Birds and Climate Change

National Park Service
U.S. Department of the Interior

Lyndon B. Johnson 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 Lyndon B. Johnson 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 7, remain stable for 23 (e.g., Figure 2), and worsen for 15 species. Suitable climate ceases to occur for 7 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 16 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 3, remain stable for 40, and worsen for 19 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 50 species not found at the Park today, potentially resulting in local colonization.

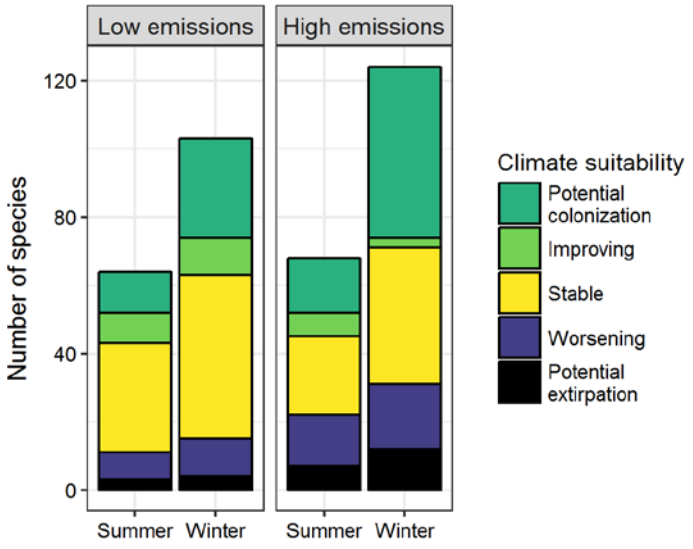

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.14 in summer (18th percentile across all national parks) and 0.20 in winter (27th percentile) under the high-emissions pathway. Potential species turnover declines to 0.08 in summer and 0.11 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 3 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 3 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, Lyndon B. Johnson National Historical Park falls within the low change group.** Parks anticipating low 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 3 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.

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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
Black-bellied Whistling-Duck	Improving*	-
Fulvous Whistling-Duck	Potential colonization	-
Muscovy Duck	-	Potential colonization
Gadwall	-	Worsening
American Wigeon	-	Stable
Mallard	-	Potential extirpation
Mottled Duck	Potential colonization	Potential colonization
Blue-winged Teal	-	Stable
Cinnamon Teal	-	Potential colonization
Green-winged Teal	-	Stable
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	Potential colonization
Wild Turkey	x	Worsening

Common Name	Summer Trend	Winter Trend
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Worsening
Magnificent Frigatebird	-	Potential colonization
Neotropic Cormorant	-	Stable
Double-crested Cormorant	-	Worsening*
Brown Pelican	Potential colonization	-
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	Worsening
Great Egret	Stable	Worsening
Cattle Egret	Stable	-
Green Heron	Improving	-
Glossy Ibis	-	Potential colonization
Roseate Spoonbill	-	Potential colonization
Black Vulture	Stable	Stable

Common Name	Summer Trend	Winter Trend
Turkey Vulture	x	Stable
Osprey	-	Stable
White-tailed Kite	Potential colonization	-
Swallow-tailed Kite	Potential colonization	-
Harris's Hawk	-	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	-	Stable
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Worsening	Stable
American Coot	-	Stable
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Killdeer	-	Worsening
Spotted Sandpiper	-	Improving*
Greater Yellowlegs	-	Stable
Whimbrel	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Caspian Tern	-	Potential colonization
Sandwich Tern	-	Potential colonization^
Rock Pigeon	Stable	Potential extirpation
Eurasian Collared-Dove	x	Stable
White-winged Dove	Improving*	Improving
Mourning Dove	Stable	Worsening
Inca Dove	Stable	-
White-tipped Dove	-	Potential colonization
Yellow-billed Cuckoo	Stable	-
Groove-billed Ani	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Western Screech-Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	Potential colonization
Common Pauraque	-	Potential colonization
Chimney Swift	Stable	-
White-throated Swift	-	Potential colonization
Black-chinned Hummingbird	Worsening*	-
Allen's Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	-	Worsening
Lewis's Woodpecker	-	Potential colonization
Golden-fronted Woodpecker	Worsening*	Stable
Red-bellied Woodpecker	-	Stable
Red-naped Sapsucker	-	Potential colonization
Ladder-backed Woodpecker	Worsening	Stable
Downy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	-	Worsening
Crested Caracara	-	Stable
American Kestrel	-	Stable
Peregrine Falcon	-	Potential colonization
Eastern Wood-Pewee	Potential extirpation	-
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	-	Potential colonization
Black Phoebe	Stable	Potential colonization
Eastern Phoebe	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Ash-throated Flycatcher	Improving*	-
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	-	Potential colonization
Western Kingbird	Worsening	-
Scissor-tailed Flycatcher	Stable	-
Loggerhead Shrike	-	Stable
White-eyed Vireo	Stable	-
Bell's Vireo	Improving*	-
Green Jay	Potential colonization	Potential colonization
Blue Jay	Potential extirpation	Potential extirpation
American Crow	-	Potential extirpation
Chihuahuan Raven	Potential colonization	-
Common Raven	Stable	Potential extirpation
Northern Rough-winged Swallow	-	Potential colonization
Purple Martin	Stable	-
Barn Swallow	Worsening	-
Cliff Swallow	Stable	-
Cave Swallow	Stable	-
Carolina Chickadee	Worsening*	Worsening*
Black-crested Titmouse	Worsening*	Stable
Carolina Wren	Stable	Stable
Bewick's Wren	Worsening	Stable
Blue-gray Gnatcatcher	Stable	-
Black-tailed Gnatcatcher	-	Potential colonization
Ruby-crowned Kinglet	-	Stable

Common Name	Summer Trend	Winter Trend
Eastern Bluebird	Worsening	Stable
Mountain Bluebird	-	Potential colonization
Hermit Thrush	-	Stable
American Robin	Potential extirpation	Potential extirpation
Long-billed Thrasher	Potential colonization^	-
LeConte's Thrasher	Potential colonization	-
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Stable
European Starling	Stable	Worsening
Cedar Waxwing	-	Potential extirpation
Phainopepla	Potential colonization	-
Ovenbird	-	Potential colonization
Orange-crowned Warbler	-	Stable
Northern Parula	-	Potential colonization
Yellow-rumped Warbler	-	Worsening
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Olive Sparrow	-	Potential colonization
Rufous-crowned Sparrow	-	Stable
Rufous-winged Sparrow	-	Potential colonization
Bachman's Sparrow	-	Potential colonization
Chipping Sparrow	-	Stable
Brewer's Sparrow	-	Potential colonization
Field Sparrow	-	Stable
Vesper Sparrow	-	Worsening

Common Name	Summer Trend	Winter Trend
Lark Sparrow	Worsening	Stable
Savannah Sparrow	-	Worsening*
Song Sparrow	-	Worsening
Lincoln's Sparrow	-	Stable
White-throated Sparrow	-	Worsening*
Harris's Sparrow	-	Stable
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Worsening*	-
Western Tanager	-	Potential colonization
Northern Cardinal	Stable	Stable
Indigo Bunting	-	Potential colonization
Painted Bunting	Stable	-
Red-winged Blackbird	Potential colonization	Worsening
Eastern Meadowlark	-	Stable

Common Name	Summer Trend	Winter Trend
Western Meadowlark	-	Stable
Brewer's Blackbird	-	Stable
Common Grackle	Stable	-
Great-tailed Grackle	Improving	Stable
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Potential extirpation	-
Hooded Oriole	Potential colonization	-
Audubon's Oriole	-	Potential colonization
House Finch	Potential extirpation	Stable
Pine Siskin	-	Potential extirpation
Lesser Goldfinch	Worsening	Potential extirpation
American Goldfinch	-	Worsening
House Sparrow	x	Potential extirpation