

Birds and Climate Change

Ecological Disruption in Motion

A Briefing for Policymakers and Concerned Citizens
on Audubon's Analyses of North American
Bird Movements in the Face of Global Warming



Audubon

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Science reveals the message from the birds

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Each year for more than a century, dedicated volunteers have braved snow, wind, rain and ice to record the number and location of North American birds. The carefully organized and compiled observations of tens of thousands of Citizen Scientists participating in Audubon's annual Christmas Bird Count have grown to form the world's longest uninterrupted repository of bird population information. Analyses of its data have time after time revealed important trends, alerting America to perils and opportunities with implications far beyond avian well-being. Birds are well-known barometers of environmental health. Changes in their condition can warn of threats to habitats and natural systems critical to all life on earth. Like canaries in a coal mine, they can alert us to danger. And, if we heed their warnings, caring for the birds can help us protect ourselves and the future of the world we share.

Amid mounting concerns over accelerating global climate change, Audubon looked to the birds to determine if and how these sensitive creatures might be responding to changes here in the continental U.S. Birders have long reported surprising sightings of species far north of expected ranges. But are the reports significant? If so, are they connected to documented changes in our climate? Analyses of four decades of Christmas Bird Count data provide some answers. The results confirm what bird lovers have long suspected. Findings summarized in the pages that follow offer a look at forty years of change, a peek at what the future likely holds in one part of our nation, and an urgent message of warning from the birds—a message we would be wise to heed.

It took legions of bird-loving citizen scientists to document how North America's birds are responding in the face of global warming. It will take action by America's millions of self-proclaimed bird enthusiasts—and their elected representatives—to address the problem of climate change while there's still time.

Front cover: Greater Yellowlegs by Donna Dewhurst / USFWS.
The Greater Yellowlegs has shifted its wintering range 124 miles north in the last 40 years.

Birds on the Move Show Significant Changes Underway

Analysis of four decades of Christmas Bird Count observations reveal 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% of the observed species—177 of 305. More than 60 moved in excess of 100 miles north, while the average distance moved by all studied species—including those that did not reflect the trend—was 35 miles northward.

There was also movement inland, from warmer coastal states into areas not long accustomed to winter temperatures suitable for their new arrivals.

The analysis found these trends among nearly every type of species; their sheer numbers and variety pointing to a powerful common force contributing to the movements.

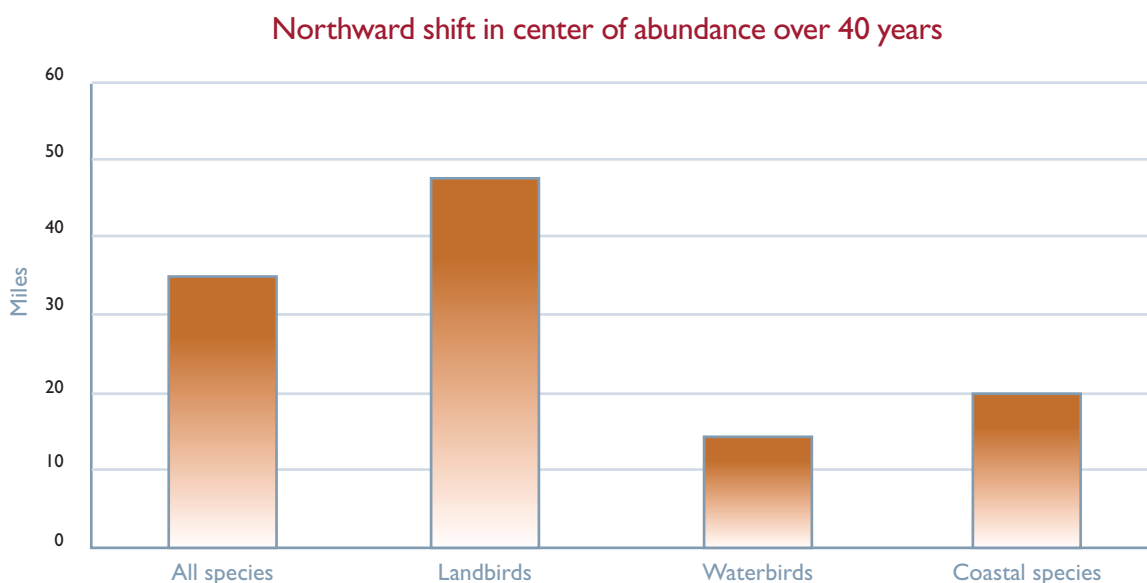
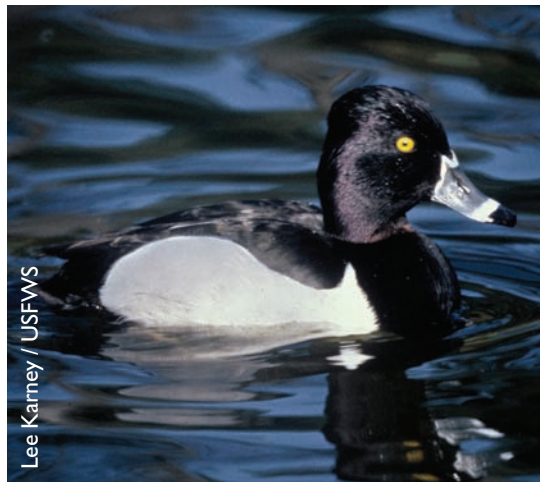


Figure 1, Source: National Audubon Society

Audubon's Christmas Bird Count tallies the species and number of birds in 2,000 specified locations (count circles) each year within two weeks of Christmas. Audubon scientists analyzed forty years of CBC data (Christmas 1966-2005), examining observations on 305 species that are regularly encountered in five or more states or provinces to assess changes in the range of North American birds. Identified range changes are based upon movement in the centers of abundance for each of the 305 species – half the individuals of a species are found south of the center of abundance; the other half are found north.



Left to right: The Brant (a coastal bird), Ring-necked Duck (a waterbird), and American Goldfinch (a landbird), all moved about 200 miles north over four decades.

The Climate Culprit

Climbing average annual temperatures have been well documented by scientists studying global warming. Average temperatures for January, the coldest month, rose more than five degrees F. in the continental U.S. over the past 40 years (figure 2).

Temperature increases coincided with anecdotal reports of northward movement of bird populations—now confirmed by Audubon's analysis (Figure 3).

Is climate change causing bird movements? While causation is nearly impossible to prove, global climate change is by far the most probable explanation. Indeed, the movements are consistent with birds' biological needs.

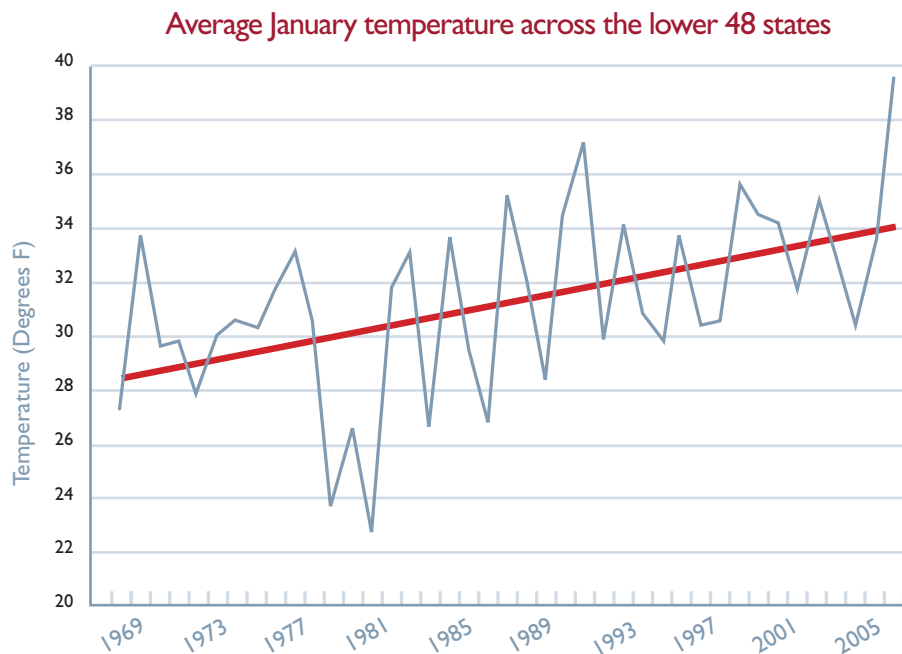


Figure 2, Source: National Oceanic and Atmospheric Administration

Change in center of abundance among 305 widespread bird species in North America

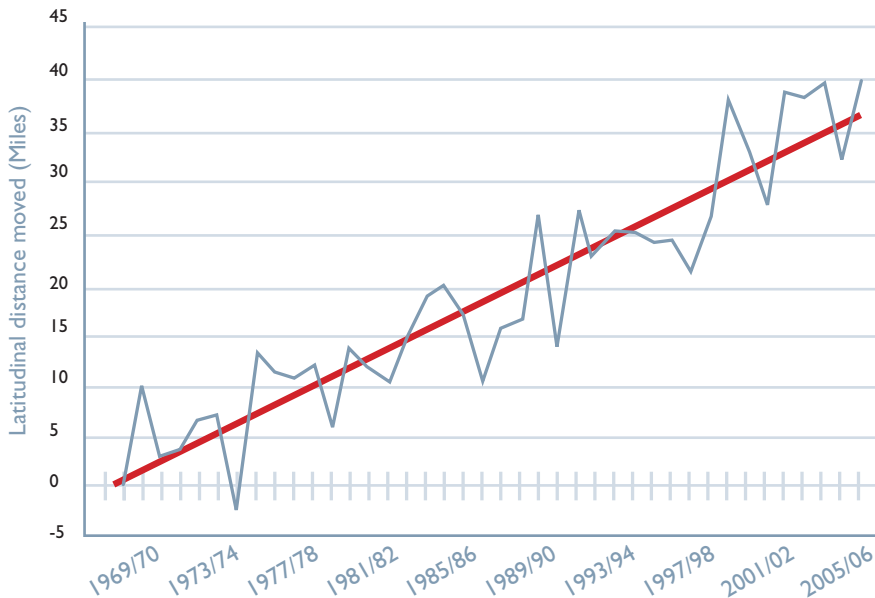


Figure 3, Source: National Audubon Society

Rising winter temperatures make northern latitudes increasingly more hospitable to many species commonly found farther south. Audubon's analysis reveals that species' populations grew the most in the states experiencing the greatest warming, surpassing the growth in areas that did not warm as much. Similarly, the warming climate's moderation of inland temperature extremes allows species to shift inland from the coast.

Citizen scientists have long observed that conditions in late fall and early winter predict how far north many species will be found during the Christmas Bird Count that follows soon after. Audubon's analysis confirms their suspicions, revealing statistical correlation between annual species locations and the November/December temperature fluctuations leading up to the count. In combination, these findings leave little doubt that ongoing climate change is a primary and direct factor in the overall shift of many winter ranges.

We're seeing compelling signs that climate change has been with us and having serious biological consequences for the past 40 years. Little else could explain this kind of spectacular movement across such a wide range of birds.

Birds frequently alter their ranges due to many factors, especially habitat changes and interactions with other species. Audubon does not suggest that all the birds that moved north or inland did so in response to climate change; a wide variety of other factors play a contributing role and explain why a minority of species showed no movement or even shifted southward. However, the correlation between shifting ranges and winter temperature trends cannot be ignored in explaining some of the widespread and directionally consistent movements seen among U.S. bird species. Among key findings:

1 Annual latitudinal distributions of birds are correlated with annual temperatures.

2 Among states and provinces, rates of bird population change are correlated with rates of temperature change, independent of latitude.

3 Among all the species in our study, twice as many bird species moved north as south; twice as many species moved inland as moved coastally. Both of these directional movements are consistent with a climate change model. However, an equal number of birds moved east as moved west. Under global warming, movements away from the Atlantic and Pacific should be about equal, with no other expectation of differences in east-west movement.

4 Latitudinal movement patterns among birds centered in different latitudinal regions of North America are generally consistent with a climate change model, but inconsistent with movements predicted as a result of range shifts in response to population increases or decreases.

5 Birds found only in a few southern states, and thus not included in the main part of this study, have been observed in increasing numbers, suggesting that they have moved north from south of the United States.



Dave Menke / USFWS

Red-breasted Merganser
Moved 317 miles North



Steve Maslowski / USFWS

American Black Duck
Moved 182 miles North



Donna Dewhurst / USFWS

Green-winged Teal
Moved 157 miles North

On the Move...

Over the past 40 years, the Christmas Bird Count has documented shifts to the north or inland for the majority and for nearly every kind of North American bird species. Audubon's analysis confirms the anecdotal evidence from bird enthusiasts who have frequently reported changing populations filling their skies.

Given the strong evidence that global warming is indeed a key factor in observed bird movements, shifts like these will continue for familiar species—for better or worse—as long as the climate continues to change. Though these movements clearly point to significant ecological disruption underway, their short and long term impacts will vary for specific species and even groups.

We must act decisively to control global warming pollution to curb the worst impacts of climate change, and take immediate steps to help birds and other species weather the changes we cannot avoid.



Tim Bowman / USFWS

Black-bellied Plover
Moved 114 miles north



Tim Bowman / USFWS

Black Turnstone
Moved 178 miles North



Ryan Hagerty / USFWS

Northern Gannet
Moved 83 miles North

...To an Uncertain Fate

WATERBIRDS

More than half of the waterbird species (52%) moved north, including a wide variety of ducks, such as Red-breasted Merganser, American Black Duck, and Green-winged Teal. Waterbirds have benefited in recent years from less ice cover in northern and interior states, but future conditions under global warming scenarios are not promising—a hotter and drier climate will dry many wetlands that waterbirds require.

COASTAL BIRDS

Coastal waterbirds did not move inland, primarily because they require saltwater or habitats found only near saltwater. However, many of these species (46%) still moved north, including the Black-bellied Plover and Black Turnstone (shorebirds), and Northern Gannet (a large fish-eating bird). The short-term health of many of these species is already in decline from development and the degradation of coastal habitats. These areas need significant protection and restoration. In addition, avian diets—not to mention seafood production—are threatened by the loss of food-rich ocean currents that disappear or become less predictable with global warming. Coastal habitats themselves are further threatened by sea-level rise associated with climate change.



Glenn Tepke

Pine Siskin
Moved 288 miles North



Glenn Tepke

Spruce Grouse
Moved 316 miles North



John & Karen Hollingsworth / USFWS

Western Meadowlark
Moved 25 miles South

LANDBIRDS

Among all landbirds in the study, 64% showed significant northward movement, including more than 70% of all woodland birds and 70% of those that frequent feeders.

Feeder birds such as Pine Siskin, Boreal Chickadee, and Pygmy Nuthatch have moved hundreds of miles since 1966. Already adapted to human habitats, they are unusually well suited to a shifting climate. Most will fare well in the short term, as long as food is provided. However, northern-wintering birds are highly vulnerable to the sudden onset of cold and stormy conditions. They are also likely to further disrupt ecosystem balance by displacing less adaptable species.

Woodland birds that do not visit bird feeders, such as Spruce Grouse, American Three-toed Woodpecker, and Barred Owl, also showed long-distance northward movements. Their continued success in northern winters will depend on healthy forest habitat, which is already at risk due to both the drying effects of global warming and over-exploitation by humans.

Grassland birds including Eastern Meadowlark, Vesper Sparrow, and Burrowing Owl are among the few groups that did not move north over the past 40 years. Only 10 of 26 (38%) grassland species moved north significantly, while nine moved south. Most probably could not move into northern areas despite increasingly moderate temperatures because conversion to intensive human uses such as row crops, pastures, and hayfields has greatly reduced availability of grassland habitat. In combination, global warming and ongoing overuse of grasslands by humans will doom grassland birds to continued population declines if we fail to take corrective actions.

Threats to Species, Habitats and More

Whether they have already shifted their ranges or are unable to do so, bird species illustrate how the impact of global warming compounds other well-known threats. Scientists have long predicted dire consequences from global warming for birds and other species.

International experts from the Nobel Prize-winning Intergovernmental Panel on Climate Change warned in 2007 that “approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperatures exceed 1.5-2.5 degrees C.” Others have projected that more than 30% of Neotropical songbirds could be lost in some parts of the continental U.S.

While these predictions are outside the scope of Audubon’s analysis, the study reveals that the ecological disruptions that threaten birds, other wildlife and human communities are likely already in motion. Arctic and alpine tundra and coastal beaches, salt marshes, and mangroves are in great jeopardy. As the world warms, permafrost underlying the tundra will melt, allowing the habitat to be invaded by woody plants. As sea level rises, all coastal habitats are at risk. In undeveloped areas, coastal habitats may recede inland; but in developed areas, people and natural habitats will compete for the decreasing space. Habitats such as grasslands and deserts (including significant parts of the American West) will face increasing stresses, as will the species that depend on them. Carefully planned, science-based habitat conservation efforts will be increasingly essential to avoid a growing toll on birds and wildlife, along with the loss of a wide array of ecological benefits, from clean water supplies, and the insect control and seed distribution provided by birds, to travel and tourism revenues. According to the U.S. Fish and Wildlife Service, birding related activities alone generate \$85 billion in input to America’s economy.

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USFWS

Moving Toward the Future

The need to address the impact of climate change on bird populations is also demonstrated by additional new research conducted by Audubon California. The new analysis models changes in geographic ranges over the next 100 years and indicates that about 80 of California's 310 native bird species will lose at least a quarter of their distributions in the next several decades due to climate change. These reductions will be part of massive range shifts among all of the state's bird species caused wholly or in part by the effects of climate change.

Models used in this research indicate that the magnitude of bird range loss in California will depend in large part on the steps we take now to reduce greenhouse gas emissions worldwide.

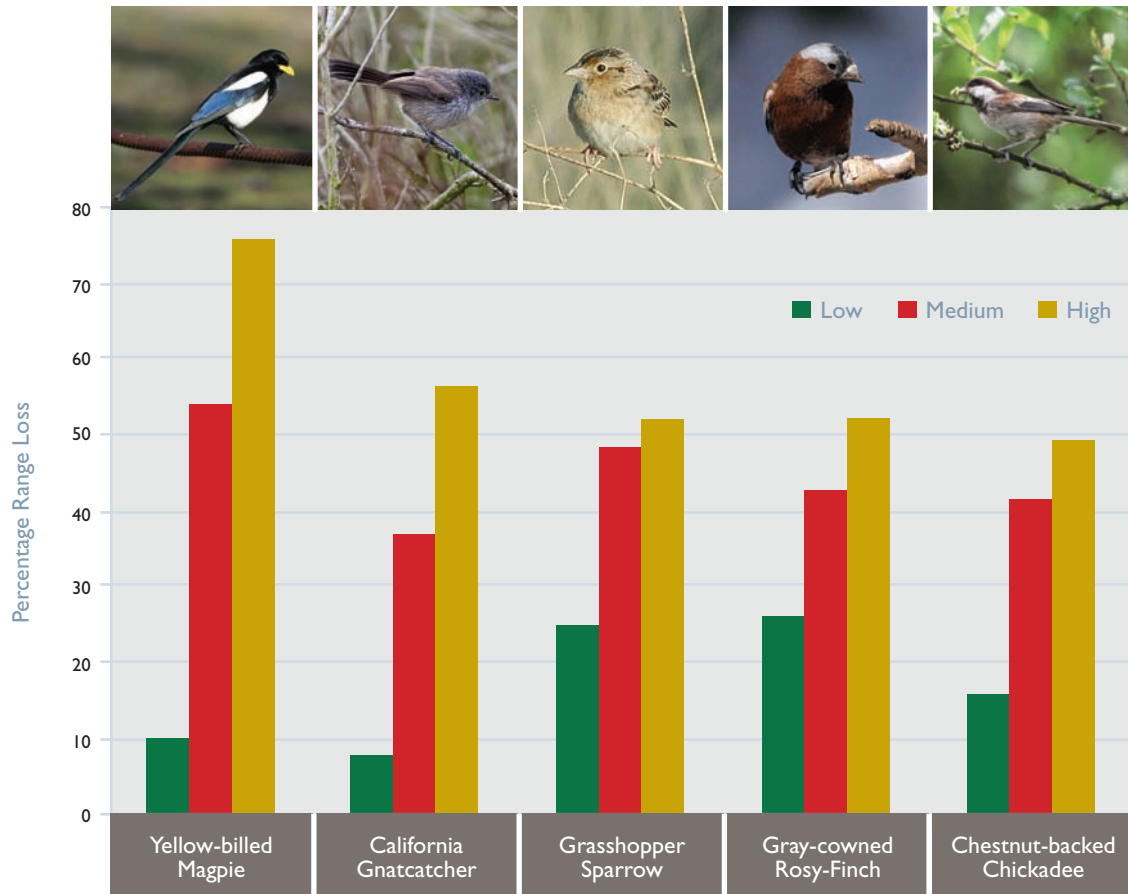
Scenarios generated by the Intergovernmental Panel on Climate Change inform the California research by defining emission levels for low, medium and high scenarios.



Figure 4, Source: Graphic adapted from IPCC 2007 by National Audubon Society

As emissions increase, the research projects a growing impact on birds, as illustrated by five familiar California species.

Range Loss under three emission scenarios.



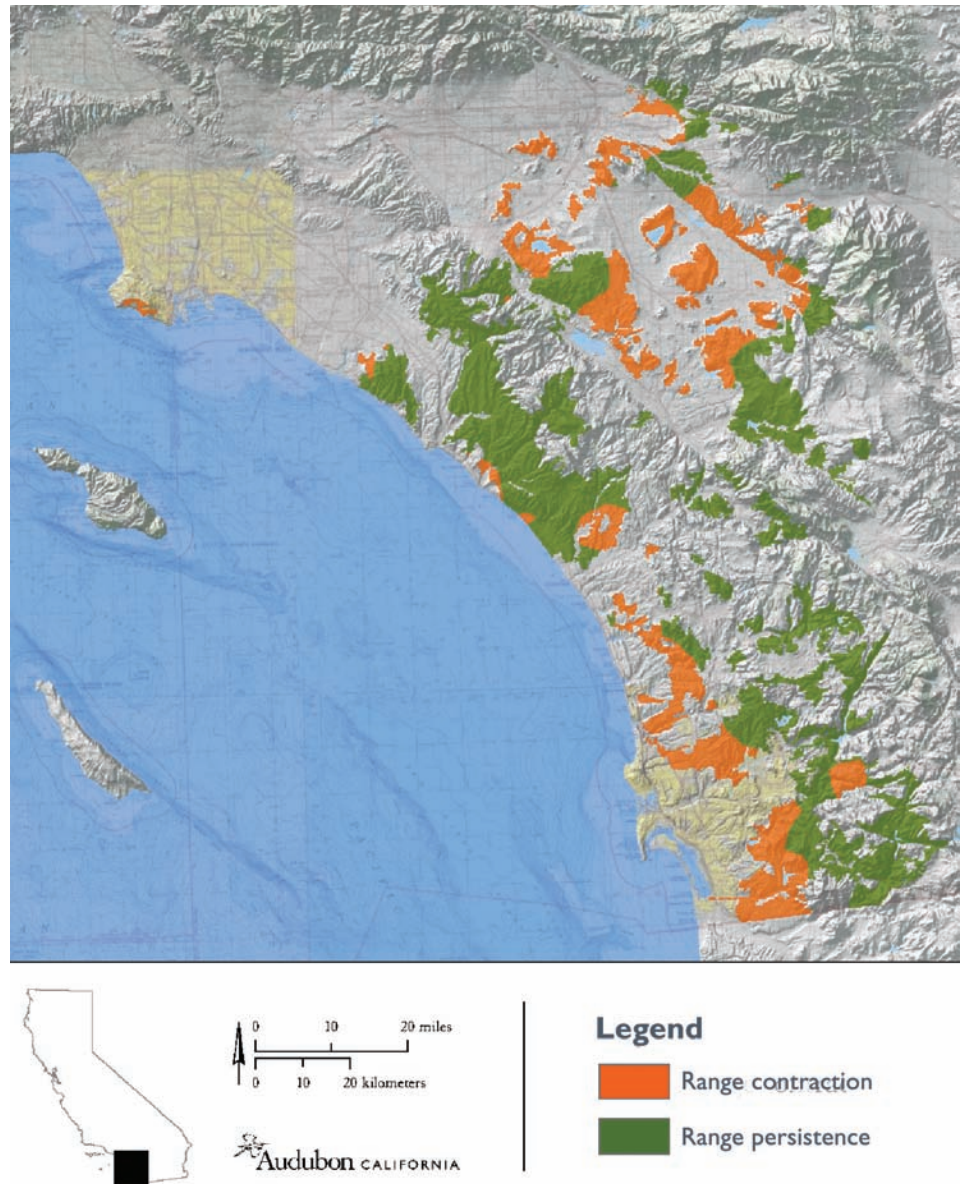
Photos (L to R): Ashok Khosla, Dennis Ancinec, Bob Martinka, Glenn Tepke, Lee Karney / USFWS

Figure 5, Source: Audubon California

Audubon California models identify where conservation investments are likely to have the biggest impact. We must combine efforts to curb global warming emissions with science-based habitat conservation planning and execution if we hope to maintain healthy habitat for birds, other wildlife and people.

The Outlook for One Species

Projected range changes for the California Gnatcatcher over the next hundred years illustrate the impact of climate change, while identifying areas where future conservation can shape its long-term prognosis. This projection is based on the medium-level emissions scenario.



The findings were derived by combining 40 years of data compiled by volunteers for the Audubon Christmas Bird Count with Breeding Bird Survey information and geographic climate data. Datasets were used to build a Geographic Information Systems library and database, allowing researchers to identify and map habitat areas where species of special concern will benefit from habitat conservation. A critical element of these models is the inclusion of climate change data layers summarized by the Intergovernmental Panel on Climate Change.

Global Warming Requires Immediate Action

Whether seen in the movement of the birds, or the melting of ice caps, the evidence cannot be denied—ecological disruption is underway. Failure to prevent the worst impacts of global warming would undermine much of the conservation work that Audubon has accomplished over more than a century. Tackling this critically important challenge is one of Audubon's top priorities. Species at greatest risk may already be unable to escape the worst consequences of climate change. But there is still opportunity to protect most birds, wildlife, and habitat from the growing threats posed by accelerating global warming. To do so, we must reduce global warming pollution to the levels recommended by the world's leading scientists.

Scientists agree that immediate and far-reaching action is needed to prevent global average temperatures from increasing more than another 2° F. from today's levels if we are to avoid the worst impacts of climate change. According to the Nobel Prize-winning Intergovernmental Panel on Climate Change, we can meet this objective if developed countries as a whole cut their emissions 25–40 % from 1990 levels by 2020 and at least 80 % by 2050.

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Audubon's Policy Recommendations

Reduce Global Warming Pollution

The United States should set mandatory limits on global warming pollution and establish a cap and trade program that is consistent with preventing average global temperature from rising another 2° F. Any such program should require pollution permits to be auctioned, use the revenue to ensure a rapid transition to a clean energy economy, and provide necessary assistance for helping people, wildlife, and ecosystems adapt to climate changes caused by global warming.

Repower America with Clean and Efficient Electricity

The United States should strive toward achieving a 100 % clean energy future by maximizing energy efficiency, vastly expanding our use of renewable energy, and developing the needed infrastructure to deliver clean energy to America—all in an environmentally-responsible manner that will help reduce our global warming emissions while minimizing the impacts on birds and habitat. In order to achieve this clean energy vision, Audubon recommends the following first steps:

- Adopt a suite of state and federal policies designed to increase energy efficiency by at least 15 % by 2020.

- Adopt a national renewable electricity standard that will require 25 % of all electricity to be provided by renewable resources by 2025.
- Accelerate the development of properly sited transmission to serve new renewable energy and a “Smart Grid” to transmit that energy more efficiently.

Reduce Our Dependence on Oil

In order to put America on a path toward meeting our goals for reducing global warming pollution, the United States should start by cutting our dependence on oil by half. This can be achieved by significantly increasing fuel efficiency for cars and trucks, expanding the use of more fuel efficient and less polluting vehicles, using cleaner and environmentally sustainable fuel alternatives, investing in clean transportation infrastructure, public transportation, and sustainable communities, and providing Americans with more transportation alternatives.

Invest in the Clean Energy Economy of Tomorrow

The United States should make major new investments in clean energy technologies and infrastructure that will allow us to reduce global warming pollution while also creating the clean energy economy of the future. By limiting global warming pollution and requiring polluters to pay for their pollution, we can fund the necessary investments in energy efficiency, clean energy, and technology research and development.

Help Species and Ecosystems Adapt

Climate change is underway and will continue for decades. Actions we take today can limit the severity of warming and the damage it will bring in the future. We must help wildlife and ecosystems adapt to changing new conditions, even as we work to curb climate change itself.

Species management and habitat conservation efforts must take into account the habitat shifts and ecosystem changes that climate change will inevitably bring. Science-based models like those produced by Audubon California can identify habitats that will become increasingly important to the future survival of birds. In essence, there are three critical strategies:

- 1) we must continue to protect birds and their habitats to maximize population sizes so species will have maximum vigor to withstand the challenges posed by climate change,
- 2) we must improve habitat resilience—the ability of healthy ecosystems to absorb disturbances and changing conditions without undergoing fundamental shifts in character; and
- 3) we must support the movement of species and habitats into areas with more suitable conditions when the other two options are not enough.

Essential Steps

- Assessing, prioritizing, protecting, and restoring habitats of regional, national, continental and global significance for species survival—the Audubon/Birdlife International Important Bird Areas program is a prime example of such an effort.
- Expanding protected area networks, including such places as state and national wildlife refuges and sanctuaries to protect species in all parts of the country; and maintaining healthy habitat corridors to connect them.
- Reducing existing human-imposed stresses that erode ecosystem resilience such development, pollution, habitat fragmentation, and the introduction of invasive species.

Policy makers can play a critical role by advancing an agenda to help species and habitats weather the climate assault. This involves:

- Including dedicated funding for natural resources conservation and wildlife adaptation in any comprehensive climate change legislation.
- Passing legislation creating new funding sources to help migratory birds and their habitats survive climate change.
- Integrating global warming adaptation into all wildlife conservation planning, including state Wildlife Action Plans.
- Incorporating global warming considerations into public lands planning, such as the development of Comprehensive Conservation Plans for national wildlife refuges.
- Building global warming planning into strategic growth priorities for public lands such as the Land Acquisition Priority System for national wildlife refuges.

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Learn more at www.audubon.org

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