Birds and Climate Change

National Park Service
U.S. Department of the Interior

Hopewell Culture National Historical Park

Background

Birds are useful indicators of ecological change because they are highly mobile and generally conspicuous. As climate in a particular place changes, suitability may worsen for some species and improve for others. These changes in climate may create the potential for local extirpation or new colonization. **This brief summarizes projected changes in climate suitability by mid-century for birds at Hopewell Culture National Historical Park (hereafter, the Park) under two climate change scenarios (see Wu et al. 2018 for full results, and Langham et al. 2015 for more information regarding how climate suitability is characterized).** The high-emissions pathway (RCP8.5) represents a future in which little action is taken to reduce global emissions of greenhouse gases. The low-emissions pathway (RCP2.6) is a best-case scenario of aggressive efforts to reduce emissions. These emissions pathways are globally standardized and established by the Intergovernmental Panel on Climate Change for projecting future climate change. The findings below are model-based projections of how species distributions may change in response to climate change. A 10-km buffer was applied to each park to match the spatial resolution of the species distribution models (10 x 10 km), and climate suitability was taken as the average of all cells encompassed by the park and buffer.

IMPORTANT

This study focuses exclusively on changing climatic conditions for birds over time. But projected changes in climate suitability are not definitive predictions of future species ranges or abundances. Numerous other factors affect where species occur, including habitat quality, food abundance, species adaptability, and the availability of microclimates (see Caveats). Therefore, managers should consider changes in climate suitability alongside these other important influences.

We report trends in climate suitability for all species identified as currently present at the Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park is projected to become suitable in the future (Figure 1 & Table 1). This brief provides park-specific projections whereas Wu et al. (2018), which did not incorporate park-specific species data and thus may differ from this brief, provides system-wide comparison and conclusions.

Results

Climate change is expected to alter the bird community at the Park, with greater impacts under the high-emissions pathway than under the low-emissions pathway (Figure 1). Among the species likely to be found at the Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 27 (e.g., Figure 2), remain stable for 10, and worsen for 11 species. Suitable climate ceases to occur for 13 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 21 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 18, remain stable for 9, and worsen for 8 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 34 species not found at the Park today, potentially resulting in local colonization.

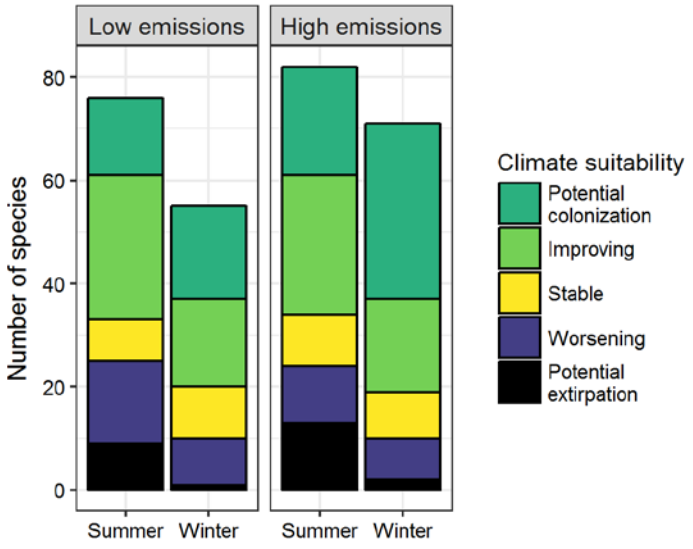

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.23 in summer (37th percentile across all national parks) and 0.20 in winter (26th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.13 in winter under the low-emissions pathway. Turnover index was calculated based on the theoretical proportions of potential extirpations and potential colonizations by 2050 relative to today (as reported in Wu et al. 2018), and therefore assumes that all potential extirpations and colonizations are realized. According to this index, no change would be represented as 0, whereas a complete change in the bird community would be represented as 1.

Climate Sensitive Species

The Park is or may become home to 2 species that are highly sensitive to climate change across their range (i.e., they are projected to lose climate suitability in over 50% of their current range in North America in summer and/or winter by 2050; Table 1; Langham et al. 2015). Suitable climate is not projected to disappear for these 2 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Park in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/Flickr (CC BY 2.0).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Hopewell Culture National Historical Park falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 2 species that are highly sensitive to climate change across their range (Table 1; Langham et al. 2015) but for which the park is a potential refuge. Monitoring to identify changes in bird communities will inform the selection of appropriate management responses.

Caveats

The species distribution models included in this study are based solely on climate variables (i.e., a combination of annual and seasonal measures of temperature and precipitation), which means there are limits on their interpretation. Significant changes in climate suitability, as measured here, will not always result in a species response, and all projections should be interpreted as potential trends. Multiple other factors mediate responses to climate change, including habitat availability, ecological processes that affect demography, biotic interactions that inhibit and facilitate species' colonization or extirpation, dispersal capacity, species' evolutionary adaptive capacity, and phenotypic plasticity (e.g., behavioral adjustments). Ultimately, models can tell us where to focus our concern and which species are most likely to be affected, but monitoring is the only way to validate these projections and should inform any on-the-ground conservation action.

More Information

For more information, including details on the methods, please see the scientific publication (Wu et al. 2018) and the project overview brief, and visit the NPS Climate Change Response Program website.

References

eBird Basic Dataset (2016) Version: ebd_relAug-2016. Cornell Lab of Ornithology, Ithaca, New York.

Langham et al. (2015) Conservation Status of North American Birds in the Face of Future Climate Change. PLOS ONE.

Wu et al. (2018) Projected avifaunal responses to climate change across the U.S. National Park System. PLOS ONE.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park is projected to become suitable in the future. "Potential colonization" indicates that climate is projected to become suitable for the species, whereas "potential extirpation" indicates that climate is suitable today but projected to become unsuitable. Omitted species were either not modeled due to data deficiency or were absent from the I&M and eBird datasets. Observations of late-season migrants may result in these species appearing as present in the park when they may only migrate through. Species are ordered according to taxonomic groups, denoted by alternating background shading.

*** Species in top and bottom 10th percentile of absolute change**

^ Species that are highly climate sensitive

- Species not found or found only occasionally, and not projected to colonize by 2050

x Species not modeled in this season

Common Name	Summer Trend	Winter Trend
Cackling/Canada Goose	x	Stable
Mute Swan	-	Potential extirpation
Wood Duck	-	Potential colonization
American Wigeon	-	Improving
American Black Duck	-	Potential extirpation
Mallard	-	Stable
Blue-winged Teal	-	Potential colonization
Ring-necked Duck	-	Improving
Bufflehead	-	Potential colonization
Common Goldeneye	-	Potential colonization
Red-breasted Merganser	-	Potential colonization^
Eared Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Double-crested Cormorant	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	Improving
Great Egret	Potential colonization	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Potential colonization	-
Mississippi Kite	Potential colonization	-
Cooper's Hawk	x	Worsening*
Bald Eagle	-	Potential colonization
Red-shouldered Hawk	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Stable	Improving
Ferruginous Hawk	-	Potential colonization
Killdeer	Stable	Improving
Least Sandpiper	-	Potential colonization
American Woodcock	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	-	Stable
Forster's Tern	-	Potential colonization
Rock Pigeon	Worsening	Worsening*
Mourning Dove	Stable	Worsening
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Potential extirpation	-
Greater Roadrunner	Potential colonization	Potential colonization
Common Nighthawk	Potential colonization	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Stable	-
Red-bellied Woodpecker	Improving	Improving
Downy Woodpecker	Improving	Worsening*
Northern Flicker	Potential extirpation	Stable
American Kestrel	x	Improving
Eastern Wood-Pewee	Improving	-
Willow Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving	Potential colonization
Great Crested Flycatcher	Improving	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Loggerhead Shrike	Potential colonization	Potential colonization
White-eyed Vireo	Improving*	-
Bell's Vireo	Potential colonization	-
Warbling Vireo	Potential extirpation	-
Red-eyed Vireo	Stable	-
Blue Jay	Improving	Stable
American Crow	Stable	Worsening
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Worsening	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Improving*	Improving
Tufted Titmouse	Improving	Stable
White-breasted Nuthatch	Stable	Worsening*
Brown-headed Nuthatch	Potential colonization^	Potential colonization
House Wren	Potential extirpation	-
Sedge Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Eastern Bluebird	Improving	Improving
Wood Thrush	Worsening*	-
American Robin	Worsening	Improving
Gray Catbird	Potential extirpation	-
Brown Thrasher	Improving	Potential colonization
Northern Mockingbird	Improving	Improving

Common Name	Summer Trend	Winter Trend
European Starling	Worsening	-
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	-^	Potential colonization
Yellow-breasted Chat	Improving	-
Eastern Towhee	Stable	x
Chipping Sparrow	Potential extirpation	Potential colonization
Field Sparrow	Improving	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	-
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Stable	-
Henslow's Sparrow	x	Potential colonization

Common Name	Summer Trend	Winter Trend
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Stable
Summer Tanager	Improving*	-
Northern Cardinal	Improving	Improving
Blue Grosbeak	Improving*	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Dickcissel	Improving*	-
Red-winged Blackbird	Worsening	Improving
Eastern Meadowlark	Improving	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Improving	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Worsening*
American Goldfinch	Worsening	Stable
House Sparrow	x	Worsening*