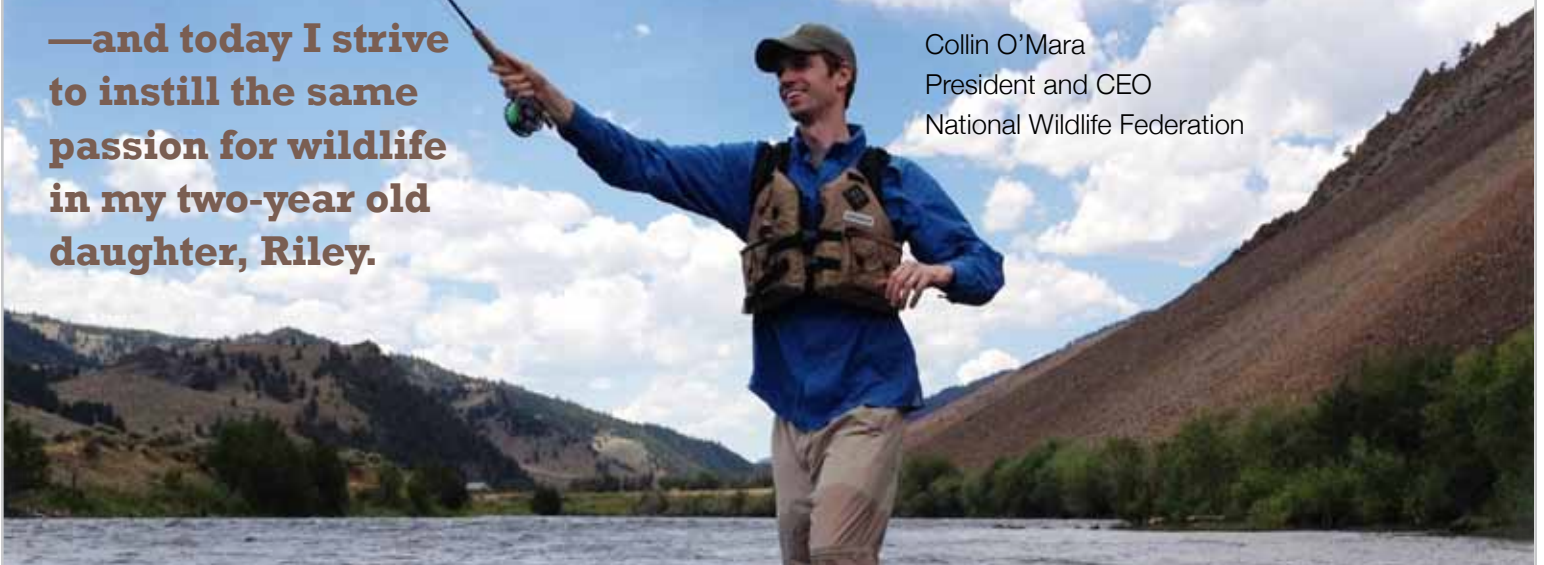
Every child across the nation deserves the opportunity to grow up loving wildlife and actively experiencing the great outdoors. We all know the lifelong passion that contact with nature can inspire and the unfortunate consequences of a feeling of indifference for those who lack such exposure. Experiencing nature with my family and doing the outdoor activities in *Ranger Rick*® magazine were the foundation of my commitment to wildlife conservation—and today I strive to instill the same passion for wildlife in my two-year old daughter, Riley.

All of us at the National Wildlife Federation, including our 49 state affiliates and our more than four million members and supporters, are committed to protecting wildlife and connecting Americans with nature. Our work is more important than ever because across the nation critical wildlife habitat and outdoor experiences are being impacted by climate change. We are seeing mosquito, tick, and fire ant populations explode, invasive species threaten native plants and animals, and fires and droughts ravage our forests and wetlands. Ask any hunter, angler, birder, or gardener, and they will tell you that things are clearly changing.

The changes that we are experiencing serve as a clarion call for us to take action. By both improving the resiliency of wildlife habitat and reducing carbon pollution, we will help ensure that future generations have the same opportunities to enjoy nature as we have. We owe it to every child in America, like my Riley, to ensure that they experience the wonder of seeing sea lions, otters, great blue herons, turtles, moose, elk, bison, shorebirds, horseshoe crabs and many other species. I hope you'll join the National Wildlife Federation and our state affiliates in our efforts to make sure all Americans can enjoy wildlife for generations to come. Learn more at www.nwf.org.

See you outdoors!

Collin O'Mara
President and CEO
National Wildlife Federation



Introduction*



National Wildlife Federation/Charlie Archambault

Nearly half of the nation's residents spend time each year engaged in outdoor recreation (Figure 1). The natural world enriches outdoor activities: the spectacular scenery; the amazing wildlife; flowers and trees; clear skies; blue waters; and so much more. Being outdoors is a part of the very fabric of life for so many, and has been for generations. Nowadays, with electronics taking over our lives, getting outdoors happens far too seldom for adults and children alike. But when we do get outdoors it is refreshing, invigorating and provides a sense of well-being as we relax and reconnect with nature. This is what the American outdoor experience is all about.

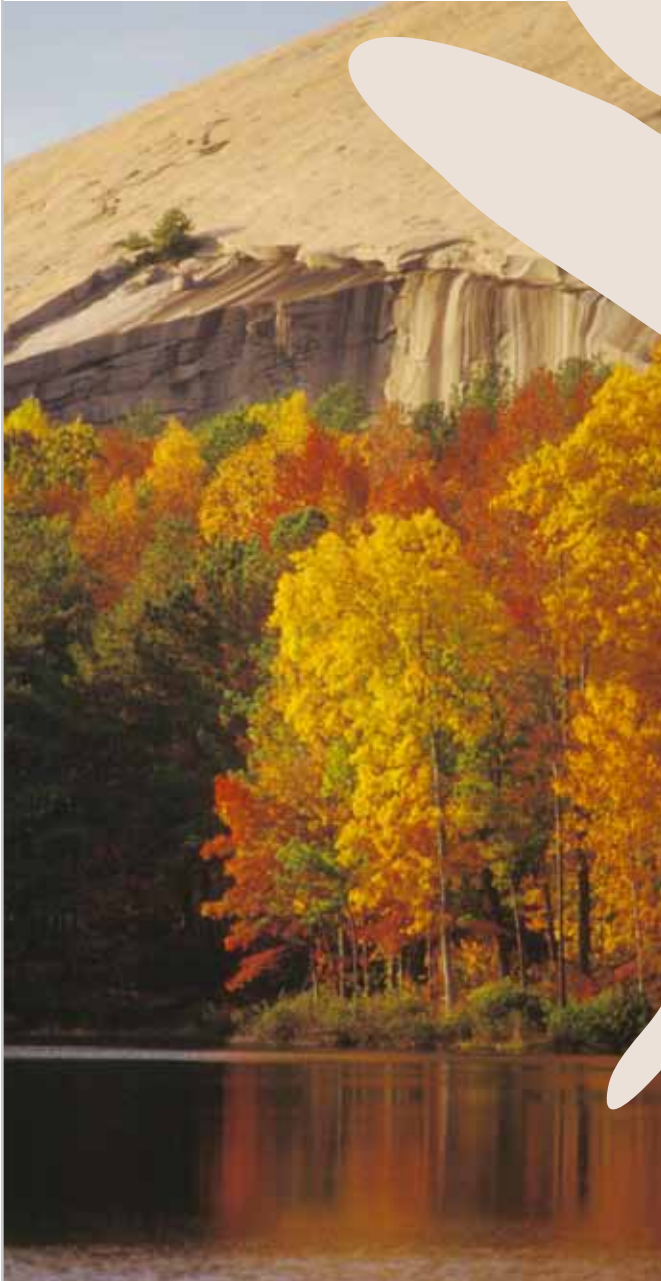
Outdoor Activity	Annual Participation
Going to the Beach	58 million
Bird Watching	50 million
Canoeing	10 million
Fishing	33 million
Hiking	35 million
Hunting	14 million
Kayaking	14 million
Watching Wildlife	72 million

Figure 1. The number of people participating annually in various outdoor recreation activities.

Your Outdoor Experience Opportunities

- Backpacking
- Beach Going
- Bicycling
- Bird Watching
- Boating
- Windsurfing
- Camping
- Canoeing
- Climbing
- Fishing
- Gardening
- Hiking
- Hunting
- Kayaking
- Pet Walking
- Photography
- Picnicking
- Rafting
- Running
- Sailing
- Scuba Diving
- Skiing
- Snorkeling
- Snowboarding
- Snowshoeing
- Surfing
- Swimming
- Wildlife Viewing

*References for each section of this report may be found at: www.nwf.org/tickedoff.



USFWS/George Gentry

Every cloud and snowflake has a different shape and every evening a different sunset. This is the great outdoors.

The great outdoors we cherish so much is an ever-changing world. Move a few miles and you may be swimming in a pristine lake instead of climbing a rugged mountain. The changing of the seasons may have you snowshoeing on a familiar trail you were hiking just a few months ago. The storm-driven winds of yesterday are replaced today by a breeze gentle enough to barely flicker a candle flame. The silver flash of a leaping fish quickly becomes a mere ripple on the water's surface. The riotous flowers of spring grow into fruits and seeds to start the cycle of life all over again. Every cloud and snowflake has a different shape and every evening a different sunset. This is the great outdoors.

But climate change is bringing about stressful new changes to our outdoor world, and we need to take notice. Extreme weather is becoming more common. Droughts and floods are more severe and more frequent. Winter snow is melting away earlier in the spring and fall weather is slower and slower to come about. These and other aspects of climate change are impacting the plants and wildlife that are a central component of the American outdoor experience. We might like an early spring, but so do tiger mosquitoes with their bothersome presence and bites. An Indian summer may be welcomed by us, but it helps winter ticks survive in huge numbers...enough to suck more blood out of a moose than its body contains. Warm winters are a welcome mat for fire ants and deer ticks to expand their range northward where they can inflict pain or disease on unsuspecting people and wildlife. Poison ivy, which we always steer away from, is growing faster and becoming even more toxic, thanks to the rise in carbon dioxide in the atmosphere.

We don't have to and shouldn't stand by and accept what climate change is doing to our planet and our outdoor experience. There are ways to protect ourselves from the pests and poisonous plants that climate change is helping to proliferate (Figure 2). We must also take action as a nation to combat the root of the problem – carbon pollution. We already have the technology and know-how to reduce our carbon pollution by expanding our use of renewable energy sources and increasing energy efficiency. And we can take action to help safeguard wildlife from the impacts of climate change for future generations to enjoy.

To ensure our ability to enjoy the outdoor experience and protect wildlife and communities alike, we should:

- Require reductions in carbon pollution from our largest sources. The U.S. Environmental Protection Agency (EPA) recently took a major step forward by proposing standards to limit carbon pollution from our country's largest source – power plants. These standards, known as the Clean Power Plan, are a critical first step in reducing our country's carbon pollution. We must support the EPA in strengthening and finalizing the Clean Power Plan by June of 2015, and then work with states to ensure they are robustly implementing the plan.

- Transition to clean, renewable energy sources, such as solar and wind power, thereby reducing our dangerous dependence on polluting fossil fuels. We should increase investments in non-polluting sources of energy to speed the way to a clean energy future.
- Safeguard wildlife and wildlife habitat by designing and carrying out climate-smart conservation strategies to reduce the magnitude of climate change impacts and enhance the ability of wildlife and wildlife habitats to survive in a changing climate.

Be Safe Outdoors

When enjoying the outdoors there is always the risk of bites and stings from insects. However, there are some simple ways to minimize or avoid these occurrences while participating in your favorite outdoor activities. Recommendations by the Centers for Disease Control and Prevention (CDC) and others include:

- Wear light-colored, smooth-finished clothing
- Avoid perfumed soaps, shampoos and deodorants
- Don't wear cologne or perfume
- Use approved insect repellents
- Wear clean clothing and keep clean
- Dress to cover as much of the body as possible
- Tuck pants into socks or boots
- Wear tight-fitting sleeve cuffs and collars
- Keep outdoor areas clean and free of discarded food
- Remain calm and still if a single stinging insect is flying around
- If attacked, seek shaded areas or shelter



Doug Inkley

Figure 2. With proper precautions, we can all enjoy the outdoor experience.

Tiger Mosquitoes



NWF/Carla Brown



CDC/James Gathany

The Asian tiger mosquito first appeared in North America in Houston, Texas in 1985 and is thought to have been transported in the residual water in car tires shipped from Asia. The rapid spread of this bloodsucker has been underway for nearly two decades, and it is now present in 26 states in the continental United States, and Hawaii. An Asian tiger mosquito larva can complete its development into a biting, blood-sucking, adult mosquito in as little as a tablespoon of water.

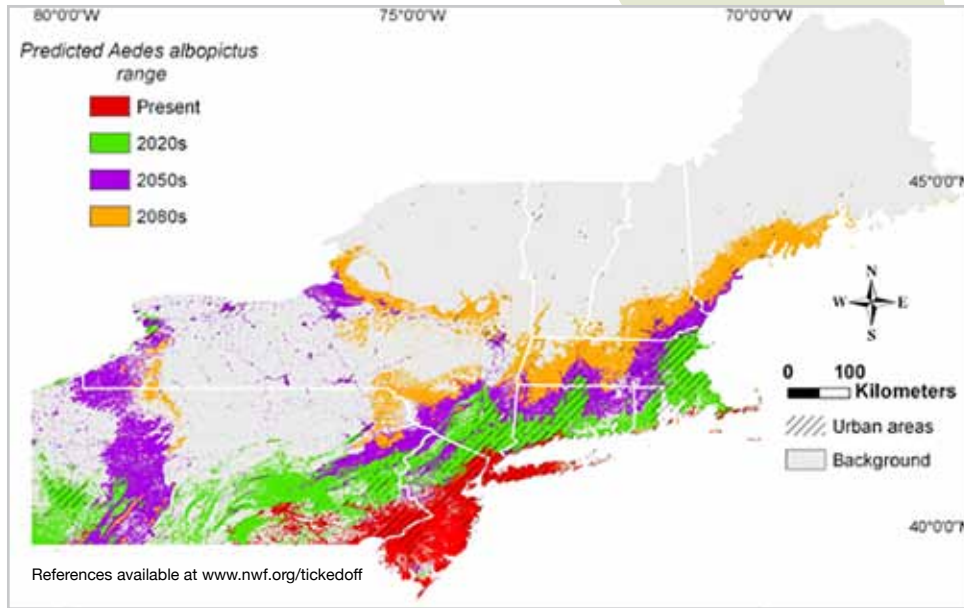
While mosquitoes and their bites are irritants, of even greater concern is their potential for disease transmission. Asian tiger mosquitoes are known to transmit more than

30 different viruses, including West Nile, eastern equine encephalitis, dengue, and chikungunya, all of which pose serious human health risks. And in some places, the Asian tiger mosquito is the principal source of heartworm infections in dogs.

Climate change is projected to bring about an earlier emergence of tiger mosquitoes in the spring, leading to more generations per year. Tiger mosquitoes typically carry tropical diseases such as dengue, also known as “break-bone fever” for the excruciating pain it causes in its victims.

In the Northeast, the tiger mosquito has made it to southeastern Pennsylvania, the southern two-thirds of New Jersey, and Long Island. But climate change promises to make a bad situation worse. Thanks to climate change, the species could move as far north as coastal

Maine and the shores of Lake Erie (Figure 3). Currently inhabiting less than 20 percent of the Northeast, by the end of the century suitable climate areas in the region are expected to double, and the number of people facing exposure is expected to rise to about 30 million.



In the Northeast, the tiger mosquito has made it to southeastern Pennsylvania, the southern two-thirds of New Jersey, and Long Island. But climate change promises to make a bad situation worse.

Figure 3. Expansion of areas with suitable climate is projected to expand to the north and west with high increases in CO₂ emissions.

The Popularity of Paddling and Rafting

Almost 10 million canoers and 14 million kayakers a year paddle in their favorite lakes, ponds, rivers and streams. Joined by 3.7 million rafters, recreation in our nation's waters is a popular activity.

Water safety is a must, but there are other challenges as well. Thanks to climate change, enjoying the water sports requires some extra precautions. The increase in algal blooms, dead zones and fish kills associated with warmer water may make some areas just too unpleasant to venture into.



USFWS/Mark Lisac

Poison Ivy



The towpath in the Chesapeake & Ohio National Historical Park is a popular recreational trail./Doug Inkley



USFWS/Jan Miller

More than 350,000 cases of poison ivy are estimated to occur annually. You can 'get' poison ivy from direct contact, or by indirect contact by touching affected clothing or a pet. The irritating rash can last up to three weeks after contact. Breathing smoke from burning firewood with poison ivy growing on it can cause irritation of the lungs and can be quite dangerous.

In the lower-48 states only California is lucky enough to escape this toxic and unpleasant plant. Instead, California is frequented by poison oak, a very similar species that exudes the same toxic chemical.

Poison ivy is widespread, commonly growing across the ground, up to waist high in shrub-like form, and climbing trees, rocks and buildings. It is particularly common in disturbed habitats such as roadsides, forest edges, old fields and more.

Although its leaves turn a beautiful red in the fall and the

Poison ivy thrives with rising CO₂ levels. As if not already widespread and prolific enough, it grows more rapidly and produces more leaves as atmospheric CO₂ concentration rises.

berries are eaten by birds, people in the outdoors should know how to identify this toxic plant and stay away from it, especially as it becomes more and more prevalent.

The driving force in climate change is the rising level of CO₂ in the atmosphere from the burning of fossil fuels. This increased concentration of carbon dioxide in the atmosphere can directly affect the growth of many plants, as carbon is the basic building block from which photosynthesis creates sugars and releases oxygen.

With higher levels of CO₂ in the air, plants can increase photosynthesis, thereby growing faster and bigger.

Poison ivy thrives with rising CO₂ levels. As if not already widespread and prolific enough, it grows more rapidly and produces more leaves as atmospheric CO₂ concentration rises. Faster-growing vines such as poison ivy could also harm some forest habitats by out-competing slower growing trees, thereby reducing tree regeneration and increasing tree mortality.

Of equal or even greater concern than the more rapid and lush growth of poison ivy is that with increased CO₂ concentrations the plants produce a more allergenic form of urushiol – so not only will climate change bring more poison ivy, but it will be more toxic.

Forests and Fields

Who doesn't love to spend time in the vast fields and forests across our country? The United States has some 72 million wildlife watchers, 14 million hunters, 35 million hikers, 53 million runners and 42 million bikers, as well as countless backpackers, campers, outdoor and wildlife photographers, and more (Figure 1, page 2). No doubt, at one time or another, the vast majority have come into contact with poison ivy and had to deal with the allergic reaction several days later: itching, rash, oozing blisters, or worse in people that are particularly sensitive.

"For 6 years I've noticed a growing encroachment of poison ivy on the downtown Richmond mountain bike trails. What was an occasional outbreak on a small part of my ankle is now a 2 or 3 time a year bout either covering part of my lower leg, or more common, patches across my body, even where clothed; I still carry scars from 4 years ago! The trail overgrows within days of a good rain, and it seems the growing season starts earlier each year and lasts well into the fall. That poison ivy will proliferate even more and become more toxic thanks to climate change, is most unwelcome!"

-Chris Harnish, Ph.D., Exercise Physiology



Chris Harnish

Fire Ants



USFWS/Steve Hillebrand



USDA Agricultural Research Service/Stephen Ausmus

Outdoor enthusiasts throughout the southeastern United States are all too familiar with “red imported fire ants,” often simply called “fire ants.” Native to South America, this species most likely first made its way into Alabama, perhaps transported in ship ballast in the 1930s or 1940s. Since then, it has infested more than 300 million acres across the entire Southeast, from Texas to North Carolina to Florida. Fire ants bite and sting en masse, injecting venom that causes extremely unpleasant burning sensations and blistering. A single colony can contain 250,000 fire ants.

Fire ants can be deadly to wildlife, especially young that are relatively immobile and unable to escape their attack. Ground-nesting birds, as well as lizards, snakes, mice and other native wildlife are at risk of attack and declines in abundance.

The red imported fire ant is projected to benefit from warmer temperatures due to climate change. By the end of this century its range could advance northward by about 80 miles, spreading further across Texas, Oklahoma, Missouri, Tennessee and Virginia.

Native to South America, this species most likely first made its way into Alabama, perhaps transported in ship ballast in the 1930s or 1940s. Since then, it has infested more than 300 million acres across the entire Southeast, from Texas to North Carolina to Florida.

Deer Ticks

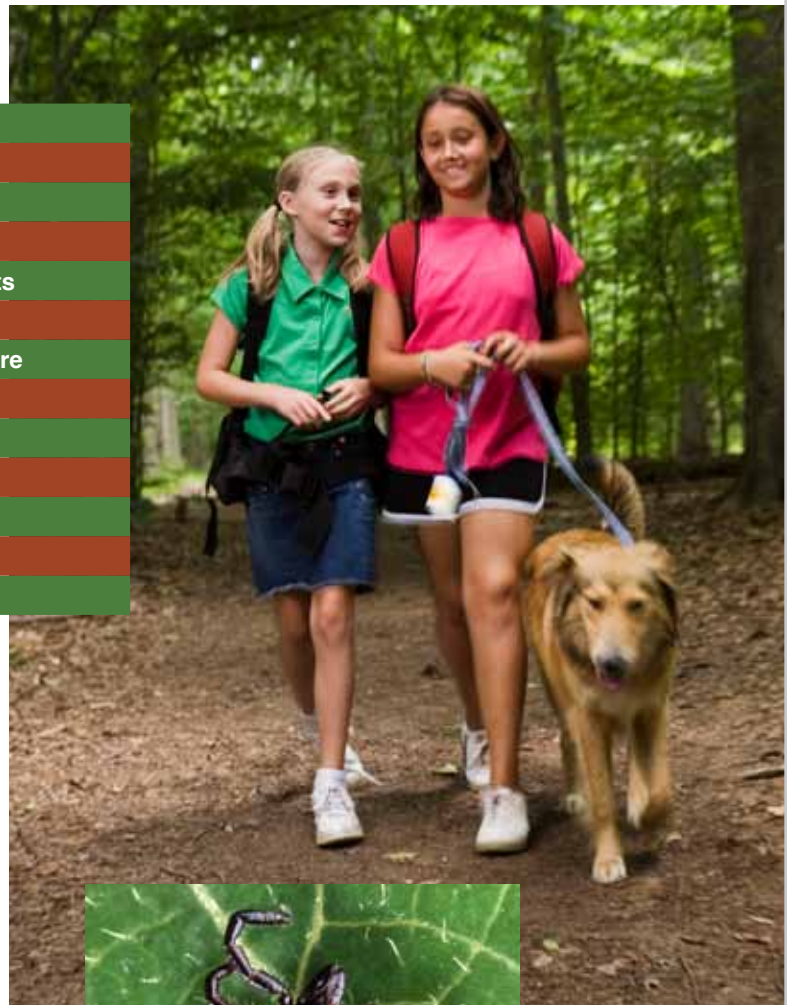
There are many different species of ticks and many different diseases they can transmit. The most well-known is the blacklegged tick (*Ixodes scapularis*), commonly known as a “deer tick,” which transmits Lyme disease. Widely distributed throughout the eastern half of the United States, the deer tick’s life cycle takes two years to complete. Larvae hatch from eggs in the late summer, feed on small rodents such as mice, and molt into nymphs that feed throughout the spring and summer of the following year, then molt into adults. Adults mate either off or on the host and are active through the fall and winter into the next year, laying their eggs in the spring, thus completing the life cycle. The bacterium that causes Lyme disease is picked up by deer tick larvae and nymphs when they feed on infected mice. Most of the ticks that bite and infect humans with the disease are nymphs, which are most active in the summer months when people and pets are also most active. However, the small nymphs are often overlooked, and people most commonly notice on themselves the larger and more obvious adult deer ticks.

Lyme disease in North America can cause a variety of debilitating symptoms, from fever and headaches to chronic joint and central nervous system impacts. In rare cases, Lyme disease can be deadly. Deer ticks can also transmit the bacterial disease anaplasmosis, and babesiosis, which is a protozoan, to humans. Lyme disease and anaplasmosis can be transmitted by deer ticks to dogs as well.

More than 30,000 cases of Lyme disease are reported annually to the Centers for Disease Control and Prevention, but the actual number of cases may be 10 times greater than that. Most cases are in the Great Lakes region and especially the northeastern United States (Figure 4, page 11 & Table 1). Although deer ticks are widespread and abundant in the Southeast, due to differences in the host species diversity the ticks feed on there, they are less likely to carry and transmit the disease.

Connecticut
Delaware
Maine
Maryland
Massachusetts
Minnesota
New Hampshire
New Jersey
New York
Pennsylvania
Vermont
Virginia
Wisconsin

Table 1. Some 95% of Lyme disease cases were reported from just 13 states in 2012.



NWF/Charlie Archambault



Agricultural Resource Service/Scott Bauer

Deer ticks are projected to be more widespread than ever before primarily due to climate change.

Reported Cases of Lyme Disease - United States, 2012



1 dot placed randomly within county of residence for each confirmed case

Figure 4. Lyme disease cases reported in 2012.

Deer ticks are projected to be more widespread than ever before primarily due to climate change. Average minimum winter temperatures below about 19°F keep deer ticks from establishing stable populations. As the climate change trend continues, milder winters are projected to significantly increase their range. However, in Ohio, their range is already spreading faster than projected.

We can only hope that while the deer tick range expands, the climate and other factors in those areas won't be equally favorable for the diseases they carry and their transmission to humans. But, even within their current range, the tendency for adult ticks to become active during winter thaws suggests that warmer winters will increase exposure of humans to ticks and contraction of Lyme disease.



National Wildlife Federation Photo Contest/Sandra Fifield

Forests and Fields

Who doesn't spend time in the fields and forests? There are many reasons so many people do...more than 72 million wildlife watchers (including more than 50 million birders), nearly 14 million hunters and more than 35 million hikers, as well as countless backpackers, campers, photographers and more. As outdoors people, we always know it's important to be alert to poison ivy, ticks, mosquitoes and other risks. This becomes even more important as climate change gives poison ivy, fire ants and disease-carrying ticks and mosquitoes a big boost.

"I'm ticked "Orff" about deer ticks.

I grew up into my teen years in the early 1960's in southern New Hampshire. I was a "boy of the woods." I knew I was destined to become a wildlife biologist since I was very young. Actually, I called it "a forest ranger that worked with animals" since I had not yet heard the term wildlife biologist.

One thing my vision of my dream job did not entail was dealing with ticks. You see, there were none back then. I never had a tick on me or my dog until the last two or three decades. And it seems that the number of ticks has increased significantly within the last decade or so as New Hampshire's winters have melted away before my very eyes. Yes, for the last decade or more our winters have warmed leaving us with an abundance of ticks.

I, like many of my fellow New Hampshire wildlife biologists, have had Lyme disease in the last decade or so. It is a constant battle to try to prevent the disease in us and our pets. Just this last year when I took my bird dog in for her annual spring heartworm check and Lyme disease shot when she was diagnosed with anaplasmosis, another disease transmitted by deer ticks. This required a month-long treatment with an antibiotic called doxycycline. And just this past month my mom's dog was diagnosed with the same disease.

Looking at her vet bill I see- Annual Lyme Vaccine \$26, Lyme and heartworm test \$40, Doxycycline \$37. I just see these as more of the burden of cost on us of carbon pollution causing climate change and increased tick numbers."

- Eric Orff, Ticked Orff about Ticks and Bear Biologist (retired), New Hampshire Fish and Game Department

Winter Ticks



National Wildlife Federation Photo Contest/Phillippe Henry

Winter ticks (*Dermacentor albipictus*), also known as moose ticks or elk ticks, have a completely different life cycle than deer (black-legged) ticks. Unlike deer ticks, they do not parasitize humans and aren't known to carry any diseases that can infect humans. Winter ticks parasitize their host during the winter, unlike deer ticks, which are most active in the summer. In the fall the larvae of winter ticks climb vegetation, where they can catch a ride when a large mammal such as a moose brushes by. A moose can be parasitized by thousands of ticks at a time, as the larvae on the vegetation interlock their legs so that when one tick is swooped up by a passing animal they are all transferred. Once on their host, the ticks stay with that animal throughout the winter as it develops from larvae to nymph to adult, eating blood meals in all three stages. In the spring the adults drop off to lay eggs and the cycle starts over again when the eggs hatch into larvae in the late summer.

“Climate change can be predicted to improve conditions for winter ticks through longer, warmer falls and earlier snowmelt in the spring.”

- Natural Resources Research Institute, University of Minnesota

Climate change is helping winter tick populations explode. When larvae are seeking out their hosts in the fall, their activity increases as the temperature increases, which leads to greater success finding a host. And, a late onset of winter means a longer period of time during which moose are exposed to picking up ticks. Finally, late onset of winter also means higher populations of tick larvae seeking a host, as snow and cold help kill some of them off, limiting population growth. In the spring when adult ticks drop off their host to lay their eggs, their survival rate is higher on bare ground than it is on snow, meaning that earlier springs with less snow on the ground also help winter tick populations grow.

Winter ticks can infect moose, elk, caribou, white-tailed deer and mule deer. However, moose are the most susceptible to severe infestation, sometimes by the tens of thousands. It is unclear why, but their vulnerability appears to be related to moose having a much lower propensity to groom, which would help rid them of more ticks. Severe infestations can cause high mortality in spring, as well as likely increased vulnerability and loss to predation. Body weights can become so low that moose are unable to regain enough weight by fall to become pregnant. Heavy tick loads also result in severe anemia, causing death especially in calves, as well as a loss of hair which results in hypothermia. Heavily infected moose essentially starve to death because they eat less when irritated by ticks, lose body heat due to hair loss, and suffer extensive blood loss to the ticks.

In Minnesota, some moose have been found burdened by 50,000 to 70,000 winter ticks—ten to twenty times more than normal. In an effort to rid themselves of the winter ticks, moose will rub against trees and scratch with their teeth and hooves. These behaviors causes their hair to break off at the base, which is white. These resulting “ghost” moose are then without insulating hair, leaving them vulnerable to cold exposure and death.

The rising winter tick populations in Maine and New Hampshire have contributed to increased mortality, reduced productivity and population decline. As a result, the moose hunting season has been cut back, with fewer permits issued. In 2014, moose hunting permits in Maine were slashed by 25 percent because of the explosion in the winter tick population. In Minnesota, moose hunting has been completely closed due to a rapid population drop. Under intense investigation, winter ticks may also be an important factor in Minnesota’s moose decline.

Hunting

Nearly 14 million people annually engage in hunting. In our modern era, professional wildlife management has developed the ability to maintain healthy wildlife populations while providing an abundance of game wildlife for this popular fall tradition. Hunters range the fields, forests and streams seeking ducks, grouse, partridge, deer, moose and other wildlife.

The hunting tradition is changing as the climate warms. The nationwide heat wave of 2012 caused widespread outbreaks of hemorrhagic disease in white-tailed deer. Large die-offs were reported in many areas, necessitating reducing the number of deer hunting permits allowed so as to sustain the population. Waterfowl hunters are finding delays in the fall duck migration and swatting mosquitoes in their duck blinds, which used to be killed off by early frosts. Bird hunters need to be aware that their bird dogs, like humans, are susceptible to Lyme disease and anaplasmosis, which can be transmitted by deer ticks to dogs.

Hunting and Deer Ticks

“I’ve hunted and fished pretty much my whole life. I big game hunt, but upland bird hunting with my dogs is the highlight of my outdoor experience each year. I love hunting for grey partridge and sharp-tailed grouse during the crisp cool days of fall. Out here in the great big open, with endless skies, the dogs working back and front of you, and walking 12 and 14 miles a day: to me, it’s the best time of the year.

The deer tick, which carries Lyme disease, is my main concern. As a boy growing up in the Hudson River Valley, there were few kids who were in the woods more than I was, and I don’t remember ever once finding a tick as a child. Then we had this explosion of deer ticks. I remember one day my buddy and I came out of the woods from deer hunting in tree stand and picked 42 ticks off each other.

I now live in Montana, and I believe it’s the last state that doesn’t have the deer tick. A lot of hunters in this region hunt throughout the country, and they take their dogs with them and bring them back. We have now seen the spread of the deer tick across the United States, and I’m very concerned that we will wake up one day and have deer ticks in Montana as well.

I know many families are now not letting their children go in the woods because of the concern of Lyme disease. If we don’t let children play in the woods and connect with nature, I think we are really going to be in trouble, so the deer tick is a real concern to me personally.”

- Ken Barrett, TV Host of “Life in the Open” 2005-2010.



USFWS/Brett Billings

Algal Blooms



USFWS/Carl Zitsman

Fish, like all wildlife species, have certain habitat requirements that must be met if they are to survive, reproduce and maintain a population for the long term. All fish require oxygen and a particular range of water temperatures in which they thrive. Some fish species are more tolerant than others to low oxygen levels and high water temperatures, but even these fish have their limits. Higher temperatures combined with oxygen depletion can be a quiet killer.

Climate change is raising water temperatures across the country. In the Pacific Northwest, when the average daily air temperature in the warmest summer months is greater than 69.8° Fahrenheit, the “thermal limit” has been broached for most adult salmon, steelhead, and trout species, species that need cold water to thrive. Northern pike, another cool-water species, is a particularly vulnerable fish species because they are unable to adjust to higher water temperatures for more than a few days. Other species endangered by higher water temperatures include walleye, yellow perch, and bluegills. If water temperatures stay above average for too long, a river may become an unsuitable habitat for fish.

Rising temperatures have indirect impacts on fish, too. The combination of warmer water, which cannot hold as much oxygen, and algal blooms which use oxygen as they grow and subsequently die and decay, can cause oxygen levels to plummet, causing “dead zones” where fish simply cannot survive. There is yet another indirect climate-driven force exacerbating the growth of algae and decline in dissolved oxygen. Heavier rain events brought on by climate change can create voluminous runoff from fertilized areas. The unusually high nutrient load then creates ideal conditions for further algal growth and even greater oxygen depletion.

When water gets too warm and oxygen levels decline, fish can be more susceptible to toxins, parasites, and disease, and growth rates can decline. Extreme conditions result in ‘fish kills,’ as we saw in the extreme summer heat wave that enveloped the nation in 2012.

Fishing

Fishing is a favorite pastime across the country. More than 33 million Americans annually engage in fishing. But, during the heat wave of 2012 the stench of rotten fish was common across the country in rural and urban areas alike as fish died by the tens of thousands, if not millions. Driven by climate change, water temperatures are rising and becoming just too hot to bear, resulting in fatal consequences for fish and other aquatic life.

Extreme weather from climate change is also impacting fisheries. For 22 fishing seasons, Charter Boat Captain Dave Spangler of northern Ohio has kept a careful eye on changes to Lake Erie. *“I’ve been fishing here since the ‘70s – saw the nutrient over-loading, primarily from sewage treatment plants, and deadly algal blooms back then get cleaned up – but now fear we are headed quickly downhill again. The harmful algal blooms of 2011 really rang the alarm bell.”* (see Figure 5)

Increasingly heavy precipitation events have prompted what Spangler estimates is a doubling of draining tiles in watershed farmland. *“When we used to get storms, they’d be one inch here, one inch there. Now we get frequent three-inch rainfalls combined with faster run-off from the drainage tiles, and the phosphorus from farms comes rushing into the lake.”*

Spangler and the Lake Erie Charter Boat Association are taking a ‘citizen-science’ approach to combating algal blooms and catching fish. Once a week a charter boat captain takes water samples and sends them to researchers at The Ohio State University who track the health of the lake and make projections about the severity and location of algal blooms. In addition, fish samples are sent to Heidelberg University for testing to ensure that the fish continue to be safe to catch and eat.



NASA Earth Observatory

Figure 5. Heavy algal growth in the shallow western basin of Lake Erie in October, 2011. NWF President and CEO Collin O’Mara near Toledo, Ohio during the drinking water ban in August, 2014 due to toxins produced by the proliferating algae.

Jellyfish



National Wildlife Federation Photo Contest/Foley

istockphoto

Jellyfish have inhabited our oceans for about 500 million years. We perceive them as both beautiful science-fiction-like creatures gliding throughout the ocean and as deadly venomous creatures lurking in the depths. Deserving of both views, they are also unique and fascinating organisms. Simple in design and transparent in body, they can swim and migrate as well as sense water depth, salinity, sunlight and other animals.

Jellyfish are best known for their tentacles, effective natural weapons used both for defense and for feeding. Small “nematocysts” on the tentacles have barbs on a coiled thread. When touched, the thread rapidly uncoils, thereby impaling its prey or enemy and injecting toxins. Some jellyfish have weak nematocysts unable to penetrate our bodies and inflict pain, while others are deadly. According to an estimate by the National Institutes of Health, there are about 150 million jellyfish stings globally every year.

Jellyfish blooms, wherein massive numbers of jellyfish occur, are considered to be a natural phenomenon of

healthy ecosystems. However, massive outbreaks of jellyfish have become more common, with overfishing and climate change, as well as habitat change and high levels of nutrients, all thought to be contributing factors. Scientists think that there may be a link between the warm ocean water and the abundance of jellyfish. Jellyfish have been observed to be more common in warmer years. Not surprisingly, jellyfish blooms are expected to become more frequent and more severe as the climate changes. Already, in Chesapeake Bay jellyfish blooms are being reported earlier in spring and later in fall as the water has warmed.

A notable instance of an unusual abundance of jellyfish was observed in the western Bering Sea off the coast of Alaska in the early 1990s. Jellyfish population levels remained relatively constant throughout the 1980s but increased more than 10-fold during the later decade. Researchers and fisherman who had worked in the Bering Sea for decades reported that they had never seen such high numbers and suggest that this influx might have been correlated with a climate shift that occurred in the area at that time.

A Day at the Beach

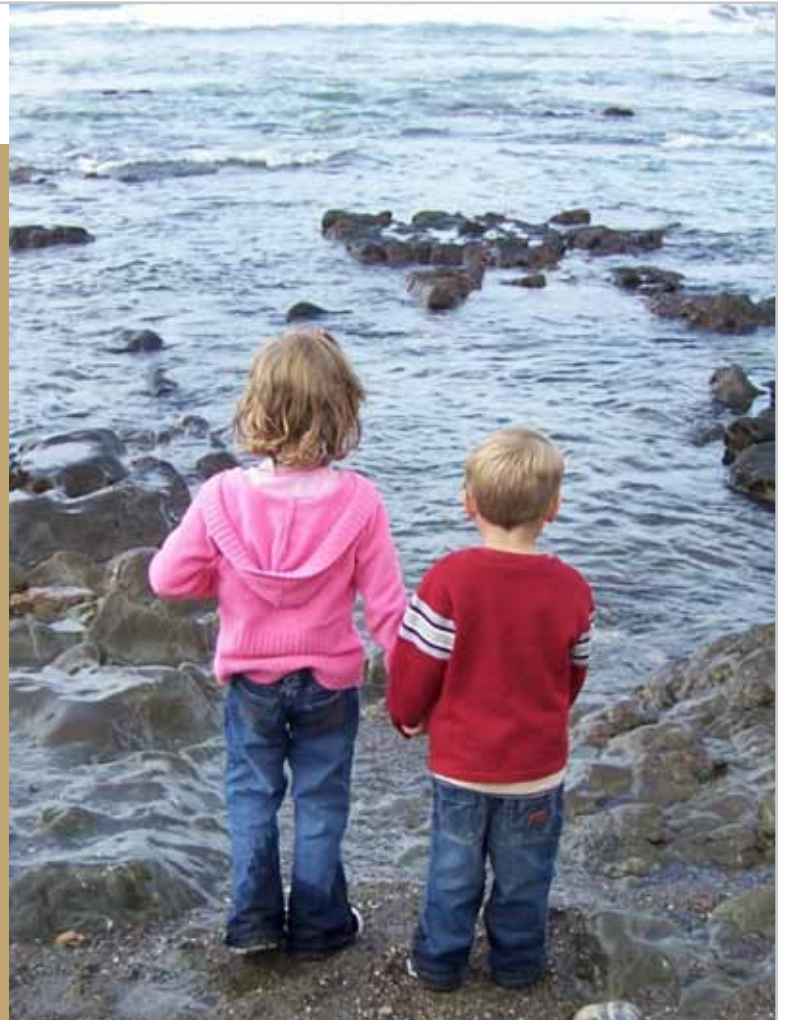
Some 58 million people in the United States visit the beach every year. That is a lot of sunscreen. From Memorial Day through Labor Day our coastal beaches are teeming with people swimming, sun-bathing, surfing, fishing, walking and relaxing. It's almost a rite of passage for our youth.

Climate change is making waves when it comes to visiting the beach. Stronger hurricanes such as Superstorm Sandy are on the rise. The warmer ocean water temperature is like high-octane fuel for a hurricane. Their devastating power forces us to flee coastal areas, only to return later and find massive destruction....beaches, roads, bridges, homes and businesses washed away.

Yet, there is another more subtle change at the beach that is literally a painful sign of the changing climate....the proliferation of jellyfish. Scientists think that there may be a link between the warm ocean water and the abundance of jellyfish. They foresee more jellyfish blooms as the climate continues to warm.

"I have always enjoyed swimming in the open ocean. Long distance swimming in lakes and oceans is an opportunity for me to relax and connect with nature. Run-ins with jellyfish are not uncommon and are, in fact, becoming a more frequent occurrence when I hit the water. Sometimes I find myself swimming through hundreds of jellies, hitting my fingers, legs, thighs and even a few head-on collisions. After a particularly bad swim, I will have to rinse off with ammonia to kill the sting. While I will always love ocean swims, the jellies make it increasingly more difficult to enjoy swimming safely."

—Joey Simon, Long-Distance Swimmer



National Wildlife Federation Photo Contest/Melanie Premo

Stink Bugs



National Wildlife Federation/Doug Inkley

Stink bugs are aptly named, given their propensity for emitting a foul odor to deter predators when disturbed. Although there are about 230 species of native stink bugs in North America, they generally go unnoticed. However, two non-native stink bug species recently found their way to the eastern United States via international trade or travel, and are anything but unnoticed. Kudzu and brown marmorated stink bugs neither bite nor sting, and both species winter over as adults. In the fall they congregate by the thousands as they seek shelter, commonly in structures - such as homes. Their sheer numbers can be a nuisance, especially during outdoor activities in the fall.

The brown marmorated stink bug population has exploded in the past decade, widely invading fields, forests, crops and homes in the Central Atlantic Region. This species has a very broad diet, including popular backyard garden crops such as tomatoes, beans, berries, asparagus, sweet corn, peppers and more. Garden and orchard produce is often damaged or even completely destroyed thanks to these munching bugs. Their sucking of juices from fruits and berries interrupts normal development, and can also cause extensive rotting.

NWF Resources for Getting Children Outdoors

National Wildlife Federation and its 49 affiliate organizations have worked for decades to reconnect children and youth with nature and the outdoors, inspiring children through *Ranger Rick*® magazine, working with educators to get kids learning outdoors, and helping parents find new ways to engage their children outside.

To learn about the following and other National Wildlife Federation programs to get 10 million kids outdoors, visit: www.nwf.org.

Eco-Schools USA - Provides hands on science-based environmental curricula and green management of grounds and facilities

Garden for Wildlife

Promotes backyard and schoolyard wildlife habitats

Great American Backyard Campout®

Introduces children to camping

National Wildlife Week

Celebrates nature and connects kids to wildlife

Ranger Rick® **Magazine** - Includes

wildlife stories and outdoor activities for families



Gardening

The prospect of fresh flowers, as well as tomatoes, corn, watermelon and other produce, compels people across the country to backyard gardening. This popular outdoor activity is enjoyed by more than two-thirds of all households in the United States. As with so many outdoor activities, climate change may pose some new challenges for gardeners.

Although a longer growing season may be welcomed, more-extreme droughts and rain events present problems for gardeners. Also of concern is how climate change might affect the abundance of ticks and various other pests. The Asian tiger mosquito is much more active during the daytime than our native mosquitoes. The likely expansion further to the north of the range of this invasive species means more gardeners putting up with more mosquito bites and itching while tilling the soil, weeding and picking the fruits of their labor.

The invasive brown marmorated stink bug is already a devastating pest for many vegetable gardeners, and climate change could make things worse.

"I've been growing vegetables in my backyard for 25 years. In the last decade I have fought a super-abundance of this invasive pest, including more than 26,000 wintering over in my house in just one year. Yes, I counted them, and living with so many was definitely not fun. One year they destroyed my entire tomato, asparagus, bean and corn crops. I already have such a huge problem gardening because of this pest that I gave up even planting this year. I'm horrified by the thought that if this stink bug has more generations each year, my vegetable gardening days will forever be gone."

Doug Inkley, Member, Brown Marmorated Stink Bug Stakeholder Advisory Panel, USDA



National Wildlife Federation
Photo Contest/Linda Zurawski

Brown marmorated stink bugs are affected by many environmental factors, making determination of the effects of climate change on them challenging. However, warmer temperatures bring about more rapid growth in stink bugs, shortening their life cycle. Thus, as the climate warms, there could be an increase in the number of

generations each year, causing the population to grow even more. Currently the U.S. population has one to two generations per year. Stink bugs also have a higher rate of survival during winter hibernation when winters are warmer, which could lead to higher breeding populations in the spring. On the other hand, extremely hot summer temperatures could be detrimental to stink bugs.

The kudzu stink bug and the kudzu vine, the "plant that ate the South," are both invasive species. Kudzu takes a big ecological toll throughout the South as it literally out-grows and takes over natural landscapes, outgrowing native plants and habitats and reducing biological diversity. The nearly impenetrable masses of kudzu have no benefit for enjoying the outdoors, and in fact make large areas useless for outdoor activities.

Ironically, the kudzu stink bug, a more recent invasive into the U.S., may actually help control the kudzu vine, which would benefit the natural habitats we recreate in. But, the optimism that the invasive kudzu stink bug might help reduce kudzu vine infestations is tempered by the expectation that the warming climate will facilitate the range expansion of kudzu vine as far north as New England.

Taking Action

We don't have to sit idly by while climate change erodes our ability to enjoy America's great outdoors. We can take actions today to combat the underlying cause of these increasingly annoying pests and help ensure that wildlife and our communities can adapt to a warming climate.

Priority actions for combating climate change:

- **Reducing carbon pollution from our largest sources.** The Clean Air Act was put in place to protect people and wildlife from pollution. Under this law, the U.S. Environmental Protection Agency (EPA) has the authority and obligation to limit carbon pollution from the largest sources, most notably coal-fired power plants. In June of 2014, the EPA took a historic step by proposing the Clean Power Plan, establishing the first ever limits on the amount of carbon pollution power plants can dump into our atmosphere. EPA plans to finalize these standards by June, 2015, and we should support them to ensure the standard stays strong and will achieve meaningful reductions in carbon pollution. You can help ensure this happens by sending in a comment to the EPA telling them you support a Clean Power Plan. After the plan has been finalized, we will also need to encourage states to quickly and robustly implement the plan to reduce carbon pollution from the power sector.

EPA should also move forward with separate standards to require pollution reduction from other large sources of carbon pollution, like the oil and gas industry. Reducing carbon pollution means we need to 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 carbon pollution for decades.



USFWS/George Gentry

- **Investing in clean, wildlife-friendly energy and increasing energy efficiency.** A serious effort to reduce carbon pollution must include investing in clean energy sources such as geothermal, on and offshore wind, solar, and sustainable bioenergy. We can also make significant improvements in the efficiency with which we use energy – in fact, energy efficiency is the cheapest, fastest way for us to use less energy, lower consumers' electricity bills and reduce pollution! It is time for the U.S. to make smarter energy choices and prioritize clean, responsible energy and energy efficiency instead of the carbon-polluting energy sources of the past. As we make this transition 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 they depend upon.

- **Safeguarding wildlife and their habitats from the impacts of climate change.** We must also adopt climate-smart conservation approaches to help wildlife survive and adapt to a changing climate. We may need to adjust conservation practices to enhance the resilience of our natural ecosystems to climate impacts. For example, maintaining or re-establishing habitat connections among parks, wildlife refuges, and other protected habitats will provide animal and plant species with the space they will need to track shifts in climatic conditions. Safeguarding our natural systems will also help people and local communities become more resilient to climate impacts, for instance, by maintaining the ability of wetlands and floodplains to buffer against increasingly severe weather and flooding.

The outdoor experience is so important for all of us. By taking action now, we can help protect wildlife for our children's future. They expect and deserve nothing less.

Now is the Time to Protect the Outdoor Experience

Take Action! www.nwf.org/tickedoff

National Wildlife Federation Photo Contest/Alex Bentley

Authors:

Doug Inkley, Ph.D., National Wildlife Federation and Tara Losoff, National Wildlife Federation

Acknowledgements:

Special thanks to the NWF staff members on our report team for their many contributions: Greta Bagwell, Meredyth Gottschall, Samantha Lockhart, Claudia Malloy, Lena Moffitt, Becca Shapiro and Mollie Simon. Other NWF staff providing support included: Linda Argueta, Russell Bassett, Nic Callero, David Dittloff, David Ellenberger, John Gale, Miles Grant, Jennifer Janssen, Jane Kirchner, Carol Oldham, Kelly Senser, Felice Stadler, Bruce Stein and Frank Szollosi. We are also sincerely grateful for the time and advice of many NWF partners including Brenda Archambo, Joy Bergey, Gary Botzek, Jay Chancellor, Dawn Erlandson, Chelsea Harnish, Todd Martin, Christopher Maxie II, G. Richard Mode, Michael O'Leary, Eric Orff, Ed Perry, Lisa Pohlmann, Tracy Sabetta and Emmie Theberge.

We appreciate the engagement of the National Wildlife Federation's 49 affiliate organizations in outdoor recreation and wildlife conservation in a changing climate. We especially thank the Natural Resources Council of Maine, Minnesota Conservation Federation, North Carolina Wildlife Federation and the Virginia Conservation Network for their collaboration on this report.

In addition, we are grateful for expert review and suggestions provided by: Glen Needham, Ph.D., Public Health Specialist/ Medical Entomologist and Kristine Rines, Moose Project Leader, New Hampshire Fish and Game Department. We appreciate the creative talents and patience of Maja Smith of MajaDesign, Inc.

This report was made possible through the generosity of our donors and supporters.

Front Cover Photo Credits:

Clockwise from upper left: child running, Bigstockphoto/Samuel Borges; fish, USFWS; boy carrying fish, Louise Brooks; Great Blue Heron, USFWS/Robert Burton; girls swimming, National Wildlife Federation Photo Contest/Worob; woman with binoculars, Michael Scott; girls wildlife watching, National Wildlife Federation/Charlie Archambault; Mule deer, Oregon Department of Fish & Wildlife; boy with fish, USFWS/Carl Zitsman; Red-winged blackbird, USFWS/George Gentry.

End Notes:

References for each section of this report may be found at: www.nwf.org/tickedoff.

Graphic Design by MajaDesign, Inc.

Copyright © National Wildlife Federation 2014

To learn more and take action, visit: www.nwf.org/tickedoff

