



SHIFTING SKIES

MIGRATORY BIRDS IN
A WARMING WORLD



The climate crisis is already changing the playing field for birds, other wildlife and their habitats across America. Urgent action is needed to preserve America's conservation legacy.

The climate crisis requires that we consciously prepare for and adapt to the current and future threat climate change poses to America's treasured birds, other wildlife and their habitats. We must address the underlying cause of climate change by reducing our carbon pollution and quickly transitioning to cleaner, more secure sources of energy.



A handwritten signature in black ink that reads "Larry Schweiger". The signature is fluid and cursive, with the first name being the most prominent.

Larry Schweiger
President and CEO
National Wildlife Federation

EXECUTIVE SUMMARY

Our nation's birds and other wildlife are currently dealing with a climate crisis that grows worse with each passing year. Climate stressors are expected to cause large contractions in the ranges of even some of the common and widespread species we enjoy today. Some bird species will be pushed closer to extinction.

Migratory species, such as most birds, face the unique challenge of climate change affecting the multiple habitats they require to breed, migrate and overwinter. Bird ranges are shifting and populations changing. The timing of migration and breeding are changing, affecting the availability of food needed to raise their young.

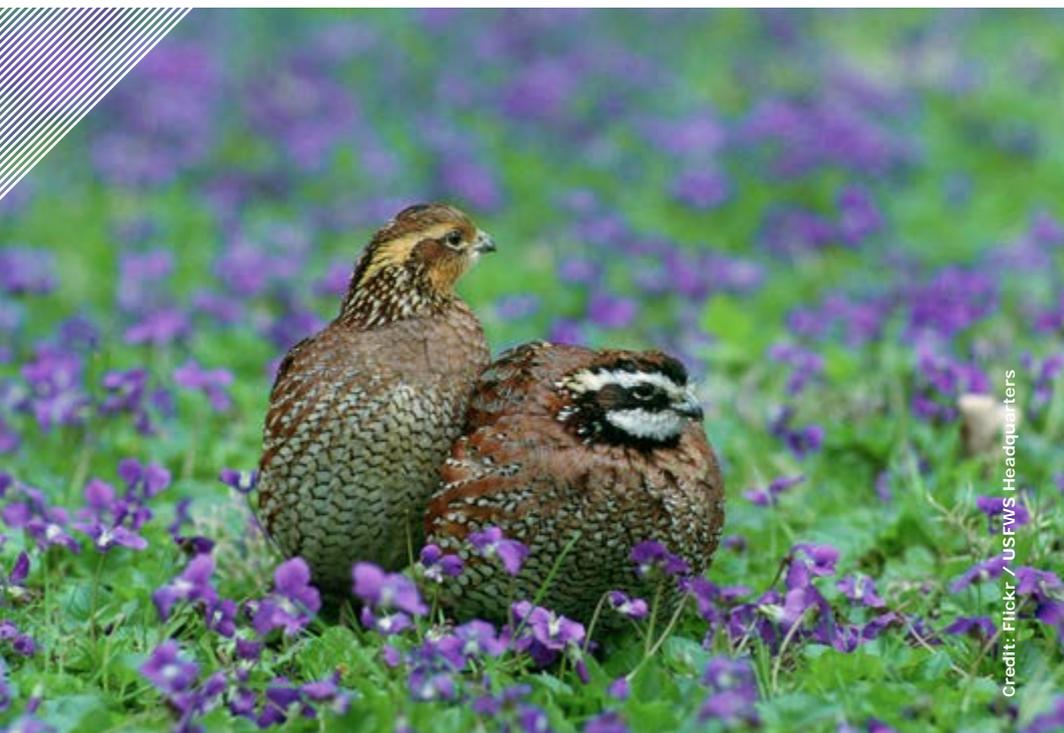
The very landscapes birds inhabit and upon which they rely are showing the effects of climate-driven changes. Forests are now encroaching on the formerly treeless Alaskan tundra, and deciduous forests are moving up mountains, crowding out alpine coniferous habitats. Millions of acres of pine forests in the West are being decimated by unprecedented epidemics of pine beetles, and catastrophic wildfires are reconfiguring habitats throughout the West. Coastal beaches and marshes are being drowned by rising seas.

The climate crisis must and can be addressed. To reduce the magnitude and threats of climate change, America must be a leader in taking swift, significant action to reduce carbon pollution. This means using the Clean Air Act to limit carbon pollution from the largest sources, including power plants, oil refineries and cars. Moreover, it is essential to plan energy policies that support a rapid and responsible transition away from fossil fuels and advance the clean, renewable energy sources needed to build a clean, healthy energy economy here at home.

We must also work now to prepare for and address the effects of climate change on all our natural resources and wildlife, including birds. Because of the warming already underway we will be unable to avoid many of the impacts of climate change. However, we can reduce and accommodate some of the effects by modifying our approaches to wildlife conservation and natural resource management in ways that take into account the new challenges posed by the changing climate.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	3
GAME BIRDS	13
SONGBIRDS	18
WETLAND BIRDS	22
OCEAN AND COASTAL BIRDS	25
A NEW COURSE FOR BIRDS	29
CONCLUSION	34



INTRODUCTION

The outdoors would be strangely silent without the springtime melodies and flights of birds migrating overhead and living all around us.¹ We see birds every day and they contribute much to our personal lives. Beyond their aesthetic, cultural and ecological values, activities associated with birds give a big boost to the U.S. economy. In 2011, more than \$54 billion was spent to watch wildlife, including more than \$4 billion to purchase seed for wild birds. Migratory game bird hunters spent more than \$1.8 billion that same year.²

Every region of the United States is inhabited by birds, no matter how extreme the conditions seem to us. Ptarmigan survive in the arctic cold temperatures of Alaska and the high mountains of several western states. Roadrunners endure Death Valley's³ extreme summer temperatures that are consistently well in excess of 100°F.⁴ Tens of millions of waterfowl breed in the Prairie Potholes of the upper Midwest and Canada, annually hatching 50 percent of North America's ducks.⁵ Our Pacific, Atlantic and Gulf coastal beaches and marshes are frequented by shorebirds such as the red knot. Many ocean birds, such as the Hawaiian petrel, frequent the open seas.

Everywhere birds are an integral part of our natural ecosystems, sometimes in ways not immediately obvious. Birds pollinate plants and disperse their seeds, thereby facilitating genetic exchange and seed germination.⁶ Birds also play important roles in controlling populations of some insect pests, such as mosquitoes, Japanese beetles and European corn borer moths.⁷ Birds can be sensitive indicators of threats to environmental health, such as when DDT was widely used, imperiling bald eagles, osprey and peregrine falcons across the lower-48 states.

Habitat loss, pollution and other factors have already led to 91 U.S. bird species becoming listed as threatened or endangered under the Endangered Species Act.⁸ Climate change will almost certainly cause more species to be added to these lists, as well as exacerbate the challenges rare, threatened and endangered species already face. Moreover, large contractions in the range of many currently common and widespread species are expected.⁹



Credit: Flickr / winnu

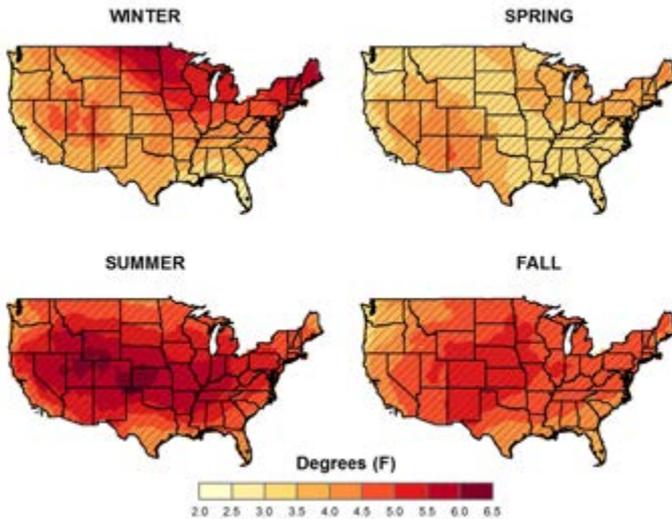
This report demonstrates the very real vulnerabilities of birds and their habitats to climate change by providing an overview of major issues, highlighting selected species in four broad categories: upland game birds, songbirds, wetland birds, and ocean and coastal birds. We conclude with recommendations on how to chart a better course for the future of birds and other wildlife by reducing carbon pollution and safeguarding wildlife from the current and future impacts of climate change.

Climate change is the biggest threat that birds face this century.¹⁰ The existing climatic conditions to which birds and other wildlife are adapted are rapidly changing. Although there have been significant climate and habitat changes in the past, they have occurred over a much longer period of time (thousands of years or longer) in contrast to the rapidly accelerating climate shifts driven by carbon pollution of the last century or so. While humans can anticipate some events, take steps to reduce carbon pollution and prepare for increasing climate impacts, wildlife cannot plan ahead. Efforts to safeguard birds are both crucial and challenging. We must reduce carbon pollution to limit the magnitude of these impacts; we must intensify and modify our conservation practices to reduce the impact of these changes when possible; and we must manage for the ecological changes that climate change is already causing.

NATIONAL WILDLIFE FEDERATION

Migratory Birds Face Unique Climate Challenges

Although there is evidence of some bird ranges shifting northward in response to climate change, it would be a mistake to think that the mobility of birds somehow makes them capable of easily accommodating climate change. In fact, many migratory birds face unique challenges associated with climate.



If carbon pollution emissions continue to increase rapidly, all areas of the United States will warm, with the biggest effect in the middle of the country during the summer. These maps show the average temperature increases simulated by climate models for 2041-2070 compared to 1971-2000. The warming will mean fewer extremely cold days and more extremely hot days.

Source: NOAA NESDIS (2013): Regional Climate Trends and Scenarios for the U.S. National Climate Assessment.

Every fall, some 350 bird species leave their breeding grounds in North America to fly to more suitable climates in South or Central America for the winter, and then return again in the spring.¹¹ These migrants face multiple hazards during their long and arduous journey because they must find suitable habitats in multiple locations, including on their breeding grounds, along their migratory corridors, and on their wintering grounds. One broken link in this chain could pose a major challenge and threaten the integrity of the entire chain and the species, themselves. Given the worldwide changes in climate, we can expect disruptions across the entire spectrum of habitats used by migrating birds.

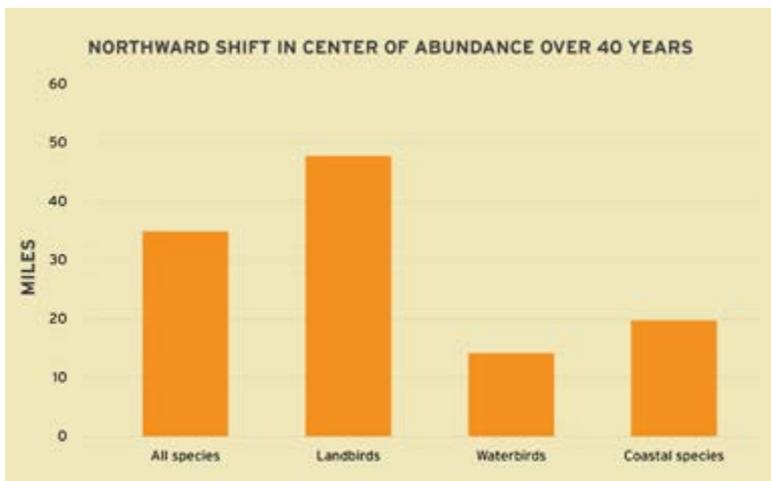
Changes in Timing and Missed Connections

Timing is of the essence for migratory birds to accommodate the changing seasons. As climate change brings earlier springs and later arrival of winter in North America, some birds are changing the times at which they migrate.¹² During a six-decade study in Wisconsin, spring temperatures increased and some birds, such as the eastern phoebe and rose-breasted grosbeak, arrived earlier. By contrast, the fox sparrow and eastern towhee exhibited no change in spring arrival date, retaining their long-held migration timing.¹³ When migration behavior is triggered by non-weather related cues such as sun position or day length, those species will likely migrate about the same time year after year, in contrast to other species whose migration is triggered by weather-related cues.

One challenge for all migratory birds is the possibility of arriving at their breeding grounds only to find they've missed important insect foods or flowers whose seasonal timing, or phenology, was altered by the changing climate. One study suggested that local plant phenology has been advancing to earlier in the spring three times more rapidly than advances in bird migration.¹⁴ This type of climate-driven mismatch led to about a 90 percent decline in some populations of pied flycatchers in the Netherlands over a two decade period.¹⁵

Birds and Habitats Are Shifting Location

Climate change is causing shifts in geographic ranges of birds, sometimes at faster rates than scientists expected.¹⁶ As temperatures have increased, 177 of 305 species of birds tracked in North America have shifted their centers of abundance during winter northward by 35 miles on average during the past four decades (Figure 1).¹⁷ Species with northward shifts exceeding 100 miles include the ring-necked duck, American goldfinch, red-breasted merganser, American black duck, green-winged teal, black-bellied plover, pine siskin and black turnstone.¹⁸



Analysis of four decades of bird counts reveals that birds seen in North America during the first weeks of winter have moved dramatically northward, toward colder latitudes over the past four decades. Significant northward movement occurred among 58 percent of the observed species. There was also movement inland, from warmer coastal states.

Source: "Northward shift in center of abundance over 40 years" located at page 3 in "Birds and Climate Change, Ecological Disruption in Motion," February 2009, © 2009 National Audubon Society.

Many bird habitat locations are also shifting. Forests are moving northward into the Alaskan tundra¹⁹ and tree lines are moving upward and displacing the alpine tundra of the Sierra Nevada in California.²⁰ Broadleaf forests are encroaching into higher altitudes of the coniferous zones of New England's mountains.²¹ It may not seem like a shift in the ranges of some birds and habitats would be of great concern, but birds and their habitats are not likely to shift at the same rate or into and from the same areas. This would likely disrupt existing complexes of birds and habitats, or create new complexes with unknown consequences. Continued climate change this century is projected to change 20 percent of North America from one major ecosystem to another.²²

Habitats Disappearing and Changing From Within

The many species of plants and other organisms that make up common habitat types will respond in unique ways to climate change, meaning that the species composition of habitats will be changing from within. In turn, this is likely to lead to changes in the structure and function of ecological communities. There are likely to be both negative and positive consequences of changes in the species composition of ecological communities, but exactly how this will affect birds is extremely challenging to predict.

Coastal birds face the challenge of the outright disappearance of some wetland and beach habitats due to sea-level rise. The average global sea level has risen about 8 inches during the past century, and is expected to increase by another 12-48 inches or even more during this century.²³ While coastal habitats might naturally move inland as the sea level rises, the current rate of increase is likely to be too fast for these natural processes to occur. Moreover, man-made efforts to resist increasing coastal erosion by building sea walls and other "hard" infrastructure prevents inland migration of coastal habitats and could exacerbate coastal wetlands loss by about 20 percent.²⁴



Credit: Flickr / vsmoothie

Conifers killed in the pine beetle epidemic unleashed by climate change.

Important bird habitat is also being dramatically changed by massive pest and disease epidemics. Mountain pine beetle epidemics decimated trees on more than 26.8 million acres from 1997-2010, killing billions of trees in western North America and completely altering the fundamental nature of these regions.²⁵ Forest birds that require mature healthy forests, such as tanagers and some flycatchers, are likely to decline as catastrophic fires burn trees and create more open habitats.

North America's boreal forests are home to many breeding warblers and other songbirds. Rising temperatures are projected to make the boreal forest drier overall, leading to increases in fire frequency and intensity, and changes in surface hydrology. The climate-driven epidemics of pine beetles have intensified and moved northward and eastward into previously unscathed areas of British Columbia and Alberta, destroying countless millions of trees.^{26, 27} These epidemics are expected to continue as the climate warms.²⁸

Extreme Weather is Challenging Birds and Their Habitats

The expected increases in the frequency of extreme weather events such as floods, droughts, tropical storms and heat waves are likely to have some of the most substantial impacts on birds in the coming decades. These events can exceed the normal tolerance levels of birds and their habitats, causing long-lasting or permanent changes to the habitat.

Superstorm Sandy in October 2012 was a disastrous example of what extreme weather events mean for the future of America's coasts. Atlantic hurricanes have increased in power since 1970 as predicted,²⁹ driven by carbon pollution causing climate change.³⁰ Although coastal beaches, coastal wetlands and barrier islands are constantly changing, the rising sea level and increasing intensity of storms, in combination with other factors, are altering coastal processes. Beyond the tragic loss of life and severe damage to coastal communities, Superstorm Sandy also severely affected many National Wildlife Refuges. The U.S. Fish and Wildlife Service is now spending \$68.2 million to make repairs and restore habitats on 25 National Wildlife Refuges, including important wintering habitat for waterfowl on the Mackay Island National Wildlife Refuge in North Carolina.³¹ But, some habitats were altered forever.

As Superstorm Sandy did, unusually intense hurricanes can transform habitats virtually overnight, but it was not unprecedented. In 1989, Hurricane Hugo dealt a devastating blow to the second-largest population of the endangered red-cockaded woodpecker. In this storm 87 percent of the active cavity trees on the Francis Marion National Forest were destroyed.^{32, 33} Hurricanes Katrina and Rita in 2005 caused the loss of 217 square miles of Louisiana's coastal wetlands,³⁴ destroying important nesting, wintering and foraging areas for countless birds, including many species of waterfowl, wading birds such as egrets and herons, brown pelicans, and more.

The dramatic increase in the incidence and severity of wildfires is another example of extreme events associated with climate change that are destructive to North American bird populations.



Prime Hook National Wildlife Refuge in Delaware experienced damaging flooding during Superstorm Sandy.

Although moderate fire is natural and helpful to some ecosystems, catastrophic wildfires can destroy and transform vast expanses of habitat, causing adverse impacts to birds and other wildlife.³⁵ Climate change has contributed to a four-fold increase in the number of major fires and a six-fold increase in the area of forest burned in western states since 1986 compared to the period 1970-1986.³⁶ It is projected that the average burned areas could double across 11 western states, including quadrupling in Montana by 2070-2100.³⁷

Birds and Reducing Carbon Pollution

Impacts to birds caused by the extraction of carbon-based fuels have been and continue to be enormous. The Gulf oil disaster in 2010 accelerated the loss of coastal wetlands used by birds and it will never be known how many birds died from direct contact with the oil. Extraction of oil from the tar sands of Alberta is destroying large areas of boreal forests important for dozens of songbird species and other migratory birds. Strip-mining for coal has forever destroyed the precious streams, forests and grassland habitats of birds in areas across the country including West Virginia, Wyoming, Pennsylvania and many other states. Moving away from carbon-based fuels will reduce their continuing huge impacts to birds, other wildlife and their habitats.

As clean energy sources are developed to reduce carbon pollution it is important to first avoid, then minimize, and ultimately compensate for unavoidable impacts to birds, other wildlife and their habitats caused by construction of new projects. Potential biofuel plant stocks must be screened to avoid using invasive species that are a risk to native bird habitats. Biomass energy production must not be at the expense of converting native habitats and ecosystems to croplands. Wind energy projects need to take into account potential impacts to birds and other wildlife when sites are chosen.



Wind Energy and Birds

To protect birds and other wildlife from the dangers of climate change, NWF is calling for half of America's electricity to be generated from responsibly-sited renewable sources by 2030. A key component of this goal is to secure strong wildlife safeguards to protect sensitive species and habitats during the siting, construction, and operation of wind energy projects both on and offshore. NWF is working hard to shape the following efforts to make sure that wind energy is developed responsibly:

- The American Wind Wildlife Institute—a multi-stakeholder collaboration—is supporting research, analytical tools, and development of best practices for responsible wind energy development.
- The U.S. Fish and Wildlife Service is implementing voluntary wind energy guidelines for wildlife at projects throughout the country.
- Coordinating with stakeholders, the U.S. Interior Department is developing much needed guidance and conservation programming for wind energy's potential impact on protected bald and golden eagles.
- Leading wind energy developers are working with federal and state agencies to develop a conservation plan for imperiled birds of the Great Plains, such as the whooping crane and lesser prairie chicken.
- Federal land managers are establishing pre-screened, low-conflict offshore "Wind Energy Areas."

A bipartisan group in Congress has introduced the Public Lands and Renewable Energy Development Act to secure funds for addressing landscape-scale development impacts.

GAME BIRDS



In the fall, game birds such as ducks, geese, doves and quail are eagerly pursued by hunters across the country. Climate change will likely increase the challenges of maintaining sustainable populations of some game birds. The northern bobwhite, long in decline in the Southeast,³⁸ is sensitive to high midday temperatures,³⁹ which are rising due to climate change. In 2012 wild turkeys were hit hard by severe drought that reduced food supplies,⁴⁰ demonstrating their vulnerability to projections of more-frequent and more-severe drought. Increased evaporation associated with higher temperatures is expected to reduce prairie pothole wetland frequency and duration, especially in core waterfowl production areas.

Ducks

The Prairie Pothole Region of the United States ranges from portions of Montana to as far east as Minnesota and southward into Iowa. The Prairie Potholes of the United States and Canada combined produce at least half of the ducks in North America.⁴¹ The region provides important breeding habitat for ducks like mallard, pintail, gadwall, blue-winged teal, shovelers, canvasback and redhead.⁴² What happens in the Prairie Potholes affects the entire continent because ducks produced there have been found in all of the lower 48 states.⁴³

“All waterfowl hunters should recognize the complex nature of what lies ahead for waterfowl and the future of hunting. If we act now, future generations of hunters will be thankful - and a magnificent heritage can be maintained.”

– Erik Fritzell, Professor Emeritus,
Oregon State University





THE PRAIRIE POTHOLE REGION



Credit: U.S. Fish and Wildlife Service

Should climate change affect wetlands and ducks as projected,⁴⁴ waterfowlers across the country may find themselves asking “Where have all the ducks gone?” as they sit in their duck blinds at dawn.

Waterfowl nesting success is closely tied to the number of ponds in the region in spring. In fact, spring surveys of the number of ponds in the Prairie Potholes are an important factor for projecting fall populations of ducks and in setting hunting season regulations. The abundance of these breeding ponds is determined by fall soil moisture, winter snowfall and spring rains. In dry years, there can be as few as two million ponds, in contrast to as many as six million in wet years.⁴⁵

Prairie pothole wetlands are expected to dry more rapidly and have lower water volumes as temperatures increase.⁴⁶ During dry years mallard ducklings have much lower survival rates.⁴⁷

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 even with good moisture,⁴⁸ forcing ducks to breed in less productive areas.

North of the Prairie Potholes, the boreal forest, harbors up to 40 percent of North America's ducks.⁴⁹ The 12 to 15 million ducks that typically nest in the fens, bogs and lakes of the boreal forest region⁵⁰ include scaup, mallard, American widgeon, green-winged teal and scoters.⁵¹ This forest habitat also supports more than half of North America's annual production of buffleheads, goldeneyes, ring-necked ducks and mergansers.⁵²

Climate change is altering the boreal forest landscape by increasing fire and pine 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. Moreover, the impact of climate change is compounding the effects of other factors causing the loss of boreal forest habitats, including oil and gas production, tar sands open pit mining, development of hydroelectric power, and increased timber harvest.⁵³ Climate change will intensify all of these impacts and result in potentially significant declines in waterfowl of the boreal forest.

The Greater Sage Grouse

The greater sage grouse was once widespread throughout much of the West, but has been declining for decades due to extensive habitat loss.⁵⁴ This led to the closing of hunting across much of its range and consideration for listing under the Endangered Species Act.⁵⁵ Sage grouse require healthy and expansive sagebrush habitats. A study in Montana, Wyoming, South Dakota and North Dakota projects extensive decline in acreage of sagebrush based on various climatic variables, especially declining precipitation.⁵⁶

Even in areas where future climate may support sagebrush, climate change may help the spread of cheatgrass,⁵⁷ an invasive plant that provides ready tinder for wildfires. Sagebrush habitats historically burned infrequently and cannot survive frequent fires.⁵⁸ In 2007 alone, in the Great Basin where cheatgrass is pervasive, more than 2.7 million acres burned.⁵⁹ Making matters worse for sagebrush,



Credit: Flickr / USEWS Pacific Southwest Region

higher concentrations of atmospheric carbon could stimulate cheatgrass growth, increase fire frequency, and make it an even more aggressive invader.⁶⁰ The projected future distribution of cheatgrass needs to be considered in management strategies to maintain sagebrush habitats for sage grouse.

Many birds, including sage grouse, are susceptible to West Nile Virus, an introduced disease in the United States transmitted by mosquitoes.^{61, 62, 63} The incidence and spread of West Nile Virus at higher elevations is moderated by cold temperatures restricting the length of the season during which mosquitoes, the carriers of West Nile Virus, are active. Rising temperatures are projected to make conditions more suitable for mosquitoes at higher elevations, thereby increasing the probability that sage grouse will be exposed to West Nile Virus in these areas.⁶⁴

When the effects of climate change on sagebrush distribution and the risk of West Nile Virus transmission are considered together, the most suitable areas for sage grouse are projected to be in high elevation sagebrush habitats of southwestern Wyoming.⁶⁵

SONGBIRDS



Native North American songbirds include orioles, tanagers, some 50 species of warbler and many more, most of which are both beautiful to see and hear in springtime. Birdwatchers particularly anticipate the spring migration of birds in the thrush family because of their beautiful songs. In North America, the thrush family includes bluebirds, the American robin and six species of thrushes.

American Robin

The distinctive song of the American robin is a sure sign of spring. Even though common and distributed across the entire lower-48 states and nearly all of Alaska, the American robin is showing some signs of being affected by climate change. In Colorado, robins migrate in spring from lower to higher elevations, typically arriving well before bare ground is exposed by snowmelt. Over a 19-year study period they arrived at the higher elevations on average 18 days earlier, even though the average date of snowmelt was unchanged. With robins arriving earlier but no change in the blossoming date of herbaceous and flowering plants, this mismatch in timing could eventually result in scarcity of springtime food resources.⁶⁶

Bluebirds

Another favorite thrush—because of its brilliant blue color—is the bluebird, of which there are three species in the United States: western, eastern and mountain. Thousands of dedicated volunteers have maintained nest box “trails” to help bluebirds recover from widespread deforestation and other factors.⁶⁷

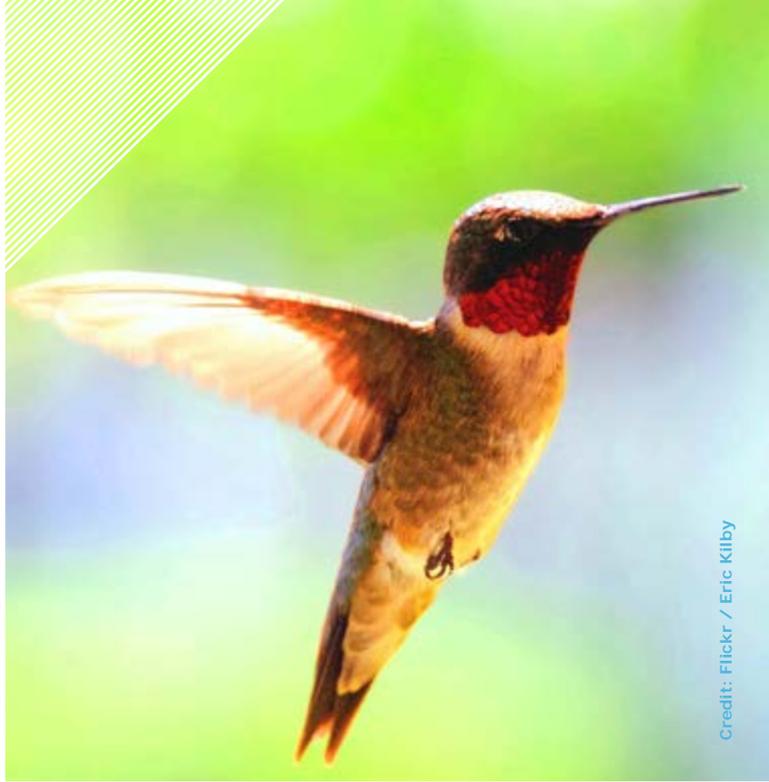
Bluebirds are a good example of how climate change can affect a single species in several ways, and that effects also vary between species. Eastern bluebirds had no apparent change in arrival dates in Wisconsin over six decades.⁶⁸ Yet, during the last 50 years eastern bluebirds have been laying their first clutch of eggs earlier in the year throughout much of their range.⁶⁹ In Alberta, Canada spring arrival dates of mountain bluebirds were tracked for 40 years, revealing earlier spring arrival associated with warming trends in spring temperatures.⁷⁰



The net effect of rising temperatures on bluebird populations is difficult to know. Bluebird nestlings are vulnerable to hypothermia in cold weather,⁷¹ making it likely that early broods have the potential to benefit from warmer springs. In contrast, nestlings are susceptible to heat stress and dehydration in hot weather.^{72, 73} As a result, second and third broods are likely to be more at risk due to higher summer temperatures, especially during heat waves. Temperatures can be 8°F warmer than ambient air temperatures in wooden nest boxes.⁷⁴

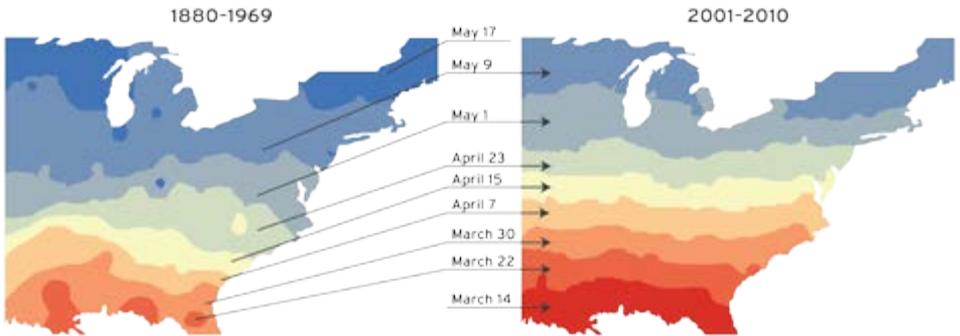
Bicknell's Thrush

The Bicknell's thrush is the poster child of the thrush family for projected impacts of climate change. It breeds in New England's mountaintop coniferous forests and is already a species of special concern in Maine, New York, Vermont and New Hampshire.⁷⁵ Increasing temperatures are driving its cold-adapted forest habitats upslope as spreading hardwood forests encroach from lower elevations.^{76, 77} The balsam fir and red spruce favored by Bicknell's thrush in these forests⁷⁸ are declining⁷⁹ and expected to continue to decline as climate change advances.⁸⁰ In fact, a 5°F to 6°F increase in July temperatures, consistent with expectations given current trends in carbon pollution, could result in loss of nearly 90 percent of its habitat in the United States.⁸¹ The U.S. Fish and Wildlife Service recently determined that listing the Bicknell's thrush as threatened or endangered, due in part to climate change, may be warranted.⁸²



Ruby-throated hummingbirds

Ruby-throated hummingbirds are distributed widely from North Dakota south to Texas and all states to the east of this line. Treasured by birders and gardeners alike, these tiny jewel-like birds migrate enormous distances from South or Central America to the United States, and they arrive in need of a reliable meal. Nectar is an important source of energy for hummingbirds, and changes in migration due to warming temperatures could mean the tired and hungry birds arrive when the flowering plants they rely upon for food aren't yet in blossom. Warmer winters and springs were associated with earlier arrival in mid-latitudes in most areas.^{B3} Their return to North America in the spring has advanced an astonishing 11 to 18 days depending upon latitude, from the early 20th century to the early 2000s. In Massachusetts the birds arrived an average of 18.4 days earlier over a recent 30-year period.^{B4}



Average arrival dates of Ruby-throated Hummingbirds in eastern North America have become earlier in the spring.

Source: Courter, Jason R. et. al., "Assessing migration of Ruby-throated Hummingbirds (*Archilocus colubris*) at broad spatial and temporal scales (Evaluación de la Migración de *Archilocus colubris* a Escalas Amplias de Tiempo y Espacio)", *The Auk*, vol. 130, no. 1, January 2013. (c) 2013 by the American Ornithologists' Union. Published by the University of California Press.

"I am one of the monitors that survey birds each spring and I watch my own data to see if I detect the possible beginnings of any trends. I have had a wonderful time bird watching for over 30 years and it has taught me a lot. I want young people growing up today to be able to have those incredibly life-enriching experiences too. It troubles me deeply that climate change is going to make many of my wonderful experiences impossible for today's young people. We can and should do a lot better than this!"

– Leda Beth Gray, Maine



bluebird box monitoring

WETLAND BIRDS



Wetlands host an incredible diversity of birds including ducks, geese, grebes, herons, many songbirds, rails, ibises and egrets. Climate change is expected to widely impact wetland ecosystems through changes in precipitation amounts and timing, increased evaporation as temperatures rise, and greater extremes in drought and flooding. Studies indicate that climate change will also enhance the spread of aquatic invasive species such as phragmites⁸⁵ and reed canary grass⁸⁶ that overwhelm native wetland vegetation, thereby changing habitat for the worse for our native bird populations. Climate change threatens coastal freshwater marshes by increasing the risk of conversion to salt marshes due to saltwater intrusion associated with sea-level rise. These combined factors will bring about changes in wetland availability, plant communities, and productivity with subsequent effects on waterfowl (see “Game Birds” section) and other wetland birds. Of the 165 wetland breeding bird species in the United States, 36 percent show medium or high vulnerability to the impacts of climate change.⁸⁷



Credit: Flickr / ra_hurd

SANDHILL CRANES (GRUS CANADENSIS)



Source: "Birds of North America Online," bna.birds.cornell.edu/bna, maintained by the Cornell Lab of Ornithology.

Sandhill Cranes

Sandhill cranes, filling the air with their loud trilling calls, annually visit Nebraska's Central Platte River en route to their summer nesting areas in Alaska, Canada and even Siberia. About half a million birds, more than 80 percent of the continental sandhill crane population, spend 3 to 4 weeks feeding, resting and socializing before continuing on their long migration north.⁸⁸ Yet, this spectacular phenomenon that all birders should witness, faces growing challenges in a changing climate.

High river flow is important for sandhill cranes because they rely on wide open areas of the river for protection from predators when roosting.⁸⁹ Persistently low river flow due to upstream dams and water withdrawal for irrigation and local communities has allowed heavy vegetation to crowd into the river channel,⁹⁰ decreasing available



Credit: Flickr / Andrea Westmoreland

roosting areas. This threat is expected to increase as moderate to severe drought becomes more common,⁹¹ facilitating further encroachment of dense vegetation. Reduced snowpack in the Rocky Mountains and earlier snowmelt are also expected to further reduce flow and change the timing of spring flows, respectively.

King Rail

In marked contrast to the sandhill crane's high visibility, a seldom-seen bird (even for avid birders) is the elusive and secretive king rail. This species resides primarily in coastal and inland freshwater wetlands in southeastern states, but occasionally ranges as far north as the Great Lakes region. The king rail's population has declined markedly over the last 40 years due primarily to wetland loss. Within the king rail's range 18 states have lost 50 percent or more of their original wetland habitats.⁹² The historic loss of freshwater emergent marshes that king rails rely on is a trend that is likely to continue, especially where sea-level rise causes encroachment of saline water into coastal freshwater marshes.⁹³

OCEAN AND COASTAL BIRDS



Many oceanic birds, such as auklets, shearwaters, puffins, albatrosses and storm petrels, are seldom seen because they frequent open expanses of ocean, usually venturing ashore only to breed. Coastal species may be more easily spotted than ocean birds; however, many are restricted to very specific and uncommon coastal habitats during their migration. Climate change poses a significant risk for many of North America's ocean and coastal birds due to factors such as sea-level rise, ocean acidification and altered food supplies.

Ocean Birds

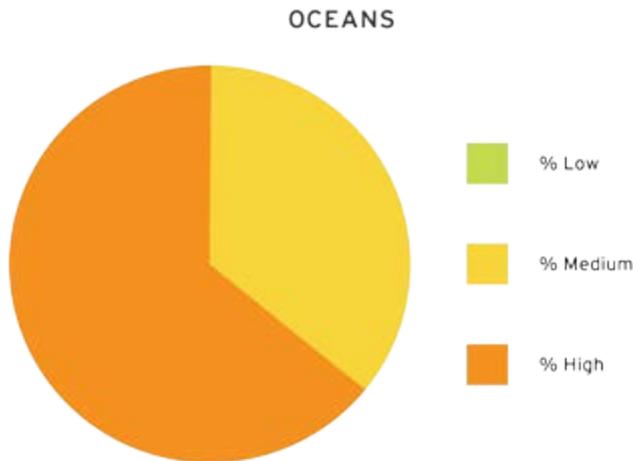
All 67 ocean bird species in U.S. waters, such as petrels, albatross and murre, are considered to be at medium or high vulnerability, making them the most at-risk group of U.S. birds due to climate change.⁹⁴ While many ocean birds nest on high cliffs, the Laysan albatross and other species nest on low-lying islands⁹⁵ such as Hawaii's Laysan Island,⁹⁶ making them vulnerable to sea-level rise. Several other climate trends affect ocean birds.

Climate-driven changes in marine ecosystems are a concern for birds which feed in ocean waters. Our oceans are absorbing much of the carbon dioxide released into the atmosphere. The carbon dioxide is transformed into carbonic acid as it dissolves, causing the pH of the world's oceans to decrease, making the water more acidic. This ocean acidification can decrease both the ability of shellfish to make and maintain their shells and for corals to build their skeletons.⁹⁷ As a result, the entire marine food chain is likely to be affected. Furthermore, as water acidity increases it appears to increase the vulnerability of corals to thermal bleaching, thereby reducing productivity.⁹⁸

The marbled murrelet, a threatened species,⁹⁹ nests high in tall trees in old-growth forests along the Pacific coast from Alaska southward to Washington, Oregon and California.¹⁰⁰ Losses in this breeding

habitat are expected due to increased fire in old-growth forests, as well as increases in extreme flooding, landslides and wind damage.¹⁰¹

Climate change may pose a risk to marbled murrelets via alterations to the marine environments in which it forages.¹⁰² Marine productivity is sensitive to water temperature.¹⁰³ Marbled murrelets appear to have higher reproductive success during cooler years¹⁰⁴ when food availability is good,¹⁰⁵ making warming waters a concern. Furthermore, changes in oceanic water currents could shift foraging areas where upwellings with high productivity are located. Areas currently with high productivity could decline, while new upwellings might pop up in other currently unproductive ocean areas.



All 67 ocean bird species along America's coasts show a medium or high vulnerability to climate change; 43 of which are at the highest level of vulnerability.

Source: North American Bird Conservation Initiative, U.S. Committee (2010): Figure on page 6 of The State of the Birds 2010 Report on Climate Change, United States of America. U.S. Department of the Interior.



Credit: Flickr / U. S. Fish and Wildlife Service - Northeast Region

Coastal Birds

Coastal birds are especially vulnerable to disappearing habitat due to sea level rise, especially wherever “hardening of the beaches,” such as the building of seawalls, is attempted to resist increasing coastal erosion.¹⁰⁶ Coastal areas will also experience more flooding and erosion driven by warming ocean temperatures increasing tropical storm intensity. Especially at risk are species using coastal beaches and marshes for nesting, such as the piping plover, American and Black oystercatchers, and the saltmarsh sparrow.¹⁰⁷

Most coastal North American shorebirds breed in the Far North during the summer, then undertake long-distance migrations to warmer climates in South America. As long-distance migrants, it is important that shorebirds find suitable habitat in their breeding, migration and winter habitats. The dependence of many shorebirds on very specific habitat conditions throughout their range is a major reason they are especially vulnerable to climate change. Any break in the chain of required habitats puts these birds at risk. Of 49 North American shorebird species recently assessed, nearly 90 percent were predicted to have an increased risk of extinction due to climate change alone.

A few species projected to be the most affected include the American oystercatcher, American golden-plover, whimbrel, red knot and bar-tailed godwit.¹⁰⁸

The red knot occurs on the shores of all coastal states, including Maine, New Hampshire, Virginia, North Carolina, Florida and Oregon, among others.¹⁰⁹ Some red knots migrate 9,300 miles one way from their Arctic breeding grounds to the southernmost tip of South America where they overwinter. This long-distance migrant has a strong dependence on key habitats. A recent assessment of the red knot's vulnerability to climate change indicated a large increase in extinction risk due to the likely loss of more than half of its winter range, as well as its high degree of habitat specialization.¹¹⁰



A NEW COURSE FOR BIRDS

The habitat alterations being driven by climate change represent the biggest threat that birds and other wildlife face. Recent reports demonstrate that without significant new steps to reduce carbon pollution the world is on track for global temperature increases of at least 7°F¹¹¹ and global sea-level rise of three feet or more by the end of the century.¹¹² Such a scenario would guarantee that future generations inherit a world fundamentally different from the one we know today.

Climate-driven extinctions and range retractions are already happening.¹¹³ Without significant action to reduce carbon pollution, our forests, grasslands and other habitats will become strangely silent of many of the bird songs we know today. Thankfully, solutions exist to limit carbon pollution, safeguard birds and their habitat, and transition toward wildlife-friendly clean energy.

Solutions to Reduce Carbon Pollution and Limit Climate Change

In May 2013 atmospheric carbon passed the 400 parts per million milestone, more than a 40 percent increase since before the Industrial Revolution.¹¹⁴ We must and can take actions now to slow and reverse the accelerating rise in atmospheric carbon:

- **Use and protect the proven, existing laws to tackle carbon pollution.** The Clean Air Act was put in place to protect people and wildlife from pollution. Under this law, the U.S. Environmental Protection Agency has the authority to limit carbon pollution from our leading source: coal-fired power plants. However, this authority has not yet been implemented. The federal government has the

opportunity and an obligation to use and enforce existing laws as part of a national plan to reduce the carbon that drives climate change.

Now we need the political leadership to make the wise choices and investments needed to reduce carbon pollution in a meaningful way and safeguard birds in a changing climate.

- **Prioritize clean energy and reduce fossil fuel use.**

A serious effort to reduce carbon pollution must include smart energy choices that reduce dependence on fossil fuels and move us quickly towards a future powered by clean energy. Investing in clean energy options such as wind, solar, geothermal and sustainable bioenergy will reduce our consumption of carbon-polluting fuels like coal, oil, tar sands and natural gas, which are driving climate change. It is essential that clean energy sources be developed in an environmentally sound way to minimize and compensate for potential effects on birds and other wildlife.



The Bear River Migratory Bird Refuge in Utah added solar panels in an effort to pursue sustainable electricity production.

- **Protect and restore natural carbon sinks.** In addition to transitioning to clean energy, we must also enhance the ability of nature to balance the system. Restoring the ability of farms, forests and other natural lands to absorb and store carbon provides increased benefits to wildlife by providing critical habitat and helping mitigate climate change.

Safeguard Birds and Their Habitats from Climate Change

It is critical that conservation efforts in the twenty-first century prepare for and manage the impacts of climate change on birds, wildlife, and other natural resources. To safeguard our diverse birdlife it is imperative that we, in cooperation with other countries throughout North and South America:

- **Better understand the impact of climate change** on all aspects of bird ecology—including the unique needs of long distance migrants—and scientifically assess the vulnerabilities of different bird species and their habitats to these climate impacts.
- **Design and carry out climate-smart conservation strategies** to reduce the level of impact on our birdlife and to enhance the resilience of the habitats on which they—and we—depend.

Hunters, bird-watchers, private landowners, and public wildlife and resource management agencies all have a role to play in safeguarding birds and their habitats in the face of climate change. Conserving sensitive habitats will continue to be essential, although land and water protection efforts increasingly will need to take future climate projections into account to ensure long-term value to birds and other wildlife. Degraded landscapes need to be restored, and citizens can take action to provide important habitat through backyard¹¹⁵ and schoolyard habitat programs.¹¹⁶ Taking these and other steps to help birds, wildlife and other natural resources adapt to a changing climate will create a more sustainable future for us all.



In extreme weather events, such as severe storms, special actions may be needed to safeguard wildlife. Artificial nest cavities for the red-cockaded woodpecker had to be installed after a hurricane, in which most nest trees were destroyed.

Source: USDA, Forest Service



Credit: Marc Apfelstadt

“My most rewarding hobby in life is to provide a home for resident birds and to act as a ‘bed and breakfast’ for migrating birds. My yard provides clean water and extra protein necessary for migrating bird journeys. I have sadly watched the decrease in bird species in my yard over the past 15 years. Some migrating and summer-resident birds species have adjusted arrival times, but I no longer see some other species because my plants blossom at different times than before. My yard became one planting zone warmer during this time, and therefore, the birds’ natural food sources were reduced or eliminated. I see a snowball effect in my yard that is very upsetting, and I miss my special birds.”

– Toni S., Ohio, NWF Volunteer

CONCLUSION

Although birds across the country are already feeling the impacts of climate change at a rate much higher than originally predicted, it's not too late to harness America's spirit of ingenuity and leadership to confront this climate crisis. Inaction is no longer a viable option and is only preventing us from taking advantage of the opportunities to create jobs and economic prosperity in concert with bold, swift action to reduce the carbon pollution that is heating our planet and threatening the birds and other wildlife we treasure.

The science is clear—we know what's causing climate change and we know what needs to be done to chart a better course for the future. As we watch nature being transformed by a warming world before our very eyes, it is clear that we must cut carbon pollution, speed our transition to clean energy and safeguard America's birds and other wildlife. We have no time to waste.



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Credit: Flickr / Jmayer1129

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