



# Audubon

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**SPECIAL REPORT**

## BIRDS CAN'T FIGHT CLIMATE CHANGE. WE CAN.

389 bird species are at risk of extinction in a warming world. Many can still be protected—if we act now.



# THE FUTURE FOR BIRDS

Audubon's new climate report details grave threats to some of our most beloved species and the places they need, and steers us toward a path to save them.

BY HANNAH WATERS

ABERT'S TOWHEE • ACADIAN FLYCATCHER • ACORN WOODPECKER • ALDER FLYCATCHER • ALLEN'S HUMMINGBIRD • AMERICAN BLACK DUCK • AMERICAN DIPPER • AMERICAN GOLDEN-PLOVER • AMERICAN GOLDFINCH • AMERICAN PIPIT • AMERICAN REDSTART • AMERICAN ROBIN • AMERICAN THREE-TOED WOODPECKER • AMERICAN TREE SPARROW • AMERICAN WIGEON • AMERICAN WOODCOCK • ANCIENT MURRELET • ANNA'S HUMMINGBIRD • APLOMADO FALCON • ARCTIC TERN • ARCTIC WARBLER • ARIZONA WOODPECKER • AUDUBON'S ORIOLE • BACHMAN'S SPARROW • BAIRD'S SANDPIPER • BAIRD'S SPARROW • BALTIMORE ORIOLE • BAND-TAILED PIGEON • BARN SWALLOW • BARROW'S GOLDENEYE • BAY-BREASTED WARBLER • BELL'S SPARROW • BLACK GUILLEMOT • BLACK RAIL • BLACK ROSY-FINCH • BLACK SCOTER • BLACK SWIFT • BLACK-AND-WHITE WARBLER • BLACK-BACKED WOODPECKER • BLACK-BELLIED PLOVER • BLACK-BILLED MAGPIE • BLACK-CAPPED VIREO • BLACK-CHINNED SPARROW • BLACK-HEADED GROSBEAK • BLACK-HEADED GULL • BLACK-LEGGED KITTIWAKE • BLACK-THROATED BLUE WARBLER • BLACK-THROATED GRAY WARBLER • BLACK-THROATED GREEN WARBLER • BLACK-VENTED SHEARWATER • BLACKBURNIAN WARBLER • BLACKPOLL WARBLER • BLUE-HEADED VIREO • BLUE-WINGED WARBLER • BOAT-TAILED GRACKLE • BOBOLINK • BOHEMIAN WAXWING • BONAPARTE'S GULL • BOREAL CHICKADEE • BOREAL OWL • BOTTERI'S SPARROW • BRANT • BREWER'S BLACKBIRD • BREWER'S SPARROW • BRIDLED TITMOUSE • BROAD-TAILED HUMMINGBIRD • BROWN CREEPER • BROWN THRASHER • BROWN-CAPPED ROSY-FINCH • BROWN-HEADED NUTHATCH • BUFF-BELLIED HUMMINGBIRD • BUFF-BREASTED SANDPIPER • BUFFLEHEAD • BULLOCK'S ORIOLE • BUSHTIT • CACKLING GOOSE • CALIFORNIA GNATCATCHER • CALIFORNIA GULL • CALIFORNIA QUAIL • CALIFORNIA SCRUB-JAY • CALIFORNIA THRASHER • CALIFORNIA TOWHEE • CALLIOPE HUMMINGBIRD • CANADA GOOSE • CANADA JAY • CANADA WARBLER • CANYON TOWHEE • CAPE MAY WARBLER • CASSIN'S AUKLET • CASSIN'S FINCH • CASSIN'S KINGBIRD • CASSIN'S SPARROW • CERULEAN WARBLER • CHESTNUT-COLLARED LONGSPUR • CHESTNUT-SIDED WARBLER • CHIPPING SPARROW • CHUCK-WILL'S-WIDOW • CHUKAR • CINNAMON TEAL • CLAPPER RAIL • CLARK'S GREBE • CLARK'S NUTCRACKER • CLAY-COLORED SPARROW • COMMON EIDER • COMMON GOLDENEYE • COMMON LOON • COMMON MERGANSER • COMMON POORWILL • COMMON REDPOLL • CONNECTICUT WARBLER • CORDILLERAN FLYCATCHER • COUCH'S KINGBIRD • DARK-EYED JUNCO • DOVEKIE • DUNLIN • DUSKY FLYCATCHER • DUSKY GROUSE • DUSKY-CAPPED FLYCATCHER • EARED GREBE • EASTERN KINGBIRD • EASTERN MEADOWLARK • EASTERN TOWHEE • EASTERN WHIP-POOR-WILL • EMPEROR GOOSE • EURASIAN TREE SPARROW • EURASIAN WIGEON • EVENING GROSBEAK • FERRUGINOUS HAWK • FIELD SPARROW • FISH CROW • FLORIDA SCRUB-JAY • FOX SPARROW • FRANKLIN'S GULL • GADWALL • GILDED FLICKER • GLAUCOUS GULL • GLAUCOUS-WINGED GULL • GOLDEN EAGLE • GOLDEN-CHEEKED WARBLER • GOLDEN-CROWNED KINGLET • GOLDEN-CROWNED SPARROW • GOLDEN-FRONTED WOODPECKER • GOLDEN-WINGED WARBLER • GRACE'S WARBLER • GRAY CATBIRD • GRAY FLYCATCHER • GRAY HAWK • GRAY KINGBIRD • GRAY PARTRIDGE • GRAY VIREO • GRAY-CHEEKED THRUSH • GRAY-CROWNED ROSY-FINCH • GREAT BLACK-BACKED GULL • GREAT CORMORANT • GREAT CRESTED FLYCATCHER • GREAT GRAY OWL • GREATER PRAIRIE-CHICKEN • GREATER SAGE-GROUSE • GREATER SCAUP • GREATER WHITE-FRONTED GOOSE • GREATER YELLOWLEGS • GREEN JAY • GREEN-TAILED TOWHEE • GREEN-WINGED TEAL • GYRFALCON • HAMMOND'S FLYCATCHER • HARLEQUIN DUCK • HARRIS'S SPARROW • HENSLOW'S SPARROW • HEPATIC TANAGER • HERMIT THRUSH • HERMIT WARBLER • HOARY REDPOLL • HOODED ORIOLE • HOODED WARBLER • HOOK-BILLED KITE • HORNED GREBE • HOUSE WREN • HUDSONIAN GODWIT • HUTTON'S VIREO • INDIGO BUNTING • KENTUCKY WARBLER • KING EIDER • KITTLITZ'S MURRELET • LAPLAND LONGSPUR • LARK BUNTING • LAWRENCE'S GOLDFINCH • LECONTE'S SPARROW • LECONTE'S THRASHER • LEAST FLYCATCHER • LEAST SANDPIPER • LEAST TERN • LESSER PRAIRIE-CHICKEN • LESSER SCAUP • LESSER YELLOWLEGS • LEWIS'S WOODPECKER • LINCOLN'S SPARROW

• LITTLE GULL • LONG-BILLED CURLEW • LONG-BILLED DOWITCHER • LONG-BILLED THRASHER • LONG-TAILED DUCK • LONG-TAILED JAEGER • LOUISIANA WATERTHRUSH • LUCY'S WARBLER • MACGILLIVRAY'S WARBLER • MAGNOLIA WARBLER • MARBLED GODWIT • MARBLED MURRELET • MCCOWN'S LONGSPUR • MERLIN • MEW GULL • MEXICAN JAY • MONK PARAKEET • MONTEZUMA QUAIL • MOUNTAIN BLUEBIRD • MOUNTAIN CHICKADEE • MOUNTAIN PLOVER • MOUNTAIN QUAIL • MOURNING WARBLER • MUTE SWAN • NASHVILLE WARBLER • NELSON'S SPARROW • NORTHERN FLICKER • NORTHERN FULMAR • NORTHERN GANNET • NORTHERN GOSHAWK • NORTHERN HAWK OWL • NORTHERN PARULA • NORTHERN PINTAIL • NORTHERN PYGMY-OWL • NORTHERN SAW-WHET OWL • NORTHERN SHRIKE • NORTHERN WATERTHRUSH • NORTHWESTERN CROW • NUTTALL'S WOODPECKER • OAK TITMOUSE • OLIVE SPARROW • OLIVE WARBLER • OLIVE-SIDED FLYCATCHER • ORANGE-CROWNED WARBLER • OVENBIRD • PACIFIC GOLDEN-PLOVER • PACIFIC LOON • PAINTED REDSTART • PALM WARBLER • PARASITIC JAEGER • PECTORAL SANDPIPER • PELAGIC CORMORANT • PHILADELPHIA VIREO • PIGEON GUILLEMOT • PINE GROSBEAK • PINE SISKIN • PINE WARBLER • PINYON JAY • PIPING PLOVER • PLAIN CHACHALACA • PLUMBEOUS VIREO • POMARINE JAEGER • PRAIRIE WARBLER • PURPLE FINCH • PYGMY NUTHATCH • RAZORBILL • RED CROSSBILL • RED PHALAROPE • RED-BREASTED MERGANSER • RED-BREASTED NUTHATCH • RED-BREASTED SAPSUCKER • RED-CROWNED PARROT • RED-FACED CORMORANT • RED-FACED WARBLER • RED-HEADED WOODPECKER • RED-NAPED SAPSUCKER • RED-NECKED GREBE • RED-NECKED PHALAROPE • RED-THROATED LOON • RING-NECKED DUCK • RINGED KINGFISHER • ROCK PTARMIGAN • ROCK SANDPIPER • ROCK WREN • ROSE-BREASTED GROSBEAK • ROSS'S GOOSE • ROUGH-LEGGED HAWK • RUBY-CROWNED KINGLET • RUDDY TURNSTONE • RUFFED GROUSE • RUFOUS HUMMINGBIRD • RUFOUS-CROWNED SPARROW • RUSTY BLACKBIRD • SABINE'S GULL • SAGE THRASHER • SAGEBRUSH SPARROW • SALTMARSH SPARROW • SANDERLING • SANDHILL CRANE • SAVANNAH SPARROW • SCALED QUAIL • SCARLET TANAGER • SCOTT'S ORIOLE • SEASIDE SPARROW • SEDGE WREN • SEMIPALMATED PLOVER • SEMIPALMATED SANDPIPER • SHARP-SHINNED HAWK • SHARP-TAILED GROUSE • SHORT-BILLED DOWITCHER • SHORT-EARED OWL • SMITH'S LONGSPUR • SNAIL KITE • SNOW BUNTING • SNOW GOOSE • SNOWY OWL • SOLITARY SANDPIPER • SONG SPARROW • SORA • SPECTACLED EIDER • SPOTTED DOVE • SPOTTED OWL • SPOTTED SANDPIPER • SPOTTED TOWHEE • SPRAGUE'S PIPIT • SPRUCE GROUSE • STELLER'S EIDER • STELLER'S JAY • STILT SANDPIPER • SULPHUR-BELLIED FLYCATCHER • SUMMER TANAGER • SURF SCOTER • SURFBIRD • SWAINSON'S THRUSH • SWAMP SPARROW • TENNESSEE WARBLER • THICK-BILLED KINGBIRD • THICK-BILLED MURRE • TOWNSEND'S SOLITAIRE • TOWNSEND'S WARBLER • TREE SWALLOW • TRICOLORED BLACKBIRD • TROPICAL PARULA • TRUMPETER SWAN • TUNDRA SWAN • VARIED THRUSH • VAUX'S SWIFT • VEERY • VESPER SPARROW • VIOLET-GREEN SWALLOW • VIRGINIA RAIL • VIRGINIA'S WARBLER • WANDERING TATTLER • WESTERN BLUEBIRD • WESTERN GREBE • WESTERN SANDPIPER • WESTERN TANAGER • WESTERN WOOD-PEWEE • WHIMBREL • WHISKERED SCREECH-OWL • WHITE-CROWNED PIGEON • WHITE-CROWNED SPARROW • WHITE-HEADED WOODPECKER • WHITE-RUMPED SANDPIPER • WHITE-TAILED HAWK • WHITE-TAILED KITE • WHITE-THROATED SPARROW • WHITE-THROATED SWIFT • WHITE-WINGED CROSSBILL • WHITE-WINGED SCOTER • WHOOPING CRANE • WILLIAMSON'S SAPSUCKER • WILLOW FLYCATCHER • WILLOW PTARMIGAN • WILSON'S PHALAROPE • WILSON'S SNIPE • WILSON'S WARBLER • WINTER WREN • WOOD THRUSH • WOODHOUSE'S SCRUB-JAY • WORM-EATING WARBLER • WRENTIT • YELLOW RAIL • YELLOW WARBLER • YELLOW-BELLIED FLYCATCHER • YELLOW-BELLIED SAPSUCKER • YELLOW-BILLED LOON • YELLOW-BILLED MAGPIE • YELLOW-EYED JUNCO • YELLOW-RUMPED WARBLER • YELLOW-THROATED VIREO • YELLOW-THROATED WARBLER

WE CAN HELP THESE BIRDS  
Climate change puts 389 species at risk of extinction; limiting warming reduces the threat for the 290 species in yellow.





Unlike the Northern Flicker, the Gilded Flicker is uniquely adapted to desert habitats.

**W**HEN TOWERING SAGUARO CACTUSES IN THE Sonoran Desert erupt spectacularly into springtime bloom, winged flashes of red and yellow dart among them. Gilded Flickers flit between flowers like overgrown hummingbirds, lapping up ants and nectar with long, sticky tongues. These large woodpeckers' lives are wrapped up in those of the saguaro; not only do they dine on insects living in the succulent flesh, but they also hammer out cavities that protect their families from the harsh sun. When they vacate the hollows, Elf Owls, Purple Martins, and Brown-crested Flycatchers move in.

But the Sonoran's avian real estate developers could go extinct by 2080 if the region grows hotter and drier, creating prime conditions for wildfires that incinerate the flickers' homes. It's just one of the sobering findings from Audubon's report, *Survival by Degrees: 389 Bird Species on the Brink*, published in October. Using advanced climate models, the report gives an unparalleled view into which birds, and which places, are at greatest risk, providing our best field guide to the future of North American birds.

Under the worst-case scenario, the changes to that future field guide are stark. The shorebird section would be considerably slimmer, since Arctic breeders like Sanderlings and American Golden-Plovers would have largely disappeared, unable to reproduce once temperatures climb too high. Pages of grassland birds such as Baird's Sparrows and Long-billed Curlews, and woodland specialists like Acorn Woodpeckers and Clark's Nutcrackers, would be removed as the Great Plains dry out and western forests decline due to drought and wildfire. The artwork would be less colorful with the loss of Blackburnian and Magnolia Warblers and other neotropical migrants that have for millennia flocked to the boreal forest each spring.

In this speculative book, the range maps of species distribution would morph considerably. Some would balloon: Barn Swallows, European Starlings, Downy Woodpeckers, and Northern

Mockingbirds would blanket far more of the continent, while Great Egrets and Great Blue Herons would expand north into areas previously too cold. But the maps on many pages would cover substantially less ground than they do today.

Of the 604 species modeled, 389 are vulnerable to extinction, meaning that as soon as 2080 more than half of their current range would become inhospitable and they wouldn't gain new ground. If that comes to pass, that future guide would be half the thickness of the one now on your shelf. Ninety-nine percent of birds could have to cope with more frequent extreme-weather events, like intense spring heat and heavy rainfall; at the same time, sea-level rise and urbanization could consume much-needed habitat. Most birds will likely experience multiple, compounding threats—unless we curb emissions and prioritize conserving the areas, identified by the models, that will be critical to climate-threatened birds.

**UNDER THE WORST-CASE SCENARIO, THE CHANGES TO THAT FUTURE FIELD GUIDE ARE STARK. PAGES OF GRASSLAND BIRDS AND WOODLAND SPECIALISTS WOULD BE REMOVED.**

The models, the culmination of five years of research, are "cutting-edge," says Josh Lawler, an ecologist at the University of Washington in Seattle who uses similar models to predict how wildlife might respond to climate change; he was not involved in the study. "Not only did they use new climate data, but they did things in about as sophisticated a way as you can for this kind of

modeling." Such geographically broad and species-rich studies are needed to help us help wildlife survive climate change, he says. "There is time to identify the places to protect, the places to restore, the species that are going to need the most help."

The report tells us that the time to act is now and points at the strides that could make the difference between survival and extinction for Gilded Flickers and myriad other species.

#### A Model for These Times

The new study comes five years after Audubon published its first climate report, an investigation that was itself seven years in the making. The 2014 study found that of the 588 bird species investigated, 314 could potentially face extinction by 2080.

At the time, it was the broadest and most detailed study of its kind. The scientists reached their startling conclusion by first combing 44,000 records from the Audubon Christmas Bird Count and North American Breeding Bird Survey to determine where birds live. Then they pinpointed the range of temperatures, amount of rainfall, and other climate characteristics of each species' habitat and plugged the information into computer projections of the global climate. Out came potential future ranges with suitable climate conditions for each species, mapped to a resolution of 10 square kilometers.

Since then, huge advances have occurred in computing and access to international databases has grown, allowing scientists to generate even more detailed forecasts. "We are learning every day how to improve models," says Terry L. Root, a retired biologist who pioneered computerized avian distribution models in the 1980s; she sits on the National Audubon Society board. "And we are just getting better."

To more precisely define the climate conditions species inhabit today, Audubon scientists incorporated a whopping 140 million bird observations from 70 datasets. (If you submit sightings to eBird, you likely contributed to the new study.) They included data from Mexico and Canada that weren't used in 2014. They also went beyond simply considering climate conditions by factoring in vegetation, agriculture, surface water, and other variables in order to ensure that birds would have fitting habitat, too. "We want to get at the areas that are not only suitable based on climate, but also have the appropriate habitat—they're not converted to agriculture or a city or something that's not appropriate for that particular species," says Brooke Bateman, Audubon's senior climate scientist who led the research.

Bateman and colleagues fed those variables into climate models to determine where species would likely occur in a warming world, comparing best-case and worst-case scenarios. Already global temperatures have risen by between 0.8 and 1.2 degrees Celsius since 1880, with 18 of the 19 hottest years on record occurring since 2001. According to the United Nations' Intergovernmental Panel on Climate Change (IPCC), if carbon emissions continue to increase, the planet will likely warm by an average 2 degrees around 2050 and 3 degrees around 2080. If they flatline, we will see a 1.5-degree Celsius increase by around 2050.

The scientists then used the projected range maps, which have a resolution of one square kilometer, to assess each species' vulnerability to extinction from climate-driven shifts in temperature, rainfall, and vegetation. Highly vulnerable species are predicted to lose at least half their current range and not regain it elsewhere.

Perhaps unsurprisingly, generalists will fare better than specialists. Birds with more flexible diets and habitat requirements, like American Crows, Cedar Waxwings, Red-winged Blackbirds, and European Starlings, could gain considerable ground. Whereas those that rely on more particular food sources or landscapes could face serious hardship, including Red Crossbills, whose bizarre



#### BEAT THE HEAT

Young birds like these Least Terns are highly vulnerable. They can't flee predators. They can't feed themselves. Many can't regulate their own temperature. And excess heat can be deadly. "The most temperature-sensitive part of a bird's life isn't when it's an adult," says ornithologist Morgan Tingley, "but when it's very, very young."

That makes baby birds particularly helpless against climate change. Heat waves can kill nestlings; drought can prompt adults to abandon nests or skip breeding. And while most populations can weather the odd poor breeding year, several in a row can be disastrous for populations.

Some birds are finding ways to keep their chicks cool. California mountain birds nest a week earlier than they did a century ago. Globally, plover dads are spending more time on eggs, reducing their heat exposure. And Costa Rican and other tropical birds are shifting upslope. Such adaptations are helping birds hang on, but even those have limits and trade-offs—making it all the more critical to get climate change under control. —H.W.

beaks evolved to dismantle pinecones, and Greater Sage-Grouse that cannot survive without sagebrush.

In addition to mapping each species, the team grouped the results by geographic area to provide a larger picture of how birds that depend on certain habitats will be affected. At greatest risk are those that live or breed in the Arctic tundra and boreal forests, which are warming at twice the rate of the rest of the planet. Mountain Chickadees and Cassin's Finches, already clustered on western mountainsides with narrow climate conditions, could run out of vertical space to move into. Scarlet Tanagers and other eastern forest birds that depend on deciduous trees could be pushed north into areas that are now evergreen. Many birds that can already cope with heat, meanwhile, like southwestern aridland species and widespread marshbirds, could colonize new areas.

"There's uncertainty about any given one of those species in any given one of those projections, but on average these predictions should actually be relatively accurate," says Morgan Tingley, an ornithologist and conservation biologist at the University of Connecticut not involved in the research. "That might tell us about which areas may lose species or gain species, and which areas may be key for movement and dispersal. Those are actionable conservation items."

Ben Zuckerberg, a bird-focused climate ecologist at the University of Wisconsin-Madison, who also did not participate in the study, agrees. "What these models are really good for is giving people an approximation of which regions we expect to see some of the biggest shifts in their suitable climate space," he says. "It gives a best-guess estimate of what species are going to





📷 American Golden-Plovers, like this one in Alaska's Brooks Range, are sensitive to rising temperatures in their Arctic breeding grounds.

be increasingly in inhospitable climate conditions because that climate space is moving to such a large degree and so fast.”

Pinpointing these at-risk species and sites is just the start to this story, though, because as birds shift to keep up with their climate space, they’ll encounter a veritable obstacle course of challenges.

### Going to Extremes

During past climate changes, over many millions of years, birds had ample space to shift into. Today, they’re working under tight constraints: one-third of U.S. land is cow pasture, another fifth is farmland, and the urban 3.6 percent is impassable for most wildlife. “A lot of the same pathways by which species have been able to move with a changing climate are no longer there for them,” Zuckerberg says. What’s more, climate change is creating a caustic atmosphere more prone to extreme weather events like wildfires, heavy rainfall, and drought, while sea-level rise from

melting polar ice consumes valuable coastal habitat.

“Birds aren’t just going to have to shift; they’re going to have to deal with these other added threats,” Bateman says. So she and her team modeled these so-called regional threats, which affect certain places more than others, to see how they intersect and overlap with the current and projected future ranges of 544 species.

They zeroed in on nine threats. The five short-term threats—extreme spring heat, spring droughts, fire weather, heavy rain, and false springs—affect birds during the highly sensitive breeding season (See “Beat the Heat,” page 17), while sea-level rise, Great Lakes level change, urbanization, and cropland expansion persistently destroy habitat. The scientists modeled these threats across the continental United States at 1.5 and 3 degrees Celsius of warming, then overlaid the regional threat maps with the projected bird-range maps to see which birds could be affected by which threats.

PATRICK J. ENDRES/ALASKA PHOTOGRAPHICS.COM

If temperatures rise 3 degrees, 99 percent of birds studied could suffer from extreme spring heat, and 96 percent could encounter two or more threats range-wide. More than half of birds could face weather primed for fire. Eastern and Pacific Northwestern birds could bear the bulk of heavy rainfall, while southwestern birds could be hit by frequent spring droughts. Coastal birds could lose beachfront habitat to urbanization and sea-level rise, squeezing populations from both sides.

These regional threats are substantially less severe if we mitigate climate change. The proportion of birds that would be threat-free improves markedly to 17 percent at 1.5 degrees, compared with 1 percent at 3 degrees. And nearly two-thirds of birds would face only one threat—in almost all cases, extreme spring heat, which could stretch across half the country.

Taken together, the studies warn of a potentially massive loss in biodiversity. Generalists are poised to thrive and expand, positioning them to be more resilient to the chaotic nature of extreme weather.

## THE JOY OF SPOTTING A RARE WARBLER MAY NO LONGER COME WITH SPRING MIGRATION; THE REASON TO TRAVEL TO A UNIQUE HABITAT MAY GO EXTINCT.

For birders, that would translate to a shorter life list, with few of the endemics that make travel thrilling. The joy of spotting a rare warbler may no longer come with spring migration; the reason to travel to a unique habitat may go extinct. “The diversity of nature is very much due to species being able to fill myriad niches and adopt really weird ways of living and create all sorts of different life forms,” Tingley says. “If you’re a birdwatcher, you know this because these are often the species that you think are super cool and you seek out.”

Far more than our enjoyment of birds is at stake. “There will be species that are already stressed by other means, like pollution or pesticides, and then they’re going to have the added stress of heat or droughts or floods,” says Root, who won a Nobel Peace Prize for co-authoring the fourth IPCC assessment. “They’re not going to make it. And they’re going to be species we need.”

Baird’s Sparrows eat grasshoppers and other insects that consume crops, while owls and hawks hunt varmints. Hummingbirds pollinate fruit-producing flowers; Clark’s Nutcrackers and other seed eaters replant forests and replenish vegetation. Northern Pintails and King Eiders are hunted for food and sport, and hunting permits raise millions of conservation dollars annually. Scavengers, like vultures, crows, and gulls, clear carcasses and garbage, reducing disease spread. Woodpeckers slow outbreaks

of invasive bark beetles. Seabirds redistribute nutrients between land and sea, and their guano is a valuable fertilizer.

Even birds that don’t directly serve human needs still help us. The cavities that Gilded Flickers carve into saguaro cactuses provide safe nesting sites for pest-controlling martins and owls.

This bird business goes on invisibly. But if they blink out, we’ll feel their absence.

### A Reason for Hope

Tomorrow’s field guides don’t have to lose their familiar heft: There’s still time to get back on track and save many bird species. If we stabilize global carbon emissions, scores of birds would be better off. Nearly 300 species would be less vulnerable to extinction at 1.5 degrees warming than at 3, and nearly 150 species could be pulled back from the brink, the report found.

“The biggest value of this study is the way they’ve linked it to the climate policy-based thresholds,” Lawler says. “If you don’t know the benefit, it’s hard to make the case for less warming.”

“Our report tells us that climate change is an existential threat to birds and gives us a strong signal that we have to choose a different path, now,” says Renee Stone, vice president of Audubon’s Climate Initiative. “Climate solutions are already on the table that will lower carbon emissions at the speed and scale we need.”

For the 286 species still vulnerable at 1.5 degrees, curbing emissions won’t be enough. The report helps there, too, says Chad Wilsey, Audubon’s vice president of conservation and report co-author. “There might be specific places that are important to a population that will be impacted,” he says. “The analysis helps identify those places so we can take efforts to protect or restore habitat.”

In other words, the report shows us the places it’s critical to protect. Safeguarding swaths of boreal forest for breeding warblers and waterfowl also locks up carbon in trees and soil, helping to further stall warming. For coastal birds threatened by sea-level rise, conservationists can create conditions so that beaches and marshlands can migrate inland, and in the same action buffer coastal towns and cities from storm surge. Great Plains areas projected to persist through climate change, known as strongholds, can be managed to sustain habitat for grassland birds and pollinators. Connecting fragmented forests by protecting or restoring corridors can guide wildlife to safer areas.

This work wouldn’t benefit birds alone. Already, the West’s forests are burning more frequently and intensely. Heat waves on land and at sea are on the rise. When hurricanes form in the tropical Atlantic, they will likely be bigger, stronger, and more destructive to coastal towns and cities. These disasters have displaced many thousands of people, America’s first climate refugees, even if unofficially. “The landscape is not just changing for birds; it’s changing for everybody,” Bateman says. “Through the lens of birds, we can see how things are anticipated to change.” The question is, then, how much change we’re willing to let happen. **A**

## BIRDERS ON A MISSION

In summer and winter, birders fan out to count species in the name of climate science. The data they compile on bluebirds, nuthatches, goldfinches, towhees, and Painted Buntings help scientists compare real-life behavior against predictions

made by Audubon’s models. So far, the models are largely holding true, says Audubon’s Brooke Bateman. In winter, species are shifting into areas projected to become more suitable. But in an unexpected twist, some are staying put in

summer, perhaps reluctant to leave established breeding sites.

Other discoveries no doubt await. The field observations gathered through the Climate Watch program will feed into the models, making Audubon’s analyses even more precise.

“The more people we have counting across the country, the more information we’ll have to understand climate change,” Bateman says—yielding insights for how to best help birds. Sign up at [audubon.org/climate-watch](https://audubon.org/climate-watch). —H.W.