



Climate Watch Results Report: 2017

*Community science to help understand birds in a changing climate
May 2018*

Eastern Bluebird. Photo: Nick Shearman / Audubon Photography Awards

Overview

From January 15 – 30 and June 1 – 15, 2017, more than 600 volunteers from across the U.S. looked for bluebirds and nuthatches as part of Audubon's Climate Watch program. Climate Watch is a community science program that integrates species' climate-based range projections with community volunteers' local knowledge to study how birds will respond to climate change. Volunteers collected data on seven target species: Eastern, Western, and Mountain bluebirds and White-breasted, Red-breasted, Brown-headed, and Pygmy nuthatches.



From left: Eastern, Mountain, Western Bluebirds, Brown-headed, White-breasted, Red-breasted, Pygmy Nuthatches. Photos from left: Jim Chagares, Timothy Lenahan, Rick Lewis, Sid Ehlert, Nick Saunders, Megumi Aita, Clyde Dexter. All from Audubon Photography Awards

Our preliminary analysis of the 2017 data are starting to reveal how bluebirds and nuthatches are already responding to climate change. Bottom line, it is complicated! Some species appear to be tracking along with climate change range shifts, while others are being left behind.

Valuable data from climate watch participants has helped us show that climate change is already having an influence on where birds are breeding and spending their winter months. We are also able to make more realistic predictions of each species' future range – based on where our Climate Watch volunteers are actually seeing these birds. While we are already seeing important trends, more data and greater participation will make these analyses much more concrete. That is why your ongoing participation in Climate Watch and encouraging others in your community to take part is so important.

In this report, we will provide an overview of the analysis and results from the 2017 survey year, diving into how birds are responding to climate change within both the summer and winter.

We will also provide information below about how you can help birds facing the worst impacts of climate change. Community scientists, like you, are seeing the effects of climate change first hand. We need your help to prioritize action on climate change with policy makers, such as your congressperson.

Table of Contents

Species Results at a Glance.....	5
Results Summary.....	8
What does this all mean?	8
What can we do next?.....	9
Winter 2017 Target Species Results	11
Eastern Bluebird.....	12
Mountain Bluebird	13
Western Bluebird	14
Brown-headed Nuthatch	15
White-breasted Nuthatch	16
Red-breasted Nuthatch	17
Pygmy Nuthatch.....	18
Summer 2017 Target Species Results	19
Eastern Bluebird.....	20
Mountain Bluebird	21
Western Bluebird	22
Brown-headed Nuthatch	23
White-breasted Nuthatch	24
Red-breasted Nuthatch	25
Pygmy Nuthatch.....	26
How did we analyze the data?.....	27

Climate Watch Results Report: 2017


With your help, we are doing important work for birds!

What did we find out?

Species Results at a Glance

Climate change is a complex issue, and our Climate Watch target species are revealing that so are their responses to climate change mediated range shifts. Looking at our **Species Results-at a Glance summary table**, we can see that even within related bird species, range shifts are not always in the same manner.

For bluebirds, Eastern Bluebird and Western Bluebird appear to be having opposite responses to winter range shifts, but we still need to collect more data to understand how bluebirds are responding to climate change range shifts, particularly in summer.

Species	Summer 	Winter 
 Eastern Bluebird	?	—
 Mountain Bluebird	?	?
	?	+

Western Bluebird		
 Brown-headed Nuthatch	?	+
 White-breasted Nuthatch	-	?
 Red-breasted Nuthatch	+	-
 Pygmy Nuthatch	-	?

Species results- At a Glance summary table: Summary table of each target species response within each survey period (summer and winter). Symbols represent positive relationship with range shift, i.e. the species appears to be tracking climate change (+ green), negative relationship with range shift, i.e. the species is being 'left behind' by climate change (- red). Species with not enough data to obtain a statistically significant relationship are indicated with a question mark (?).

For Nuthatches, some species are tracking climate change range shifts, such as Brown-headed Nuthatch in winter and Red-breasted Nuthatch in winter. However, even within the same species (Red-breasted Nuthatch), we are also seeing the opposite relationship with climate change-induced range shifts during summer.

For a few of our target species, we need more data to be able to understand how they are shifting along with climate change range shifts. For these species, our analyses have not revealed statistically significant relationships for our single season models. As Climate Watch data collection increases and spans several years, we are looking forward to working on more in-depth models for our target species and to reveal patterns of range shifts for the species for which we have yet to see significant relationships.

To find out more about each species relationship with climate change-associated range shifts, see the in-depth results for each season and target species at the end of this document.

Results Summary

Climate change is disruptive in ways that are hard to predict, even among closely related species and between seasons. The unpredictability makes conservation planning more challenging in the face of climate change, and highlights how such a monitoring effort will both complement and improve our projected species range maps to portray a more realistic future for birds.

Bluebirds:

We still have a lot to uncover about how bluebirds are responding to climate change related range shifts. Western Bluebird, which is predicted to have winter range expansion, does appear to be moving into areas that are becoming more suitable. That is not the case for the Eastern Bluebird, which is becoming stuck in areas that are becoming unsuitable.

Nuthatches:

For this group, we have a better understanding of how each species is tracking their range shifts. However, for Red-breasted Nuthatch at least, responses can differ within the same species between the two seasons. Brown-headed Nuthatches and Red-breasted Nuthatches appear to be tracking along with range shifts (for winter and summer, respectively), while White-breasted Nuthatch and Pygmy Nuthatch, as well as Red-breasted Nuthatch in winter, appear to be falling behind.

What does this all mean?

These results are complex, and we need more data before we can get the full picture on our target species' response to climate change. However, it is expected that these target species will respond differently to climate change, and that for some, change on the ground will take longer than it will for other species. This is why Climate Watch is such a valuable program, as getting a sense of how these birds are responding at each location to broad-scale climate change will help us target conservation efforts for these species at the scale that matters- the local level!

As we continue to monitor these species with Climate Watch and develop multi-year models that will look at how are target species are responding over several years, we will get a better sense of which species are falling behind. For these species, targeted conservation efforts in the face of climate change, such as close population monitoring and habitat restoration and protection, will be important. For now, we can take a closer look at Eastern Bluebird, White-breasted Nuthatch and Pygmy Nuthatch, as well as Red-breasted Nuthatch in winter to start to understand where these species might be falling behind and why.

This information, which is novel and exciting from a scientific perspective, allows us to:

- Show that climate change is already having an influence on where birds are breeding and spending their winter months. Our goal is to publish Climate Watch results in the scientific literature, to provide evidence of climate change induced range shifts in birds as it happens.
- Improve on our models of future ranges of birds under projected climate change (climate.audubon.org) by allowing us to make more realistic predictions of each species' future range – based on where our Climate Watch volunteers are actually seeing these birds!

Climate change is a landscape scale issue, but it affects all of us locally. Thanks to the efforts of our Climate Watch volunteers across the country, we can start to tell the story that the birds are telling *us* about climate change!

What can we do next?

Beyond collecting data in Climate Watch, it is important for us to stress that you are the local experts on your birds in your area. Through your work for the birds, not only are you contributing to the larger scientific investigation of birds' responses to climate change, but you also carry the knowledge of what the birds are telling us about climate change in your area.

As a community scientist, you are seeing the impacts of climate change first-hand. It is critical in order to protect birds and the places they need that we demand legislators prioritize climate change and clean energy solutions. Please take a few minutes to use your power as a constituent and community leader to voice your demand for change by sending a letter to your legislator and submitting a letter to the editor of your local newspaper. We have created a [draft letter to an elected official](#) and [draft letter to the editor](#) to get you started. Please contact us at

climateaction@audubon.org to let us know how you are making climate change solutions a priority.

Additionally, you can help us protect the places birds need by planting native plants and supporting land conservation. Learn more about [Audubon's Plants for Birds Program](#) or take action to reauthorize the [Land and Water Conservation Fund](#), which has supported efforts to protect habitat in nearly every state.

We hope that together we can be the voice for the birds in a changing climate!

Thank you, for all you do for the birds!

Winter 2017 Target Species Results

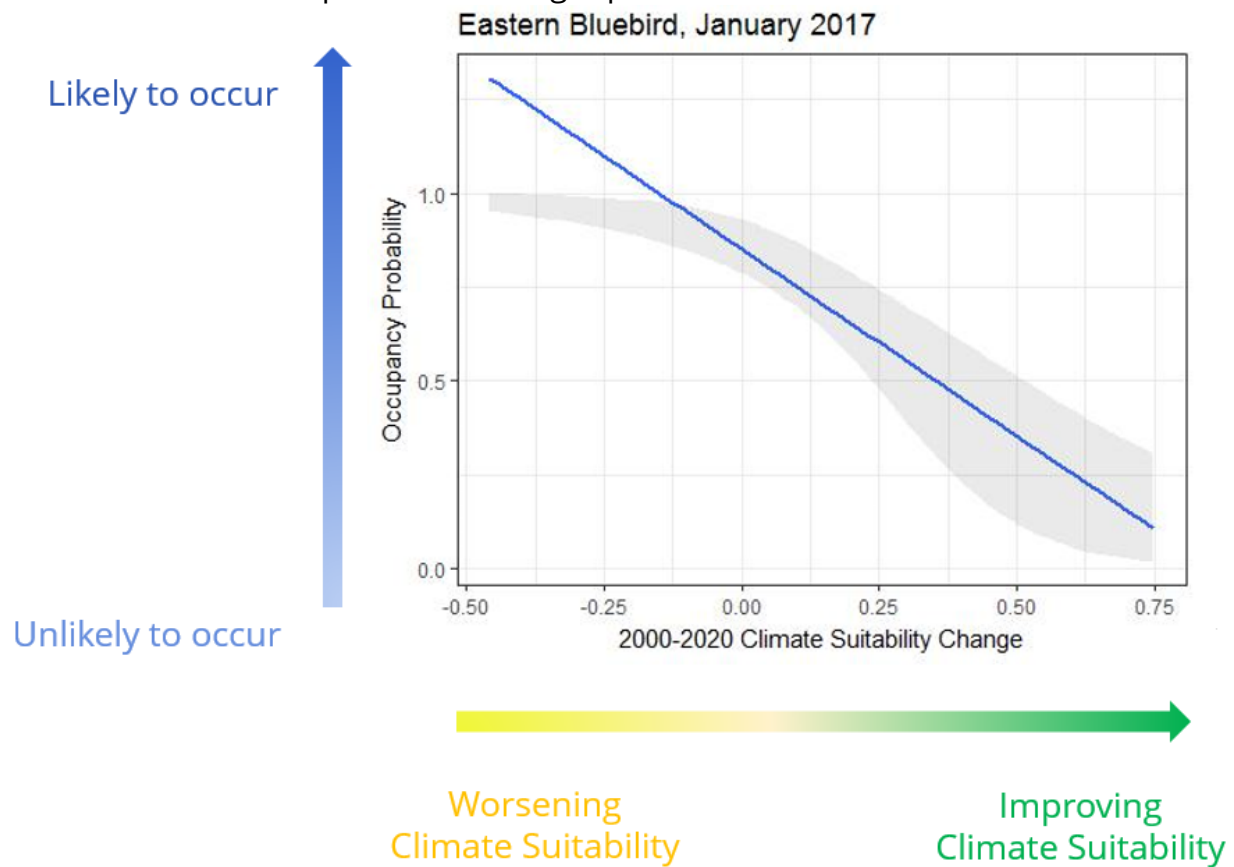


Photo: Brooke Bateman/Audubon



Eastern Bluebird
Winter

In winter 2017, Eastern Bluebird was more likely to occur in areas of worsening climate suitability, indicating that individuals are becoming 'stuck' in areas where ideal climate for this species is no longer present.



Bottom Line: Eastern Bluebird is falling behind and becoming stuck in areas with worsening climate suitability in winter.



Mountain Bluebird
Winter

For Mountain Bluebird, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



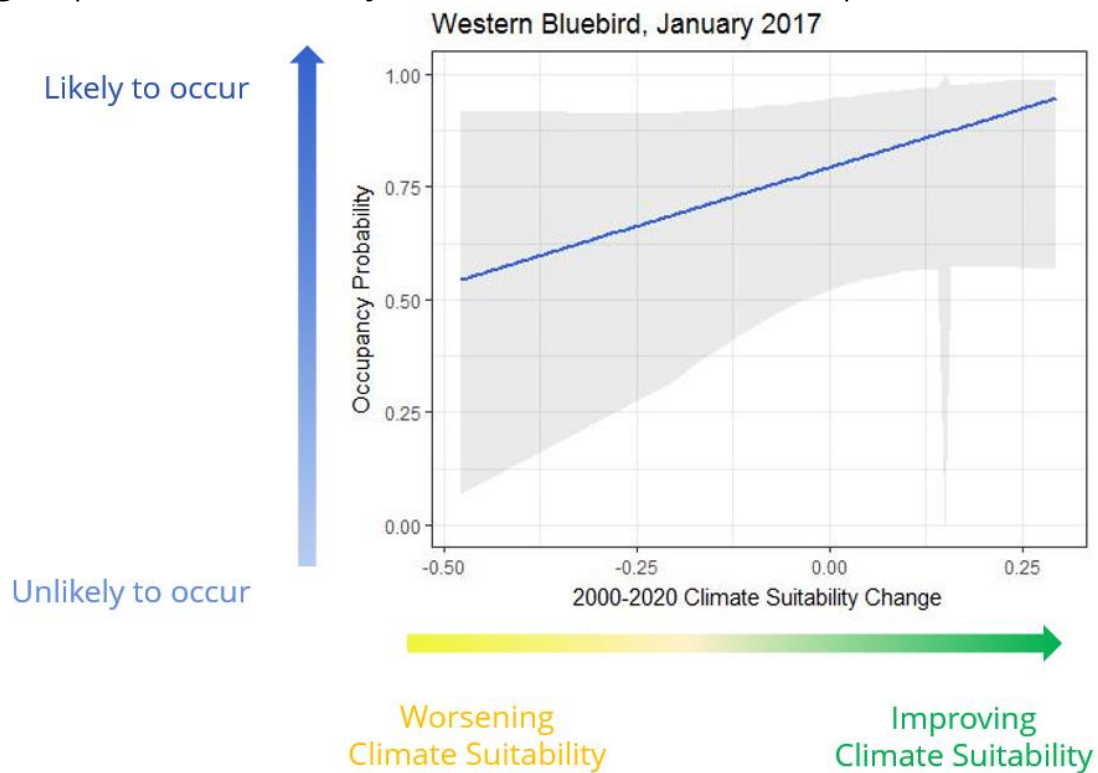
Bottom Line: We need more information and data collected on Mountain Bluebird in winter.



Western Bluebird
Winter

In winter 2017, Western Bluebirds were more likely to occur in areas becoming more suitable into the future. This suggests that in winter, this species is tracking towards improving climate conditions.

This species is considered climate threatened, but is predicted to have 73% of its winter range remain as stable (i.e. limited shift in climate suitability), with 64% increase in its winter range predicted by 2080. It is possible that the predicted range expansion and stability in winter is beneficial for this species.



Bottom Line: Western Bluebird is shifting along with climate change in summer.



Brown-headed Nuthatch
Winter

For Brown-headed Nuthatch, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



Bottom Line: We need more information and data collected on Brown-headed Nuthatch in winter.



White-breasted Nuthatch
Winter

For White-breasted Nuthatch, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



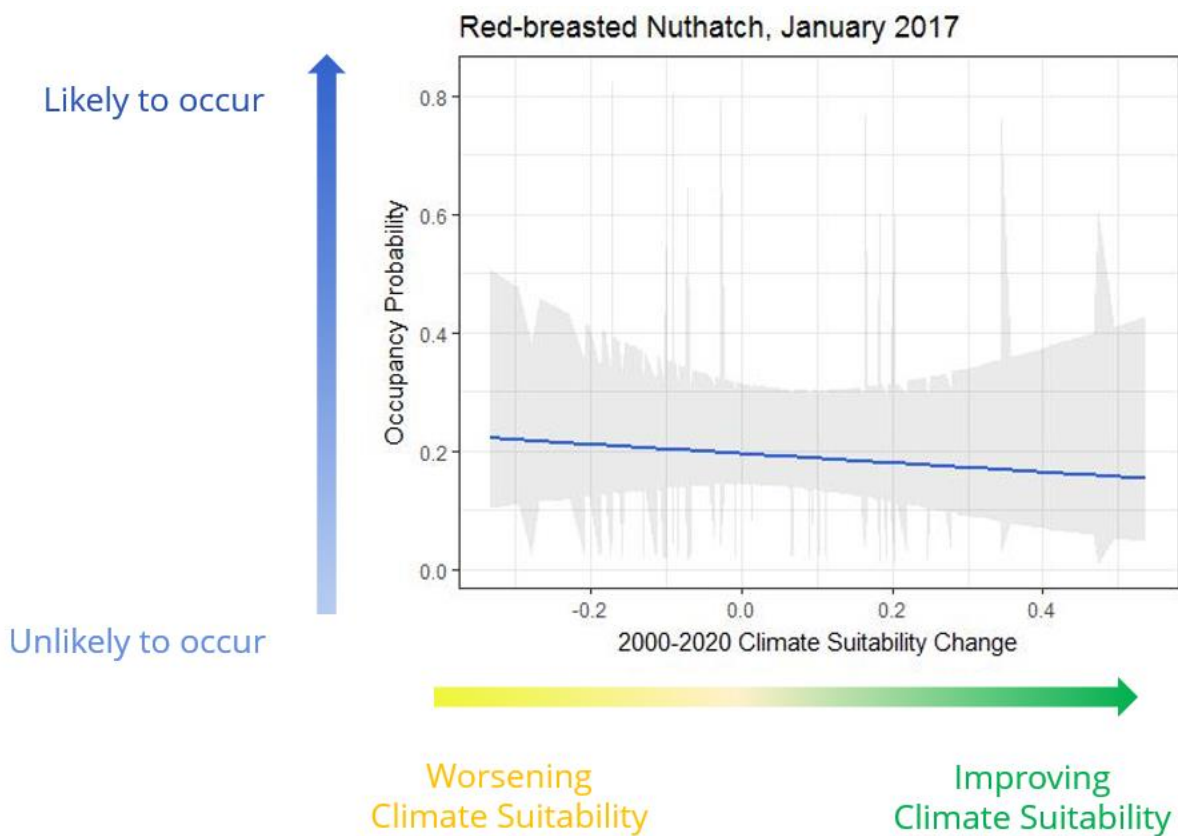
Bottom Line: We need more information and data collected on White-breasted Nuthatch in winter.



Red-breasted Nuthatch
Winter

In winter 2017, Red-breasted Nuthatches were more likely to occur in areas of worsening climate suitability, indicating that individuals are not moving into areas that are improving and fewer areas will remain suitable in the future.

In winter, only 58% of its range is predicted to remain stable, with a 2% decrease in area that will remain suitable during winter in the future.



Bottom line: Red-breasted Nuthatch is not shifting along with climate change in winter.



Pygmy Nuthatch
Winter

For Pygmy Nuthatch, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



Bottom Line: We need more information and data collected on Pygmy Nuthatch in summer.

Summer 2017 Target Species Results



Photo: Camilla Cerea/Audubon



Eastern Bluebird
Summer

For Eastern Bluebird, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



Bottom Line: We need more information and data collected on Eastern Bluebird in summer.



Mountain Bluebird
Summer

For Mountain Bluebird, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



Bottom Line: We need more information and data collected on Mountain Bluebird in summer.



Western Bluebird
Summer

For Western Bluebird, there were not enough data to obtain a statistically significant relationship with occupancy probability and climate change.



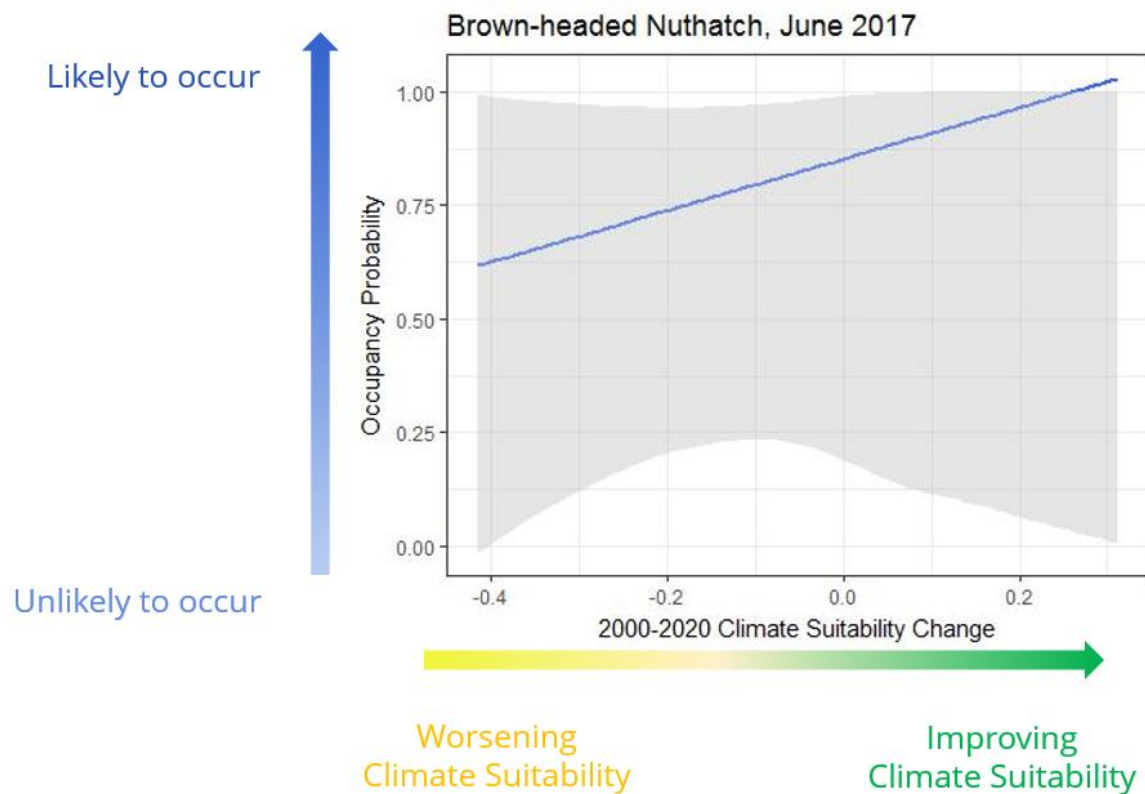
Bottom Line: We need more information and data collected on Western Bluebird in summer.



Brown-headed Nuthatch
Summer

In summer 2017, Brown-headed Nuthatches were more likely to occur in areas becoming more suitable into the future. This suggests that in summer, individuals are tracking towards improving climate conditions.

For this species, 0% of its summer range is predicted to be stable in the future, with a 95% decrease in their summer range by 2080. Thus, it is particularly encouraging to see that Brown-headed Nuthatches are able to shift their distributions to compensate for changing climate conditions.



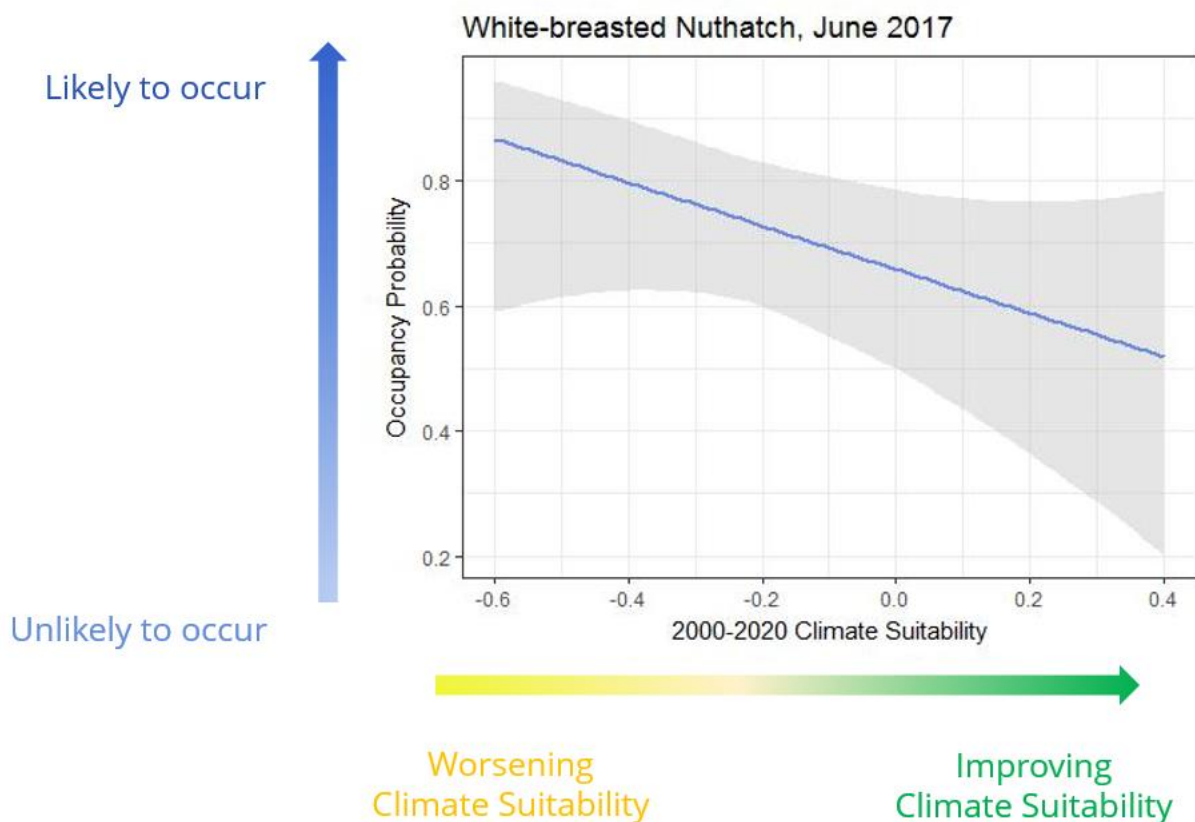
Bottom line: Brown-headed Nuthatch is shifting along with climate change in summer.



White-breasted Nuthatch
Summer

In summer 2017, White-breasted Nuthatch was more likely to occur in areas that are worsening in climate suitability. This species appears to be failing to shift along with climate change.

Only 22% of the historically suitable summer range is stable for this species, with a predicted 16% decrease in summer range by 2080.



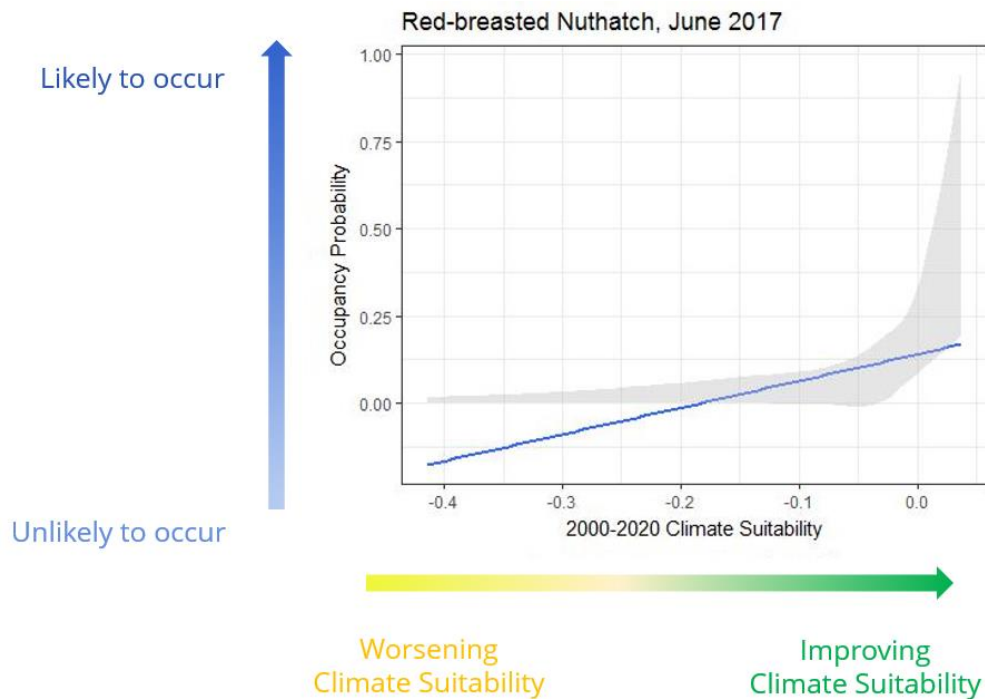
Bottom line: White-breasted Nuthatch is not shifting along with climate change in summer.



Red-breasted Nuthatch
Summer

In summer 2017, Red-breasted Nuthatches were more likely to occur in areas becoming more suitable into the future. This suggests that in summer, this species is tracking towards improving climate conditions, an opposite relationship to that found in winter. However, much of this species' range is shifting north of our current Climate Watch study areas, and we have limited data in areas with improving climate suitability for this species.

19% of its summer range is predicted to be stable, with a 23% decrease in range predicted by 2080.



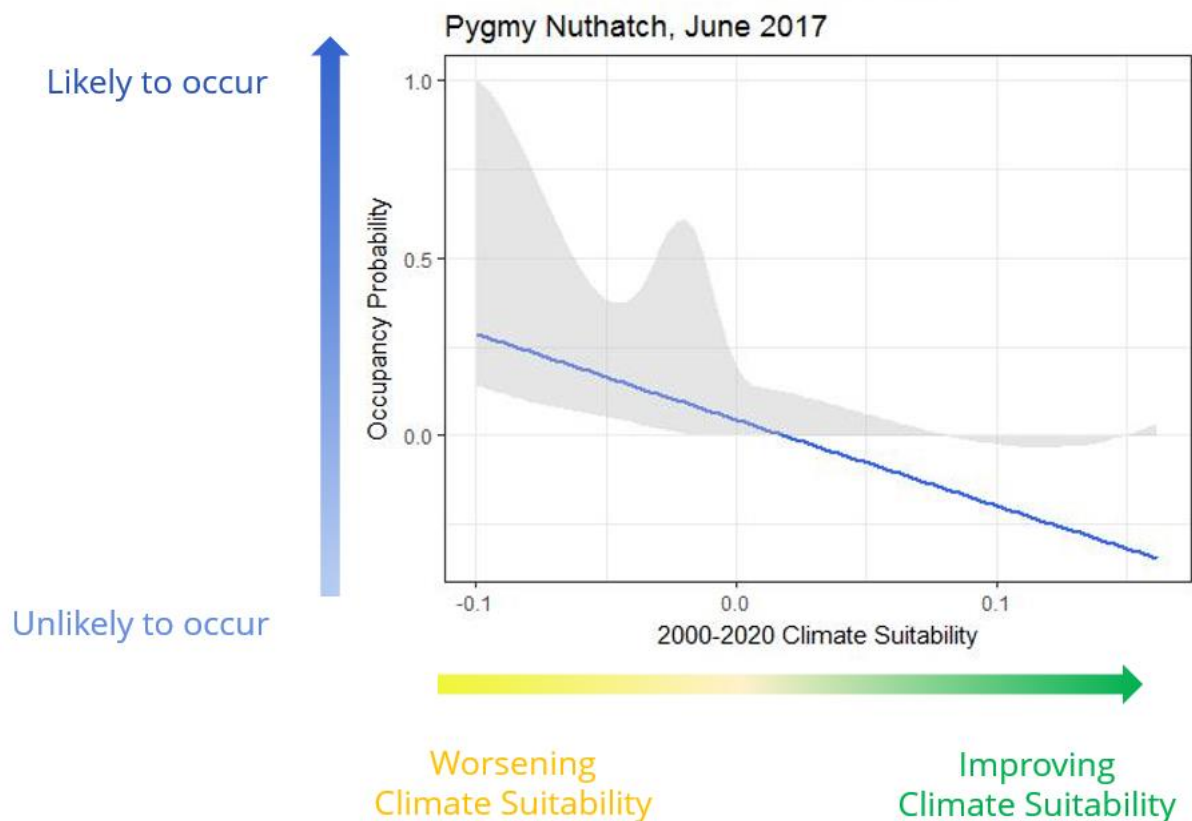
Bottom line: Red-breasted Nuthatch is shifting along with climate change in summer.



Pygmy Nuthatch
Summer

In summer 2017, Pygmy Nuthatch was more likely to occur in areas that are worsening in climate suitability. This species appears to be failing to shift along with climate change in summer.

Only 9% of their historically suitable summer range is stable, with an 80% decrease in their summer range predicted by 2080. This means that the Pygmy Nuthatch summer range is both shifting and shrinking with climate change.



Bottom line: Pygmy Nuthatch is not shifting along with climate change in summer.

How did we analyze the data?

What is occupancy estimation?

Occupancy estimation is a model-based approach for analyzing species presence and absence data. A model is used to describe and predict real world systems based on limited information - meaning, we can't know where every individual bird is or isn't, but we can use the information we gather from a small portion of the birds we can count to help better understand that system. With this, we can also start to understand how that system might respond to changes in the environment, like climate change.

Occupancy estimation is a powerful statistical tool that can:

- Account for imperfect detection
 - Since many factors can affect whether a species is detected on a survey (habitat, weather etc.), we will not always 'get it right' when we are counting birds. Sometimes we will not see or hear a bird species that is actually there. We might also count a bird species as being present when in fact it is not. This is imperfect detection. Occupancy models were developed to correct for imperfect detection by estimating the proportion of times when birds that were present were not detected.
- Provide a measure of "Occupancy"
 - Occupancy allows us to understand how likely it is that a bird species is present in the survey area.
- Can relate "Occupancy" to changes in environment
 - We can relate this measure of occupancy of a bird species to change in the environment, in this case climate change suitability.

How are the Climate Watch data used in occupancy estimation?

Replication is a key design component of occupancy estimation. For Climate Watch, the surveys are repeat visits in space, meaning there are multiple (12) survey points within each Climate Watch Square.

These replications allow us to get a measure of the probability that a species occurs within the Climate Watch survey area, based on the proportion of survey points at which the species is detected. Therefore, we need to estimate our ability to **detect** the species before we can get a reliable estimate of **occupancy**.

In Climate Watch, repeat surveys at the survey point level help to address imperfect detection.

In addition, specific data are collected that are known to affect species detection such as:

- Time since local sunrise
- Habitat type
- Location of Birding Group (does detection differ regionally?)
- Party size (does detection differ if there are more or fewer observers?)
- Target species
 - Targeted habitat (survey was targeting that species in the best possible habitat)
 - Non-targeted habitat (surveys were not targeting that species, and were in other habitat types)
- Abundance of target species

At the Climate Watch square level, which is made up of the 12 repeat surveys and the associated detectability of the species determined from each point, we can model the occupancy probability of that species in an area. Information on nestboxes and feeders are also important at the square level, as they can attract species into an area and increase its probability of occupancy.

Once we have an estimate of how likely a species is to occur across our study area, we can then use that information in relation to changes in climate and other factors. In the results presented here, we assessed how the change in climate suitability from the recent past (2000s) to the near future (2020s) was associated with the probability of occupancy of each species.

The results from 2017 are based on single season occupancy estimation models, but as the program grows and data are collected over time, we will be able to develop more detailed and complex models. We look forward to working on multi-year models that will look at how are target species are responding over several years within each Climate Watch survey period.

For more information on occupancy modeling, here is a general overview document for reference:

<https://www.nps.gov/olym/learn/nature/upload/OccupancyModelFactSheet.pdf>

Questions?

Please email us at Climatewatch@audubon.org

***Report Prepared
by the Climate
Watch Analytical
Team:***

Brooke Bateman, Senior Climate Scientist, Director Climate Watch
Nicole Michel, Senior Quantitative Ecologist
Zach Slavin, Program Manager, Community Science
Sarah Saunders, Quantitative Ecologist

***Climate Watch
Additional Team
Members:***

Kathy Dale, Director, Science Technology
Doss Dingli, Director, Enterprise GIS
Molly Finch, Dangermond Fellow, Enterprise GIS
Sarah Friedman, Program Manager, Climate
Ryan Hobbs, Enterprise GIS Technician
Gary Langham, Chief Scientist
Tebello Marumo, Senior Marketing Manager
Geoff LeBaron, Director, Christmas Bird Count
John Rowden, Director, Community Conservation
Gregg Verutes, Data Visualization Specialist
Hannah Waters, Senior Associate Editor

Thanks to the following organizations for their efforts collecting data for Climate Watch:

Arkansas River Valley Audubon Society
Atlanta Audubon Society
Audubon Center at Riverlands
Audubon Society of Forsyth County
Audubon Society of the District of Columbia
Audubon South Carolina
Big Bluestem Audubon Society
Central New Mexico Audubon Society
Chemung Valley Audubon Society
Chesapeake Audubon Society
Coastal Georgia Audubon Society
Elisha Mitchell Audubon Society
High Peaks Birders

John James Audubon Center at Mill Grove
Madison Audubon Society
Mecklenburg Audubon Society
Mesilla Valley Audubon Society
New Hope Audubon Society
North Shore Audubon Society
Olympic Peninsula Audubon Society
Ozark Gateway Audubon Society
Pickering Creek Audubon Center
Prairie Rapids Audubon Society
Southern Adirondack Audubon Society
St. Louis Audubon Society
Wake Audubon
Wyncote Audubon Society